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Gary Fields
Saumik Paul *Editors*

Labor Income Share in Asia

Conceptual Issues and the Drivers

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Preface

The functional distribution of income has always been a topic of concern for economists. David Ricardo's statement, published back in 1817, serves as a testimony to this fact: *To determine the laws which regulate [this] distribution is the principal problem in political economy*. The study of factor income shares plays an important role in understanding the relationship between national income and personal income, the relationship between wage inequality and wealth inequality, and how they link to overall income inequality and concerns for fairness in different sources of income.

The labor income share is defined as the share of national income paid in wages. In contrast to its simple definition of the labor income share, which is the share of labor income in national income, measuring it with available data is not so straightforward. While national income is easily found in national accounting statistics in the form of GDP, labor income equivalent is not as it involves both incomes earned by wage employees and income earned by the self-employed. National accounting statistics in many countries usually record the total wage bill of employees as "compensation of employees." However, these statistics often do not record self-employed income, and even if they do, it is generally difficult to isolate a labor income component as self-employed income consists of compensation for both the labor and capital that self-employed workers own.

In the world including developing Asia, labor income share exhibits three major trends. The first is a trend toward falling labor income share in the world. The second is falling labor income share in advanced and emerging economies taken separately. The third is a wide diversity of country experiences. The growing concern over the decline in the labor income share has encouraged debate about fair distribution of personal incomes, due to the disproportionate share of the decline among different skill groups. While the labor income share has decreased for low-skilled workers, this has coincided with an increase for high-skilled workers. The literature offers several explanations, but there is little consensus on the drivers of the decline in the labor income share.

To understand more deeply the causes and consequences of the changes in labor's income share in developing Asia, in June 2018, the Asian Development Bank Institute hosted a conference entitled *Labor Income Share in Asia: Conceptual Issues and the Drivers*. Part I of this book reviews the prior literature and the conceptual issues related to the measurement of the labor income share, while Part II summarizes the principal theoretical and empirical advances emerging from the conference and raises some consequent policy considerations.

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Chapter 1
Previous Literature and New Findings

Gary Fields and Saumik Paul

1 Previous Literature

1.1 Measurement Issues

1.1.1 Attempts Have Mostly been Made to Estimate Labor Income Share at the National Level, not at a More Disaggregated Level (Sector or Firm)

The United Nations System of National Accounts (UN SNA) collects information on the compensation of employees and provides the unadjusted labor income share for 93 low- and middle-income countries with an average time span of 15.3 years per country. Since only about one third of developing countries report mixed income, the mixed-income adjusted labor income shares are computed for only 38 countries from this dataset. The adjusted labor share using the employment structure of a country is also calculated with ILO's data of Key Indicators of the Labour Market (KILM), which produces estimates for 73 countries. The second group of data sets extend the coverage of data from UN SNA and KILM by including additional national data sources. The Penn World Tables (PWT) expands the coverage of self-employed-income adjusted labor income shares by using proxy variables for countries whose mixed-income data is not available. As most self-employed workers in low- and middle-income countries are active in

The authors are thankful to Juzhong Zhuang for many helpful comments and sharing the data for Figure 5.

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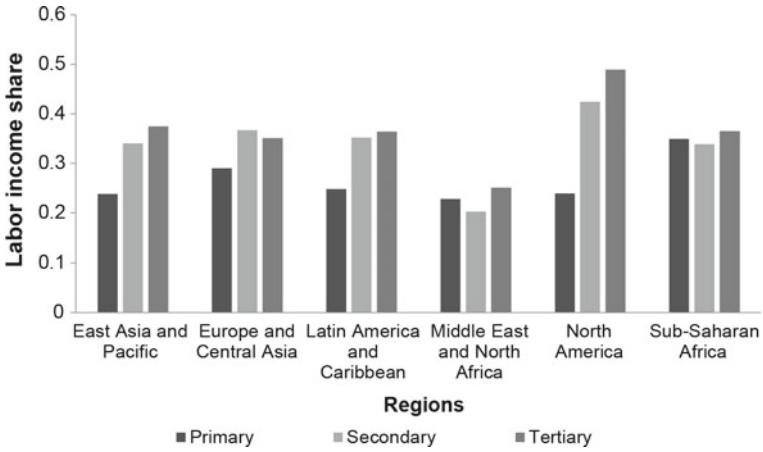

Fig. 1 Labor income share (broad sectors) across regions. *Source* Oishi and Paul (2018). *Note* The definition of the sectors follows the Groningen Growth Data Center (GGDC) classification of sectors. The primary sector consists of agriculture, hunting, forestry, fishing, mining and quarrying. The secondary sector consists of manufacturing and construction. The tertiary sector contains gas and water supply, wholesale and retail trade, hotels and restaurants, transport, storage, and communication, finance, insurance, real estate and business services, government services and community, social and personal services

agriculture, PWT uses value added in agriculture recorded in the World Input Output Database (WIOD) as a proxy for self-employed income. Trapp (2015) also uses proxy variables of agriculture to compute the labor income share. A recent study by Oishi and Paul (2018) puts together 10-sector labor income share data for 54 countries including 20 developing countries. Figure 1 compares the unweighted regional averages of the labor income share across three broad categories using data from Oishi and Paul (2018). On average, labor receives the smallest share of income in the primary sectors in all the regions except the Middle East and North Africa (MENA) and Sub-Saharan Africa (SSA).

1.1.2 Various Adjustment Methods Have been Suggested to Approximate the Labor Income Share

Gollin (2002) proposes three adjustment approaches to include income from self-employment in the labor income. The first approach adds the entire amount of mixed income to compensation of employees based on the assumption that activities related to self-employment do not possess capital. The second one assumes that the labor income share of workers in self-employment is the same as that of wage employees. Gollin (2002)'s third approach assumes that, on average, wages from self-employment is equivalent to wages earned elsewhere. A conventional approach divides total compensation of employees by GDP without taking income from self-employment into consideration. This could be a reasonable approximation of

the labor income share in developed countries where the share of self-employment is low, but this is likely to underestimate the labor income share in developing countries where self-employment in the informal sector is prevalent.

1.2 Theoretical Considerations in Labor's Changing Income Share

1.2.1 The Assumption of a Non-unitary Elasticity of Substitution (σ) Between Capital and Labor Plays a Crucial Role in the Movement of the Labor Income Share

The crucial role of σ in analyzing the factor income shares has been noted since the seminal work of Hicks (1932) and Robinson (1933). In a CES production function (Eq. 1), assuming constant returns to scale, capital-augmenting (A) and labor-augmenting (B) technological progress and perfectly competitive factor markets, there is a stable relationship between the labor income share, the elasticity of substitution (σ) and capital-output ratio. Under these assumptions and using the aggregate production function (1)

$$Y = \left[(AK)^{\frac{\sigma-1}{\sigma}} + (BL)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

the labor income share can be derived as

$$L_S = \frac{(BL)^{\frac{\sigma-1}{\sigma}}}{(AK)^{\frac{\sigma-1}{\sigma}} + (BL)^{\frac{\sigma-1}{\sigma}}} \tag{2}$$

and the capital-output ratio as

$$k = \left[\frac{(AK)^{\frac{\sigma-1}{\sigma}}}{(AK)^{\frac{\sigma-1}{\sigma}} + (BL)^{\frac{\sigma-1}{\sigma}}}\right]^{\frac{\sigma}{\sigma-1}} \tag{3}$$

Combining (2) and (3), we get

$$L_S = 1 - (k)^{\frac{\sigma-1}{\sigma}}. \tag{4}$$

The expression for the labor income share in Eq. (4) is called the "SK" schedule (Bentolila and Saint-Paul 2003), which shows a functional relationship between the labor income share, σ and capital-output ratio. When $\sigma > 1$ i.e., labor and capital are gross substitutes, availability of more capital per unit of labor reduces the labour

income share as the capital price goes down. This is known as "Accumulation view". Similarly, when σ < 1, i.e., labour and capital are gross complements, a higher *k* increases the labour income share.

1.2.2 Using the Model Just Presented in Eqs. (1)–(4), a Fall in the Relative Price of Capital Produces a Declining Labor Income Share Provided that Capital and Labor are Gross Substitutes at the Aggregate Level (i.e., $\sigma_{\text{Agg}} > 1$). However, in the Case of More Than One Skill Category of Labor, It Is Possible for the Labor Income Share to Decrease When the Relative Price of Capital Falls Even When Capital and Labor are Gross Complements at the Aggregate Level

Consider a labor market with skilled and unskilled workers. A nested-CES production function production function with three inputs, capital (K), skilled labor (S) and unskilled labor (U), can be written as

$$Y = \left[\theta\left[\emptyset K^{\frac{\rho-1}{\rho}} + (1-\emptyset)S^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}\frac{\sigma-1}{\sigma}} + (1-\theta)U^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = N_1(K,S) + N_2(U) \qquad (5)$$

θ and $\emptyset$ denote distribution parameters; σ denotes the elasticity of substitution between K and U (similarly, between U and S). The sub-processes N_1 (with inputs K and S) and N_2 (with just input U) are mutually exclusive and exhaustive. In Eq. (5), ρ denotes the intra-nest elasticity of substitution between K and S and σ denote the inter-nest elasticity of substitution between K and U. We assume that $\sigma > \rho$, i.e., capital is more complementary to skilled labor than to unskilled labor. Following Oberfield and Raval (2014), the relationship between σ_{Agg} can be expressed as a weighted average of σ and ρ $\sigma_{Agg} = (1-\aleph)\sigma + \aleph\rho$, where $\aleph$ represents a heterogeneity index, which takes a value of zero if capital and skilled labor are perfect complements. In the presence of perfectly competitive factor markets, in equilibrium (i.e., when marginal products equal factor prices), the labor income share (L_S) can be written as

$$L_S = \frac{W_S S + W_U U}{y}, \text{ or} \frac{L_S}{1-L_S} = \frac{W_S S}{rK} + \frac{W_U U}{rK} \qquad (6)$$

Taking logs and differentiating Eq. (6) with respect to the log of the input-price ratio, we get

$$\frac{d\ log\left(\frac{L_S}{1-L_S}\right)}{d\ log\left(\frac{W_S}{r}\right)} = \frac{d\log\frac{W_S S}{rK}}{d\log\frac{W_S}{r}} + \frac{d\log\frac{W_U U}{rK}}{d\log\frac{W_U}{r}} \qquad (7)$$

$\overline{W}$ is the average wage in the labor market. If L_S declines, then the sum of the signs of the terms on the right-hand side of Eq. (7) must be negative. In Eq. (7), changes in the ratio of factor income shares become functions of ρ and σ (Anderson and Moroney 1993). This relationship depends on the Morishima elasticities of substitution.[1] It may be shown that

$$\frac{dlog\frac{W_S S}{rK}}{dlog\frac{W_S}{r}} = 1 - MES_{SK}(=\rho) = 1 - \rho \tag{8}$$

$$\frac{dlog\frac{W_U U}{rK}}{dlog\frac{W_U}{r}} = 1 - MES_{UK}(=\sigma) = 1 - \sigma \tag{9}$$

and from (7)–(9), we get

$$\left|\frac{dlog\left(\frac{L_S}{1-L_S}\right)}{dlog\left(\frac{W}{r}\right)}\right| = |1-\rho| + |1-\sigma| \tag{10}$$

Paul (2018) shows that if $\sigma > \rho$ and $\sigma > 1$, then L_S declines with $\rho < 1$ as long as we have $\left|\frac{dlog\frac{W_S S}{rK}}{dlog\frac{W_S}{r}}\right| < \left|\frac{dlog\frac{W_U U}{rK}}{dlog\frac{W_U}{r}}\right|$ or $|1-\rho| < |1-\sigma|$. With $\sigma > 1 > \rho$, it is possible to have an estimate of σ_{Agg} to be less than unity since $\sigma_{Agg} = (1-\aleph)\sigma + \aleph\rho$. In this case, a declining labor income share resulting from a drop in the relative price of capital may not require capital and labor to be gross substitutes at the aggregate level.

1.3 Empirical Findings in the Literature

1.3.1 Both Within Sector Growth and the Process of Structural Transformation are Responsible for the Movements in the Labor Income Share

Changes in the aggregate labor income share between t and $t+1$ can be decomposed into the contribution of various factors using a shift-share decomposition methodology (Fabricant 1942; de Vries et al. 2013). In Eq. 3, LIS_i is the labor

[1] MES holds prices of other factor inputs constant and adjusts the measure of the elasticity of substitution accordingly. MES can be expressed as a function of the own price and the cross-price elasticities of two inputs as $MES_{ij} = \frac{dlogx_i}{dlogp_i} - \frac{dlogx_i}{dlogp_i}$, where p_i and $p_j$are the prices of inputs x_i and x_j. Blackorby and Russell (1989) showed that changes in the ratio of factor income shares can be directly predicted by MES as $\frac{dlog\frac{p_i x_i}{p_j x_j}}{dlog\frac{p_i}{p_j}} = 1 - MES_{ij}$.

income share in sector i, and LIS denotes the aggregate labor income share. Labor is reallocated across sectors between two points in time, t and $t+1$, and VA_i^t denotes the value-added share of sector i in period t.

$$\Delta LIS = \sum_i (VA_i^t)(\Delta LIS_i) + \sum_i (\Delta VA_i)(LIS_i^t) \tag{11}$$

The first term on the right-hand side of Eq. (11) shows the contribution of within-sector changes over time and the second term collects the contribution of or structural transformation. Many studies[2] show that changes in the aggregate labor income share are driven by declines in within-industry labor shares rather than the process of structural transformation through an increasing flow of activities from high to low labor share industries. In another study, Dao et al. (2017) find that almost 90% of the changes in the aggregate labor income shares in PRC come from within-industry changes rather than sectoral reallocation. Arpaia et al. (2009) examine the role of structural transformation for a panel of OECD countries and find dominance of within-sector effects. However, de Serres et al. (2002) estimate that about 50% of the changes in the aggregate labor income share in the US is due to structural transformation across sectors.

1.3.2 Technological Advancement, Measured by the Long-Term Decline in the Relative Price of Investment Goods, Has been the Largest Contributor to the Decline in Labor Income Shares in Advanced Economies

A growing number of empirical analysis suggests that about half of the total decline in labor income shares can be traced to the impact of technology in advanced economies. However, Dao et al. (2017) show that in emerging markets, there is no discernible role of technology in the evolution of labor shares. They also find a relatively mild decline in the relative price of investment goods in emerging economies, which arguably explains the limited role of technology behind the movement in the labor's share of income. On the other hand, while a very extensive literature on skilled-biased technical change provides useful hints, not much work has been done on the impact of different types of capital (Koh et al. 2016) and different types of labor (European Commission 2007; Lawless and Whelan 2011) on the labor income share.

[2]Lawrence (2015), Elsby et al. (2013), Rodrigues and Jayadev (2010)

1.3.3 There is Considerable Diversity in the Movement in the Sectoral Labor Income Share Across Advanced Economies; the Highest Decline in Labor Income Share (in Terms of Percentage Point Differences) in Services and Manufacturing was in Japan and Portugal, Respectively

If the elasticity of substitution between capital and labor is different from one and varies across sectors (e.g., agriculture versus manufacturing), then the sectoral labor income share trends are likely to follow different trajectories despite identical factor price movements across sectors. Figure 2 shows a scatterplot of 16 countries between changes in the labor income shares in manufacturing and changes in the labor income share in services. We find four categories of countries. Belgium is the only country that had an increase in the labor income share in both sectors. Then we have the next category consisting of Greece, Hungary, Denmark, and Portugal, where the labor income share declined only in the manufacturing sector. Spain, France, and the UK made up the next group of countries that had a drop in the labor income share only in services. Finally, the largest group of countries (Australia, Austria, Finland, Japan, Italy, Germany, Sweden, and the Netherlands) shows declining labor income shares in both sectors.

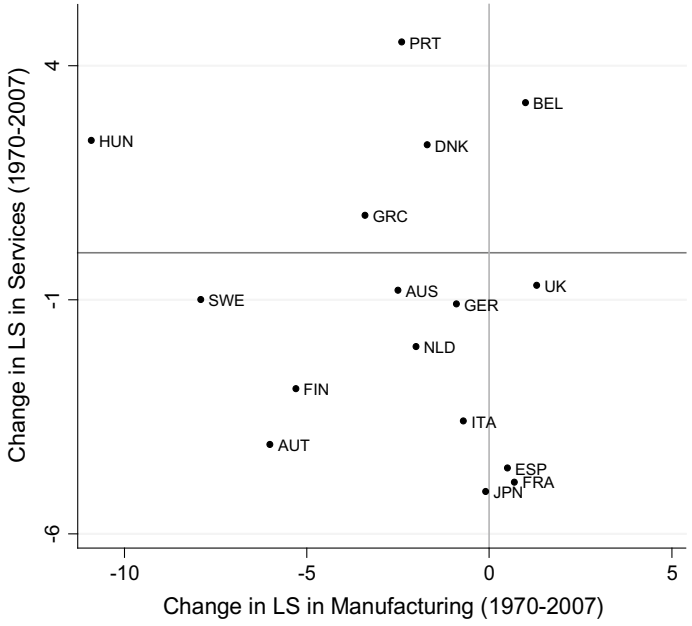

Fig. 2 Changes in labor income shares: manufacturing versus services, 1970–2007. *Source* Cuadrado et al. (2015); original data source: http://www.euklems.net

1.3.4 We Now Turn to Changes in Labor Income Share at a More Disaggregated Sectoral Level. In Japan, the Labor Income Shares Remained Almost Constant in Heavy Manufacturing and Light Manufacturing Whereas the Other Sectors Showed Downward Trends in the Period from 1970 to 2010.

During the same period, we observe the secular trends of structural transformation: employment shares rising in services, falling in agriculture, and remaining unchanged in manufacturing. We use the Japan Industrial Productivity (JIP), which covers 108 industries for the period 1970–2012. We divide 108 industries into six broad categories of sectors. *Agri* consists of agriculture, forestry, and fisheries. *Heavy manufacturing* comprises mining, chemicals, petroleum, fabricated metals, machinery, construction, and electrical machinery. *Light manufacturing* consists of food, textiles, pulp, nonmetallic minerals, primary metals, transport equipment, precision instruments, and other manufacturing. *Utilities* include electricity, gas, and water supply. *Commerce* consists of wholesale and retail trade, finance and insurance, real estate, transport, and communication. We include both private services and government services in *Services*. Figure 3 shows labor income share trends for these six broad sectors.

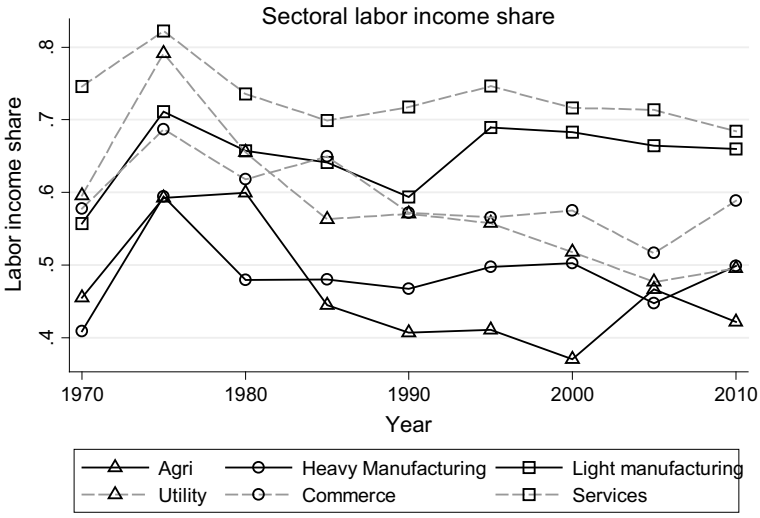

Fig. 3 Sectoral labor income and employment share in Japan, 1970–2010. *Source* Authors' calculation based on the Japan Industrial Productivity (JIP) database https://www.rieti.go.jp/en/database/JIP2015/#01, and Regional-Level Japan Industrial Productivity (R-JIP) database, http://www.rieti.go.jp/en/database/r-jip.html. The latter data set consists of 23 sectors. We divide them into six broad categories

1.3.5 In the People's Republic of China, There is a Steady Downward Labor Income Share Trend in Government (GOV) and Mining (MIN) Sectors Since the Early 1990s, Whereas Wholesale and Retail Trade (WRT) and Finance, Insurance and Related Business Services (FIRE) Show an Upward Trend

We use a recent data set compiled by Oishi and Paul (2018). This paper creates a novel dataset on the labor income share at the disaggregated 10-sector level following the classification of the Groningen Growth Data Centre (GGDC).[3] Various issues stem from the accounting method of national income, treatment of intangible inputs, measurement of non-private sectors and informal sectors, and attribution of mixed income. We use three data sources, the GGDC 10-Sector Database, the Socio-Economic Account (SEA), and ILOSTAT. We obtain the denominator of the labor income share, estimated value added, from the GGDC and SEA. For the numerator, we obtain the mean nominal monthly earnings of employees and the number of employees from ILOSTAT. For the People's Republic of China, data are available for 7 sectors (MIN, MAN, PU, WRT, TRA, FIRE, and GOV) for the period from 1986 to 2007. Figure 4 plots the time series of the estimates of the labor income share for 7 sectors. We find a steady downward trend in GOV and MIN since the early 1990s, whereas WRT and FIRE show an upward trend. One possible reason for the declining labor income share in MIN could be that MIN has become more capital intensive over time. The labor income share is the smallest in PU, followed by MIN and manufacturing.

1.3.6 Across the Asian Countries, Most Sectors Experienced a Decline in Labor Share of Income in Recent Years, Except China Where Most Sectors Experienced an Increase in the Labor Income Share in Recent Years

Figure 5 shows percentage point changes in the sectoral labor income share for 17 Asian economies from mid-2000s to early 2010s. The graph in the top panel suggests a decline in the labor income share in all the sectors except Wholesale and Retail, Construction, and Real Estate for 16 Asian countries on average, excluding China, between 2005 and 2011. The graph in the bottom panel shows results for China where most sectors experienced an increase in the labor share of income between 2005 and 2012, except Finance and Insurance and Other Services. It should be noted that earlier studies suggest that China also experienced a significant decline in the labor income share, especially in the manufacturing sector, between

[3] 1. Agriculture, hunting, forestry and fishing (AGR); 2. Mining and quarrying (MIN); 3. Manufacturing (MAN); 4. Electricity, gas and water supply (PU); 5. Construction (CON); 6. Wholesale and retail trade, hotels and restaurants (WRT); 7. Transport, storage, and communication (TRA); 8. Finance, insurance, real estate and business services (FIRE); 9. Government services (GOV); 10. Community, social and personal services (OTH).

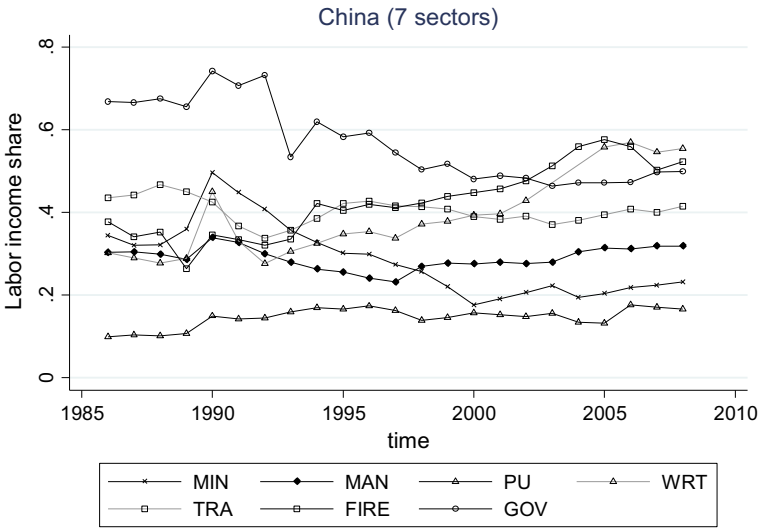

Fig. 4 Sectoral labor income share in the People's Republic of China, 1985–2010. *Source* Oishi and Paul (2018)

the early 1990s and mid-2000s (see, for example, Zhuang (2016), "Understanding Recent Trends of Income Inequality in China", ADB Economics Working Paper Series, No. 489). The recent increase in the labor income share in China, including the manufacturing sector, is likely to have been caused by government policy measures to address rising income inequality, such as raising the minimum wages and mandatory contributions to various social insurance schemes by enterprises, and a decline in rural surplus labor causing labor shortages and rising wages in the coastal areas.

2 The Contributions of the Chapters in This Volume

2.1 Part I. Conceptual Issues

The more exposed a country is to routinization, the greater is the probability that mid-skilled jobs are substituted by ICT capital, lowering the overall wage share of workers.

Chapter 2 analyzes the evolutions of the labor share of income in Asia, a region where some Asian countries had steep increases in labor income share, some had steep decreases, and some had stable shares since 1990. An innovation of this chapter is to expand the standard drivers of labor shares—technological advance, trade, institutions and policies—by considering whether the exposure to routine jobs has also played a role in the evolution of the labor share of income. Using a

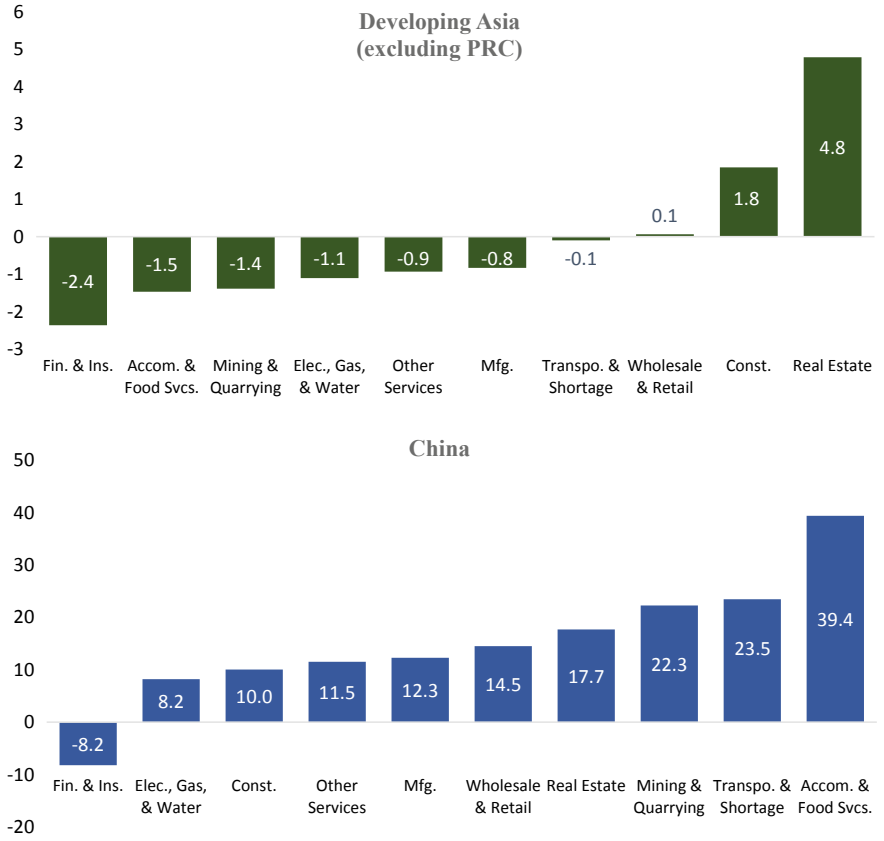

Fig. 5 Percentage point change in the labor share of income in 17 Asian economies, mid-2000s–early 2010s. *Source* Supply and Use Tables for 17 Asian economies (BAN, BHU, BRU, CAM, PRC, FIJ, HKG, INO, IND, MAL, MLD, MON, NEP, SRI, TAP, THA, VIE), ADB

new dataset on the exposure to routinization, the chapter finds that the initial exposure to routinization is an important determinant of the evolution of labor shares.

A new measurement of labor income share is proposed in Chap. 3 based on five different methodologies of estimation commonly used in the labor share literature. Results show that the authors' suggested indicator is correlated to the other five measures, but it also retains unique information.

This chapter presents a global dataset of the labor income share across 151 countries—both developing and developed—for all or part of the period 1970–2015. Contrary to the traditional assumption of stability of factor shares, it documents the existence of considerable heterogeneity across countries and variability over time. Specifically, there has been a general decline in the labor share in the majority of the countries since the mid-1980s.

Institutional differences are not the main source of variation in labor share movements, as the negative trend is common to countries with different regulatory settings.

Chapter 4 investigates the causes of the decline of the labor share exploring the effect of technology vis-à-vis the role played by market regulations, namely Employment Protection Legislation (EPL), Product Market Regulation (PMR), and Intellectual Property Rights (IPRs) protection. The results show that, in the long run, productivity upgrades and ICT capital diffusion are the major sources of the decline in the labor share. IPRs protection is the only dimension of the institutional setting affecting (positively) the share of industry income accruing to labor. The results also show that hysteresis characterizes the dynamics of the labor share in all countries.

Using new cross-country data, both at the national and sectoral level, trade openness is found to be negatively correlated with the labor income share.

Chapter 5 provides new empirical evidence on trade and structural transformation as drivers of the labor income share. Trade openness is negatively correlated with the labor income share, and the empirical findings are robust across national and disaggregated level, and across different model specifications. However, the relationship between the process of structural transformation and labor income share is at best mixed. It also finds weak evidence that skill-biased structural transformation is likely to be positively correlated with the share of labor income predominantly in the services sectors.

Democracy allows workers to achieve a higher share of national income.

Chapter 6 attempts to shed some light on the long-run and political economy determinants of the labor income share. It revisits and extends previous empirical research on democratic political institutions and the labor share using a dataset of 112 countries over the period 1970–2015. The principal finding is that democracy is associate with a higher labor share, and this evidence is robust to different indices of democracy and different periods of time, and after performing instrumental variables estimation. These results are particularly relevant today, considering the recent global decline in the labor income share and current crisis of democracy.

2.2 *Part II. The Drivers of Labor Income Share*

India experienced a sharp decline in labor share from around 30 percent in 1980 to less than 10 percent in 2014. Trade can explain a part of this decline. The results confirm that trade, by dampening the bargaining power of labor, reduces labor share of Indian industries.

Chapter 7 explores if decline in strikes and lockouts, reduced man-days lost from disputes per factory and increased use of contract workers in all major states in India. The author assumes them as the signs of reduced bargaining power. The approach suggested by Levinsohn and Petrin (2003) is applied on 3-digit level of industrial data over major states during 1998–2014, regressing Solow residual

(proxy for productivity) on trade share along with its interaction terms capturing market imperfections. Mark-up tends to rise with trade. The influence of trade on the labor income share and the productivity growth is explained through the channels of mark-up and bargaining power.

> An increase of labor income share in Malaysia is contributed mainly by the growing importance of more traditional services sub-sectors, and SMEs in the economy.

Labor income shares have been falling in many advanced and emerging economies within the last few decades, driven in part by a combination of impacts from technology and increased global integration. This in turn is associated with the relative slow growth of wages, especially for middle-skilled workers, and worsening of income inequality in these economies. In contrast, Malaysia's labor income share has been increasing since 2005, together with a reduction in income inequality. Chapter 8 investigates this development by exploring the differences in trends of labor income shares across different economic sectors and firm sizes and identifying factors that could explain the increase of labor income share in Malaysia. These findings have important policy implications for Malaysia, including the potential trade-off between driving labor productivity and fostering inclusiveness.

> The decline of the labor share observed in Japan during the period of analysis was highly concentrated in the private services sectors, the employment share of which has increased remarkably.

Chapter 9 investigates the long-term drivers of the falling labor share in Japan using data form the Japanese Industrial Productivity database from 1970 to 2012. Descriptive and econometric results indicate the private services sectors experienced a strong increase of non-regular workers, which in Japan identify a secondary segment of the labor market characterized by low wages and very limited union coverage. The low protection of this group of workers and the increase in market power concentration have probably contributed to reducing the bargaining power of labor vis-à-vis employers and, consequently, the labor share.

Firms' labor income share can also depend on the share of regular workers, firms' international engagement and various institutional settings of product and labor markets.

The labor share in Japan has been declining significantly over the last three decades, accompanied by a low economic growth and an unprecedented increase in economic inequalities. The existing literature in Japan is limited and confined to country or industry studies. Chapter 10 is the first attempt to analyse the drivers of the labor share in Japan at firm level. To achieve this aim, it employs a panel of manufacturing firms from the Basic Survey of Japanese Business Structure and Activities spanning from 2001 to 2012. By means of panel data estimations it shows how, besides technological variables, firms' labor share also significantly depends on the share or regular workers and on various institutional settings.

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Part I
Conceptual Issues

Chapter 2
Does the Exposure to Routinization Explain the Evolution of the Labor Share of Income? Evidence from Asia

Mitali Das

Abstract This paper analyzes the evolution of the labor share of income in Asia, a region where countries have experienced steep declines and increases as well as stable labor income shares in the quarter-century since 1990. An innovation of this study is to expand the standard drivers of labor shares—technological advance, trade, institutions, and policies—by considering whether the exposure to routine jobs has also played a role in the evolution of the labor share of income. The more exposed a country is to routinization, the greater is the probability that ICT capital substitutes mid-skilled jobs, lowering the overall wage share of workers. Using a new dataset on the exposure to routinization, the study finds that it is an important determinant of the evolution of labor shares in developed Asian economies, where the initial exposure was high, but not in developing Asian economies where the share of routine jobs was small.

JEL Classification C23 · E24 · E25 · O33

1 Introduction

After decades of relative stability, labor income shares began to decline globally in the 1980s (Fig. 1). A deeper examination of the country evolutions behind the global decline, as Fig. 1 shows, indicates, however, that this evolution was remarkably heterogeneous both across and within regions (Fig. 2). North and South America, Europe, Asia, and Africa witnessed declining and rising as well as stable labor shares of income. For example, within Asia, the labor share of income fell in Japan and the People's Republic of China (PRC) but rose in Malaysia and Thailand and remained relatively stable in Singapore (Fig. 3). However, on the global scale, the labor shares of income declined in the largest economies of the world, including

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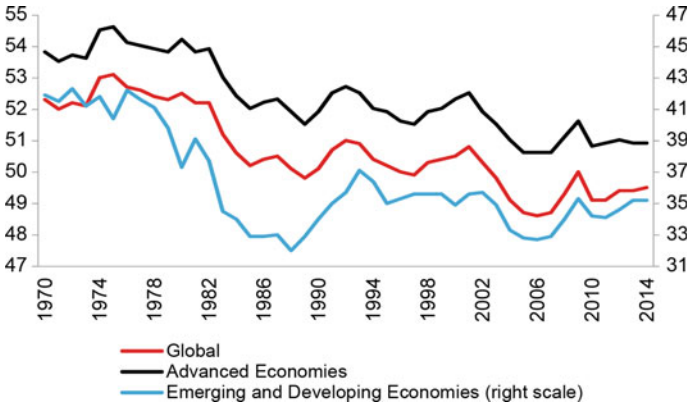

Fig. 1 Evolution of the labor share of income (%). *Sources* National authorities and IMF staff calculations

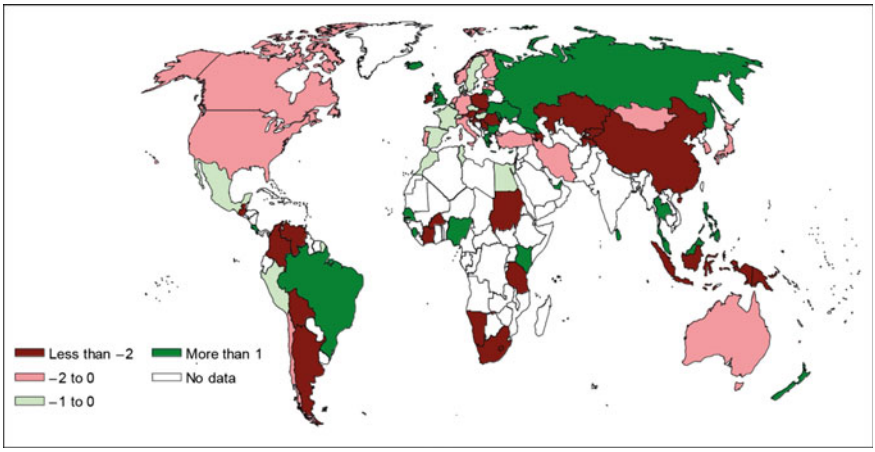

Fig. 2 Trends in the labor share of income (percentage points per 10 years). *Sources* National authorities; and IMF staff calculation. *Note* This world map shows the labor share trend of countries with at least 10 years of data, starting from 1990

four of the five largest economies and eight of the largest ten, resulting in the observed (GDP-weighted) decline in the global labor share of income.

This paper will discuss the evolution of the labor shares within Asia, a region that has not received much attention in the literature relative to the large body of work that has examined the decline in the labor share of income in the United States and in advanced economies more generally (see e.g., Blanchard 1997; IMF 2007; Karabarbounis and Neiman 2014). Asia is particularly interesting, because its constituent countries are highly diverse along many dimensions. For example, Asia includes a heterogeneous set of countries in terms of their economic development,

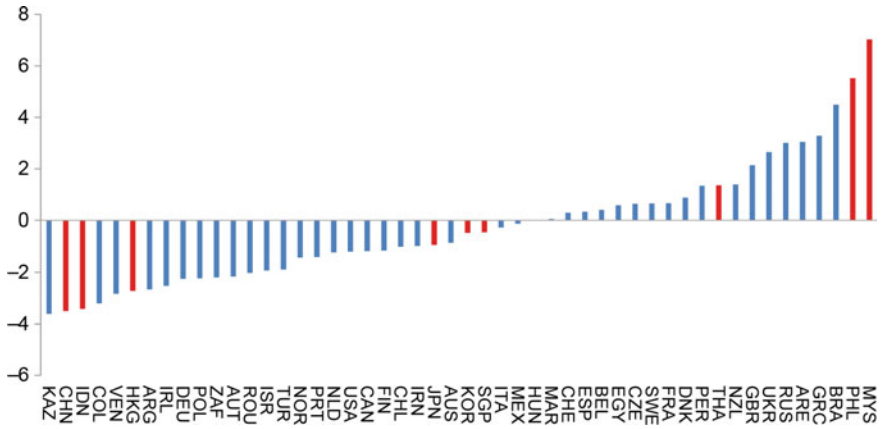

Fig. 3 Evolution of Asian labor shares, in global perspective (percentage points per 10 years). *Notes* and *Sources* Data are from National Authorities. Figure shows the trend change in labor shares for countries with at least 10 years of data, starting in 1990

consisting of developed economies such as Japan, large emerging economies such as the PRC, Malaysia, and Thailand, newly industrialized economies such as Singapore and Hong Kong, China, and lower-income countries such as the Philippines.[1] Countries within Asia also have remarkable diversity in demographics, technological advancement, and trade linkages with countries within and outside Asia, which may be relevant factors in analyzing the evolution of the labor share of income.

To date, the understanding of the forces behind this striking—though heterogeneous—decline in the labor share is not complete. However, the recognition of the global nature of its evolution—through the peaks and troughs of domestic business cycles and over a period that has experienced profound structural transformation in advanced and emerging economies alike—has led to an emerging consensus that the primary forces behind this evolution are likely to be global as well, with varying impacts across countries reflecting varying exposures to common global factors. In recent years, authors have advanced hypotheses that have narrowed these forces down to two key factors: the globalization of trade and capital (see e.g., Elsby et al. 2013; Dao et al. 2017) and technological changes (e.g., Karabarbounis and Neiman 2014).

Concerning technological advancement, the hypothesis is that the rapid advance of technology has lowered the relative price of investment goods and thereby

[1]The data for the labor share of income are from official sources and Dao et al. (2017). Official data are unavailable for certain Asian countries, including India, Bangladesh, and Cambodia.

induced forms to replace labor with capital.[2] Karabarbounis and Neiman (2014) estimated that the associated capital deepening—in combination with an estimated elasticity of substitution between capital and labor that is larger than one—explains about half of the decline in labor shares globally. However, several authors have pointed to a predominant role of information and communication technology (ICT), in particular in the declining relative price of investment.[3] Following this, we present an exploratory analysis that differentiates the impact of technology on labor shares through two distinct but intertwined mechanisms: (a) the decline in the relative price of investment goods, reflecting technological progress broadly; and (b) the nature of technological progress, in particular the *routine bias* of technological change, that is, the development of technologies that induce firms to substitute capital for labor performing *routine* tasks.

As Autor et al. (2003) define, routine tasks are those that ICT capital can easily substitute, as they require little abstract thinking, follow a natural sequence of operations, and are easily codifiable by programmers; thus, computerization can easily automate them. The two mechanisms are also likely to interact: a decline in the relative price of investment goods may trigger greater substitution away from labor that performs more routine tasks.[4]

It is well known that the steep decline in the price of automating technology in advanced economies over the last quarter-century has resulted in a large-scale "hollowing out" of the labor force—displacing middle-skilled labor into low-paying jobs (or unemployment) and raising the demand and wage premium for high-skilled workers (see e.g., Autor and Dorn 2013; Goos et al. 2014; Ikenaga and Kamibayashi 2016). As Dao et al. (2017) discuss, the hollowing out is likely to have played a role in reducing the labor shares of income by lowering the incomes of low- and mid-skilled workers significantly more than it raised the incomes of high-skilled (capital-owning) workers. Very little knowledge, however, exists about the incidence of routine tasks in countries beyond the advanced economies that the

[2]Technological progress affects the labor share by lowering the user cost of capital and inducing firms to substitute capital for labor (with the impact on the labor share depending on the elasticity of substitution between labor and capital). The user cost of capital is the opportunity cost of using rather than selling the existing capital and is a positive function of the price of capital, the interest rate, the depreciation rate, and the expected decline in the price of capital. More efficient technology for producing investment goods lowers the price of capital and thus the user cost. A decline in interest rates or capital depreciation rates could play a similar role to technological progress in lowering the user cost of capital.

[3]For example, Krusell (1998) discussed the role of ICT in the relative price of investment; Katz and Krueger (1998) and Feenstra and Hanson (1999) that in skilled wage premia; and Autor et al. (2003), Autor and Dorn (2013), and Goos et al. (2014) that in the displacement of labor.

[4]We draw on a measure of routinization developed in Das and Hilgenstock (2018); see also Das (2018). This measure begins with a score for the routinizability of every occupation that Autor and Dorn (2013) created and then computes an occupation-weighted score for each sector in a country and an aggregate score for the country. The routinization scores vary over time as the occupation weights change.

existing literature has focused on, and whether the displacement of routine labor has similarly affected the labor shares in these countries.

By "globalization," the literature refers broadly to the surge in three inter-related cross border trades: trade in final goods and services; trade in intermediate goods exemplified by the rise of supply chains; and financial asset trade. Regarding trade in final goods and services, the classical Stolper–Samuelson trade theory predicts that globalization (reflected most significantly in the entry of the PRC, India, the countries of the former Soviet bloc, and other economies into the global trading system) will lead capital-abundant developed economies to specialize in the production of capital-intensive goods, triggering resource reallocation across sectors that reduces the aggregate labor share in their economies, while the opposite will occur in developing economies.

Trade in intermediate goods and services is a closely related, but distinct, aspect of globalization that can affect labor shares following the entry of low-cost suppliers of intermediate inputs into the global economy (Feenstra and Hanson 1996; Grossman and Rossi-Hansberg 2008). The hypothesis is that access to cheaper intermediate inputs spurs "offshoring" in developed economies, as a Heckscher–Ohlin model for vertical trade predicts. Such offshoring is likely to raise the capital intensity of the remaining production in developed economies and labor's share of income where the capital–labor elasticity of substitution is lower than one. A separate channel through which the rise in intermediate trade may decrease labor's share is the credible raising of firms' threat to offshore jobs, lowering workers' bargaining power.

Finally, financial globalization is another plausible explanation for the decline in the labor share of income, as it lowers the cost of capital for developing economies that have removed the barriers to capital mobility, spurring an increase in capital-intensive production and a decline in the labor share of income. We will discuss these factors in further detail in Sect. 3.

1.1 Motivations

The decline in the labor share of income has potentially large and complex macroeconomic and social implications. A decline in the labor income share, by definition, implies that the owners of capital have accrued a greater share of income. As capital holdings tend to concentrate in the upper tail of the income distribution (Wolff 2010), an increase in the capital share raises income inequality, all else being equal. If the decline in labor shares is more pronounced among unskilled workers, this can further widen the income gap. Such trends may fuel populist perceptions that the gains from growth are not broadly shared, raising the risk of a backlash against globalization—a trend that people widely perceive to benefit capital over labor. These concerns are of increasing importance in Asia, where political commentators have noted that rising populism may be an even bigger threat than in the West given that strong domestic institutions and norms will not constrain such forces (Kurlantzick 2017).

Falling labor shares can also imply that wages have been growing at a slower pace than labor productivity (Dao et al. 2017). This phenomenon can have a range of macroeconomic implications, including on aggregate demand and wage inequality. As capital holdings tend to concentrate in the upper tail of the income distribution, an increase in the capital share at the expense of the labor share increases income inequality. Research has identified several countries in Asia, including Viet Nam and the PRC, as experiencing extreme inequality (Asian Development Bank 2014), and exacerbation of these trends risks a significant backlash. Furthermore, if the decline in the labor share is more pronounced in the unskilled sector, this would further widen the income gap. Changes in factor shares have implications not only for the distribution of income but also for the design of the fiscal policy. For instance, since lower-income households have a higher marginal propensity to consume, a declining labor share can depress the growth in the aggregate demand. This may be especially relevant in the lower-income countries of Asia, where the share of households in poverty is large.

The link between labor shares and income inequality is not always straightforward, however. Income inequality could increase due to a change in the distribution of wages, without any accompanying change in the labor share of income. At the same time, gains in employment and wages that concentrate in the upper tail of the income distribution could raise both the labor share and the income inequality at the same time. Finally, a decline in the average remuneration of labor vis-à-vis capital could increase the labor share if firms respond by substituting labor for capital, that is, if the so-called elasticity of substitution between labor and capital is high (above one).

Changes in factor shares also have implications for the design of tax and benefit policies. For instance, to the extent that a decline in the labor share results from the displacement of labor due to globalization and technological change, policy responses to ease the reallocation of workers across sectors could include the widening of safety nets as well as the strengthening of education and job retraining. In addition, to the extent that the same factors that reduce the labor share also lie behind higher inequality, greater use of redistributive policies may be necessary. More generally, identifying the forces behind the decline in the labor share is important for our understanding of the macro economy, particularly in emerging markets and developing economies, where the drivers of the labor share of income are not well understood.

Against this backdrop, this study will examine the role of exposure to routinization in the evolution of the labor share of income in Asia. We will begin in Sect. 2 by describing a measure of the exposure to technologies that tend to displace labor in routine tasks and presenting stylized facts about the exposure to routinization across Asian economies. Section 3 will examine the mechanisms that link the exposure to routinization with the labor share of income and consider whether these mechanisms apply in both developed and developing economies. Section 4 presents an empirical study that decomposes the contributions to the change in the labor share, illustrating the role of exposure to routinization in developing versus developed economies. Section 5 concludes.

2 Exposure to Routinization: Stylized Evidence for Asia

Estimations have indicated that the real cost of computing power fell at a staggering rate of more than 50% *annually* between 1969 and 2005 (Nordhaus 2007). A fundamental insight into the implications of this technological revolution—on the nature of tasks, patterns of international trade, and industrial structure—began with the characterization of those tasks that the surge in computer capital is most likely to affect as *routine* tasks (Autor et al. 2003). This work defines routine tasks as those that "… require methodical repetition of an unwavering procedure … exhaustively specified with programmed instructions and performed by machines."

The steep decline in computing costs has presented firms with strong incentives to automate routine tasks. Such *routinization* (i.e. the automation of routine tasks) apparently lies behind the substantial displacement, stagnant wage growth, and declining labor share in many advanced economies (Autor and Dorn 2013; Goos et al. 2014; Dao et al. 2017).[5] The magnitude of these dislocations, however, varies across economies, suggesting that, if routinization does lie behind these trends, either the intensity of routine occupations varies across countries or countries with comparable routine intensities automate at different rates, reflecting idiosyncratic factors such as industrial composition, or both.

Assessing such considerations empirically requires a consistent and comparable measure of routinization across industries and countries. Recently, Das and Hilgenstock (2018) proposed such a metric. This measure begins with a set of ordinal scores (Autor and Dorn 2013) that gauge the intrinsic routinizability of an occupation (i.e. its likelihood of automation by information technology). The scores contain no information other than the ordinal position of occupations in increasing order of routinizability. On the left tail of this scale are the most non-routinizable occupations: farming, firefighting, and teaching; on the right tail are the most routinizable tasks: cashier work, proofreading, and machine operation.

Using consistently defined occupations across countries from national population censuses, labor force surveys, and other sources, Das and Hilgenstock constructed employment-weighted scores of occupations in industries and the economy to measure the *exposure to routinization*. Thus, for occupation category l, industry j, and country i at time t, the industry- and country-level routinization exposures are respectively:

$$RTI_{jit} = \sum_{l} \omega_{ljit} \times RTI_{l}, RTI_{it} = \sum_{l} \omega_{lit} \times RTI_{l}$$

where ω_{ljit} and ω_{lit} are respectively occupation l's share of employment in industry j, in country i, at t and occupation l's share of employment in country i at t, and the intrinsic routinizability of a task (i.e. the propensity of a routine task to be

[5]Autor and Dorn (2013) and Goos et al. (2014).

automated) is denoted *RTI*, following Autor and Dorn (2013).[6] We construct the exposure for 160 countries (116 developing economies and 38 developed economies) and 14 2-digit industries.

Using these data, this study analyzes the exposure to routinization across Asia and establishes several stylized facts. First, the labor markets in developing Asia are significantly less exposed to routinization than those in developed Asia and remain less exposed for the duration of the quarter-century between 1990 and 2015. This finding emerges from the industrial distribution of employment, as production concentrates in labor-intensive industries (agriculture, retail trade, and services) in developing Asia, particularly in manual tasks, which are naturally indisposed to automation, while it concentrates in routine-intensive industries (manufacturing, transportation, construction, and financial services) in developed Asia. This stylized finding suggests that, insofar as technological advancement (particularly in the adoption of ICT) lies behind the labor share, its role is likely to be consequential in developed Asia but inconsequential in developing Asia.

Figure 4 illustrates this by presenting the distribution of exposures across industries. Panel A shows the "initial" exposure, measured as the earliest observation in 1990–95, while panel B shows the "subsequent" exposure, measured as the last available observation in 2010–15. Both panels also show the average routine exposure for each industry, separately for developed and developing economies.[7] The width of each box whisker line represents the range of routine exposures across economies.

Second, the initial exposure to routinization (measured in the early 1990s) has a strong, negative correlation with subsequent exposure (measured in or around 2015), as Fig. 5 shows. However, there is sharp asymmetry in the level of exposure. In developed Asia, where countries had already been heavily exposed to routinization by the early 1990s, the higher was the initial exposure, the lower was the subsequent exposure. Meanwhile, developing Asian economies largely fall into the second quadrant of Fig. 5, indicating that the higher was the initial exposure, the lower was the subsequent *rise* in exposure.

For developed Asia, the interpretation is clear: the higher was the initial exposure to routinization, the greater was the displacement of middle-skilled labor as firms in advanced economies displaced them more intensely with capital, lowering the overall wage share of workers and resulting in *lower* subsequent exposure to routinization.

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[6]This assumption implies that the tasks that, for example, a babysitter performs present inherent challenges to computerization, while those that an assembly plant worker performs are inherently automatable, regardless of the industry or the time when they are performed. Importantly, note that the assumed intrinsic quality of the task is *distinct* from whether the task is actually automated, which may indeed vary with time or across industries or countries.

[7]These are weighted averages, with weights given by value added, and we calculate them separately for developed and developed economies. For example, for developed economies, the weights are the share of an industry's value added in the total value added of that industry across all developed economies. We use the same weighting scheme for developing economies.

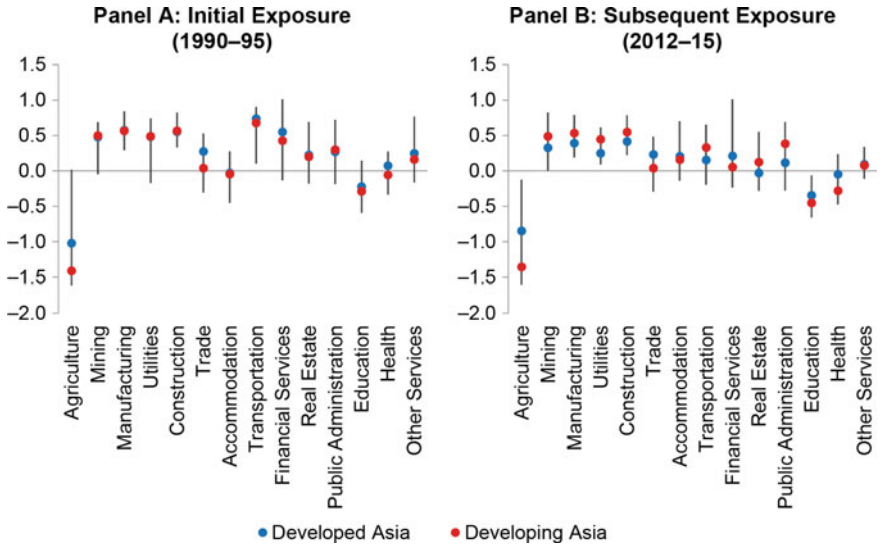

Fig. 4 Exposures to Routinization across Industries. *Source* Das and Hilgenstock (2018). *Note* The circles represent the average routine exposure for each industry in developed (blue) and developing (red) Asian economies

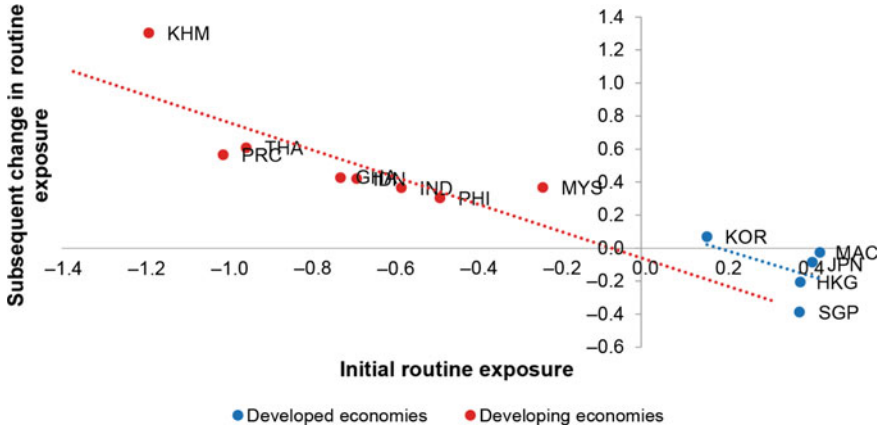

Fig. 5 Initial routine exposure and subsequent change in routine exposure. *Source* Das and Hilgenstock (2018)

In developing Asia, where economies fall into the second quadrant of Fig. 5, the interpretation is that the less initially exposed was an economy to routinization, the greater was its increase in exposure to routinization. A logical explanation for this phenomenon is that, in developing economies, the natural transition from agriculture to manufacturing and services—structural transformation—is consistent with

the rise in routine-intensive jobs (which are high in manufacturing and certain service sector industries) and a decline in routine-weak jobs (which are predominantly in agriculture and low-skilled services). As the next section discusses, the globalization of trade may have also played a role as developed countries from Asia and other parts of the world offshored routine-intensive factory jobs to developing Asia (Blinder and Krueger 2013), raising the capital intensity of production and with it the capital share of income.

3 Linking the Exposure to Routinization to the Labor Share of Income: Mechanisms

Having described stylized facts about the exposure to routinization in Asia, we now propose several mechanisms by which routinization could affect the labor share of income, drawing from the literature on the risk of the skilled wage premium (see e.g., Bergin, Feenstra and Hanson 2007), the globalization of trade (e.g., Blinder and Krueger 2013), and job polarization—the phenomenon of lowering employment and wages of mid-skilled labor relative to those of high- and low-skilled labor. The literature has emphasized these links in advanced economies, as this is where the preponderance of the evidence on skilled wage premia, offshoring, and polarization lies. Such drivers may operate differently in developing economies, reflecting differences in the factor shares of capital and labor, price distortions, informational asymmetries, and the low stage of development, or they may not even operate at all (Maloney and Molina 2016). We discuss four inter-related factors that are relevant.

The most significant factor is that the advancement of ICT—which the rapid improvement in its productivity as well as the steep decline in the cost of computerizing routine tasks reflect—has presented firms with incentives to displace routine labor for capital (see e.g., Levy and Murnane 1996; Card and DiNardo 2006; Autor and Dorn 2013; Beaudry et al. 2016). The hypothesis is that, all else being equal, in countries where the relative price of investment goods has declined more, mid-skilled labor will have been displaced more to lower-paying jobs or unemployment and the labor share of income is likely to have declined more sharply.[8]

[8]Following a large literature, we measure the relative price of investment goods as the ratio of the investment deflator to the consumption deflator. In a two-sector economy, consisting of a capital goods sector and a consumption goods sector (e.g., Whelan 2000), a declining relative price of investment can result from either an increase in productivity in the investment goods sector or a decline in productivity in the consumption goods sector and leads to an increase in the employment of investment goods in production relative to factors used in consumption goods (which may include labor as well as other factors of production).

Second, for routinization to result in a decrease in the labor share of income, a significant share of the economy must be engaged in routine occupations. That is, the routine exposure must be large enough for a shock, such as a steep decline in automation costs, to trigger measurable dislocations of routine labor. The implication is that, for a given decline in the relative price of investment goods, the higher the exposure to routinization, the larger the adoption of labor-saving technologies and the more severe the decline in the labor share of income.

Another factor, which, for example, Feenstra and Hanson (1997) and Acemoglu and Autor (2011) emphasized, is the skill bias of ICT (i.e., its complementarity with skilled labor and its substitutability or neutrality for less-skilled labor).[9] The argument is that the adoption of ICT technologies has raised the demand for skilled labor, leading to a steady increase in their employment share; by simultaneously displacing middle-skilled labor performing routine tasks into lower-paying service sector jobs, it has also raised the employment share at the bottom of the wage distribution. Even if high-skilled wages rise measurably, if the majority of the labor force is engaged in low- and mid-skilled labor, the net impact of the skill bias of ICT will be to lower the labor share of income.[10]

The last possible mechanism lies at the intersection of trade and technology. Several authors have argued that technological advances have not just made the automation of routine tasks more feasible; by drastically lowering the costs of offshoring tasks to locations with lower factor costs, they have spurred vertically integrated production (Blinder and Krueger 2013). Blinder (2007), for example, noted that the tasks that companies are most likely to offshore are low-skilled clerical or factory jobs that require neither face-to-face interaction nor physical proximity to specific sites. Many of these characteristics, as Autor and Dorn (2013) noted, are also defining features of routine tasks.[11] This suggests that automation and offshoring may be mutually reinforcing, together lowering the relative demand for routine labor and contributing to a decline in the labor share of income.

We consider how these arguments apply to the evolution of the labor shares in Asia, distinguishing their likely effects in developed versus developing countries.

[9]Feenstra (2002) proposed the skill bias of ICT as the main explanation for the rising wage premium of skilled workers. Feenstra argued that, as routine tasks were automated and offshored, the composition of the remaining production in developed economies became more skill-intensive, raising the demand for high-skilled workers and generating a skilled wage premium. The growth of low-skilled labor and the "twisting" of the wage distribution has led to the additional observation that the skill bias of ICT lies behind labor market polarization.

[10]Among others, Katz and Murphy (1992), Autor et al. (2006), Firpo et al. (2011), and Autor and Dorn (2013) presented empirical evidence.

[11]In contrast, non-routine, low-skilled tasks, like construction and babysitting, require either physical proximity or face-to-face interaction, making them unsuitable for offshoring.

3.1 Relative Price of Investment Goods

The steep decline in the relative price of investment goods is strongly evident in developed Asian countries, but in developing Asia it has experienced only very mild declines, has remained stable, or has even risen over the last quarter-century, mirroring the general pattern globally (see Dao et al. 2017). Figure 6 illustrates: whereas the relative price of investment has declined by 15% in the developed Asian countries since 1990, in the developing countries of Asia, it has risen by 13% in the same period.[12]

This suggests that developing Asia has not faced the pecuniary incentives to automate jobs and thus the decline in the labor share in these countries is unlikely to be related to technological advancement, while it is likely to have played a role in the evolution of the labor share in developed Asia. Considering that the labor costs in developing economies are a fraction of those in developed economies, countries in developing Asia would have needed an even *stronger* decline in the price of investment goods than in their developed counterparts to adopt labor-saving technologies, all else being equal.

3.2 Occupational Distribution of Employment

Even if faced with rising capital goods prices, countries in developing Asia might have elected to adopt labor-saving technologies if the resulting efficiency gains had outweighed the higher factor costs. This could have resulted in dislocation from routine jobs, with downward pressure on wages. For this to have a measurable effect on the labor share of income, however, a nontrivial share of the existing tasks in developing Asian economies would need to be automatable by information technologies.

There is a widely held belief, however, that labor in developing economies concentrates in jobs with low susceptibility to routinization (ILO 2014; Maloney and Molina 2016). The ILO estimates that the primary sector employs about 40% of their workforce. Confirmation comes from the low exposure to routinization of developing Asia (shown in Fig. 5), a result of the large share of the workforce in low routine-intensive agriculture and service occupations and the small share in high routine-intensive occupations. The disparity between the exposures to routinization reflects the differences in the occupational structure of employment between developed and developing Asia. The small share of routinizable jobs

[12]This is distinct from the stylized finding that the price *level* of investment goods is higher in developing economies (Hsieh and Klenow 2003). The factors behind this differential evolution may be related to the high dependence on capital imports in developing countries, where local currency prices are subject to import tariffs; the commodity intensity of imports; non-trade barriers and transportation costs; and the volatility of exchange rates (Dao et al. 2017).

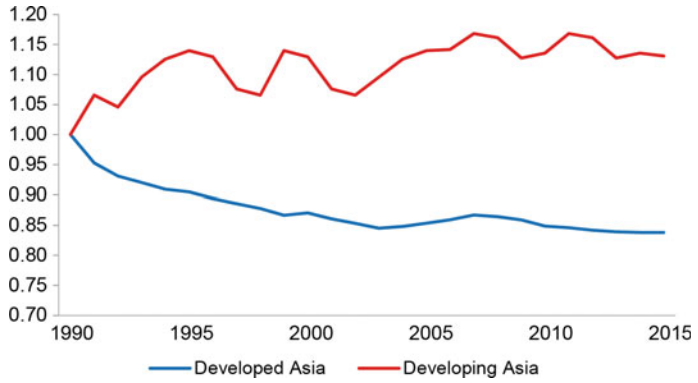

Fig. 6 Relative price of investment goods, 1990–2015. Index (1990 = 1). *Source* World economic outlook, national authorities, and author's calculations

suggests that even a favorable shock to capital goods prices may not result in significant labor displacement in the short term (see also Das and Hilgenstock 2018).

4 Globalization and the Offshoring of Routine Tasks

Research has established well that, starting in the 1990s, Asia was the predominant destination of jobs offshored from advanced nations. If developing Asia is a recipient of low-skilled jobs offshored from developed countries (including those in Asia) and such jobs have high routine intensity, as Blinder (2007) suggested, then offshoring should raise their employment of routine labor and with it the capital intensity of production.

By the same logic, the offshoring of routine-intensive jobs from advanced Asia would lower their demand for routine labor and thus reduce the capital intensity of production. This suggests that the globalization of trade—as the rising phenomenon of vertically integrated chains and offshoring reflects—is likely to have affected the labor share of income differently in developed versus developing economies: increasing the labor share of income in developed countries and decreasing it in developing ones. Autor and Dorn (2013) acknowledged that the polarization of the United States labor market could result from offshoring in addition to (or in place of) the automation of routine jobs; see also Elsby et al. (2013).

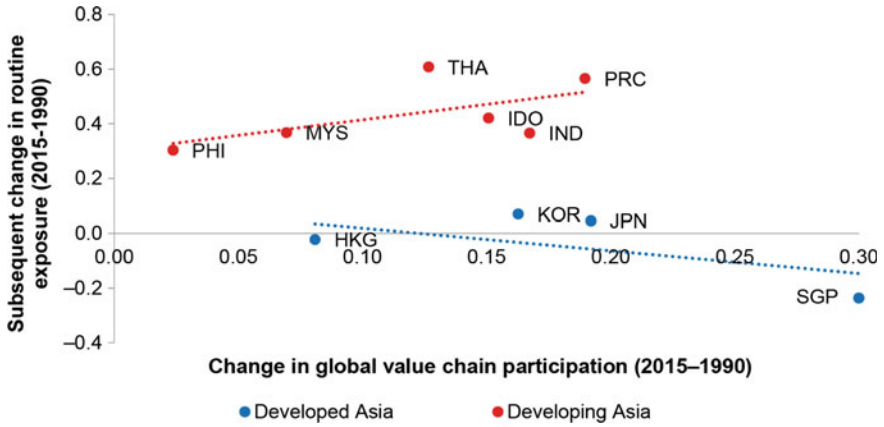

Fig. 7 Global value chain participation and subsequent change in routine exposure. *Notes* and *Sources* Change in GVC participation and routine exposures are measured as the difference of the measures in 2010–15 and in 1990–95. Data sources: Dao et al. (2017), Autor and Dorn (2013), Das and Hilgenstock (2018), and authors' calculations

Using the measure of participation in global value chains (GVCs) of Koopman et al. (2014),[13] Figure 7 suggests that the globalization of trade could have played a role in both raising routine exposure in developing economies and lowering it in developed economies. We test this hypothesis further in the empirical analysis.

Finally, one must acknowledge that idiosyncratic factors may constrain the adoption of technologies in developing Asian economies. Comin and Mestieri (2013) found that the adoption lags have recently begun to converge with those in developed countries but that the penetration rates have simultaneously diverged. Insufficient information about new technologies, a key determinant of adoption, is one factor that research has cited as a cause of lower penetration (Foster and Rosenzweig 1995). Institutional barriers related to ineffective property rights enforcement, misappropriation of funds, and a lack of enforcement are structural impediments that hinder large-scale technological adoption. The lack of information, coupled with a limited number of suppliers of new technology, can lead to significant price dispersion à la Stigler, whereby the end-users face significantly higher prices than those at the port, making the adoption of technologies less likely on the margin.

[13]This is a widely used metric of value-added trade, which includes measures of both backward linkages (defined as the share of foreign value added in gross exports, which captures the extent of offshoring of intermediate inputs used in exports) and forward linkages (defined as the share of exports consisting of intermediate inputs that trading partners use for the production of their exports to third countries, which is a measure of the extent of vertical specialization). See for example Koopman et al. (2014) and Dao et al. (2017).

5 Exploring the Impact of the Exposure to Routinization on the Labor Share of Income

We now examine the empirical relation between labor shares and their key determinants, including technology, globalization, and other factors, introducing the exposure to routinization as an additional determinant. Following influential work on the analysis of labor shares, the approach focuses on long-run trends in labor shares and relates them to long-run trends in potential drivers.[14] Important considerations motivate this strategy, including the fact that adjustments to the structural changes that technological advances and globalization trigger occur over long horizons and that, even at the business cycle frequency, changes in labor shares can exhibit little to no change even when the underlying trend is declining.

Limiting the analysis to countries that have at least 10 years of data over the period 1990–2015, the empirical analysis focuses on a sample of 49 countries (33 advanced economies and 16 emerging markets). We then apply the estimated results to Asia.

To estimate the effect of technology, the analysis follows Karabarbounis and Neiman (2014) by using the trend change in the relative price of investment goods as a proxy for firms' incentives for capital–labor substitution and adding to that the change in exposure to routinization. By measuring the exposure to routinization for each country at the start of the time period, this approach circumvents the concern that high initial exposure to routinizable jobs will itself lead to greater adoption of routine technology and thereby lower the subsequent exposure to routinizability.

To examine the impact of globalization, we use several measures, including the long-run trends in overall trade (measured as the sum of value-added exports and imports relative to the GDP); participation in global value chains (GVCs, measured as the sum of forward and backward linkages)[15]; and, as an approximate measure of financial globalization, the sum of external assets and liabilities (excluding international reserves) as a percentage of the GDP. For the labor and product market structure, we use the trend changes in union density and corporate taxation rates and an indicator for those countries that enacted significant reforms in deregulating employment protection and in product markets.

The estimated model is:

$$\widehat{LS_c} = \alpha + \beta_2 \widehat{PI_c} + [\beta_3 IER_{0,c} + \beta_4 IER_{0,c} \widehat{PI_c}] + \beta_1 \, '\widehat{G_c} + \beta_5 \, '\widehat{Pol_c} + \varepsilon_c \qquad (1)$$

[14]See, for example, Harrison (2005), Elsby et al. (2013), Karabarbounis and Neiman (2014), and Acemoglu and Restrepo (2017).

[15]Backward linkages capture the extent of offshoring of intermediate inputs used in exports, and we define them as the share of foreign value added in gross exports. Forward linkages measure the extent of vertical specialization, and we define them as the share of exports consisting of intermediate inputs that trading partners use for the production of their exports to third countries (see Koopman et al. 2014).

where (hat) variables are long-run annualized changes during the period 1990–2015, the subscript c denotes countries, PI denotes the relative price of investment, ER_0 indicates the initial exposure to routinization, and G subsumes the variables measuring the evolution of globalization: the trend in total goods trade, trade in intermediate inputs, and trends in financial globalization (inward plus outward FDI as a percentage of the GDP). Pol summarizes the policy/institutional factors, including trends in union density, corporate taxation, and the incidence of a given country to implement major employment protection legislation (EPL) or carry out product market reforms (PMR). Table 1 provides the results.

While overall trade intensity does not appear to matter much for labor shares, participation in GVCs does. The research estimates that participation in GVCs exerted a strong negative effect in both advanced economies and emerging markets, supporting the notion that offshored tasks are labor intensive for the former group of countries but raise the capital intensity in the latter.[16]

Financial globalization, which the trend change in external assets and liabilities approximates, has contrasting effects on the two country income groups, depressing the labor shares in advanced economies while raising them in emerging economies. Research has long argued that rising capital mobility strengthens capital owners' bargaining power relative to that of labor by facilitating the relocation of production.[17] The empirical estimates are consistent with this notion for advanced economies, which are in general the source countries of FDI flows. The finding for emerging markets is consistent with the notion that capital inflows lower the cost of capital and, if production has limited substitutability of capital for labor, raise the labor share of income, an outcome that is most likely a result of the high-skilled labor share.[18] The measures of trend changes in labor and product market regulation, as well as changes in corporate taxation, do not appear to have robust effects on the labor share trends over the sample period, having accounted for the trends in technology and globalization.

Figure 8 presents a decomposition to gauge the relative contributions to the labor share trends in advanced versus developing Asian economies. In advanced Asia, technological advancement, as the declining relative price of investment goods and the initial exposure to routinization reflect, has been the largest

[16]The larger impact of offshoring in receiving developing economies could reflect the fact that the reallocation of displaced workers in advanced economies from manufacturing to low-skill (but labor-intensive) service industries (as Autor and Dorn 2013 showed) may itself raise the labor share and work against the negative effect of offshoring, while, in developing economies, the reallocation effect (from labor to more capital-intensive jobs) is more unambiguous. Another reason is that imported intermediate inputs may increase the labor share in some tasks/sectors in developed countries through their positive effect on productivity if such tasks have a relatively low elasticity of substitution.

[17]Feenstra and Hanson (1997), Harrison (2005), IMF (2007).

[18]See Jaumotte et al. (2013).

Table 1 Drivers of the change in labor shares of income

	(1) Technology	(2) Globalization	(3) Institutions, policies		(4) All
Initial exposure to routinization	–0.0001 (0.001)				−0.0003 (0.001)
Rel. price of investment x initial exposure to routinization	0.27** (0.09)				0.53*** (0.099)
Relative price of investment	0.09** (0.04)				0.17*** (0.05)
GVC participation (intermediate trade)		−0.53*** (0.15)			−1.27*** (0.25)
Financial globalization		−0.003** (0.001)			0.045*** (0.013)
Final goods and services trade		0.017** (0.007)			
Product and labor market reform			−0.0002 (0.0002)	0.0001 (0.0002)	
Unionization				0.05 (0.05)	0.02 (.03)
Corporate taxation				0.18*** (0.06)	0.03 (.04)
N	47	48	48	26	47
R-squared	0.21	0.25	0.02	0.36	0.62

Notes Results are for Eq. (1), estimated using generalized least squares with robust standard errors shown in parenthesis

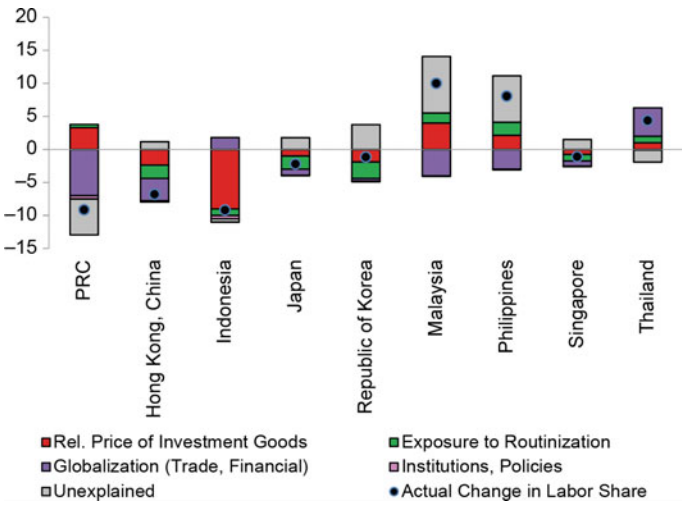

Fig. 8 Estimated Decomposition of the Change in Labor Shares (percentage points). *PRC* = People's Republic of China. *Notes* The decomposition is based on the estimated coefficients in Table 1, applied to the economies shown. A decomposition could not be calculated for those countries for which there are no data for some covariates

contributor to the downward trend in labor shares, accounting for half or more of the overall decline. This is particularly the case in Japan and the Republic of Korea, countries that experienced heavy exposure to routinization in the early 1990s and subsequently automated a significant number of manufacturing jobs (see Ikenaga and Kamibayashi 2016). Globalization—using participation in GVCs and financial globalization as proxies—together contribute less than half as much as technology to the estimated decline in labor shares for Japan and the Republic of Korea but are significant in explaining the estimated decline in Hong Kong, China, an economy with stronger exposure to trade in global value chains. Overall, institutions and policies contribute a negligible amount to the estimated change in the labor share in developed Asian economies.

For developing Asian economies, the forces of globalization have generally been the predominant driver of the evolution of the labor share. As Fig. 8 shows, in the PRC, Indonesia, Malaysia, Thailand, and the Philippines (which are the developing Asian economies for which there are adequate data on the covariates), the contribution of globalization has generally lowered labor's share of income. The surge in global value chains, in particular, has raised the capital intensity of production and thus raised the capital shares, although in many cases financial globalization has partially offset this, lowering the cost of capital and directing a smaller share of income toward capital owners.

Technology has generally played a small role in the evolution of developing Asia's labor shares, although its impact is fairly heterogeneous across individual countries. In certain cases (e.g., Malaysia, the Philippines, and the PRC), in which the relative price of investment goods has risen since 1990, it has spurred a greater allocation of production *away* from capital and toward labor, increasing the labor share of income. With low initial exposure to routinization in these economies, there has been little contribution of the routinization of labor to the trend changes in the labor share. Indonesia is one exception to the general findings, as its relative price of capital has declined, which, unlike in most other developing economies, is the predominant contributor to the change in the labor share in this country. Even in Indonesia, however, the exposure to routinization has played an insignificant role in the trend decline in the labor share.

6 Conclusions

This study begins with the observation that the downward trend in the global labor share of income since the early 1990s has been broad based, though heterogeneous, across regions but also within regions. It focuses on the evolution of the labor shares in Asia, a region that is highly diverse in its demographics, technological advancement, and trade linkages, all of which may be relevant to an analysis of the labor share of income.

To expand on the growing literature on labor shares, this paper considers whether the exposure to routinization plays a role in driving the labor share of income and why its impact may differ across countries. The key hypothesis is that, where the initial exposure to routinization was high, firms more intensely displaced routine labor with capital as the price of automation declined. This led routine (mid-skilled) labor into lower-paying jobs or unemployment, pushing down the overall labor share of income.

The empirical analysis points to a dominant role of both technology and globalization, although to very different degrees in developed versus developing Asian economies. Technological progress, as the steep decline in the relative price of investment goods as well as the high exposure to routine occupations that can be automated reflect, has been the key driver in advanced Asia, with globalization playing a smaller contributing role. In developing Asia, the evolution of labor shares is driven predominantly by the forces of globalization, with a very limited role for technology. This reflects in part a much less pronounced decline in the relative price of investment goods as well as lower exposure to routinization, which has bounded the impact of technology on displacing labor.

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Chapter 3
The Labor Share of Income Around the World: Evidence from a Panel Dataset

Marta Guerriero

Abstract There are two fundamental reasons why factor shares have traditionally been overlooked in the economic literature. First, because of their nature, factor shares are conceptually difficult to define and measure. Second, they have for a long time been perceived as constant across time and space. In this study, we provide an evaluation of five different methodologies of estimation commonly used in the labor share literature and propose a new measurement. We then compile a global dataset of the labor income share across 151 economies—both developing and developed—for all or part of the period 1970–2015. Results show that our suggested indicator is correlated to the other five measures but it also retains unique information. Contrary to the traditional assumption of stable factor shares, we document the existence of considerable heterogeneity across economies and variability over time. Specifically, there has been a general decline in the labor share around the world, in particular from the mid-1980s onwards.

Keywords Factor shares · Income distribution · Labor

JEL Classification E25 · J30 · E01

1 Introduction

Recent contributions on income distribution indicate that striking changes have taken place in recent decades. For example, the decline in the share of labor in national income, which has been witnessed in recent years in several economies, is an interesting phenomenon (Elsby et al. 2013; IMF 2017; Karabarbounis and Neiman 2013; Stockhammer 2017). This constitutes a major historical transformation, as the stability of functional income distribution has often been described in the past as a "stylised fact of growth" (Kaldor 1961).

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Most research on the labor income share provides only a partial picture, focusing mainly on industrialized economies (Elsby et al. 2013; Piketty and Zucman 2014), the corporate sector (Karabarbounis and Neiman 2013) and relatively short periods of time (IMF 2017). Authors also question whether this apparent decline is mainly due to problems of measurement. Studies find that, after appropriately adjusting for self-employment income (Bernanke and Gürkaynak 2001; Gollin 2002), indirect taxation and capital depreciation (Bridgman 2017; Rognlie 2015), factor shares are practically uniform across economies and approximately constant over time. Consequently, there has been little systematic attempt to generate a comprehensive global database of the labor income share.

This study intends to address these issues. Firstly, since factor shares are conceptually difficult to define (Gollin 2002) and highly dependent on the way they are constructed (Bridgman 2017; Izyumov and Vahaly 2015; Mućk et al. 2018), we examine different methodologies of measurement. Secondly, after comparing five alternative measures used in the existing empirical literature, we propose a sixth indicator, which allows us to compile a new global dataset of the labor income share across 151 economies—both developing and developed—for all or part of the period 1970–2015. Finally, we use descriptive statistics to document the existence of considerable heterogeneity across economies and variability over time.

The remainder of this study is organized as follows. Section 2 presents the main problems related to the definition and estimation of factor shares of income, highlights the importance of appropriate measurement and provides an evaluation of the methodologies most commonly used to estimate labor income shares. By building on the empirical work of Gollin (2002) and the theoretical conceptualization of Atkinson (2009), we propose an alternative approach to measuring labor shares. Section 3 provides a brief overview of our dataset, computed using the six methodologies described in Sect. 2. In Sect. 4, we use descriptive statistics to present an account of the performance of factor shares over time and across economies, and draw comparisons with the existing empirical literature. Our analysis offers some evidence against the proposition that the labor share is stable over time and that it converges across economies. Concluding remarks are made in Sect. 5.

2 Problems of Definition and Alternative Approaches

The labor share of income is conventionally computed by dividing the total compensation paid to employees[1] by the national income. Although it may be considered straightforward to determine, several problems of a conceptual and practical nature arise from its measurement.

[1]The compensation of employees includes wages and salaries as well as other forms of non-wage compensation which also constitute returns from labour.

This study builds on the methodologies proposed in the existing academic literature (Krueger 1999; Glyn 2009; Gollin 2002) illustrating measurement issues in both time series and cross-economy data on the labor income share. We use data from the United Nations (UN) National Accounts Statistics[2] (UN 2018), which provide yearly national accounts tables for more than 200 economies. Even though the data suffers from some comparability issues (Hartwig 2006), these estimations are useful and have been widely applied in the cross-economy literature on labor shares (Bernanke and Gürkaynak 2001; Gollin 2002; Jayadev 2007).

The labor income share is a ratio. Two adjustments are required for the computation of its denominator—the income aggregate—subject to data availability.[3] First, taxes on production and imports (minus subsidies) are removed from gross value added at market prices, converting the income aggregate to factor cost: indirect taxes (net of subsidies) do not represent any kind of return to capital nor to labor and therefore should not be counted (Glyn 2009; Gollin 2002; Izyumov and Vahaly 2015; Rognlie 2015). Second, capital income needs to be calculated net of capital consumption, by subtracting consumption of fixed capital from the value added to obtain a measure that is net of depreciation (Glyn 2009; Kuznets 1959; Piketty and Zucman 2014). According to Rognlie (2015), the distinction between labor income and net capital income (instead of gross capital income) is indeed more directly relevant to considerations of income distribution and inequality.

Turning to the numerator of the ratio, from a conceptual perspective, the total compensation of employees differs from labor income because it disregards the contribution of the self-employed. By counting only payments to corporate workers as labor income, it implicitly classifies all the earnings from the self-employed as capital income. This incorrectly underestimates the measure of labor share, since the income earned by the self-employed often represents a combination of returns to labor and returns to capital. Self-employment may represent emerging entrepreneurship and business start-ups; but it may also be the result of marginal employment and disguised unemployment (Gollin 2002).

From a time series perspective, a long-term decline in self-employment income would lead to an increasing trend in the labor share. In terms of international comparisons, since the rate of self-employment varies substantially across economies, the compensation of employees may significantly understate labor income in developing economies, where the self-employed account for a large portion of the workforce. According to OECD (Organisation for Economic Co-operation and Development) data (OECD 2018), self-employment in the United States decreased from 18.0% in 1955 to 6.3% in 2017, and in Japan from 56.5% in 1955 to 10.4% in 2017. Moreover, while the self-employment rate is currently 6.3% in the United States and 15.5% in the European Union, it is 31.5% in Mexico, 32.9% in Brazil and 51.9% in Colombia.

[2]Prepared by the Statistics Division of the United Nations in collaboration with national and international statistical agencies.

[3]Please see the appendix for complete information on data availability.

One solution to this problem is to analyze the corporate sector only (Bridgman 2017; Karabarbounis and Neiman 2013), or the manufacturing sector only, where the self-employed are less numerous (Azmat et al. 2011; Daudey and Garcia-Peñalosa 2007), however this approach does not resolve the issue entirely. It provides only a partial picture of the economy and it makes international comparisons difficult, since not all economies publish sector-specific data. Alternatively, in order to consider the whole economy we need to derive the labor income component of self-employment income and then add it to the compensation of employees (Johnson 1954; Kravis 1959; Kuznets 1959).

Six different measures of labor share will be presented and compared below: the unadjusted measure and five different indicators imputing a wage component to self-employment income—four of which have been proposed in the existing empirical literature.

2.1 LS1: The Unadjusted Labor Share

The unadjusted labor share, here called *LS1* (see Eq. 2.1), is the ratio of the compensation of employees to the value added (net of indirect taxes and consumption of fixed capital):

$$LS(unadjusted)\ or\ LS1 = \frac{compensation\ of\ employees}{value\ added(-indirect\ taxes - fixed\ capital)} \tag{2.1}$$

As previously argued, although this measure has been widely used in the literature (Daudey and Garcia-Peñalosa 2007; Jayedev 2007; Rodrik 1999), it results in an underestimation of the labor share.

2.2 LS2: A Rule of Thumb

The System of National Accounts (SNA) method breaks down value added into: compensation of employees, operating surplus (from rent and capital) and mixed income (or operating surplus of private unincorporated enterprises). Mixed income from self-employment "implicitly contains an element of remuneration for work done by the owner, or other members of the household, that cannot be separately identified from the return to the owner as entrepreneur" (OECD 1993). The UN National Accounts Statistics provide information on mixed income for a large number of economies.[4]

[4]Following Gollin (2002), we collect data on gross mixed income. Please see the appendix for complete information on data availability.

A common rule, proposed by Johnson (1954), is to impute two-thirds of self-employment income to labor income and the rest to capital income (see Eq. 2.2). The choice of the value '2/3' derives from the common belief that labor income represents around two-thirds of the overall economy's income. Self-employment income is then expected to be composed of a similar combination of labor and capital. This rule of thumb has been extensively used in the literature (Guscina 2006; Izyumov and Vahaly 2015).

$$LS2 = \frac{compensation\ of\ employees + \frac{2}{3} mixed\ income}{value\ added (-indirect\ taxes - fixed\ capital)} \tag{2.2}$$

The main problem with this adjustment is that the value '2/3' is arbitrary—some studies, in fact, use a ratio of '1/2' instead of '2/3'—and it treats all economies in the same way (Izyumov and Vahaly 2015). Moreover, given that the division of income between labor and capital remains constant, this measure may ignore the effect of external forces that shift the balance over time.

2.3 LS3: The Self-employed as Workers

A second adjustment (Kravis 1959) involves attributing all self-employment income to labor earnings (see Eq. 2.3). The rationale for this is that most of the self-employed in developing economies provide pure labor services.

$$LS3 = \frac{compensation\ of\ employees + mixed\ income}{value\ added (-indirect\ taxes - fixed\ capital)} \tag{2.3}$$

By using this approach, however, the labor share is unavoidably overstated, as in reality some self-employed businesses generate and use considerable amounts of capital and land, even in developing economies (Gollin 2002).

2.4 Self-employment as the Rest of the Economy

It is also possible to consider self-employment income as being composed of the same combination of labor and capital income as the rest of the economy (Atkinson 1983; Kravis 1959). The labor share is scaled up by a factor that takes into account the proportion of self-employed, who are attributed a wage equal to the average wage of employees. Mathematically, this is done by deducting mixed income from the income aggregate in the denominator (see Eq. 2.4):

$$LS4 = \frac{compensation\ of\ employees}{value\ added(-indirect\ taxes - fixed\ capital) - mixed\ income} \tag{2.4}$$

This adjustment assumes that the split between capital and labor is approximately the same in private unincorporated enterprises and in large corporations (or in the government sector). In reality, these are very different in terms of size of the workforce, structure and degree of labor-intensiveness, and vary greatly from one economy to another. Studies also show that this adjustment leads to unrealistic values of labor shares greater than 1 for some economies (Bernanke and Gürkaynak 2001). Despite being problematic, this approach is more reasonable than the previous one, since it allows for the possibility that the self-employed generate capital income. Being quite straightforward, it has been widely used in the academic literature (Izyumov and Vahaly 2015; Bernanke and Gürkaynak 2001; Rognlie 2015; Ryan 1996).

2.5 LS5: Using Data on Workforce Composition

The fundamental problem related to the three adjustments presented above is that they require data on self-employment income. Unfortunately, data on mixed income is not so widely available: the majority of economies report only operating surplus, recording income from self-employment together with capital income. For this reason, an alternative method is required.

Gollin (2002) suggests a fourth adjustment, based on data on the composition of the workforce. Not only is it easier to collect data on the number of self-employed than on their actual earnings, but studies have also shown that the self-employed tend to underreport their income (Hurst et al. 2014). This approach has been widely used in the literature for industrialized economies (Bentolila and Saint-Paul 2003; Ellis and Smith 2010) and by the OECD, the IMF (International Monetary Fund) and the EC (European Commission) in their calculations.

Information on the composition of employment can be sourced from the International Labour Organization (ILO) Yearbooks of Labour Statistics (ILO 2018), which classify the workforce into: 1. employees; 2. employers; 3. own-account workers; 4. members of producers' cooperatives; 5. contributing family workers; and 6. workers not classifiable by status. While the first category of workers represents *paid employment jobs*, categories 2–6 are defined by the ILO (1993) as *self-employment jobs*.[5]

Gollin's (2002) measurement imputes average employee compensation to all five categories of self-employed workers. This is calculated (see Eq. 2.5) by scaling

[5]Data on the composition of the workforce is not always available for every year. When absent, it is assumed to be the same as in the previous year (Gollin 2002). This is a realistic assumption (Askenazy 2003), given that the composition of the workforce is approximately constant over time.

up employee compensation by the ratio of the total workforce to the number of employees:

$$LS5 = \frac{compensation\ of\ employees \cdot \frac{total\ workforce}{number\ of\ employees}}{value\ added(-indirect\ taxes - fixed\ capital)} \tag{2.5}$$

Because of the greater availability of data,[6] this approach is preferred to the previous ones. It also considers variations in the composition of the workforce among economies and over time. It provides a better estimation of the labor share, particularly in economies where the share of self-employment is large. The fundamental disadvantage is that it requires detailed micro-data on the workforce. Furthermore, it may be problematic where there are systematic differences in income composition between employees and the self-employed.[7]

2.6 LS6: A New Adjustment

This study proposes a further adjustment based on the ILO data on workforce composition. LS6 (see Eq. 2.6) attributes the average employee's wage to all those workers who hold *self-employment jobs* but are not classified as *employers* (therefore, Categories 3, 4, 5 and 6 in the above classification), removing *employers* from the adjusted numerator.

$$LS6 = \frac{compensation\ of\ employees \cdot \frac{(total\ workforce - employers)}{number\ of\ employees}}{value\ added(-indirect\ taxes - fixed\ capital)} \tag{2.6}$$

The rationale for such an adjustment is related to the fact that LS5 overestimates the labor share. Bernanke and Gürkaynak (2001) replicate and update Gollin's (2002) measurements, obtaining unreasonable labor shares greater than 1. We believe that this is because employers' income is considered twice: as profit in the operating surplus and as labor income from self-employment.

We consequently propose to consider the entire workforce net of *employers* to reflect views which relate factor shares to concerns about social justice, collective bargaining and workers' evaluation of 'fair wages' (Atkinson 2009). These perspectives set workers' efforts against employers' profits. Employers are therefore

[6]Please see the Appendix for complete information on data availability.

[7]As a response to this criticism, Bernanke and Gürkaynak (2001) construct a measure of labour share combining information on the corporate share of the labour force and the aggregate operating surplus. However, their computation is not convincing as it is based on the assumption that the corporate share of total private-sector income is the same as the share of the labour force employed in the corporate sector. Income and employment shares may instead be very different. Their results are in fact unrealistic for those economies with very low corporate employment shares.

assumed to only capture profits and earn a negligible amount of labor income. Their labor income is certainly not comparable to that of the employees or other categories of self-employed workers engaging in substantial forms of labor.

2.7 Alternative Methods

Other approaches have also been suggested in the literature, however as they require more detailed data which is not available for a large number of economies, they cannot be considered in this study.

Glyn (2009), for example, proposes attributing the average agricultural wage to the self-employed. The rationale behind this method is that in developing economies the self-employed are mainly concentrated in agriculture, where incomes (and wages) are normally below the national average. An improvement to this approach is to value the services of labor and capital in accordance with the returns prevailing in each sector of the economy rather than in the economy as a whole (Feinstein 1968). This would allow variation to be captured across industries, which, as documented, is quite considerable: agriculture and primary commodity production, when compared to manufacturing and services, have lower employee compensation shares (Solow 1958; Kravis 1959; Glyn 2009).[8]

Young (1995) suggests another approach, attributing implicit wages to the self-employed and unpaid workers on the basis of their sector of employment, sex, age and education. The assumption is that they earn an implicit wage equal to the hourly wage of employees in the same industry, of similar sex, age and education.[9]

3 The Dataset

We compute labor shares of income using data from the UN National Accounts Statistics and the ILO Yearbooks of Labour Statistics. Given the scarce availability of data for the years preceding 1970, the analysis focuses on the period 1970–2015. All six methods introduced above (LS1–LS6) are employed, where possible.[10] Data is collected for 151 economies: 37 in Africa, 33 in the Americas, 32 in Asia, 39 in

[8]However, Gollin (2002), after considering variations in the sectoral composition of income, does not find this factor to be relevant in explaining changes in the labour share.

[9]This approach, which has been recently used in the literature (Freeman 2011), suffers from possible selection bias and is highly data-demanding.

[10]Certain adjustments have already been made for some economies (Young 2003), which cannot be entirely considered for international comparisons. The Chinese National Bureau of Statistics, for example, does not follow the accounting methods of the UN System of National Accounts, and it counts the income of the self-employed in agriculture as labour compensation.

Table 1 Overview of the data: summary statistics of the labor share measures

Variable	Obs.	Economies	$\bar{T}$	Mean	Median	St. Dev.	Min	Max
LS1	3,527	151	23.36	0.490	0.497	0.171	0.035	0.868
LS2	1,293	82	15.77	0.668	0.694	0.126	0.228	0.954
LS3	1,293	82	15.77	0.731	0.757	0.130	0.250	0.997
LS4	1,293	82	15.77	0.665	0.703	0.154	0.166	0.997
LS5	2,962	121	24.48	0.693	0.709	0.181	0.079	2.144
LS6	2,879	118	24.40	0.660	0.682	0.156	0.074	0.998

Source Author's calculations

Europe and 10 in Oceania.[11] The sample is a good representation of the entire world, including 62.92% of all economies and 81.69% of the global population. For the majority of the economies, the data covers at least a 20-year span (the average time series is 23.36 years). Most of the observations refer to the decades 1990s–2000s, however a good number of economies also possess data for the 1970s, 1980s and 2010s.

Table 1 contains summary statistics for all six measures of the labor share. As can be seen, all indicators have quite large variability, their coefficients of variation being between 17.73 and 34.98%, demonstrating that the labor share varies considerably across economies. The unadjusted labor share (LS1) has relatively large variation, with a standard deviation equal to 0.17. This can be explained by the fact that this measure is not corrected for self-employment income and therefore underestimates the labor share, especially in developing economies (Krueger 1999; Gollin 2002). Its values are indeed relatively small (at times, unrealistically smaller than 0.05[12]) and its mean and median, the smallest among the six measures, are below 0.5 (0.490 and 0.497, respectively). The unadjusted labor share is therefore flawed and needs to be replaced by a measure taking self-employment income into account.

LS2, LS3 and LS4 require data on mixed income for their computation. Due to the scarcity of information on self-employment income in several economies, the sample is considerably reduced. The total number of economy-year pair observations is reduced to 1,293 (from 3,527 observations in the case of LS1), and the total number of economies in the sample is only 82 (instead of 151). Of these, 12 economies are in Africa, 19 in the Americas, 11 in Asia, 37 in Europe and 3 in Oceania. As a result, not only is the dataset significantly smaller, but it is also biased towards the developed regions of the world, for which we possess data on mixed income. Nonetheless, all three measures seem more realistic than LS1. Of these, because of its construction, LS4 is preferable, and LS2 is in most cases a good approximation of it. The '2/3' ratio, indeed, happens to be a very close

[11]Please see the appendix for a complete list of economies included in the database.

[12]In the cases of Iraq in 2000 and Nigeria in 1998, 1999, 2000, 2002 and 2003.

estimate of the average of both LS2 and LS4 (0.668 and 0.665, respectively), and therefore a realistic approximation for developed economies. As expected, LS3 generally overstates the labor share of income. Its mean and median are the largest among all six measures (0.731 and 0.757, respectively), and its coefficient of variation is the smallest (17.73%), thus its observations are high and quite concentrated.

LS5 and LS6 are computed using ILO data on the structure of the workforce. Both the overall number of observations (2,962 and 2,879, respectively) and the overall number of economies (121 and 118, respectively) are reduced compared to the unadjusted measure, but the sample remains large. Compared to the three previous adjustments, LS5 and LS6 better represent the world as a whole, with observations more evenly distributed across different geographical regions. For the LS5 sample, 20 economies are in Africa, 29 in the Americas, 31 in Asia, 36 in Europe and 5 in Oceania. In terms of the LS6 sample, 19 economies are in Africa, 29 in the Americas, 30 in Asia, 36 in Europe and 4 in Oceania. Nevertheless, least developed countries (LDCs) and the African continent are not as well represented as in LS1 because of the absence of data on the composition of the workforce. In fact, we possess information for 21 LDCs on LS1, and only 7 on LS6. Moreover, while the LS1 sample contains 64.91% of African economies (and 70.19% of the African population), the LS6 sample includes only 33.33% of African economies (and 26.67% of the African population). Similarly, since the People's Republic of China (PRC) and India are now excluded from the dataset, the LS6 sample represents 60.00% of Asian economies, but only 17.14% of the Asian population. Nevertheless, compared to the other adjusted measures (LS2–LS4), the sample of economies for LS5 and LS6 is much larger, and the total number of observations more than double.

As previously mentioned, LS5 overstates the labor share; its mean and median being the second highest among the six measures (0.693 and 0.709, respectively). As found in Bernanke and Gürkaynak (2001), the labor share in some economies is greater than 1[13], and even 2 in one case[14] Conversely, LS6 appears to be a good measure, with a mean and a median (0.660 and 0.682, respectively) very close to those of LS2 and LS4. The standard deviation (0.156) and coefficient of variation (23.57%) are relatively large, suggesting a large variation in the data even after adjustments, in contrast to the results in Gollin (2002) and Rognlie (2015). Moreover, contrary to LS5, LS6 is never greater than 1. Since the samples for LS2 and LS4 are notably reduced, LS6 is our preferred measure out of the six computed in this study.

Table 2 shows the variance decomposition of our preferred measure of labor share, LS6, explaining how the variable changes over time (within-variation) and across economies (between-variation). The data highlights a considerable difference

[13]In the cases of Croatia in 1999, the Republic of Korea in 1970–1973 and 1980–1983, Mali in 2000–2006 and 2010–2011, Morocco in 2005 and the Netherlands Antilles in 2002–2008.

[14]In the case of Mali in 2007–2008 and 2012–2013.

Table 2 LS6 panel summary statistics: within- and between- variation

Variable		Mean	Std. dev.	Min	Max	Observations
LS6	Overall	0.660	0.156	0.074	0.998	N = 2879
	Between		0.150	0.236	0.913	n = 118
	Within		0.068	0.356	0.958	$\bar{T}$ = 24.3983

Source Author's calculations

between cross-economy and within-economy variation, with the former being much larger than the latter. As we will see in the next section, labor shares in some economies do not change substantially over time. This result is consistent with the empirical literature on income inequality, which is often considered a long-term phenomenon (Li et al. 1998), and it may explain why labor shares have long been perceived as constant over time (Goldfarb and Leonard 2005).

4 Results

This section uses descriptive statistics to provide an account of the performance of the labor income share over time and across economies. Our dataset presents evidence of substantial variability, both cross-economy and within-economy. These results are contrary to general theoretical consensus in favor of the long-term stability of factor shares and recent findings in the empirical literature suggesting that differences in labor shares are mainly determined statistically at the measurement level (Gollin 2002; Rognlie 2015; Bridgman 2017).

4.1 Global Trends

Figure 1 plots yearly unweighted averages of the six measures of labor share in the period 1970–2015. LS1 (blue) is the lowest line on the diagram: consistent with the summary statistics presented above, it is an underestimation of the labor share. As expected, the five adjustments pull up the value of the labor share. LS3 (green line) and LS5 (teal line) possibly overestimate the share, as discussed in the previous section. This is particularly evident for the last two decades, when their averages are considerably higher than the other measures. LS4 (orange line) and LS6 (red line) produce more reasonable averages and, especially in recent years with increasing data availability for LS4, the measures tend to evolve in a similar way. Finally, the averages of LS2 (maroon line) and LS4 (orange line) are very close, providing a rationale for the commonly used '2/3' ratio.

The data clearly presents medium- and long-term evidence of variability: not only do factor shares vary over time, but there also is a general declining trend over

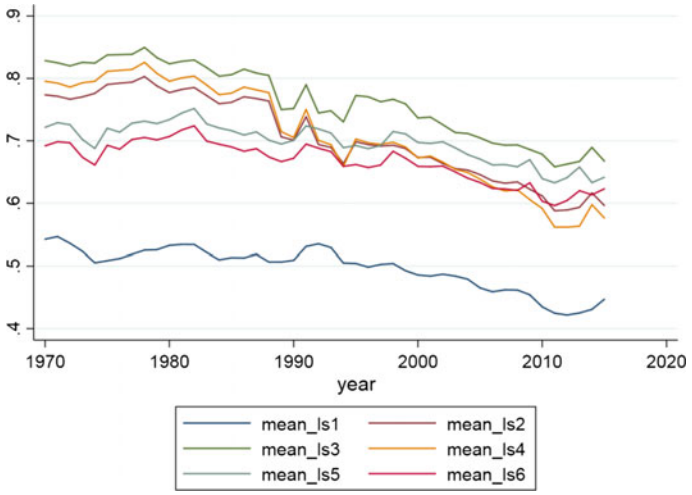

Fig. 1 Labor share averages over time: alternative measures. *Source* Author's calculations

the last two decades, in particular from the 1990s onwards. LS1 ranges, on average across economies, from a maximum value of 0.547 in the early 1970s (specifically, 1971) to a minimum of 0.422 in 2012. The maximum values of LS2, LS3 and LS4, instead, are in 1978 (0.803, 0.850 and 0.826, respectively), while LS5 and LS6 peak later on, in 1982 (0.752 and 0.724, respectively). All adjusted measures of labor share saw their average minimum values in the year 2011.

It is worth mentioning that these are averages of an unbalanced panel and that the sample of economies changes considerably between the 1970s and the 2010s. For example, while there are 1,238 observations for LS1 in the 2000s, there are only 426 observations for LS1 in the 1970s. Similarly, for LS6, the size of the sample increases from 361 observations in the 1970s to 994 observations in the 2000s. This is particularly evident in the case of LS2, LS3 and LS4, for which we possess 619 observations for the 2000s, and only 47 observations for the 1970s.

In general, the six measures behave similarly over time. Nonetheless, in some cases the lines overlap or show diverging trends, due to variations in the methodology of imputation of the labor income component of self-employment, providing evidence that the choice of measurement is fundamental. However, Fig. 1 reports the averages of an unbalanced panel and, as mentioned above, data availability differs across the measures. On average, the time series for LS2, LS3 and LS4 (15.8 years) is considerably shorter than LS5 and LS6 (24.5 and 24.4 years, respectively), but also LS1 (23.4 years).

To better understand the relationship among the different measures of labor share, pair-wise correlation coefficients are computed between the six variables for the overall time period (Table 3). As expected, the correlation coefficients are positive, strong and significant. Because of the way they are constructed, LS2, LS3 and LS4 are highly correlated, with correlation coefficients greater than 0.9. When

Table 3 Labor share measures: pair-wise correlation matrix

	LS1	LS2	LS3	LS4	LS5	LS6
LS1	1					
LS2	0.8297*	1				
LS3	0.5783*	0.9352*	1			
LS4	0.8311*	0.9864*	0.9145*	1		
LS5	0.5504*	0.7980*	0.7750*	0.7780*	1	
LS6	0.6577*	0.7818*	0.7561*	0.7646*	0.9128*	1

Source Author's calculations. Please note: $*p < 0.05$

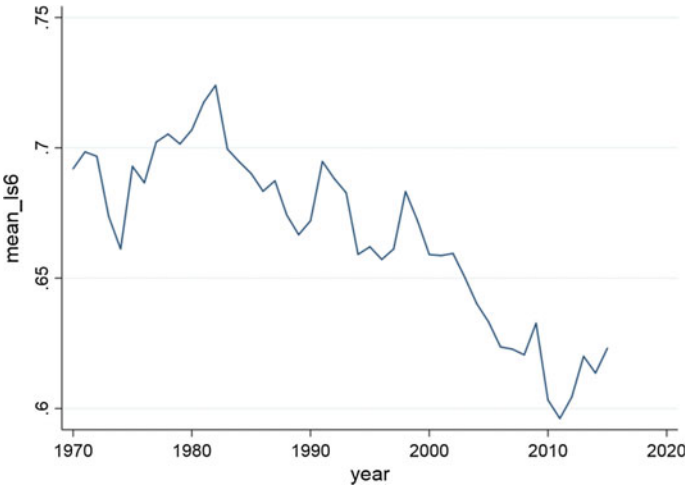

Fig. 2 Unweighted average values of LS6 over time. *Source* Author's calculations

analyzed in relation to all other measures, LS6, our preferred adjustment, is correlated but not redundant: while its correlation with LS5 is very strong (0.91), the correlation coefficients between LS6 and the other measures are lower than 0.79, implying that the measure must retain some information not held in the other adjustments, and again highlighting the importance of the choice of measurement.

Returning to the behavior of factor shares of income over time, there seems to be a general reduction in the labor income share over the last three decades. After a stationary pattern in the 1970s and 1980s, labor shares fall substantially from the 1990s onwards. The hypothesis that factor shares are relatively stable is rejected, in accordance with recent economy-specific and cross-economy studies (Glyn 2009; ILO 2008; IMF 2017) and contrary to the well-established belief of long-term constancy.

Figure 2 plots the average for LS6 over time. The overall trend for the last three decades has been decreasing. The share increases in the 1970s (with the only exceptions in 1973–1974, when it drops noticeably), reaching its maximum of

0.724 in 1982. It then decreases considerably in the 1990 and 2000s, a period of increased liberalization and integration of markets, accelerated diffusion and adoption of technologies following the ICT revolution, as well as major policy and institutional shifts in many labor markets across the globe (IMF 2017). Overall, we find that the labor income share has decreased on average by approximately 0.10 in the last 30 years and it is currently at its historical minimum (0.596 in 2011). Furthermore, the average share seems rather volatile and it appears from the figure that some of the sudden inversions in trend occur following years of financial crises or periods of instability (Diwan 2001). Similar behavior can be observed if we analyze median levels instead of average levels of the labor share.

4.2 Economy-Level Data

In addition to considering the world as a whole, we can evaluate the data on the labor share of income for each individual economy in the dataset. Table 4 provides a summary of alternative measures of labor share, as calculated in this study and in the existing empirical literature (Bentolila and Saint-Paul 2003; Bernanke and Gürkaynak 2001; EC 2007; Gollin 2002; Izyumov and Vahaly 2015). Most of the estimated labor income shares lie between 0.60 and 0.70, as expected. Compared to previous measurements, our computations seem to generate broadly consistent but relatively higher values, however a comparison among the different studies appears very difficult.

Firstly, the measures have not been constructed in the same way. Bernanke and Gürkaynak (2001), Gollin (2002) and Izyumov and Vahaly (2015) use the UN National Accounts Statistics, generating samples that, although smaller than ours, include both developed and developing economies. Conversely, Bentolila and Saint-Paul (2003) draw on the OECD International Sectoral Data Base (ISDB) 1996, concentrating their attention on 15 developed economies only. The European Commission employs the Commission's AMECO database (EC 2007) and examines only the EU-27, the United States of America and Japan.

Secondly, not all studies consider a panel dataset. Bernanke and Gürkaynak (2001), the EC (2007) and Izyumov and Vahaly (2015) construct an unbalanced panel dataset and then compute averages of the measures over the entire period of time. Gollin (2002) and Bentolila and Saint-Paul (2003), instead, consider only the cross-economy dimension, analyzing the labor share data at a particular point in time.

Thirdly, the time series in the panel datasets are different. Bernanke and Gürkaynak (2001) consider the period 1980–1995, the EC (2007) the period 1960–2006 and Izyumov and Vahaly (2015) the period 1990–2008, while this study considers the period 1970–2015.

Finally, the adjustments in the numerator and denominator of the share are different for all studies considered here, hence the discussion in the remainder of this section will concentrate only on our calculations.

Table 4 Alternative measures of labor share: a comparison with the existing empirical literature

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Algeria					0.47		0.61	0.63							
Angola															
Argentina													0.46	0.49	0.43
Armenia													0.47	0.73	0.47
Aruba															
Australia	0.5	0.72	0.67	0.68	0.57	0.68	0.66	0.68		0.65	0.66	0.63	0.62	0.65	0.62
Austria					0.61		0.7	0.71	0.66				0.64	0.65	0.64
Azerbaijan													0.4	0.38	0.31
Bahamas															
Bahrain															
Barbados															
Belarus	0.42	0.55	0.51										0.57		0.56
Belgium	0.55	0.79	0.74	0.74	0.6	0.74	0.71	0.73	0.61	0.62	0.72	0.64	0.64	0.66	0.64
Benin															
Bermuda															
Bolivia	0.26	0.83	0.63	0.48	0.37			0.67					0.41	1.17	0.4
Bosnia and Herzegovina															
Botswana	0.3	0.37	0.34	0.48	0.39	0.45							0.29	0.37	0.28
Brazil													0.48	0.62	0.47
British Virgin Islands															
Brunei Darussalam															
Bulgaria									0.51				0.48	0.47	0.45

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Burkina Faso															
Burundi	0.2	0.91	0.73		0.22	0.75									
Cabo Verde															
Cameroon															
Canada					0.62		0.68	0.69		0.67	0.62	0.65	0.6	0.67	0.6
Cayman Islands															
Central African Republic															
Chad															
Chile					0.42		0.59	0.62					0.48	0.61	0.46
PRC															
Hong Kong, China					0.51			0.57							
Macau, China															
Colombia					0.45			0.65					0.53	0.64	0.49
Comoros															
Cook Islands															
Congo	0.37	0.69	0.58		0.38	0.47									
Costa Rica					0.54		0.73	0.74							
Cote d'Ivoire	0.29	0.81	0.69		0.43	0.68									
Croatia													0.61	0.7	0.61
Cuba															
Curaçao															
Cyprus									0.57				0.55	0.56	0.54

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Czech Republic									0.52				0.56	0.57	0.55
Denmark					0.64		0.71	0.72	0.59						
Djibouti															
Dominican Republic															
Ecuador	0.21	0.82	0.57	0.5	0.25			0.45							
Egypt					0.43			0.77					0.51	0.52	0.45
El Salvador					0.35			0.58							
Estonia	0.47	0.61	0.57						0.51				0.58	0.58	0.57
Eswatini (Swaziland)															
Faeroe Islands															
Fiji															
Finland	0.57	0.76	0.73	0.68	0.62	0.71	0.71	0.73	0.62	0.69	0.7	0.72	0.62	0.68	0.62
France	0.52	0.76	0.72	0.68	0.61	0.74	0.71	0.73	0.61	0.68	0.72	0.62	0.63	0.65	0.63
Gabon															
Georgia					0.63		0.69	0.71					0.46	0.64	0.37
Germany (before 1991, Fed. Rep.of Germany)									0.62	0.64	0.69	0.62	0.66	0.65	0.66
Greece					0.45		0.79	0.86	0.66				0.47	0.61	0.45
Greenland															
Guatemala													0.5	1.22	0.45
Guinea															
Honduras													0.61	1.03	0.59

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Hungary	0.58	0.8	0.77	0.67									0.63	0.62	0.62
Iceland															
India	0.69	0.84	0.83												
Iran													0.44	0.45	0.34
Iraq															
Ireland					0.58		0.73	0.75					0.52	0.55	0.5
Israel					0.59		0.7	0.73							
Italy	0.45	0.8	0.72	0.71	0.49	0.71	0.65	0.69		0.67	0.64	0.63	0.58	0.63	0.56
Jamaica	0.43	0.62	0.57		0.53	0.6									
Japan	0.56	0.73	0.69	0.72	0.59	0.68	0.73	0.77	0.68	0.57	0.69	0.68	0.57	0.65	0.57
Jordan					0.45		0.64	0.67							
Kazakhstan													0.54	0.57	0.51
Kenya															
Kuwait															
Kyrgyz Republic													0.66	0.61	0.65
Latvia	0.37	0.55	0.47						0.5				0.58	0.56	0.56
Lesotho															
Libya															
Liechtenstein															
Lithuania									0.49				0.54	0.56	0.52
Luxembourg									0.52				0.61		0.6
Malaysia					0.43			0.66							

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Mali															
Malta	0.43	0.71	0.63						0.51*						
Marshall Islands															
Mauritania															
Mauritius	0.39	0.77	0.67	0.49	0.48			0.57							
Mexico					0.34		0.55	0.59					0.47	0.53	0.42
Federated States of Micronesia															
Monaco															
Mongolia													0.52	0.63	0.43
Morocco					0.36			0.58							
Mozambique															
Namibia															
Netherlands	0.53	0.72	0.68	0.64	0.59	0.67	0.66	0.67	0.63	0.68	0.69	0.59	0.62	0.64	0.61
Netherlands Antilles															
New Zealand					0.55		0.67	0.69							
Nicaragua															
Niger													0.61		0.47
Nigeria															
Norway	0.52	0.68	0.64	0.57	0.55		0.61	0.63		0.68	0.66	0.64	0.59	0.55	0.58
Oman															
Palau															
Panama					0.5		0.73	0.76					0.47	0.57	0.43

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Papua New Guinea															
Paraguay					0.32		0.49	0.52							
Peru					0.31		0.56	0.59							
Philippines	0.35	0.8	0.66	0.87	0.27	0.59							0.48		0.57
Poland									0.55				0.61	0.61	0.59
Portugal	0.45	0.82	0.75	0.6	0.52	0.72	0.71	0.73	0.67				0.66	0.74	0.66
Qatar															
Republic of Korea	0.47	0.77	0.7	0.8	0.48	0.65									
Republic of Moldova													0.58	0.71	0.57
Reunion	0.59	0.83	0.8												
Romania									0.68					0.7	
Russian Federation													0.58	0.54	0.57
Rwanda															
San Marino															
Saudi Arabia															
Senegal															
Serbia													0.66	0.78	0.66
Seychelles															
Sierra Leone															
Singapore					0.47		0.53	0.55							
Sint Maarten															
Slovakia									0.44				0.6	0.48	0.57

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Slovenia									0.64				0.67	0.71	0.67
Solomon Islands															
South Africa					0.59		0.62	0.63						0.58	
Spain					0.52		0.67	0.7	0.62				0.65	0.67	0.65
Sri Lanka					0.5		0.78	0.81							
Sudan															
Suriname															
Sweden	0.61	0.8	0.77	0.72	0.68	0.77	0.74	0.75	0.62	0.7	0.74	0.73	0.67	0.65	0.67
Switzerland					0.66		0.76	0.78					0.7	0.78	0.7
Tajikistan													0.49		0.34
Thailand															
Trinidad and Tobago					0.55		0.69	0.71							
Tunisia					0.41			0.62							
Turkey															
Ukraine	0.77	0.78	0.76										0.58	0.62	0.57
United Arab Emirates															
United Kingdom	0.57	0.81	0.78	0.72	0.65	0.75	0.72	0.74	0.65				0.65	0.69	0.65
United Republic of Tanzania															
United States	0.6	0.77	0.74	0.66	0.65	0.74	0.71	0.71	0.64	0.7	0.68	0.66	0.71	0.67	0.71
Uruguay					0.43		0.58	0.59					0.54	0.47	0.51
Vanuatu															
Venezuela (Bolivarian Republic of)					0.38		0.53	0.55					0.4		0.38

(continued)

Table 4 (continued)

Economy	Gollin[a] (Cross-economy)				Bernanke and Gürkaynak[b] (1980–1995)				EC[c] (2007)	Bentolila and Saint-Paul[d] (Cross-economy)			Izyumov and Vahaly[e] (1990–2008)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Viet Nam	0.59	0.83	0.8												
Yemen															
Zambia					0.48		0.72	0.78							
Zimbabwe															

Source Bentolila and Saint-Paul (2003), Bernanke and Gürkaynak's (2001), EC (2007), Gollin (2002), Izyumov and Vahaly (2015), author's calculations

[a]Gollin's (2002) calculations

(1) Unadjusted labor share: employee compensation/(GDP − indirect taxes)

(2) OSPUE entirely incorporated into labor income: (employee compensation + mixed income)/ (GDP − ndirect taxes)

(3) Gollin's adjustment for OSPUE: employee compensation/(GDP − indirect taxes − mixed income)

(4) Gollin's labor force correction: [(employee compensation/number of employees) * total workforce]/GDP

[b]Bernanke and Gürkaynak's (2001) calculations

(5) Unadjusted labor share: employee compensation/(GDP − indirect taxes)

(6) Gollin's adjustment for OSPUE: corporate employee compensation/(GDP − indirect taxes − OSPUE)

(7) Bernanke's adjustment for OSPUE

(8) Labor force correction: corporate employee compensation/ [corporate share of labor force * (GDP − indirect taxes)]

[c]EC's (2007) calculations

(9) Labor force adjustment: [(compensation of employees/number of employees) * total employment]/gross domestic employment at market price

[d]Bentolila and Saint-Paul's (2003) calculations

(10) Labor force adjustment: [compensation of employees * (total employment/number of employees)]/(GDP − net indirect taxes), year 1970

(11) Labor force adjustment, year 1980

(12) Labor force adjustment, year 1990

[e]Izyumov and Vahaly's (2015) calculations

(13) Fixed arbitrary proportion: (employee compensation + α * gross mixed income)/(GDP − indirect taxes)

(14) Wage imputation: [employee compensation + (β * average compensation in CG sector * self-employed)]/(GDP − indirect taxes)

(15) Factor share imputation: employee compensation/ (GDP − gross mixed income − indirect taxes)

Table 5 presents summary statistics of our preferred measure of labor share, LS6, for each of the economies in the sample. The data is heterogeneous, with large differences across economies.

Table 5 Overview of the data: summary statistics of LS6 across economies

Economy	Obs.	Mean	Median	Std. Dev.	Min (*Year*)	Max (*Year*)
Algeria	36	0.5545	0.5219	0.1393	0.3432 *(2006)*	0.8128 *(1971)*
Angola	14	0.6511	0.6204	0.1314	0.4748 *(2005)*	0.8863 *(2015)*
Argentina	21	0.5092	0.5075	0.054	0.4218 *(2003)*	0.6400 *(2013)*
Armenia	16	0.8781	0.8687	0.048	0.7994 *(1995)*	0.9583 *(2000)*
Aruba	9	0.6397	0.6539	0.048	0.5300 *(1994)*	0.6773 *(1999)*
Australia	39	0.7505	0.748	0.026	0.6894 *(1988)*	0.7921 *(1982)*
Austria	33	0.7932	0.8011	0.0351	0.7213 *(2006)*	0.8504 *(1978)*
Azerbaijan	18	0.4605	0.4624	0.4594	0.3743 *(2008)*	0.5532 *(2009)*
Bahamas	22	0.5536	0.5281	0.0669	0.4752 *(2008)*	0.6719 *(1997)*
Bahrain	22	0.3411	0.3356	0.0407	0.2768 *(2008)*	0.4097 *(1998)*
Barbados	2	0.8039	0.8039	0.0018	0.8026 *(1975)*	0.8052 *(1974)*
Belarus	26	0.5615	0.5682	0.0418	0.4522 *(1991)*	0.6279 *(2013)*
Belgium	34	0.7441	0.748	0.0556	0.6599 *(1989)*	0.8341 *(1996)*
Bermuda	20	0.7561	0.7708	0.0351	0.6747 *(1997)*	0.8023 *(2010)*
Bolivia (Plurinational State of)	45	0.5748	0.5861	0.0499	0.4173 *(1986)*	0.7007 *(1984)*
Bosnia and Herzegovina	7	0.7533	0.7515	0.013	0.7336 *(2007)*	0.7756 *(2009)*
Botswana	41	0.5684	0.549	0.1032	0.3817 *(2001)*	0.7948 *(1982)*
Brazil	22	0.7159	0.7199	0.0389	0.6232 *(1993)*	0.7857 *(2013)*
British Virgin Islands	30	0.5794	0.6065	0.1039	0.3994 *(1996)*	0.7664 *(2009)*
Brunei Darussalam	6	0.2358	0.2308	0.0314	0.2034 *(2011)*	0.2880 *(2015)*
Bulgaria	16	0.5424	0.5507	0.0405	0.4437 *(1997)*	0.5915 *(1999)*
Cabo Verde	8	0.6393	0.6474	0.0338	0.5985 *(2008)*	0.6827 *(2014)*
Canada	41	0.7534	0.7633	0.0282	0.6870 *(2010)*	0.8245 *(1992)*
Cayman Islands	19	0.5855	0.5787	0.0408	0.4928 *(2006)*	0.6432 *(1988)*
Chile	41	0.6362	0.6444	0.0685	0.5014 *(1988)*	0.7533 *(1999)*
Hong Kong, China	34	0.5425	0.5408	0.021	0.5036 *(1994)*	0.5793 *(2001)*
Macau, China	24	0.3878	0.3927	0.0485	0.3137 *(1995)*	0.4567 *(2008)*
Colombia	46	0.6235	0.6085	0.0685	0.5049 *(1994)*	0.7472 *(2010)*
Comoros	8	0.4353	0.4236	0.098	0.3575 *(2013)*	0.6619 *(2014)*
Cook Islands	13	0.73	0.7557	0.0588	0.6141 *(1996)*	0.7974 *(1998)*
Costa Rica	44	0.7003	0.7185	0.0705	0.5294 *(1982)*	0.8026 *(1990)*
Croatia	15	0.8646	0.8666	0.0555	0.7592 *(2008)*	0.9514 *(1999)*
Cuba	10	0.5334	0.5326	0.0191	0.5122 *(2000)*	0.5808 *(2005)*

(continued)

Table 5 (continued)

Economy	Obs.	Mean	Median	Std. Dev.	Min (*Year*)	Max (*Year*)
Cyprus	15	0.7489	0.7611	0.0333	0.6982 *(2001)*	0.7981 *(2003)*
Czech Republic	17	0.6796	0.6817	0.0168	0.6467 *(1998)*	0.7083 *(1994)*
Denmark	39	0.7904	0.7926	0.037	0.7083 *(1973)*	0.8661 *(2008)*
Dominican Republic	15	0.6722	0.6877	0.0616	0.5089 *(2004)*	0.7330 *(1999)*
Ecuador	30	0.5326	0.5132	0.143	0.2954 *(1991)*	0.8308 *(2013)*
Egypt	18	0.4104	0.413	0.0222	0.3472 *(2012)*	0.4498 *(2007)*
Estonia	22	0.6712	0.664	0.053	0.6101 *(2001)*	0.7935 *(1993)*
Eswatini (Swaziland)	8	0.7311	0.7268	0.0383	0.6856 *(1986)*	0.8065 *(1983)*
Fiji	19	0.8118	0.8169	0.073	0.6710 *(2001)*	0.9439 *(1983)*
Finland	39	0.8085	0.808	0.0623	0.7156 *(2007)*	0.9582 *(1991)*
France	40	0.7696	0.7664	0.0553	0.6597 *(1970)*	0.8722 *(1982)*
Gabon	12	0.4583	0.4173	0.1155	0.3318 *(2005)*	0.6836 *(1978)*
Georgia	18	0.8018	0.851	0.135	0.6113 *(2004)*	0.9810 *(2009)*
Germany (before 1991 Fed. Rep.)	26	0.7476	0.7498	0.0399	0.7139 *(2007)*	0.7778 *(1993)*
Greece	14	0.6624	0.6655	0.0194	0.6374 *(2007)*	0.6925 *(2002)*
Guatemala	12	0.6636	0.6573	0.0924	0.5562 *(2012)*	0.7878 *(2001)*
Hungary	24	0.7186	0.7064	0.0457	0.6585 *(1987)*	0.8193 *(1995)*
Iceland	33	0.8546	0.8558	0.0414	0.7781 *(1994)*	0.9392 *(2005)*
Iran	21	0.5123	0.5003	0.051	0.4328 *(2011)*	0.6205 *(1998)*
Ireland	39	0.7117	0.7181	0.0971	0.5615 *(2002)*	0.9075 *(1980)*
Israel	17	0.7589	0.7636	0.0315	0.7105 *(2009)*	0.7993 *(1995)*
Italy	39	0.7436	0.7323	0.0566	0.6639 *(2000)*	0.8508 *(1981)*
Jamaica	18	0.9131	0.9098	0.0357	0.8521 *(2005)*	0.9670 *(2013)*
Japan	38	0.7982	0.8112	0.04	0.6486 *(1970)*	0.8407 *(1998)*
Jordan	43	0.5482	0.5502	0.042	0.4651 *(2012)*	0.6512 *(1999)*
Kazakhstan	16	0.671	0.635	0.0915	0.5707 *(2013)*	0.8289 *(1998)*
Kuwait	24	0.3172	0.316	0.0727	0.2147 *(2006)*	0.4740 *(1992)*
Kyrgy Republic	12	0.6942	0.686	0.0568	0.6365 *(2005)*	0.8089 *(2002)*
Latvia	17	0.7125	0.6976	0.0786	0.6163 *(2002)*	0.8422 *(1995)*
Lesotho	17	0.6071	0.5968	0.0544	0.5410 *(2007)*	0.7611 *(1997)*
Libyan Arab Jamahiriya	9	0.4586	0.4585	0.0475	0.3785 *(1974)*	0.5177 *(1972)*
Lithuania	15	0.6641	0.6516	0.0345	0.6249 *(2005)*	0.7574 *(1999)*
Luxembourg	39	0.6338	0.6446	0.0485	0.5132 *(1970)*	0.7223 *(1993)*
Malaysia	5	0.4598	0.4587	0.0239	0.4365 *(1978)*	0.4928 *(1970)*
Mali	15	0.7643	0.7525	0.1138	0.6022 *(2001)*	0.9325 *(2007)*
Malta	39	0.6303	0.6191	0.0495	0.5573 *(1989)*	0.7214 *(2004)*
Mauritania	3	0.6851	0.6973	0.0393	0.6411 *(2006)*	0.7169 *(2005)*
Mauritius	5	0.4598	0.4587	0.0239	0.4365 *(1978)*	0.4928 *(1970)*

(continued)

Table 5 (continued)

Economy	Obs.	Mean	Median	Std. Dev.	Min (*Year*)	Max (*Year*)
Mexico	32	0.5599	0.5773	0.0682	0.4412 *(1987)*	0.7117 *(1993)*
Mongolia	15	0.761	0.764	0.0725	0.6460 *(1997)*	0.8883 *(2009)*
Morocco	18	0.8173	0.8029	0.1115	0.5777 *(2000)*	0.9858 *(2005)*
Namibia	27	0.7592	0.7971	0.1002	0.5790 *(2015)*	0.8882 *(1993)*
Netherlands	39	0.7579	0.7561	0.0216	0.7247 *(1985)*	0.8089 *(1979)*
Netherlands Antilles	17	0.901	0.9126	0.0499	0.7993 *(1992)*	0.9665 *(2003)*
New Zealand	36	0.6746	0.6602	0.0335	0.6315 *(2000)*	0.7411 *(1980)*
Nicaragua	22	0.7613	0.7973	0.0988	0.5806 *(1998)*	0.9416 *(2015)*
Norway	40	0.7018	0.7067	0.0632	0.5684 *(2006)*	0.8021 *(1988)*
Oman	28	0.3715	0.371	0.0529	0.2584 *(2008)*	0.4831 *(1998)*
Panama	17	0.5547	0.5796	0.0658	0.4323 *(2012)*	0.6220 *(2000)*
Paraguay	22	0.7094	0.6939	0.1143	0.5358 *(1994)*	0.9126 *(2000)*
Peru	42	0.6372	0.6403	0.1457	0.3826 *(2008)*	0.8844 *(1973)*
Philippines	21	0.5921	0.5977	0.0626	0.4624 *(2012)*	0.6807 *(2006)*
Poland	18	0.699	0.7136	0.0594	0.5974 *(2007)*	0.7724 *(1996)*
Portugal	34	0.7862	0.7926	0.1057	0.6208 *(1994)*	0.9104 *(2005)*
Qatar	19	0.2491	0.2176	0.09	0.1537 *(2008)*	0.4352 *(1998)*
Republic of Korea	39	0.9014	0.88	0.0504	0.8361 *(2004)*	0.9978 *(1973)*
Republic of Moldova	26	0.7139	0.726	0.094	0.5016 *(1999)*	0.9716 *(1991)*
Romania	14	0.6871	0.6773	0.0692	0.5751 *(1997)*	0.8396 *(2001)*
Russian Federation	19	0.6983	0.7059	0.069	0.5869 *(2000)*	0.7945 *(1996)*
San Marino	18	0.6154	0.6174	0.0515	0.5388 *(2007)*	0.7314 *(2012)*
Saudi Arabia	15	0.3391	0.3544	0.0652	0.2106 *(2008)*	0.4452 *(1998)*
Senegal	25	0.8258	0.844	0.0884	0.6036 *(1996)*	0.9817 *(2014)*
Seychelles	21	0.5272	0.5276	0.0435	0.4546 *(1976)*	0.6138 *(1982)*
Singapore	33	0.5042	0.5035	0.0265	0.4500 *(1980)*	0.5670 *(1985)*
Slovakia	23	0.6205	0.6192	0.0342	0.5487 *(2008)*	0.6752 *(1998)*
Slovenia	15	0.8499	0.8496	0.0434	0.7854 *(2008)*	0.9195 *(1995)*
South Africa	46	0.7335	0.7486	0.0549	0.6375 *(2008)*	0.8149 *(1982)*
Spain	29	0.7221	0.7316	0.0444	0.6573 *(1989)*	0.7941 *(1997)*
Sri Lanka	31	0.8606	0.8511	0.0469	0.7712 *(2001)*	0.9430 *(2013)*
Suriname	4	0.4634	0.469	0.0215	0.4329 *(2008)*	0.4829 *(2007)*
Sweden	39	0.8176	0.8133	0.0314	0.7514 *(1995)*	0.8954 *(1977)*
Switzerland	26	0.8495	0.8487	0.0253	0.8025 *(2007)*	0.9027 *(2001)*
Tajikistan	16	0.4448	0.4205	0.1155	0.3021 *(2008)*	0.6580 *(2000)*
Thailand	46	0.782	0.7895	0.0917	0.6005 *(1970)*	0.9619 *(1992)*
Trinidad and Tobago	40	0.6549	0.6794	0.1527	0.3509 *(2008)*	0.9022 *(1986)*
Tunisia	20	0.5785	0.5581	0.0545	0.5106 *(1996)*	0.6538 *(2005)*
Turkey	27	0.5034	0.495	0.0573	0.4086 *(1987)*	0.6210 *(1991)*

(continued)

Table 5 (continued)

Economy	Obs.	Mean	Median	Std. Dev.	Min (*Year*)	Max (*Year*)
Ukraine	25	0.6866	0.6546	0.0931	0.4784 *(1993)*	0.8825 *(2013)*
United Arab Emirates	22	0.2805	0.2764	0.0328	0.2204 *(2006)*	0.3562 *(1986)*
United Kingdom	36	0.7627	0.7587	0.0195	0.7349 *(1996)*	0.8166 *(1975)*
United States	42	0.7413	0.7425	0.0139	0.7085 *(2011)*	0.7673 *(1980)*
Uruguay	9	0.5733	0.5841	0.0284	0.5271 *(2003)*	0.6018 *(2001)*
Venezuela (Bolivarian Republic of)	46	0.6049	0.6045	0.0663	0.4448 *(1996)*	0.7165 *(1972)*
Yemen	11	0.6276	0.65	0.0981	0.5139 *(1973)*	0.7490 *(1981)*

Source Author's calculations

Oil-producing economies in the Middle East are characterized by very low labor share averages, their incomes being mainly dependent on the endowments of natural resources: for example, Qatar (average of 0.25), the United Arab Emirates (0.28), Kuwait (0.32) and Saudi Arabia (0.34). Conversely, North European economies, such as Iceland (average of 0.85), Sweden (0.82), Finland (0.81) and Denmark (0.79), exhibit very high shares of labor in national income.

Data in some economies, such as the United States, shows very little variation, with a standard deviation equal to 0.014; whereas in other economies, such as Trinidad and Tobago, the labor share variation over time is high, with a standard deviation equal to 0.153. The overall declining trend mentioned in the above section is visible for economy-level data when observing minimum values: most economies (56.4% of the sample) experienced their historical minimum labor share in the 21st century.

To further examine this declining trend, Table 6 considers our preferred measure of labor share, LS6, and summarizes its averages and trends of variation by decade for each economy. In the 1970s and 1980s, the majority of economies (81.52% and 80.00%, respectively) did not experience significant variation in the labor share (exhibiting an average annual variation between –1% and +1% throughout the decade), however this overall trend changed considerably from the 1990s. In particular, in the decade 2000–2009 the share of labor declined in exactly half of the sample and in the period 2010–2015 it declined in 31.87% of the sample. However, it is possible to identify notable differences across economies. In some economies, such as Peru, the labor share of income has demonstrated a clear declining pattern over the last four decades. In others, such as the Netherlands, there is no strong evidence of variation over time.

Table 6 LS6 averages and trends, by decade

Economy	Labor share averages					Labor share trends[a]				
	1970s	1980s	1990s	2000s	2010s	1970s	1980s	1990s	2000s	2010s
Algeria	0.7327	0.7208	0.5814	0.4045	0.4642	=		–	=	+
Angola				0.5727	0.7556				++	++
Argentina			0.5104	0.48	0.5803			–	=	++
Armenia			0.8746	0.8802				+	=	
Aruba			0.6403	0.6386				++	– –	
Australia	0.7441	0.7346	0.7726	0.7506		=	=	=	=	
Austria	0.8301	0.811	0.8045	0.7444		=	=	=	=	
Azerbaijan			0.4398	0.461	0.4935			–	++	–
Bahamas			0.6158	0.4949	0.4922			=	=	=
Bahrain			0.3873	0.3242	0.323			=	–	+
Barbados	0.8039					=				
Belarus			0.5339	0.5768	0.5822			=	+	=
Belgium	0.746	0.7094	0.7351	0.7916		=	–	+	=	
Bermuda			0.7094	0.7578	0.7843			+	=	=
Bolivia	0.5799	0.5595	0.6054	0.5854	0.5203	=	–	=	–	=
Bosnia and Herzegovina				0.7528	0.7547				=	–
Botswana	0.6743	0.5987	0.4943	0.562	0.5447	+	– –	+	=	– –
Brazil			0.6977	0.7148	0.755			+	=	+
British Virgin Islands	0.6629	0.5975	0.4141	0.5638	0.6606	=	–	=	++	– –
Brunei Darussalam					0.2358					++
Bulgaria			0.529	0.5483	0.5498			++	=	– –
Cabo Verde				0.602	0.6616				=	+
Canada	0.7673	0.7549	0.7951	0.744	0.687	=	=	=	–	–

(continued)

Table 6 (continued)

Economy	Labor share averages					Labor share trends[a]				
	1970s	1980s	1990s	2000s	2010s	1970s	1980s	1990s	2000s	2010s
Cayman Islands		0.6247	0.6113	0.5303	0.5679		=	–	++	=
Chile	0.6629	0.6207	0.6306	0.6799	0.559	–	=	++	=	–
Hong Kong, China		0.5308	0.535	0.5573	0.5532		=	+	=	=
Macau, China			0.3689	0.4225	0.3551			++	=	=
Colombia	0.5814	0.6208	0.5528	0.6733	0.7327	=	=	=	+	=
Comoros				0.4131	0.4486				– –	++
Cook Islands			0.6916	0.7541				++	=	
Costa Rica	0.6292	0.6702	0.7138	0.7535	0.7862	=	+	–	+	=
Croatia			0.9069	0.8642	0.8034			++	–	–
Cuba				0.5334					=	
Cyprus			0.7228	0.7582	0.7611			–	+	–
Czech Republic			0.6763	0.6826				=	=	
Denmark	0.741	0.7978	0.8009	0.8253		=	=	=	=	
Dominican Republic			0.6951	0.6377				=	– –	
Ecuador	0.514	0.4381	0.3155	0.6522	0.7737	–	–	– –	++	=
Egypt			0.4041	0.4191	0.3952			+	=	=
Estonia			0.6947	0.6506	0.6755			–	+	=
Eswatini (Swaziland)		0.7311					=			
Fiji	0.8191	0.8511	0.7635	0.7005		–	=	+	– –	
Finland	0.8118	0.8495	0.8335	0.7312		=	=	–	=	
France	0.7172	0.8291	0.7708	0.7613		+	=	=	=	
Gabon	0.5056			0.3921		++				– –
Georgia			0.7036	0.7502	0.9206			=	++	–

(continued)

Table 6 (continued)

Economy	Labor share averages					Labor share trends[a]				
	1970s	1980s	1990s	2000s	2010s	1970s	1980s	1990s	2000s	2010s
Germany (Fed Rep before 91)		0.7473	0.7548	0.74			=	=	=	
Greece			0.6708	0.6577				=	=	
Guatemala				0.6984	0.5595				– –	–
Hungary		0.7015	0.7717	0.7081			+	–	=	
Iceland	0.8626	0.8569	0.8209	0.8973		+	=	=	=	
Iran			0.562	0.5043	0.4687			++	–	=
Iraq			0.1154	0.259	0.4253			– –	++	+
Ireland	0.7504	0.8226	0.675	0.5861		=	=	–	=	
Israel			0.7864	0.7542	0.7129			=	–	=
Italy	0.7355	0.8201	0.7141	0.7002		=	+	–	=	
Jamaica			0.8971	0.8943	0.9497			=	=	=
Japan	0.756	0.8144	0.8216	0.8015		+	=	=	=	
Jordan	0.5257	0.5592	0.5849	0.5473	0.4678	=	=	+	–	– –
Kazakhstan			0.805	0.6746	0.5952			– –	–	–
Kuwait			0.3872	0.2855	0.2765			–	=	++
Kyrgyz Republic				0.703	0.6676				–	+
Latvia			0.8037	0.6648	0.6415			+	=	– –
Lesotho			0.6818	0.5755	0.6301			– –	=	+
Libya	0.4596					=				
Lithuania			0.6987	0.6467				+	–	
Luxembourg	0.5998	0.6363	0.6681	0.6307		++	=	=	=	
Malaysia	0.4601	0.4587				– –				
Mali			0.6436	0.7438	0.846				++	=

(continued)

Table 6 (continued)

Economy	Labor share averages					Labor share trends[a]				
	1970s	1980s	1990s	2000s	2010s	1970s	1980s	1990s	2000s	2010s
Malta	0.6025	0.5903	0.6169	0.6923	0.6852	=	=	+	=	–
Mauritania				0.6851					– –	
Mauritius	0.5359	0.4917	0.4747	0.4503	0.4667	=	–	=	=	=
Mexico		0.5341	0.6204	0.5401	0.4861		+	=	–	– –
Mongolia			0.7314	0.7758				+	+	
Morocco			0.888	0.8168	0.7945			++	+	=
Namibia		0.7347	0.8412	0.721	0.6902			+	–	=
Netherlands	0.7774	0.758	0.7491	0.7458		=	=	=	=	
Netherlands Antilles			0.8721	0.9266				+	=	
New Zealand	0.6829	0.6951	0.6589	0.6571		+	=	=	=	
Nicaragua			0.6193	0.7958	0.8458			– –	++	++
Norway	0.7581	0.726	0.709	0.614		=	=	=	=	
Oman		0.381	0.4206	0.3396	0.3394		– –	+	=	+
Panama			0.6117	0.5629	0.4514			=	–	– –
Paraguay			0.7237	0.7468	0.6327			++	–	–
Peru	0.81	0.6712	0.6367	0.4807	0.3884	–	=	=	– –	–
Philippines			0.6131	0.6105	0.4752			+	–	– –
Poland			0.74	0.658				+	–	
Portugal	0.7653	0.7071	0.7548	0.8923	0.8951	– –	–	++	=	–
Qatar			0.3868	0.2099	0.1753			–	–	– –
Republic of Korea	0.9472	0.9197	0.8828	0.8507		=	=	=	=	
Republic of Moldova		0.7307	0.7376	0.6825	0.726			–	++	–
Romania			0.6601	0.7021				+	=	

(continued)

Table 6 (continued)

Economy	Labor share averages					Labor share trends[a]				
	1970s	1980s	1990s	2000s	2010s	1970s	1980s	1990s	2000s	2010s
Russian Federation			0.7248	0.7074	0.6425			– –	+	– –
San Marino			0.6246	0.5854	0.6699			=	=	–
Saudi Arabia			0.3971	0.3101				+	–	
Senegal			0.7749	0.8192	0.9408			=	+	+
Seychelles	0.4764	0.5534	0.5188			+	=	=		
Singapore		0.5032	0.5023	0.5084	0.4996		=	=	=	=
Slovakia			0.6461	0.6103	0.6076			=	=	=
Slovenia			0.8973	0.8263				–	=	
South Africa	0.7622	0.7809	0.7586	0.6645	0.6799	=	=	=	–	+
Spain		0.6898	0.7331	0.7458			–	+	=	
Sri Lanka		0.8661	0.8381	0.8526	0.9279		=	=	+	=
Suriname				0.4624	0.4665				=	–
Sweden	0.8396	0.8208	0.7984	0.8109		=	=	=	=	
Switzerland			0.846	0.8537	0.8481			=	=	=
Tajikistan				0.4372	0.4574				– –	++
Thailand	0.6547	0.8044	0.9044	0.7776	0.7602	+	=	+	–	=
Trinidad and Tobago	0.6597	0.7664	0.724	0.4695		–	++	–	–	
Tunisia			0.5334	0.5999	0.6515			+	+	=
Turkey		0.4366	0.5332	0.5024	0.4882		++	+	– –	=
Ukraine		0.6469	0.6716	0.6504	0.8248			+	+	+
United Arab Emirates		0.3086	0.2539	0.2566	0.2895		+	– –	+	=
United Kingdom	0.7644	0.7601	0.7648	0.7605		=	=	=	=	
United States	0.7457	0.7536	0.7405	0.7319	0.709	=	=	=	=	–

(continued)

Table 6 (continued)

Economy	Labor share averages					Labor share trends[a]				
	1970s	1980s	1990s	2000s	2010s	1970s	1980s	1990s	2000s	2010s
Uruguay			0.5859	0.5671				+	–	
Venezuela	0.659	0.6333	0.5578	0.5691	0.6058	=	–	+	=	–
Yemen	0.5876	0.7341				++	=			

Source Author's calculations

[a]Please note: ++ Average annual variation greater than +3%
+ Average annual variation between +1 and +3%
= Average annual variation between −1 and +1%
– Average annual variation between −3 and −1%
– – Average annual variation less than −3%

5 Concluding Remarks

The study of the labor income share is severely hampered by measurement problems. As summarized by Kravis (1959, p. 918), it *"is handicapped by the fact […] that the nature of the components of income for which we have data has not been determined by the requirements of the economists but by legal and institutional arrangements of our society."* This study represents an attempt to construct a global dataset of the labor share of income. By suggesting an adjustment to the most commonly used methodologies of estimation, it offers an argument on the importance of accurate measurement and some useful information for future research.

We compile a new measure of the labor share of income across 151 economies —both developing and developed—using the UN National Accounts Statistics and the ILO Yearbooks of Labour Statistics for all or part of the period 1970–2015. Compared to five other measurements previously used in the empirical literature, the estimate suggested here allows us to consider a large sample of economies and it retains unique information.

Our analysis of the data offers evidence against the traditional hypothesis of the stability of factor shares (Kaldor 1961). We also reject more recent suggestions that changes in factor shares are mainly due to the lack of appropriate adjustment for self-employment income (Bernanke and Gürkaynak 2001; Gollin 2002), indirect taxation and capital depreciation (Bridgman 2017; Rognlie 2015).

Our study finds evidence that the labor income share varies considerably across economies and it has generally declined over time, especially in the last three decades. On a socio-political level, this trend risks creating perceptions that workers are not receiving 'fair' shares of the income they produce, and it thus may endanger socio-political stability (Atkinson 2009). On an economic level, it may risk jeopardizing the sustainability of future economic growth by constraining wage-based household consumption (Onaran and Galanis 2013). These issues are even the more significant in light of the negative repercussions on labor markets caused by the global financial crisis and its slow recovery in many parts of the world (Smeeding and Thompson 2011).

Our results are relevant for policymakers wishing to pursue adequate pro-poor and pro-labor policies. These are particularly important today, given the recent changes in global labor markets caused by increasing international trade and capital flows and by rapid technological progress. Given that factor shares are found to be relatively persistent over time, policies in both industrialized and developing economies should aim to devise instruments which safeguard labor and should reconsider traditional approaches targeted at protecting capital.

Appendix

List of Economies and Data Availability

Economy	Time series	Adjustments to value added		Adjustments to self-employment income		
		Net of indirect taxes	Net of consumption of fixed K	Gross mixed income	Workforce composition	
					Employees	Employers
Algeria	1970–1978 and 1989–2015	Yes	Yes	No	Yes	Yes
Angola	2002–2015	Yes	No	No	Yes	Yes
Argentina	1993–2013	Yes	No	Yes	Yes	Yes
Armenia	1994–2009	Yes	Yes	No	Yes	Yes
Aruba	1994–2002	Yes	Yes	Yes	Yes	Yes
Australia	1970–2008	Yes	Yes	Yes	Yes	Yes
Austria	1976–2008	Yes	Yes	Yes	Yes	Yes
Azerbaijan	1995–2012	Yes	Yes	No	Yes	Yes
Bahamas	1989–2010	Yes	Yes	No	Yes	Yes
Bahrain	1994–2015	Yes	Yes	No	Yes	Yes
Barbados	1974–1975	No	Yes	No	Yes	Yes
Belarus	1990–2015	Yes	No	Yes	Yes	Yes
Belgium	1975–2008	Yes	Yes	Yes	Yes	Yes
Benin	1974–1978, 1982–1986, 1994–2012	Yes	Yes	Yes	No	No
Bermuda	1996–215	Yes	Yes	No	Yes	Yes
Bolivia	1970–1986, 1988–2015	Yes	No	No	Yes	Yes
Bosnia and Herzegovina	2005–2011	Yes	Yes	No	Yes	Yes
Botswana	1974–2001, 2003–2015	Yes	Yes	Yes	Yes	Yes
Brazil	1992–2013	Yes	No	Yes	Yes	Yes
British Virgin Islands	1970–1977, 1984–1987, 1995–2012	Yes	Yes	No	Yes	Yes
Brunei Darussalam	2010–2015	Yes	No	No	Yes	Yes
Bulgaria	1994, 1996–2010	Yes	Yes	Yes	Yes	Yes
Burkina Faso	1979–1984 and 1999–2014	Yes	Yes	No	No	No

(continued)

(continued)

Economy	Time series	Adjustments to value added		Adjustments to self-employment income		
		Net of indirect taxes	Net of consumption of fixed K	Gross mixed income	Workforce composition	
					Employees	Employers
Burundi	1984–1988 and 2005–2014	Yes	Yes	No	No	No
Cabo Verde	2007–2014	Yes	No	Yes	Yes	Yes
Cameroon	1974–1988, 1990, 1993–2011, 2013–2014	Yes	Yes	Yes	No	No
Canada	1970–2010	Yes	Yes	Yes	Yes	Yes
Cayman Islands	1983–1991, 2006–2015	Yes	Yes	No	Yes	Yes
Central Afr. Rep.	2005–2006	Yes	No	Yes	No	No
Chad	1975, 1995–2001, 2005–2010	Yes	Yes	No	No	No
Chile	1974–2014	Yes	Yes	Yes	Yes	Yes
PRC	1992–2014	Yes	No	No	Yes	No
Hong Kong, China	1980–2013	Yes	No	No	Yes	Yes
Macau, China	1992–2015	Yes	Yes	No	Yes	Yes
Colombia	1970–2015	Yes	No	Yes	Yes	Yes
Comoros	2007–2014	Yes	No	No	Yes	Yes
Cook Islands	1995–2007	Yes	Yes	No	Yes	Yes
Costa Rica	1970–2013	Yes	Yes	Yes	Yes	Yes
Cote d'Ivoire	1974–1979, 1989–2000, 2005–2013	Yes	Yes	Yes	No	No
Croatia	1997–2011	Yes	Yes	Yes	Yes	Yes
Cuba	1996–2009	Yes	No	No	Yes	Yes
Curacao	2000–2012	Yes	Yes	No	No	No
Cyprus	1996–2010	Yes	Yes	Yes	Yes	Yes
Czech Republic	1992–2008	Yes	Yes	Yes	Yes	Yes
Denmark	1970–2008	Yes	Yes	Yes	Yes	Yes
Djibouti	1990–1998	Yes	No	No	No	No
Dom. Republic	1991–2005	Yes	Yes	Yes	Yes	Yes

(continued)

(continued)

Economy	Time series	Adjustments to value added		Adjustments to self-employment income		
		Net of indirect taxes	Net of consumption of fixed K	Gross mixed income	Workforce composition	
					Employees	Employers
Ecuador	1970–1991, 2007–2014	Yes	Yes	No	Yes	Yes
Egypt	1996–2013	Yes	Yes	Yes	Yes	Yes
Estonia	1993–2013	Yes	Yes	Yes	Yes	Yes
Eswatini (Swaziland)	1980–1987	No	Yes	No	Yes	Yes
Faeroe Islands	1999–2012	Yes	No	Yes	No	No
Fiji	1977–1989, 1996–2001	No	Yes	No	Yes	Yes
Finland	1970–2008	Yes	Yes	Yes	Yes	Yes
France	1970–2009	Yes	Yes	Yes	Yes	Yes
Gabon	1972–1978, 2001–2005	Yes	Yes	No	Yes	Yes
Georgia	1998–2015	Yes	Yes	Yes	Yes	Yes
Germany (pre-1991, Fed. Rep.)	1970–2008	Yes	Yes	Yes	Yes	Yes
Greece	1995–2008	Yes	Yes	Yes	Yes	Yes
Greenland	2003–2015	Yes	No	No	No	No
Guatemala	2001–2012	Yes	No	Yes	Yes	Yes
Guinea	2006–2013	Yes	No	Yes	No	No
Honduras	1992–2015	Yes	Yes	Yes	No	No
Hungary	1980–1989, 1995–2008	Yes	Yes	Yes	Yes	Yes
Iceland	1973–2005	Yes	Yes	Yes	Yes	Yes
India	1980–2008	Yes	Yes	No	No	No
Iran	1994–2014	Yes	Yes	Yes	Yes	Yes
Iraq	1997–2015	No	Yes	No	Yes	Yes
Ireland	1970–2008	Yes	Yes	Yes	Yes	Yes
Israel	1995–2011	Yes	Yes	No	Yes	Yes
Italy	1970–2008	Yes	Yes	Yes	Yes	Yes
Jamaica	1998–2015	Yes	Yes	No	Yes	Yes
Japan	1970–2007	Yes	Yes	Yes	Yes	Yes
Jordan	1970–2012	Yes	Yes	No	Yes	Yes
Kazakhstan	1998–2013	Yes	Yes	Yes	Yes	Yes
Kenya	1970–2013	Yes	Yes	No	Yes	No
Kuwait	1992–2015	Yes	Yes	No	Yes	Yes

(continued)

(continued)

Economy	Time series	Adjustments to value added		Adjustments to self-employment income		
		Net of indirect taxes	Net of consumption of fixed K	Gross mixed income	Workforce composition	
					Employees	Employers
Kyrgyz Republic	2001–2012	Yes	Yes	Yes	Yes	Yes
Latvia	1994–2010	Yes	Yes	Yes	Yes	Yes
Lesotho	1997–20013	Yes	Yes	Yes	Yes	Yes
Libya	1971–1979	No	Yes	No	Yes	Yes
Liechtenstein	1998–2014	Yes	Yes	Yes	No	No
Lithuania	1995–2009	Yes	Yes	Yes	Yes	Yes
Luxembourg	1970–2008	Yes	Yes	Yes	Yes	Yes
Malaysia	1970–1971, 1973, 1978, 1983	No	Yes	No	Yes	Yes
Mali	1999–2013	Yes	No	No	Yes	Yes
Malta	1973–2011	Yes	Yes	Yes	Yes	Yes
Marshall Isl.	1997–2015	Yes	Yes	No	No	No
Mauritania	2001, 2005–2006	Yes	No	No	Yes	Yes
Mauritius	1970–2010	Yes	No	No	Yes	Yes
Mexico	1980–2011	Yes	Yes	Yes	Yes	Yes
Fed. States of Micronesia	1995–2015	Yes	No	Yes	No	No
Monaco	2005–2009	Yes	No	No	No	No
Mongolia	1995–2009	No	Yes	Yes	Yes	Yes
Morocco	1998–2015	Yes	No	No	Yes	Yes
Mozambique	1996–2012	Yes	Yes	Yes	No	No
Namibia	1989–2015	Yes	Yes	No	Yes	Yes
Netherlands	1970–2008	Yes	Yes	Yes	Yes	Yes
Netherlands Antilles	1992–2008	Yes	Yes	Yes	Yes	Yes
New Zealand	1971–2006	Yes	Yes	No	Yes	Yes
Nicaragua	1994–2015	Yes	Yes	Yes	Yes	Yes
Niger	1975–1977, 1995–2015	Yes	Yes	Yes	No	No
Nigeria	1981–2013	Yes	Yes	No	No	No
Norway	1970–2009	Yes	Yes	Yes	Yes	Yes
Oman	1988–2015	Yes	Yes	Yes	Yes	Yes
Palau	2000–2015	Yes	No	Yes	Yes	No
Panama	1996–2012	Yes	Yes	Yes	Yes	Yes

(continued)

(continued)

Economy	Time series	Adjustments to value added		Adjustments to self-employment income		
		Net of indirect taxes	Net of consumption of fixed K	Gross mixed income	Workforce composition	
					Employees	Employers
Papua New Guinea	1970–1974, 1983–1991, 1994–2006	Yes	Yes	No	No	No
Paraguay	1994–2015	Yes	Yes	Yes	Yes	Yes
Peru	1970–2011	Yes	Yes	Yes	Yes	Yes
Philippines	1992–2012	Yes	Yes	No	Yes	Yes
Poland	1991–2008	Yes	Yes	Yes	Yes	Yes
Portugal	1977–2010	Yes	Yes	Yes	Yes	Yes
Qatar	1995–2013	Yes	Yes	Yes	Yes	Yes
Rep. of Korea	1970–2008	Yes	Yes	No	Yes	Yes
Rep. of Moldova	1989–2014	Yes	No	Yes	Yes	Yes
Romania	1995–2010	Yes	No	Yes	Yes	Yes
Russian Federation	1989–2013	Yes	Yes	Yes	Yes	Yes
Rwanda	1975–1989	Yes	Yes	No	No	No
San Marino	1997–2014	Yes	Yes	Yes	Yes	Yes
Saudi Arabia	1995–2009	Yes	Yes	Yes	Yes	Yes
Senegal	1990–2014	Yes	Yes	No	Yes	Yes
Seychelles	1976–1996	Yes	Yes	No	Yes	Yes
Sierra Leone	1984–1990, 2001–2014	Yes	Yes	No	No	No
Singapore	1980–2012	Yes	Yes	No	Yes	Yes
Sint Maarten	2008–2014	No	Yes	No	No	No
Slovakia	1993–2015	No	Yes	Yes	Yes	Yes
Slovenia	1995–2009	Yes	Yes	Yes	Yes	Yes
Solomon Islands	1984–1986	No	Yes	No	No	No
South Africa	1970–2015	Yes	Yes	No	Yes	Yes
Spain	1980–2008	Yes	Yes	Yes	Yes	Yes
Sri Lanka	1983–2013	Yes	No	No	Yes	Yes
Sudan	1972, 1978–1983, 1995–2010	Yes	Yes	No	No	No
Suriname	2007–2010	Yes	No	No	Yes	Yes
Sweden	1970–2008	Yes	Yes	Yes	Yes	Yes
Switzerland	1990–2015	Yes	Yes	Yes	Yes	Yes

(continued)

(continued)

Economy	Time series	Adjustments to value added		Adjustments to self-employment income		
		Net of indirect taxes	Net of consumption of fixed K	Gross mixed income	Workforce composition	
					Employees	Employers
Tajikistan	2000–2015	Yes	Yes	No	Yes	Yes
Tanzania	1998–2013	No	Yes	No	No	No
Thailand	1970–2015	Yes	No	No	Yes	Yes
Trinidad and Tobago	1970–2009	Yes	Yes	No	Yes	Yes
Tunisia	1992–2011	Yes	Yes	No	Yes	Yes
Turkey	1987–2006, 2009–2015	Yes	Yes	Yes	Yes	Yes
Ukraine	1989–2013	Yes	Yes	Yes	Yes	Yes
United Arab Emirates	1983–1990, 2001–2014	Yes	Yes	No	Yes	Yes
United Kingdom	1970–2005	Yes	Yes	Yes	Yes	Yes
United States	1960–2011	Yes	Yes	Yes	Yes	Yes
Uruguay	1997–2005	Yes	Yes	Yes	Yes	Yes
Vanuatu	2001–2012	Yes	No	No	No	No
Venezuela	1970–2015	Yes	Yes	Yes	Yes	Yes
Yemen	1972–1982	No	No	No	Yes	Yes
Zimbabwe	1970–1990, 2009–2015	Yes	No	Yes	No	No

Source UN National Accounts Statistics (available to download at: http://data.un.org/)
ILO Statistics (available to download at: https://www.ilo.org/ilostat)

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Chapter 4
Technology, Market Regulations, and Labor Share Dynamics

Mary O'Mahony, Michela Vecchi and Francesco Venturini

Abstract We investigate the causes of the decline in the labor share, exploring the effect of technology vis-à-vis the role of market regulations, namely employment protection legislation, product market regulation, and intellectual property rights (IPR) protection. Our results show that, in the long run, productivity upgrades and information and communication technology capital diffusion are major sources of the decline in the labor share. IPR protection is the only dimension of the institutional setting that affects (positively) the share of industry income accruing to labor. Our results also show that hysteresis characterizes the dynamics of the labor share in all countries. This further corroborates the idea that institutional differences are not the main source of variation in labor share movements, as the negative trend is common to countries with different regulatory settings.

Keywords Labor share · Technological change · ICT capital · Market regulations · Hysteresis

JEL Classification C23 · E24 · E25 · O33

1 Introduction

The decline in the labor share has attracted increasing interest among economists, policy makers, and the press. Although conceptually different, researchers have often discussed it in conjunction with wage inequality, an issue with a wider understanding. While wage inequality relates to the distribution of wages across the

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employed, the labor share is concerned with the division of the income (output) generated between workers and capital. The decline in the labor share means that workers earn comparatively less than capital owners due to fewer job opportunities or lower wages. From a social viewpoint, workers, especially those with a lower skill endowment, have experienced sluggish wages for several decades in most developed countries, a situation that can lead to lower job participation rates and higher welfare costs (Juhn and Potter 2006). Workers typically have a greater propensity to consume than capital owners, and, in the long run, a smaller labor share can lead to a decrease in the aggregate demand, with adverse effects on economic growth and employment (OECD 2015).

The initial research on the decline in the labor share emphasized the role of technological change and globalization. Recent technologies have been increasingly capital augmenting and have made production activities more capital intensive (Bentolila and Saint-Paul 2003; Lawless and Whelan 2011; Piketty and Zucman 2014). A decrease in the price of capital goods has facilitated this trend (Karabarbounis and Nieman 2014). The new vintages of capital goods are not only cheaper but also increasingly able to substitute routinized workers' tasks, thanks to the development of automation and the diffusion of information and communication technology (ICT).

Research has often blamed globalization for the decline in job opportunities and wage rates in the advanced countries, particularly for low-skilled workers. However, the empirical evidence is more divided on this issue. Elsby et al. (2013) argued that globalization is the main reason behind the decrease in the labor share in the US, supporting Gushina's (2006) earlier work. However, examining a global sample of countries, Guerriero and Sen (2012) found that the overall impact of trade on the labor share is positive. More recently, Autor et al. (2017a) showed that the decline in the labor share involves both traded and non-traded goods sectors, further weakening the hypothesis that globalization is a key driver of the labor share decline.

Although technological conditions determine factor substitutability, the speed at which firms replace inputs depends on frictions in factor markets, which countries' institutional settings determine. The literature has considered various types of market regulations, but the estimated effect has tended to differ across studies. For example, studies have generally associated increasing competitiveness with increasing labor shares, as the fall in barriers to entry decreases the rents that firms appropriate and increases those accruing to workers (Bassanini and Manfredi 2012). However, the privatization of network services in the OECD has contributed to the reduction of the labor share by shifting the focus of managers away from employment targets and toward profitability targets (Azmat et al. 2012).[1] Studies have often considered labor market deregulation as one of the main causes of the decline in the labor share (Blanchard and Giavazzi 2003; Bassanini and Duval

[1]The fact that wages tend to rise after privatization can only partially compensate for this effect (La Porta and Lopez-de-Silanes 1999).

2009; Suchanek 2009), yet Azmat et al. (2012) did not find any evidence for this effect.

The main objective of this paper is to contribute to this important debate by providing new evidence on the role of technology and institutional factors. Although researchers have widely recognized the importance of technological factors, we extend the current literature by focusing on a large group of OECD countries, hence contributing to a debate that the US evidence has largely dominated. The role of institutional factors has been one of the most challenging issues to assess, partly because of the difficulty in finding reliable proxies to measure their impact. In fact, little time and cross-sectional variation generally characterizes the available measures of market regulations. The recent results that Autor et al. (2017b) obtained showed that increasing market concentration, fostered by new technological advances, is likely to drive the decline in the labor share in the US. Hence, the role of market regulations is now at the forefront of the different explanations for the decline in the labor share and deserves further investigation.

To explore these issues, we make use of data for 14 European countries, Australia, the US, and Japan. For each country, we collect data on 20 industries, covering manufacturing and services, over the 1970–2007 period. We account for the impact of technological factors by including a measure of total factor productivity (TFP) and by dividing the total capital assets into non-ICT and ICT components. We capture the role of market regulations using three variables that vary across countries and industries and over time: the employment protection burden indicator, which we construct following the methodology of Bassanini et al. (2009); the regulation impact indicator (Conway et al. 2006), which accounts for the impact of service regulation on downstream industries (Bourlés et al. 2013); and the indicator of the enforcement of intellectual property rights (IPR) protection (Aghion et al. 2015).

Our analysis also accounts for the impact of market regulations in an indirect way by testing for the presence of hysteresis in the labor share. Studies have often used the concept of hysteresis to explain persistence in unemployment as a consequence of institutional factors (labor unions pushing for high wages for their members) and workers' skill deterioration while unemployed. If regulations play a role in the labor share movements, our results should be consistent with those that the unemployment literature has found; that is, we should find evidence of hysteresis only in countries with stricter regulations. As for skill deterioration, in an environment characterized by fast technological developments, skills can quickly become obsolete. Following a recession, workers who lose their jobs might not be able to re-enter the labor market with the same job specification and wage level, and this will lead to a persistent decline in the labor share. Given that all the countries in our sample have access to the same technologies, whilst greatly differing in terms of regulatory setting, widespread support for the presence of hysteresis would indicate that technology, rather than institutional factors, is responsible for the labor share decline. The analysis of hysteresis associated with the labor share is another novel contribution of our paper.

Our results show that the impact of technological change is strong, negative, and statistically significant across industries and countries. The effect of institutional factors is always positive but not always significant. The protection of intellectual property rights displays the most robust and significant effect, while we do not find evidence of a long-run impact of employment protection legislation and competitiveness. Our analysis also reveals the presence of hysteresis in the majority of countries. This suggests that technological factors, rather than institutions, are the main drivers of labor share movements.

We organize the remainder of the paper as follows. Section 2 describes the background theoretical framework and the empirical approach used. Section 3 presents the data and descriptive statistics. Section 4 contains our results. Section 5 presents some policy implications and then concludes the paper.

2 Empirical Approach

We study the determinants of the labor share dynamics following Bentolila and Saint-Paul (2003) and Bassanini and Manfredi (2012) by expressing the labor share of output (value added) as a function of a set of technology factors:

$$LS_t = f(\theta; A_t, k_t). \tag{1}$$

We derive this equation from a constant elasticity of substitution (CES) output production function, where θ is a parameter reflecting the degree of substitutability between factor inputs (namely capital and labor). A is the level of total factor productivity (TFP), which we use as a proxy for input-specific technical change, and k is the capital-value added ratio, which we measure in real terms. In the following, we decompose the capital-to-output ratio into ICT[2] and non-ICT assets, which we denote respectively with ki and kn, and we estimate a long-run approximation of Eq. (1) as follows:

$$\ln LS_{ijt} = \alpha_{0ij} + \alpha_1 \log A_{ijt} + \alpha_2 \log ki_{ijt} + \alpha_3 \log kn_{ijt} + \varepsilon_{ijt}, \tag{2}$$

where j denotes industries and i countries. α_{ijo} are industry-country fixed effects, and ε_{ijt} is a spherical error term. A negative coefficient for A would indicate that technical change is not neutral but biased toward the use of capital assets, that is, capital augmenting ($\alpha_1 < 0$). Similarly, if labor and capital were gross substitutes, we would expect the coefficients of capital intensities to be negative ($\alpha_2 < 0$ and $\alpha_3 < 0$). We estimate this empirical model with a dynamic formulation and by means of an estimator that is robust to several econometric issues (augmented mean group, AMG). The Appendix provides all the methodological details.

[2]ICT stands for information and communication technology (computers, software, and communication equipment).

In model (1), the technology parameter (θ) determines the degree of factor substitutability. However, the way in which firms exchange capital for labor strongly depends on the functioning of factor markets. Research has shown the regulatory framework of factor markets to influence production efficiency (Foster-McGregor et al. 2013), investment in capital goods (Alesina et al. 2005), and ICT endowment (Cette et al. 2013). Consequently, omitting institutional factors from our labor share specification may result in an overstatement of the impact of technology factors (*A* and *ki*). Therefore, we extend Eq. (2) to include three indicators for different types of market regulations.

To identify the role played by the weakening of labor market institutions, we investigate how the reduction in the severity of employment protection legislation (EPL) affects the labor share. This set of rules determines how firms can hire and fire workers, and, by influencing wage setting and firms' employment choice, EPL may ultimately determine the evolution of the labor share (Bassanini and Manfredi 2012).

Firms' decision to substitute capital for labor depends not only on the labor market regulations but also on the set of rules governing the other factor markets, such as intermediate inputs and technology. For instance, pro-competition policies, by removing barriers to the service supply, may lead firms to reconsider all the production phases and contract out less profitable tasks, hence affecting the occupational or wage levels. Azmat et al. (2012) studied the direct effect of pro-competition policies on deregulated (network) industries in OECD countries. Here, we extend this type of analysis to consider how deregulation in the (upstream) service sector exerts an impact on the dynamics of the labor share in other (downstream) industries by means of inter-industry intermediate inputs' transactions (Conway and Nicoletti 2006; Bourlés et al. 2013).

We also investigate whether the regulatory setting governing the technology market has some influence on the labor share dynamics, using, as our third indicator, the enforcement of intellectual property rights (IPRs). In the presence of well-defined rules on the degree of appropriability of innovation output, the incentives to undertake R&D are larger. This may exert a threefold positive effect on the labor share. First, it may increase investments in research activities, which are intensive in the use of highly educated/highly paid workers. Second, greater appropriability conditions on research outcomes grant firms larger profits and hence larger rents to share with workers. Third, by raising the volume of R&D, a higher level of IPR protection makes firms less sensitive to the competitive pressure of low-income countries.

3 Data Description and Summary Statistics

Our analysis is based on a large cross-industry, cross-country data sample that extends the EU KLEMS dataset (release 2009) to include countries' institutional characteristics. Our dataset covers 17 OECD countries and 20 market industries (12

manufacturing and 8 service industries), spanning from 1970 to 2007.[3] The exclusion of the latest years after the financial turmoil allows us to isolate the long-run impact of technological and institutional changes from the effect of the crisis.

The EU KLEMS dataset provides information on industry accounts (labor compensation, value added, and ICT and non-ICT stock).[4] The labor share is defined as the ratio of total compensation (including non-wage labor costs) to gross value added. Our measure includes the remuneration of the self-employed, which is classified as mixed income in national accounts, assuming that their compensation equals the industry average for employees. We measure the TFP levels in relative terms with respect to those that the US industries showed in 1997. We obtain the capital measures using the perpetual inventory method and geometric depreciation (see Timmer et al. 2007 for full details). We distinguish between ICT and non-ICT capital and express these variables as ratios to the real value added. We make all the monetary variables comparable using the relative PPP of industry output (1997 base), following Inklaar and Timmer (2008).

Tables 1 and 2 report the summary statistics. On average, the labor share is 0.70, showing wide variation among countries (from 0.81 in Sweden to 0.58 in the Czech Republic) and industries (from 0.86 in hotels and restaurants, H, to 0.31 in electricity, E, etc.). Sweden stands out for having the highest ratio of ICT capital to value added. At the industry level, the highest ratios are evident for post and communications (64) and electrical and optical equipment (30t33).

As discussed above, we consider the institutional characteristics of the labor and other factor markets. Aside from a few exceptions, information on the institutional setting governing the functioning of such markets is only available at the country level. Hence, to capture the variation in the impact of these factors across industries, we adopt the procedure that Rajan and Zingales (1998) devised, interacting country-level, time-varying variables with an industry-specific, time-invariant indicator reflecting how the effectiveness (enforcement) of institutional factors differs structurally among sectors.

We define our industry-level measure of the employment protection legislation (EPL) burden as the interaction between the country-level index of total

[3]Following Bassanini and Manfredi (2012), we exclude agriculture, mining, refining and petroleum, and real estate activities. The list of industries is (ISIC Rev. 2): food, beverages, and tobacco (15t16); textiles, textile products, and leather (17t19); wood and products of wood and cork (20); pulp, paper, paper products, and printing (21t22); chemicals (24); rubber and plastics (25); other non-metallic minerals (26); basic metals and fabricated metal (27t28); machinery, NEC (29); electrical and optical equipment (30t33); transport equipment (34t35); manufacturing, NEC (36t37); electricity, gas, and water supply (E); construction (F); wholesale and retail trade (G); hotels and restaurants (H); transport and storage (60t63); post and communications (64); financial intermediation (J); and business services (71t74). The list of countries is: Austria (AT), Australia (AU), Belgium (BE), the Czech Republic (CZ), Denmark (DK), Germany (DE), Finland (FI), France (FR), Hungary (HU), Ireland (IE), Italy (IT), Japan (JP), the Netherlands (NL), Spain (ES), Sweden (SE), the UK, and the US.

[4]O'Mahony and Timmer (2009) provided a general overview of this dataset.

Table 1 Summary statistics (mean) 1970–2007, country list

	AT	AU	BE	CZ	DE	DK	ES	FI	FR	HU	IE	IT	JP	NL	SE	UK	US	TOT
Labor share	0.70	0.72	0.67	0.58	0.75	0.73	0.65	0.71	0.71	0.67	0.64	0.72	0.64	0.72	0.81	0.73	0.68	0.70
TFP	1.98	5.34	2.69	2.98	24.06	1.63	8.43	1.27	13.22	1.95	1.63	12.80	28.60	4.76	2.93	17.20	103.80	15.50
Non-ICT capital/value added	0.70	0.55	0.57	0.57	0.40	0.52	0.40	0.51	0.39	0.47	0.64	0.53	0.72	0.59	0.50	0.39	0.35	0.51
ICT capital/value added	0.03	0.04	0.03	0.07	0.03	0.04	0.03	0.03	0.04	0.06	0.03	0.02	0.05	0.04	0.09	0.03	0.04	0.04

Source EU KLEMS. See footnote 3 for the country list

Table 2 Summary statistics (mean) 1970–2007, industry list

	15t16	17t19	20	21t22	24	25	26	27t28	29	30t33	34t35	36t37	60t63	64	71t74	E	F	G	H	J
Labor share	0.62	0.81	0.76	0.68	0.53	0.71	0.68	0.70	0.75	0.73	0.77	0.88	0.73	0.54	0.76	0.37	0.82	0.75	0.86	0.59
TFP	13.08	3.48	2.04	10.76	13.48	7.06	5.77	12.67	9.43	14.70	7.93	3.97	14.22	19.70	35.00	6.24	12.82	54.98	9.80	53.01
Non-ICT capital/value added	0.55	0.61	0.49	0.48	0.63	0.35	0.48	0.50	0.25	0.46	0.77	0.25	0.54	0.40	0.40	1.86	0.14	0.26	0.53	0.29
ICT capital/value added	0.02	0.02	0.02	0.05	0.02	0.01	0.02	0.02	0.02	0.06	0.06	0.02	0.05	0.11	0.10	0.05	0.01	0.03	0.03	0.06

Source EU KLEMS. See footnote 3 for the industry list

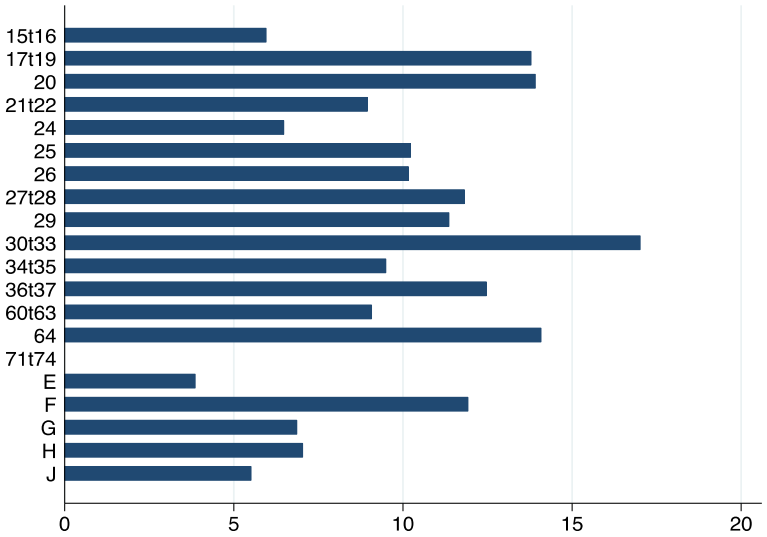

Fig. 1 EPL burden by industry. *Source* Bassanini et al. (2009). See footnote 3 for the industry list

employment protection legislation (i.e. covering both temporary and performance labor contracts) and a time-variant measure of the sector propensity to lay off workers for the UK. The former variable ranges between 0 and 6 and comes from an OECD labor market institution dataset (Venn 2009). We benchmark the latter to the US, and it ranges from 0 to 8 (Bassanini et al. 2009). Figure 1 displays the values of this indicator by industries, averaged across countries.[5] Larger values indicate more stringent regulations.

We also use an indicator defining how the degree of service regulation influences downstream (manufacturing and services) industries using services' input in production (PMR). We define this indicator as the interaction of a country-level measure capturing anti-competitive practices in service industries (entry regulation, the extent of public ownership, vertical integration, and the market structure) and the industry intensity in the use of service inputs. We take the latter from the OECD input–output tables and benchmark it to the year 2000. We normalize the regulation impact so that it ranges from 0 to 1; see Fig. 2 for an industry overview.

Finally, we assess the role of the enforcement of IPRs at the industry level following the procedure that Aghion et al. (2015) devised. We multiply the Ginarte–Park index of the strength of the legal protection of innovation (available at the country level) with the patent intensity of the sectors. We define this weighting variable as the share of each sector in the total number of patent applications of the country. We take this variable as the average value over the 1980s (i.e. in the initial

[5]The EPL indicator is missing for the industry 71t74, as no information was available for the industry lay-off propensity.

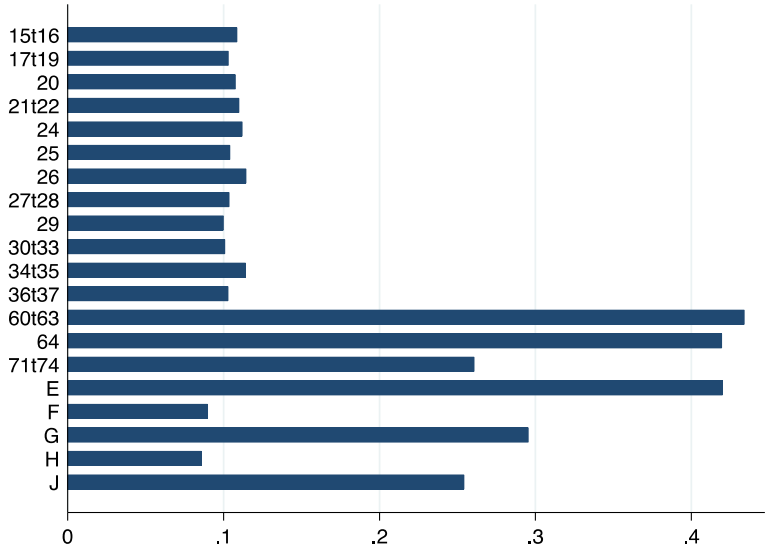

Fig. 2 Upstream regulation by industry. *Source* Conway and Nicoletti (2006). See footnote 3 for the industry list

years of the period under examination). We base the index of IPR protection, ranging from 0 to 5, on information on the coverage of patents, membership of international treaties, enforcement mechanisms, restrictions on patent rights, and duration (see Ginarte and Park 1997 and subsequent updates).[6] This interaction variable assumes that variation in the enforcement of IPR laws changes among sectors depending on the relative importance of patenting in industry production. Figure 3 shows the cross-industry differentials in this indicator, which is available only for the manufacturing industries and uses data on European Patent Office (EPO) applications.

4 Regression Results

4.1 Baseline Specification

Table 3 presents the results for a baseline specification, which only includes TFP and total capital. To check whether the imputation of self-employed wages can affect our results, we run the same specification using a definition of the labor share that we base only on the wages of employees. The first column of Table 3 shows the results for the pooled sample, while columns 2–4 refer to subgroups of

[6]Data on patent protection are available on a five-year basis. We interpolate intermediate values between benchmark years.

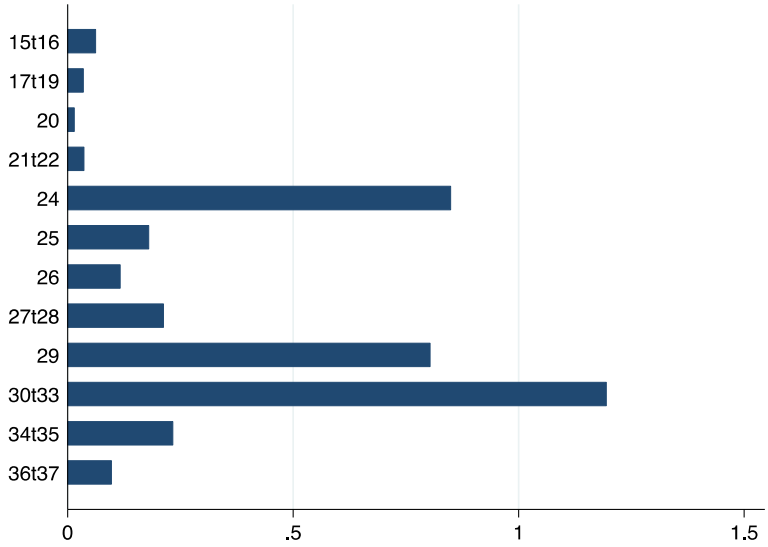

Fig. 3 IPR enforcement by industry. *Notes* Our elaboration on Ginarte and Park's (1997) data and updates. See footnote 3 for the industry list

industries, constructed according to their intensity in the use and production of ICT, following the classification that O'Mahony and van Ark (2003) devised. This distinction is crucial to identify the impact of new digital technologies, which the earlier literature identified as one of the most relevant drivers of economic growth and income inequalities (Acemoglu 2002). The impact varies between those industries that produce such technologies, those industries that make intensive use of ICT, and, finally, the residual group of industries in which the development of computers and software has not been particularly relevant (see also Stiroh 2002).

The results in Table 3 are consistent across the different specifications in terms of the direction of the effect and the statistical significance. For example, the impact of TFP is always negative and statistically significant, confirming the outcome of the existing studies (Bentolila and Saint-Paul 2003; Bassanini and Manfredi 2012). Hence, technical change is biased toward the use of capital assets. Our results for the total capital to value added ratio confirm the presence of capital-labor substitution, as the coefficient is always negatively signed. Only among ICT producers is this effect not statistically significant. Overall, these results are consistent with the evidence of Karabarbounis and Neiman (2014) and provide further support for their claim that one of the main factors behind the decline in the labor share is the decreasing price of investment goods. Table 3 also shows that, when using a labor share measure that does not account for the self-employed, the findings are largely unchanged. Hence, in the remainder of our analysis, we will continue with the more standard definition of the labor share, which includes both employees and self-employed workers.

Table 3 Capital-labor substitution and technology impact on the labor share (long-run coefficients)

	Labor share (employees and self-employed)				Employees Only			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All	ICT producers and users	ICT producers	ICT users	All	ICT producers and users	ICT producers	ICT users
TFP	–0.394***	–0.495***	–0.374***	–0.523***	–0.393***	–0.459***	–0.362***	–0.447***
	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]	[0.000]	[0.006]	[0.000]
Total capital/value added	–0.064**	–0.166***	–0.008	–0.092*	–0.084***	–0.167***	–0.053	–0.096**
	[0.034]	[0.002]	[0.969]	[0.050]	[0.004]	[0.003]	[0.845]	[0.031]
Obs.	8,280	2,484	828	1,656	8,280	2,484	828	1,656
Industries	340	102	34	68	340	102	34	68

Notes The dependent variable is the labor share of the value added. The p-values are in brackets. The AMG estimates contain parameters that are robust to outliers (Eberhardt and Bond 2013). ***, **, and * denote respectively statistical significance at the 1%, 5%, and 10% level

Table 4 ICT and Non-ICT capital labor substitution and technology impact on the labor share (long-run coefficients)

	(1)	(2)	(3)	(4)
	All	ICT producers and users	ICT producers	ICT users
TFP	–0.466***	–0.340***	–0.313	–0.465***
	[0.000]	[0.001]	[0.209]	[0.000]
Non-ICT capital/value added	–0.076	0.0531	–0.126	0.041
	[0.181]	[0.546]	[0.583]	[0.649]
ICT capital/value added	–0.030***	–0.074***	–0.159***	–0.032*
	[0.000]	[0.000]	[0.009]	[0.062]
Obs.	7,840	2,352	784	1,568
Industries	300	90	30	60

Notes The dependent variable is the labor share of value added. The p-values are in brackets. The AMG estimates contain parameters that are robust to outliers (Eberhardt and Bond 2013). ***, **, and * denote respectively statistical significance at the 1%, 5%, and 10% level

In Table 4, we extend our model by accounting for different types of capital assets, that is, distinguishing between ICT and non-ICT capital. The results show that the capital–labor substitution is driven by the ICT capital only, while non-ICT capital is not statistically significant in any of the industry groups that we consider. Looking at the role of ICT capital across different types of industries, we can see that its impact on the labor share is rather heterogeneous, ranging between –0.032 in the total sample and –0.159 in the ICT-producing sectors. Hence, workers in these sectors, which include, for example, office machinery and scientific instruments, are particularly affected by increasing investments in new digital technologies.

The insignificant coefficient for non-ICT capital, although different from some of the recent evidence (Checchi and Garcia-Penalosa 2010; Bassanini and Manfredi 2012), is not surprising, as ICT is the most innovative form of capital asset and has experienced a fast price decline over the last twenty years. Therefore, our results are in line with Karabarbounis and Neiman's (2014) discussion of the role that advances in information and communication technology play in shifting resources away from labor and toward capital. However, differently from earlier studies, our results reflect a long-run equilibrium condition, which implies that the negative impact of TFP and ICT capital on the labor share is long lasting.

4.2 Accounting for Institutional Factors

We now extend our baseline specification to include three indicators of countries' institutional framework: the EPL burden indicator, the upstream regulation index (PMR), and the intellectual property rights protection index (IPR). Table 5 presents our results. We assess the impact of each indicator individually to avoid collinearity

Table 5 Long-run coefficients: accounting for institutional factors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ALL			ICT producers and users			ICT producers			ICT users		
TFP	–0.456***	–0.537***	–0.407***	–0.338**	–0.561***	–0.618***	–0.309	–0.517*	–0.157	–0.290*	–0.597***	–0.602***
	[0.000]	[0.000]	[0.000]	[0.027]	[0.000]	[0.004]	[0.251]	[0.079]	[0.732]	[0.089]	[0.000]	[0.000]
Non-ICT capital/ value added	–0.145**	–0.105	0.0188	0.0372	–0.086	0.0521	–0.261	–0.335	0.138	0.088	–0.132	0.132
	[0.028]	[0.195]	[0.789]	[0.734]	[0.387]	[0.740]	[0.355]	[0.276]	[0.661]	[0.292]	[0.277]	[0.318]
ICT capital/value added	–0.022**	–0.046***	–0.062***	–0.069***	–0.127***	–0.117***	–0.102**	–0.259***	–0.203*	–0.035**	–0.111***	–0.150***
	[0.034]	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]	[0.034]	[0.000]	[0.068]	[0.037]	[0.000]	[0.000]
EPL burden			0.005			–0.287			0.216			–0.056
			[0.919]			[0.207]			[0.559]			[0.229]
Upstream PMR	0.09			0.305			0.268*			0.209		
	[0.130]			[0.109]			[0.060]			[0.526]		
IPR enforcement		0.0257*			0.066**			0.107			0.013	
		[0.095]			[0.048]			[0.288]			[0.477]	
Obs.	7,000	3,710	3,906	2,100	928	1,085	700	312	434	1,400	616	651
Industry	260	156	198	78	39	55	26	13	22	52	26	33

Notes The dependent variable is the labor share of the value added. The p-values are in brackets. The AMG estimates contain parameters that are robust to outliers (Eberhardt and Bond 2013). ***, **, and * denote respectively statistical significance at the 1%, 5%, and 10% level

problems, which arise from the fact that such indicators, although they vary across industries, are characterized by little time variation. The coefficient estimates are consistent with the previous results for TFP and capital assets, hence confirming the negative impact of technical change on the labor share and the fact that ICT capital is a substitute for labor. Employment protection never displays a significant effect. More stringent regulations on competition, PMR, and IPR are positively associated with the labor share, although the effect is not always significant. The direction of the impact of our indicator of PMR contradicts our expectations and part of the existing evidence, which indicated a negative effect of barriers to entry on the labor share. The IPR index is significant for the overall sample and for the group of ICT users and producers taken together, while the upstream regulation index is only significant in the ICT producer sectors.

Overall, we do not find evidence of an impact of market regulations on the labor share dynamics. A similar finding emerges when we include alternative indicators that we construct by interacting country-level wage coordination and industry union density (not reported for simplicity). One possible explanation for this outcome is the difficulty in measuring market regulations. Secondly, the effect of regulation can be ambivalent and can interfere with the technology effect, which makes the estimation of individual coefficients quite challenging, particularly when using measures that are characterized by small time variation. We therefore attempt to assess the importance of market regulation indirectly by testing for the presence of hysteresis in labor share series.

The earlier literature associated the evidence of non-stationarity in unemployment with support for the hysteresis hypothesis, that is, the increase in the natural rate of unemployment (NAIRU) following temporary shocks (Clarke and Summers 1982; Blanchard and Summers 1986; Cross 1995). In our setting, evidence of non-stationarity would imply that the long-run equilibrium level of the labor share depends on its own history and therefore shows a high degree of persistence.[7] If we find the decline in the labor share to have a broad scope across countries and industries and to be persistent over time, we should seek the key drivers of this trend elsewhere than among the institutional factors, in the light of the wide differences existing across countries in the legal discipline of factor and product markets.

To test for the presence of hysteresis in the labor share, we implement the standard procedure for running unit root tests (Cross 1995). This consists of testing whether the labor share series fluctuate around a constant mean value (stationarity)

[7]The literature has mainly focused on the European labor markets, which in that period were characterized by rising unemployment rates (Blanchard and Summers 1986). One of the causes of this phenomenon is the asymmetry in the wage-setting process between those who are employed (the insiders) and those who search for jobs (the outsiders). Another reason relates to the loss of skill that the unemployed experience, particularly those who have been without a job for a long time (Clarke and Summers 1982).

Table 6 Testing for the presence of hysteresis in the labor share

Country			Industry		
	P value	Obs.		P value	Obs.
AT	0.73	665	15t16	0.89	587
AU	0.00	665	17t19	0.50	587
BE	0.21	646	20	0.97	587
CZ	1.00	247	21t22	0.09	587
DE	0.60	665	24	0.99	587
DK	0.17	665	25	0.91	587
ES	1.00	665	26	0.79	587
FI	0.48	665	27t28	0.99	587
FR	0.89	665	29	1.00	587
HU	0.56	304	30t33	0.69	587
IE	0.00	665	34t35	0.92	587
IT	0.95	665	36t37	0.60	587
JP	0.96	646	60t63	0.91	587
NL	0.18	665	64	0.16	587
SE	0.01	665	71t74	0.98	587
UK	0.97	665	E	0.87	587
US	0.27	589	F	0.99	587
			G	0.49	587
			H	0.96	587
			J	0.96	587

Notes Pesaran's (2007) CADF test for unit roots (null hypothesis). P-values lower than 0.05 imply the rejection of the hysteresis hypothesis. See footnote 3 for the country and industry list

or rather denote a downward (or upward) trend (non-stationarity). Failure to reject the hypothesis of non-stationarity provides evidence for the presence of hysteresis. Table 6 presents the probability values for these tests, which we base on the procedure that Pesaran (2007) devised, so-called Cross-sectionally Augmented Dickey Fuller (CADF) test.

The results strongly support the hysteresis assumption, as the large probability values in the vast majority of countries and industries imply that we cannot reject the hysteresis hypothesis. These findings have important implications for the analysis of the causes that drive movements in the labor share. In fact, if the institutional differences were important, we should have been able to reject the hysteresis hypothesis in countries characterized by more flexible institutional arrangements. Our results suggest that the factors responsible for the declining trends in the labor share are more pervasive.

5 Policy Implications and Conclusions

This paper provides new evidence on the decline in the labor share for a large sample of OECD countries over a 40-year period. Our results show that technology factors play an important role. We find ICT capital to reduce the labor share throughout the whole economy, albeit with heterogeneous effects across industries and countries. Our measure of technical change, TFP, always plays a strong, negative, and significant role, which is pervasive across countries and industries.

The second novel feature of our analysis is the use of indicators of countries' institutional framework that are characterized by time and industry variation. The results based on these indicators are, however, quite weak. In general, low competitiveness, stronger labor protection, and strong protection of intellectual property rights have a positive impact on the labor share. However, only for the intellectual property rights indicator is this effect statistically significant. We argue that the role of institutional factors is difficult to assess because of measurement errors and their interaction with other factors, such as technical change. More research effort is necessary to try and disentangle these effects, as the policy implications can be very important.

The third feature of our study is the in-depth investigation of the time series properties of labor share series. Existing studies have observed that the labor share is characterized by a high degree of persistence; here, we take this observation a step further and statistically assess the dynamic properties of the labor share, showing that this is widely characterized by hysteresis. This suggests that technological rather than institutional factors are the main drivers of the decline in the labor share since the 1980s.

Our analysis offers some insights for policy making with a long-term horizon. Given the role that technological factors play, public policies should be oriented toward expanding the proportion of the workforce with skills that are complementary to the new technology and facilitating the reallocation of workers to expanding sectors.

Appendix

Econometric Method

We consider the standard specification for the labor share that Bentolila and Saint-Paul (2003) devised, which expresses the total labor compensation as a percentage of the gross value added:

$$LS_t = 1 - \alpha(A_t k_t)^{\theta}. \tag{3}$$

We derive this expression from a constant elasticity of substitution (CES) output production function within a closed-economy framework, where θ is a substitution parameter between capital and labor. *A* is the total factor productivity (TFP) level, which we use here as a proxy for input-specific technical change, and *k* is the capital-value added ratio, which we measure in real terms. In the following, we decompose capital input into ICT and non-ICT assets and denote their ratio to value added with *ki* and *kn*, respectively.

Expressing the previous equation as a first-order Taylor approximation yields (in logs):

$$\ln LS_t = Const + \theta \log A_t + \theta(\log ki_t + \log\ kn_t). \tag{4}$$

We can formulate the static version of the labor share equation as follows:

$$\ln LS_{ijt} = \alpha_{0ij} + \alpha_1 \log A_{ijt} + \alpha_2 \log ki_{ijt} + \alpha_3 \log kn_{ijt} + \varepsilon_{ijt}, \tag{5}$$

where *j* denotes industries and *i* countries, α_{ijo} are industry-country fixed effects, and ε_{ijt} is a spherical error term. A negative coefficient for *A* would indicate that technical change is not neutral but biased toward the use of capital assets, that is, capital-specific technical change ($\alpha_1 < 0$). Similarly, if labor and capital were gross substitutes, we would expect the coefficients of capital intensities to be negative ($\alpha_2 < 0$ and $\alpha_3 < 0$).

The coefficients of Eq. (5) represent long-run elasticities. Empirically, we can identify these by rewriting a dynamic version of the labor share equation using an autoregressive distributed lag process, ARDL(p, q), in which we assume a maximum lag order of one for simplicity:

$$\begin{aligned} \ln LS_{ijt} =& \beta_{0ij} + \beta_1 \log LS_{ijt-1} + \beta_2 \log A_{ijt} + \beta_3 \log A_{ijt-1} + \beta_4 \log ki_{ijt} + \\ & \beta_5 \log ki_{ijt-1} + \beta_6 \log kn_{ijt} + \beta_7 \log kn_{ijt-1} + \varepsilon_{ijt} \end{aligned} \tag{6}$$

We can reformulate this as an error correction mechanism (ECM) as follows:

$$\begin{aligned} \Delta \ln LS_{ijt} =& \gamma_{0jt} + \gamma_1 \Delta \ln A_{ijt} + \gamma_2 \Delta \ln ki_{ijt} + \gamma_3 \Delta \ln kn_{ijt} + \gamma_4 \ln LS_{ijt-1} \\ & \gamma_5 \ln A_{ijt-1} + \gamma_6 \ln ki_{ijt-1} + \gamma_7 \ln kn_{ijt-1} + \varepsilon_{ijt} \end{aligned} \tag{7}$$

Equation (7) represents our benchmark specification, which we estimate with the augmented mean group estimator that Eberhardt and Bond (2013) devised. This procedure estimates the specification of interest separately for each panel unit, controlling for the presence of cross-sectional dependence via the inclusion of a common dynamic effect. We derive the common dynamic effects from an auxiliary regression based on a standard first-difference OLS model that includes year dummies. We then include the coefficients for the year dummies in the industry

regressions as an additional variable. We derive the AMG coefficients by averaging the individual industry estimated parameters. We obtain sample coefficients by averaging the parameters obtained for single industries. To account for the effect of outliers, we report the robust mean of individual-specific coefficients. The advantage of using this estimator, compared with standard fixed effects, is that it can better account for industry heterogeneity, non-stationarity, and cross-sectional dependence, that is, the possible correlation in the disturbances across panel units.

We obtain the long-run coefficients by combining the parameters of Eq. (7). For instance, for ICT capital intensity, we define the cointegration parameter as: $\alpha_{2ij} = -\gamma_{6ij}/\gamma_{4i}$. We check the significance level of the long-run coefficients using the nonlinear test of the delta method. The coefficient γ_4 indicates the speed at which the economy returns to its long-run equilibrium. Inference on this parameter will provide insights into the presence of a long-run equilibrium relationship.

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Chapter 5
Globalization, Structural Transformation, and the Labor Income Share

Ken Suzuki, Yoko Oishi and Saumik Paul

Abstract This paper provides novel empirical evidence on the role of trade and structural transformation as potential drivers of the labor income share. Using cross-country data, both at the national and sectoral level, we find that trade openness is negatively correlated with the labor income share. The findings are robust across national and disaggregated levels, and across different model specifications. However, the relationship between the process of structural transformation and labor income share is at best mixed. We also find weak evidence that skill-biased structural transformation is likely to be positively correlated with the share of labor income predominantly in the services sectors.

Keywords Labor income share · Structural transformation · Globalization

JEL Classification E24 · E25 · N10 · O14

1 Introduction

This paper provides empirical evidence of the role of trade openness and structural transformation as the drivers of the labor income share. The downward trend in the labor income share as documented by many studies (Elsby et al. 2013; Karabarbounis and Neiman 2014; Piketty 2014; Piketty and Zucman 2014) has important implications for economic growth and income distribution. The burgeoning literature on the labor income share highlights the role of trade and structural transformation as important drivers of the secular decline in the global labor income share (Karabarbounis and Neiman 2014; Piketty 2014). However, the scattered evidence from cross-country studies and country case studies, mostly on the developed economies, confuses our knowledge on the drivers of the labor income share for the developing countries. This study aims to bridge this knowledge

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gap by providing empirical evidence using two novel cross-country data sets on labor income share at the (1) national and (2) sectoral levels.

Globalization has been broadly defined as including everything from falling prices for goods made by low-skill labor (such as garments) to increasing outsourcing by multinationals (Harrison 2002). The owners of capital have greater bargaining power over laborers, ostensibly because capital is footloose and can quickly relocate to wherever it can find the highest returns (Harrison 2002; Rodrik 1997). Slaughter (2001) argues that trade can make labor demand more elastic in two main ways: by making output markets more competitive and by making domestic labor more substitutable with foreign factors. Trade can generate these effects without also generating product-price changes and, via the Stolper-Samuelson theorem, factor price changes.[1]

Classical trade theories predict patterns of specialization and specific factor demand drive relative factor endowment. Factor reallocation in the production function induced by trade also crucially depends on the wage flexibility/rigidity regimes as shown by Decreuse and Maarek (2011). Decreuse and Maarek (2011) assume a frictional labor market with productive heterogeneity and claim that foreign direct investment (FDI) has two opposite effects on the labor income share. The first is a negative effect originated by technological advancement and then a positive effect due to an increasing labor market competition between firms. Using data from 98 developing countries over the period from 1980 to 2000, they find a U-shape relationship between labor income share and the proportion of foreign firms. Furthermore, they argue that the magnitude of the relationship is governed by the technological gap between foreign and local firms. In addition, the effect of trade openness on the labor income share also depends on the elasticity of substitution between different types of labor and capital (Guscina 2006; EC 2007). Foreign direct investment (FDI), or offshoring, can also have a negative effect on the labor income share by providing firms with an outside option with decreasing workers' bargaining power (especially for the low-skilled workers) (Guscina 2006; Harrison 2002; Jaumotte and Tytell 2007; Jayadev 2007).

New trade theories emphasize the role of firm heterogeneity in production. Factors such as capital intensity and skills, among others, drive productivity and determine the impact of increasing openness on the labor income share of different types of workers. Elsby et al. (2013) noted that increased import penetration would be expected to depress the labor share of domestic income if imported intermediates were more substitutable with labor than with capital from the perspective of an aggregate production technology (2013). The same authors argue that the more labor-intensive part of US production, the remaining production in the US economy, would be expected to become more capital intensive by offshoring. If, in

[1]For example, in a Heckscher–Ohlin trade model, if an economy's autarky relative endowment equals that of the rest of the world then when that country opens to trade it experiences no change in product prices and thus (via the Stolper-Samuelson theorem) no change in wages. But this opening can make foreign factors more substitutable with domestic ones. If product markets are imperfectly competitive in autarky, opening can also make product markets more competitive.

addition, capital is more than unit elastic with respect to labor, then, applying the concept of Hicksian elasticity (Hicks 1932), this will imply that the labor income share in the US will fall.

The literature on the relationship between structural transformation and labor income share can be classified as follows. First, some studies highlighted the usefulness of a disaggregated analysis of structural transformation and provide empirical evidence of its benefit (Herrendorf et al. 2015; Jorgenson and Timmer 2011; Duarte and Restuccia 2010). Buera et al. (2015) took this mandate forward and used the EU KLEMS database to compare the labor income shares for high-skilled labor (college graduates and above) for six key manufacturing sectors.

The second group of literature uses the standard drivers of labor income share to explain the differences in labor income share trends across sectors. For example, differences in the elasticity of substitution between capital and labor between sectors may result in different sectoral labor income share trends. In a recent study on the US, Alvarez-Cuadrado et al. (2015) showed that a larger decline in labor income share in manufacturing relative to that in services is partly driven by a larger elasticity of substitution between capital and labor in manufacturing than in services. In another paper, Buera and Kaboski (2012) argue that this rising return to skill is intimately connected to the structural transformation of economic activity towards services. They document that there is a threshold for per capita income at which the value-added share for services increases. At the same threshold level, they also find an increase in the fraction of the workforce that becomes skilled and part of the skill premium. If other sectors do not experience any such increases in the returns to skill, this is likely to widen the differences in labor income share between services and other sectors such as manufacturing.

The third group of studies (Lawrence 2015; Elsby et al. 2013; Rodriguez and Jayadev 2010) examine the role of structural transformation in the changes in the labor income share over time using a decomposition framework. In a recent study, Dao et al. (2017) found that almost 10% of the changes in the aggregate labor income shares in the People's Republic of China (PRC) came from structural transformation. De Serres et al. (2002), using data on US industries, found that about 50% of the variation in the labor share is due to structural transformation. Structural transformation could also affect the share of labor income through other channels. In the absence of modern technology in agriculture, some countries continue to have low productivity in this area. This implies more labor for agriculture and less labor for nonagriculture, which may also lead to a lower level of aggregate production given that nonagricultural sectors are more productive than agriculture sectors. Gollin (2002) show that cross-country differences in the share of employment in agriculture can account for a large proportion of the cross-country differences in aggregate output. This also leads to differences in labor income share both at the sectoral and national level. Rogerson (2008), using a model of structural transformation, compared the evolution of hours worked per working-age person in the US to that in an aggregate of five continental European economies (Belgium, France, Germany, Italy, the Netherlands) since the 1950s. His paper found that the

hours worked were about 5% higher in Europe in 1956, but in 2003 they were more than 30% lower.

Moving on, we next discuss the shift-share decomposition framework to highlight the role of structural transformation as a driver of the sectoral labor income shares and the aggregate labor income share. Following a variant of the canonical shift-share decomposition methodology (see Fabricant 1942 for the original decomposition and de Vries et al. 2013 and Arpaia et al. 2009 for the variant) we write changes in the aggregate labor income share between t and $t+1$ as follows:

$$\Delta LIS = \sum_i (\theta_i^t)(\Delta LIS_i) + \sum_i (\Delta\theta_i)(LIS_i^t),$$

where LIS_i is the labor income share in sector i, and LIS denotes the aggregate labor income share. Labor is reallocated across sectors between two points in time, t and $t+1$, and θ_i^t denotes the sectoral labor share of sector i in period t. The first term on the right-hand side of Eq. (1) measures the contribution of the within-sector effect (changes in the labor income share within a sector) whereas the second term measures the contribution of the between-sector effect (changes in the weights of the sector) or structural transformation. In the absence of structural transformation, the aggregate labor income share trend would simply be a weighted average of the sectoral labor income share trends. Many studies (Lawrence 2015; Elsby et al. 2013; Rodriguez and Jayadev 2010) find that the change in the aggregate labor income share is driven by declines in within-industry labor shares rather than the process of structural transformation through an increasing flow of activities from high to low labor share industries. In another study, Dao et al. (2017) find that almost 90% of the changes in the aggregate labor income shares in the PRC come from within-industry changes rather than sectoral reallocation. Arpaia et al. (2009) examine the role of structural transformation for a panel of OECD countries and find similar evidence of the dominance of within-sector effects. However, in a separate paper, de Serres et al. (2002) estimate that about 50% of the variation in the labor share is due to structural transformation in the US.

In this paper, we analyze cross-country data both at the country and sectoral level. For the country-level data, we use the Penn World Tables (PWT) data set as it has a broad coverage in terms of both country and year. The data set is also preferable because it uses the most plausible adjustment approach for each country and year, not resorting to a one-size-fits-all approach. In addition, the Penn World Tables (PWT) expands the coverage of self-employed-income adjusted labor income shares by using proxy variables for countries whose mixed-income data were not available. As most self-employed workers in low- and middle-income countries are active in agriculture, the PWT uses value added in agriculture recorded in the World Input-Output Database (WIOD) as a proxy for self-employed income. At the sectoral level, we use the disaggregated data from Oishi and Paul (2018) following the 10-sector level classification of the Groningen Growth and Development Centre (GGDC). They primarily use three data sources: the GGDC 10-Sector Database, Socio-Economic Accounts (SEA), and ILOSTAT.

The time series plots of the labor income share for most of the countries suggest a downward trend following the episode of trade liberalization. However, for some countries the labor income share started declining before they embraced the trade reform measures. The regression outcomes at the country level suggest that trade liberalization seemed to have a negative impact on the labor income share. Moreover, over the course of liberalization, the negative effects of opening to trade would have emerged in the period following several years after the liberalization. The empirical evidence at the sectoral level does not allow us to claim any strong causal relationship between trade and labor income share. We find support for a negative correlation between trade openness and sectoral labor income share; however, the evidence on the relationship between the process of structural transformation and labor income share is at best mixed. Skill-biased structural transformation is likely to be positively correlated with the share of labor income predominantly in the services sectors. A case study on Japan suggests a limited role of structural transformation in the movement of labor income share in Japan, and the direction of changes in certain sectors is driven by part-time employment. Overall, while the support for a negative correlation between trade openness and sectoral labor income share is somewhat robust, the evidence on the relationship between the process of structural transformation and labor income share is at best mixed.

The paper is structured as follows. We provide a description of the data sources in Sect. 2. Section 3 provides descriptive evidence on the relationship between trade openness and labor income share trends both at the country and sectoral levels. Section 4 examines the role of structural transformation in the labor income share movements by using two data sets, EU KLEMS on 16 developed countries and Japan Industrial Productivity (JIP) data, which is followed by an analysis of cross-country regression outcomes in Sect. 5. We provide some cross-country regression results to unfold the multivariate relationship between trade, structural transformation, and labor income share both at the country and the sectoral level. Section 6 presents concluding remarks.

2 Data

In contrast to its simple definition of the labor income share, which is the share of labor income in national income, measuring it with available data is not so straightforward. While national income is easily found in national accounting statistics in the form of GDP, labor income equivalent is not as it involves both income earned by wage employees and income earned by the self-employed. National accounting statistics in many countries usually record the total wage bill of employees as "compensation of employees." However, these statistics often do not record self-employed income, and even if they do, it is generally difficult to isolate a labor income component as self-employed income consists of compensation for both the labor and capital that self-employed workers own.

Table 1 Estimation approaches

$LS_{unadj} = \frac{CoE}{GDP}$
$LS_{G1} = \frac{CoE + MI}{GDP}$
$LS_{G2} = \frac{CoE}{GDP - MI}$
$LS_{G3} = \frac{\frac{CoE}{E} \times TE}{GDP}$

CoE compensation of employees, *MI* mixed income, *E* the number of wage employees, *TE* the number of total employees

Several approaches have been proposed for estimating the labor income share using available data (Table 1). A conventional approach divides the total compensation of employees by GDP without taking self-employed income into consideration (denoted as LS_{unadj}). This may be a reasonable approximation of the labor income share in developed countries where the share of the self-employed in the total number of employees is low, but this is likely to underestimate the labor income share in developing countries where self-employment in the informal sector is prevalent. To include self-employed income in the labor income, Gollin (2002) proposes three adjustment approaches, relying on three different assumptions. Two of Gollin's (2002) approaches use mixed income, which is the total income earned by self-employed workers, to extrapolate self-employed income: The first adds the entire amount of mixed income to the compensation of employees, assuming that self-employed workers do not possess capital (denoted as LS_{G1}), while the second assumes that the labor income share of self-employed workers is the same as that of wage employees (denoted as LS_{G2}). Instead of mixed income, Gollin's (2002) third approach uses the employment structure of a country to estimate the labor income share. It assumes that self-employed workers earn the same average wage as employees (denoted as LS_{G3}).

All currently available data sets that cover low- and middle-income countries have estimated the labor income share using these approaches. van Treeck (2017) reviews labor income share data and compares them by dividing them into six groups in terms of their coverage, adjustment approaches, and data sources (Table 2). As each data set uses different adjustment approaches and data sources, estimated labor income shares differ from one another.

The first group of data sets primarily rely on data from the United Nations System of National Accounts (UN SNA) for estimating the labor income share. It records GDP for almost all countries around the world as well as data on compensation of employees for about two-thirds of low- and middle-income countries. The computed unadjusted labor share covers 93 low- and middle-income countries with an average time span of 15.3 years per country and 1421 observations (denoted as SNA unadj.). For countries with mixed income data available, mixed-income adjusted labor income shares are computed (denoted as SNA G1 and SNA G2). As only about one third of developing countries reported mixed income, these adjustments result in a reduction in the number of countries to only 38. The adjusted labor share using the employment structure of a country is also calculated with ILO's data of Key Indicators of the Labour Market (KILM), which produces

Table 2 Overview of labor share measures for low- and middle-income countries since 1990

Data set	Obs.	Years	Ctry	Mean	Median	Min	Max	SD	Adj. approach	Data sources	Authors
SNA unadj.	1,421	15.3	93	35.3	35.5	5.4	90.7	11.8	Unadj.	UN SNA	UN (2017)
SNA G1	508	13.4	38	56.5	56.1	26.2	87	10.4	G1	UN SNA	UN (2017)
SNA G2	508	13.4	38	45.6	46	21	73.4	8.5	G2	UN SNA	UN (2017)
SNA G3	766	10.5	73	62	55.5	21.5	658.4	33.8	G3	UN SNA, KILM	UN (2017), ILO (2017)
ILO unadj.	1,044	14.3	73	39.6	39.9	3.4	93.8	14	Unadj.	UN SNA, KILM, OECD, China NBS, SNA Brazil	Charpe (2011)
ILO adj.	1,044	14.3	73	56.9	56.2	3.4	231.7	25.1	G3	UN SNA, KILM, OECD, China NBS, SNA Brazil	Charpe et al. (2014)
PWT	2,298	24.7	93	52	52.6	9	86.6	13.1	G2 (47%), G1[a] (47%), G3 (3%), unadj. (3%)	UN SNA, WIOD	Feenstra et al. (2015)
Trapp	1,421	15.3	93	46.8	47	6	90.7	12.5	G3[b] full (50%), G3[b] 2/3 (18%), G1 (4%), G2 (21%), unadj. (6%)	UN SNA, FAOStat, WB WDI	Trapp (2015)
WIOD unadj.	258	16.1	16	42.3	44.5	22.2	61.8	8.5	Unadj.	WIOD SEA	Timmer et al. (2015)
WIOD adj.	258	16.1	16	53.2	53.4	31.5	104.5	11.3	G3	WIOD SEA	Timmer et al. (2015)
UNIDO	1,072	11.2	96	29.9	28.3	1.7	140.9	14	Corp. manuf. sector	INDSTAT2	UNIDO (2015)

[a]Agricultural value added used as proxy for mixed-income
[b]Agricultural employment share used as proxy for self-employment share
Source van Treeck (2017)

estimates for 73 countries (denoted as SNA G3). The second group of data sets extend the coverage of data from UN SNA and KILM by including additional national data sources. A group of researchers at ILO add data from OECD statistics and from the PRC's and Brazil's statistical offices, which produces estimates of the labor income share for 73 countries (denoted as ILO unadj./adj.).

The Penn World Tables (PWT) expands the coverage of self-employed-income adjusted labor income shares by using proxy variables for countries whose mixed-income data are not available. As most self-employed workers in low- and middle-income countries are active in agriculture, the PWT uses value added in agriculture recorded in the World Input-Output Database (WIOD) as a proxy for self-employed income. To construct a "best estimate" labor share, it utilizes the most plausible adjustment approach for each country and year. When mixed income data are available, the PWT computes the LS_{G2}-definition labor income share. For a few anomalous countries whose unadjusted labor share exceeds 0.7, the PWT directly uses the unadjusted labor share as it seems reasonable that this share already includes self-employed labor income. For the remaining countries where mixed income data are not available, the PWT calculates LS_{G3}-definition labor income share and LS_{G1}-definition labor income share where value added in agriculture is used in place of mixed income and adopts the lower one as the labor share of the country.[2] Trapp (2015) also uses proxy variables of agriculture to compute the labor income share. She obtains data of the share of agricultural employment in total employment from FAOSTAT and the WB World Development Indicators and uses this as proxy for the share of self-employment. Her data set is also a combination of different adjustment approaches comprising $LS_{G3}(68\%)$, $LS_{G2}(21\%)$, $LS_{unadj}(6\%)$, and $LS_{G1}(4\%)$.

The Socio-Economic Accounts (SEA) from the WIOD and INDSTAT databases from the UN's Industrial Development Organization (UNIDO) can be used to calculate the labor income share by sector and by other characteristics. The WIOD project gathers data on employment, labor compensation, and value added from several national statistics offices. The WIOD provides not only aggregated data but also disaggregated data by 35 sectors or skills (low-, medium-, and high-skilled). The UNIDO INDSTAT is a large industrial statistics database that covers only the corporate manufacturing sector. It provides both aggregated and disaggregated data from 23 industries. In the database, 96 low- and middle-income countries are covered from the 1970s.

In our analyses, we primarily rely on the PWT data set as it has a broad coverage in terms of both country and year. The data set is also preferable because it uses the most plausible adjustment approach for each country and year, not resorting to a one-size-fits-all approach. While the UNIDO data set has the largest coverage in terms of country, this data set is not preferable for our analysis as the database includes only the corporate manufacturing sector. As mentioned above, the PWT

[2]For a few cases where the chosen labor income share is less than 40% and the share of GDP going to fixed assets is larger than 50%, the PWT adopts the larger of the two.

employs four adjustment methods to calculate labor income share. This may cause bias, therefore we denote for the value calculated by the difference adjustment method in the graphical analysis in Sect. 3. And we use the labor income share data, which are calculated using the same adjustment approach for each country for our regression analysis in Sect. 5, to eliminate the effect of applying a different adjustment approach for different years.

At the sectoral level, we use the data set that Oishi and Paul (2018) put together following the 10-sector level classification of the Groningen Growth and Development Centre (GGDC). They primarily use three data sources: the GGDC 10-Sector Database, Socio-Economic Accounts (SEA), and ILOSTAT. The denominator of the labor income share, estimated value added, is obtained from the GGDC and SEA. The mean nominal monthly earnings of employees and number of employments are obtained from ILOSTAT. This data set contains sectoral labor income shares for 54 countries across five regions based on the most recent World Bank classification of countries (nine from East Asia and the Pacific, 28 from Europe and Central Asia, 8 from Latin America and the Caribbean, 2 from the Middle East and North Africa, 2 from North America, and 5 from sub-Saharan Africa). Out of 54 countries, 20 are developing countries (based on the World Bank classification).

3 Trade Liberalization and the Labor Income Share: Descriptive Evidence

3.1 Evidence at the Country Level

The recent protectionist trade policies of some industrialized countries have provoked a debate on the impact of globalization on income inequality within countries. The neoclassical trade theory predicts that trade will benefit all countries, but this does not mean that individual income always increases. There could be both winners and losers from trade. In this section, we explore the dynamics of the labor income share over the course of trade liberalization. This sheds light on whether the production factor is key in determining the fate among individuals within countries. Theoretically, there is no consensus on how trade liberalization affects the labor income share. Two possible channels have been proposed through which trade liberalization impacts the dynamics of the labor income share: the traditional trade theory and the bargaining game framework. The traditional trade theory, the Heckscher–Ohlin model, predicts that a country will have comparative advantages in industries where a relatively abundant production factor is intensively utilized. When a country opens up to trade, the country specializes in industries with comparative advantages. Accordingly, trade changes the relative factor price such that the abundant factor gains, and the scarce factor loses. Therefore, the theory

predicts that trade will reduce the labor income share in capital-abundant advanced economies but raise it in labor-abundant developing economies.

On the other hand, the bargaining framework predicts that the income share between labor and capital will depend on the bargaining power of population groups. Reductions in trade and FDI barriers after liberalization would increase the relative bargaining power of capital owners as they can relocate their resources to destinations with higher returns. Moreover, reductions in migration barriers would make it possible to substitute imported labor for domestic labor, leading to further decreases in the bargaining power of workers. Under this framework, liberalization decreases the labor income share in both developed and developing countries.

As a measure of trade openness, we use a binary indicator from Wacziarg and Welch (2008). Their indicator was initially constructed by Sachs and Warner (1995) and later extended, updated, and revised by Wacziarg and Welch (2003, 2008). This indicator regards a country closed in any given year if at least one of the following conditions is satisfied: (a) average tariffs exceed 40%; (b) nontariff barriers cover more than 40% of its imports; (c) it has a socialist economic system; (d) the black-market premium on the exchange rate exceeds 20%; and (e) many of its exports are controlled by a state monopoly. Wacziarg and Welch (2008) cover the years from 1950 to 2001. Therefore, we exclude the data after 2001 from our sample for the countries recorded as closed as of 2001, since they might liberalize their economy after 2001, but we cannot know whether it happens, and if so, when. In terms of the countries that opened their economy before 2001, we assume that they did not close the country after 2001. We keep the data for 80 countries that have neither extrapolated nor interpolated labor income share data after 2001.

Among the 133 countries with labor income share data provided by the Penn World Tables (PWT), we analyze countries for which the trade liberalization indicator is available and whose labor income shares are estimated based on actual observed values. In the PWT, about 66.7% of labor income share data are either extrapolated or interpolated for the years for which observed data are not available. The extrapolation assumes that the labor income shares are constant over time and missing values are replaced by the closest year's labor income share. Interpolation is applied for missing years between two calculated values. It employees linear approximation and replaces the missing labor income share value, inserting a value from trajectories of the connected closest two points. As those nonobserved data are not appropriate for analyzing the impact of trade liberalization on the labor income share, we exclude them and focus on countries and years with labor income shares neither extrapolated nor interpolated. Those eliminations of the data leave 108 countries for our analysis of trade liberalization.

See Appendix in table presents the summary statistics of the labor income share and the trade liberalization variable. When we see the year of trade liberalization, about 38% of the sample countries open their economy in the late 1980s to early 1990s (from 1985 to 1994). However, we can observe the regional tendency. For example, some countries open their economy in the 1960s, and they are mainly observed in East Asian and European regions. We have five countries that open their economies before 1950 and 19 countries are characterized as being closed as of 2001.

PWT 9.0 data cover the period 1950–2014, but only France and the United States have the labor income share data, which were calculated based on the observed values from 1950. Other countries have data from 1970 at the earliest. This allows the United States to have the longest sample period and the largest observation, from 1950 to 2014 and 65, respectively. In contrast, Kenya, Togo, and the Russian Federation have only one observation each. Wacziarg and Welch (2008) report on the temporal trade openness for 13 countries. However, due to the data availability of calculated labor income shares, only four countries experienced temporal liberalization in our sample years.[3] The right-hand column of Table appendix shows the nonweighted labor income share for each country and region, though it is not comparable as it is not adjusted for the number of observations for each country, and nor are the sample years. The largest average labor income share is observed in Togo (0.852) followed by Rwanda (0.773) and Barbados (0.746), while the smallest is Iraq (0.138) followed by Nigeria (0.303) and Botswana (0.318). As regards the regional average, South Asia (0.694) has the largest unweighted average, while the smallest is Latin America and the Caribbean (0.519).

To assess the impact of trade liberalization on the labor income share, we cover a period of five years before and 10 years after trade liberalization. This left 56 countries with us, 5 from East Asia and the Pacific, 18 from Europe and Central Asia, 17 from Latin America and the Caribbean, 5 from MENA and South Asia, and 11 from sub-Saharan Africa. Figures 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 show time trends of the labor income share for each country over a period of five years of pre- and 10 years of post-liberalization. As indicated below in Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 and Appendix, the year of trade liberalization varies from country to country. Thus, in Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, the year of trade liberalization for each country is normalized to 0, and the preceding five years and the following 10 years are numbered −5 to −1 and 1 to 10, respectively.

Among East Asia and Pacific countries, New Zealand experiences a moderate decline in the labor income share after the liberalization (Fig. 1). The labor income shares of the other countries are observed only after the liberalization, but overall, they kept constant trends.

Among the first group of European and Central Asian countries, France has a moderate declining trend since five years before the liberalization. Although the labor income share data before the liberalization are not available, Georgia experienced a steep decline in the labor income share after it opened up to trade (Fig. 2).

Trends of the labor income shares of the second group of European and Central Asian countries are shaky (Fig. 3). The Kyrgyz Republic experienced a steep decline from four years to two years before the liberalization, a rapid increase from two years before to two years after the liberalization, and then a sharp decrease afterwards.

Among the third group of European and Central Asian countries, Serbia witnessed a sharp decline in the labor income share from four to one years before the

[3]Bolivia, Sri Lanka, Ecuador, and Jamaica.

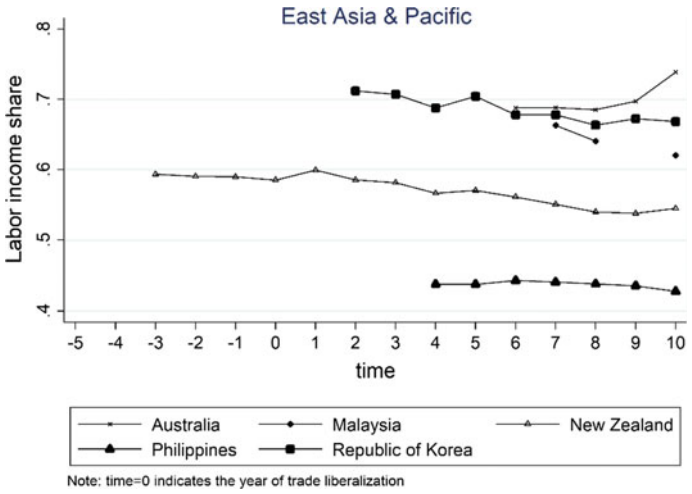

Fig. 1 Trade liberalization and labor income share in East Asia and Pacific. *Note* The period for each country is: 1970–74 (Australia); 1970–71, 1973 (Malaysia); 1983–96 (New Zealand); 1992–98 (Philippines); and 1970–78 (Republic of Korea)

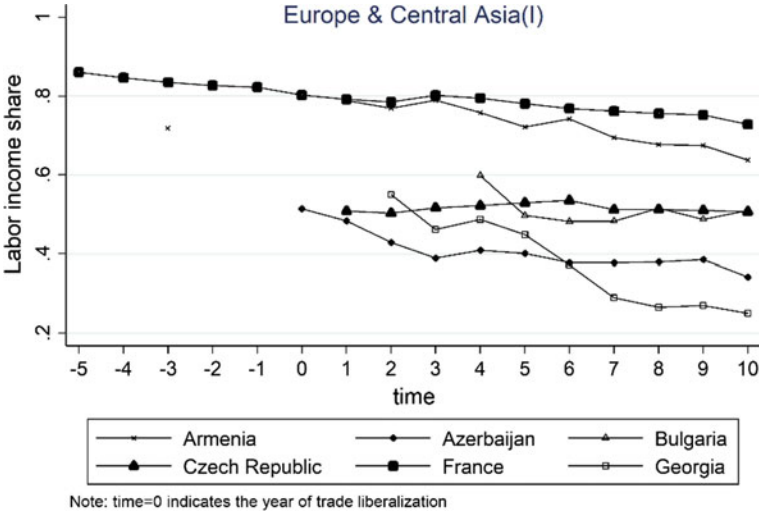

Fig. 2 Trade liberalization and labor income share in Europe and Central Asia (I). *Note* The period for each country is: 1992, 1996–2005 (Armenia); 1995–2005 (Azerbaijan); 1995–2001 (Bulgaria); 1992–2001 (Czech Republic); 1954-–69 (France); and 1998–2006 (Georgia)

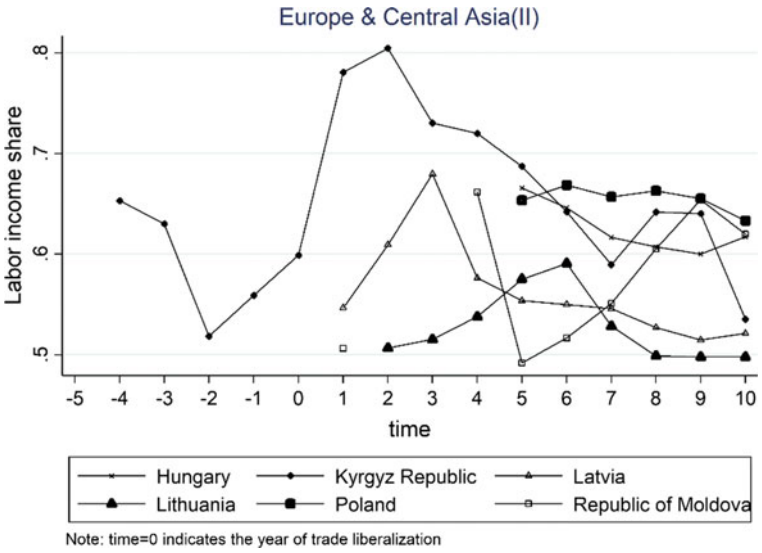

Fig. 3 Trade liberalization and labor income share in Europe and Central Asia (II). *Note* The period for each country is: 1995–2000 (Hungary); 1990–2004 (Kyrgyz Republic); 1994–2003 (Latvia); 1995–2003 (Lithuania); 1995–2000 (Poland); and 1995*, 1998–2004 (Republic of Moldova). *denotes a year in which the adjustment method used for calculating labor income share differs from the one applied for the other years

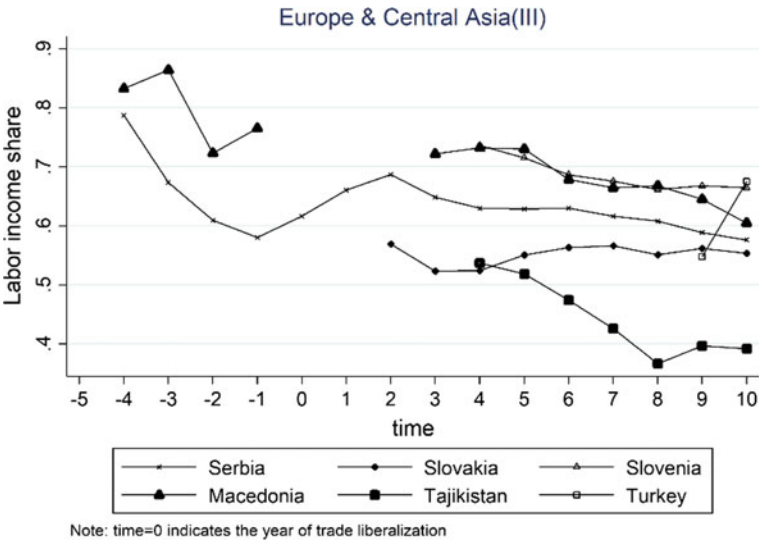

Fig. 4 Trade liberalization and labor income share in Europe and Central Asia (III). *Note* The period for each country is: 1997–2001 (Serbia); 1993–2001 (Slovakia); 1995–2001 (Slovenia); 1990*–93*; 1997–2004 (Macedonia); 2000–06 (Tajikistan); and 1998–99 (Turkey). *denotes years in which the adjustment method in calculating labor income share differs from the one applied for the other years

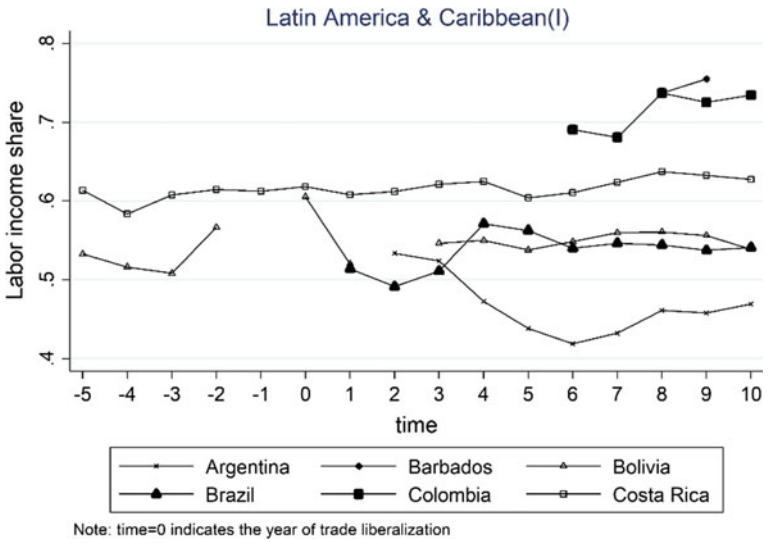

Fig. 5 Trade liberalization and labor income share in Latin America and the Caribbean (I). *Note* The period for each country is: 1993–2001 (Argentina); 1974–75 (Barbados); 1980–83, 1985–86, 1988–95 (Bolivia); 1992–2001 (Brazil); 1992–96 (Colombia); and 1981–96 (Costa Rica)

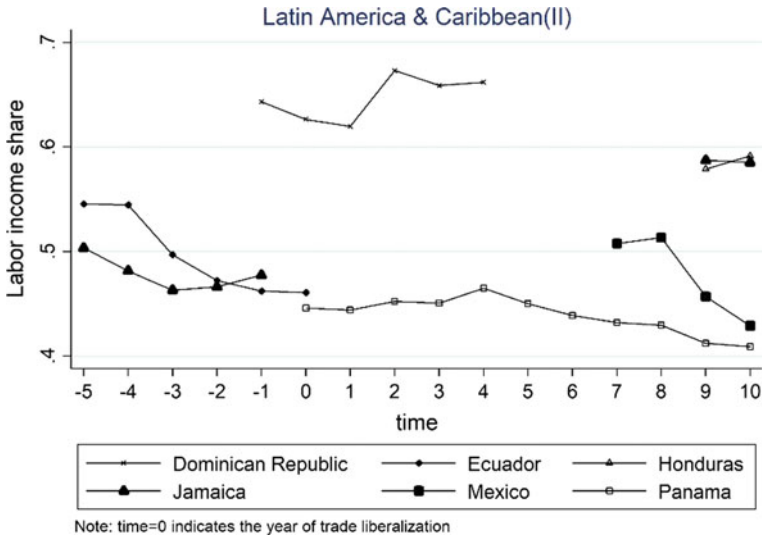

Fig. 6 Trade liberalization and labor income share in Latin America and the Caribbean (II). *Note* The period for each country is: 1991–96 (Dominican Republic); 1986–91 (Ecuador); 2000–01 (Honduras); 1984–88, 1998–99 (Jamaica); 2003–06 (Mexico); and 1996–2006 (Panama)

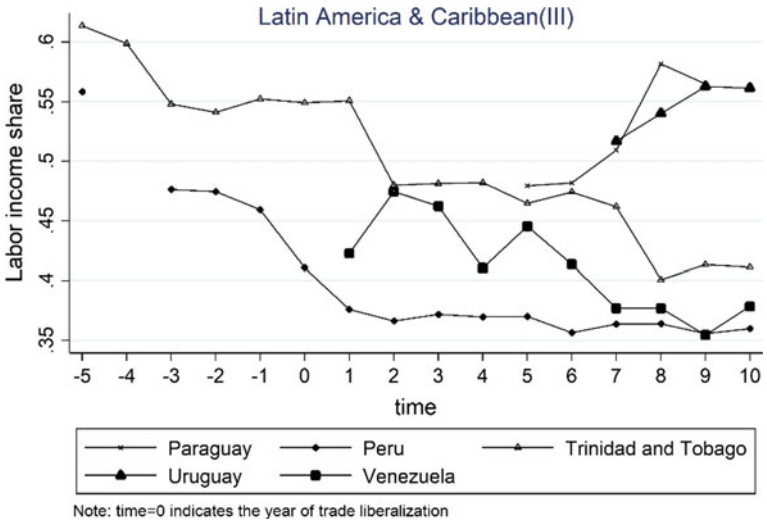

Fig. 7 Trade liberalization and labor income share in Latin America and the Caribbean (III). *Note* The period for each country is: 1994–98 (Paraguay); 1986, 1988–2001 (Peru); 1987–2002 (Trinidad and Tobago); 1997–2000 (Uruguay); and 1997–2006 (Venezuela)

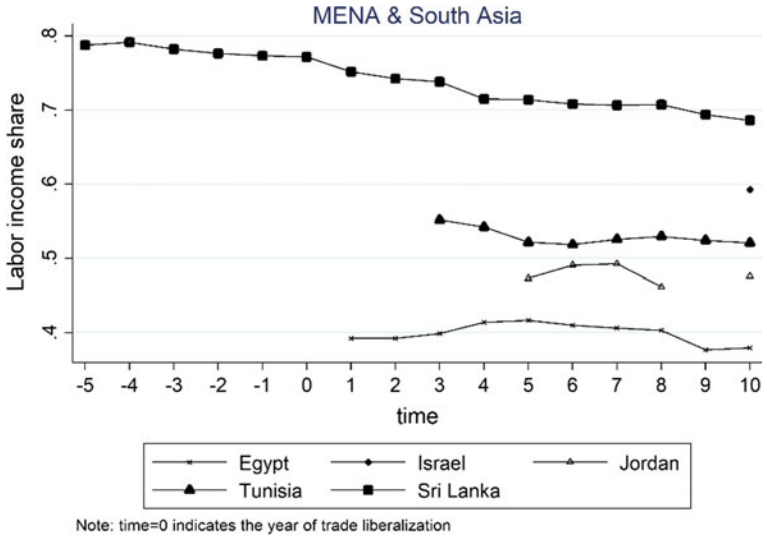

Fig. 8 Trade liberalization and labor income share in MENA and South Asia. *Note* The period for each country is: 1996–2005 (Egypt); 1995 (Israel); 1970–73, 1975 (Jordan); 1992–99 (Tunisia); and 1986–2001 (Sri Lanka)

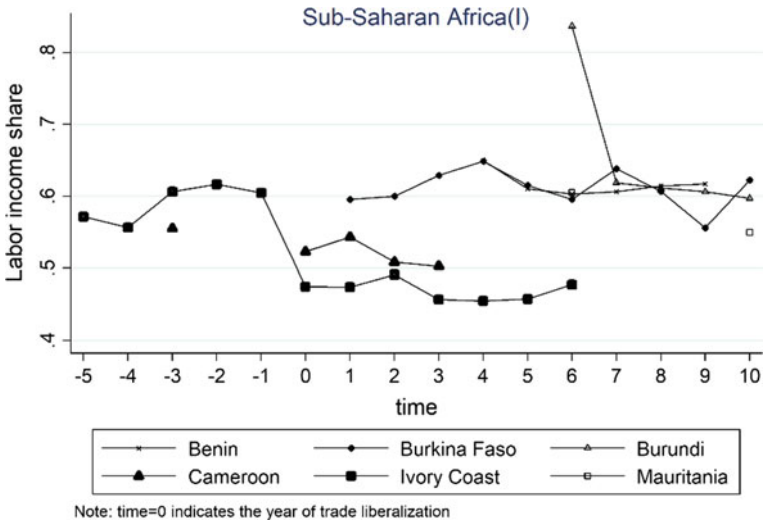

Fig. 9 Trade Liberalization and Labor Income Share in Sub-Saharan Africa (I). *Note* The period for each country is: 1994–99 (Benin); 1999–2008 (Burkina Faso); 2005–09 (Burundi); 1990, 1993–96 (Cameroon); 1989–2000 (Ivory Coast); and 2001, 2005 (Mauritania)

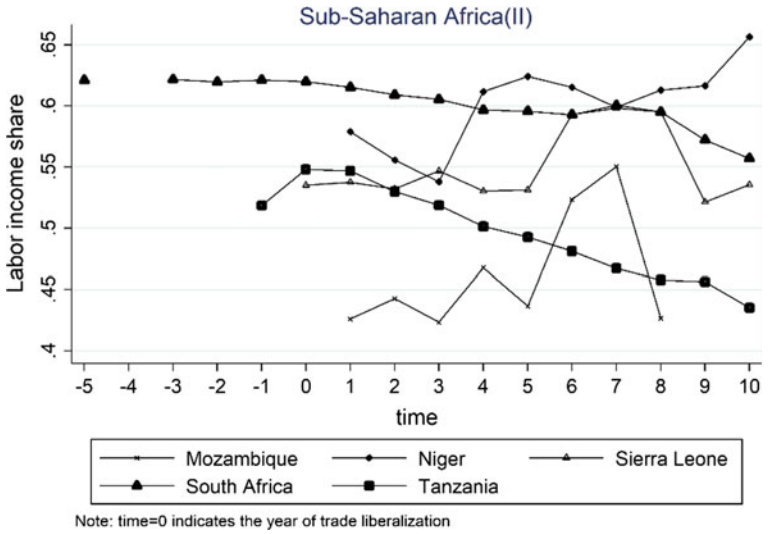

Fig. 10 Trade liberalization and labor income share in Sub-Saharan Africa (II). *Note* The period for each country is: 1996–2003 (Mozambique); 1995–2004 (Niger); 2001–11 (Sierra Leone); 1986, 1988–2001 (South Africa); and 1994–2005 (Tanzania)

liberalization, a slight increase right after the liberalization, and then a moderate decline from two years after the liberalization (Fig. 4).

Among the first group of Latin American and Caribbean countries, Costa Rica had a relatively constant trend in the labor income share (Fig. 5). Argentina experienced a decline after the liberalization, while Brazil witnessed an increase after the liberalization (Fig. 6).

Among the second group of Latin American and Caribbean countries, Panama witnessed a slight decline in the labor income share after the liberalization. The labor income share of Ecuador had a declining trend before the liberalization, while its post-liberalization data are not available.

Among the third group of Latin American and Caribbean countries, Trinidad and Tobago and Peru had decreasing trends for four to five years prior to liberalization and continued to decrease after opening up to trade (Fig. 7). The labor income share of Venezuela was shaky, but it had a long-term declining trend after the liberalization.

Among MENA and South Asian countries, Sri Lanka experienced a long-term declining trend after the period that predated the liberalization (Fig. 8). The labor income share was relatively constant for Egypt after the liberalization.

Among the first group of sub-Saharan African countries, Ivory Coast witnessed a drop in the labor income share in the year of liberalization (Fig. 9). Burundi experienced a sharp decline from six to seven years after the liberalization.

Among the second group of sub-Saharan African countries, South Africa followed a decreasing trend, which predated the trade liberalization (Fig. 10). Tanzania experienced a decline in the labor income share after the liberalization, while Niger witnessed an increase after three years of trade liberalization.

The time series plots of the labor income share for most of the countries suggest a downward trend following the episode of trade liberalization. However, from this bivariate analysis it is difficult to identify whether a fall in labor income share was driven entirely by trade openness, as for some countries the labor income share started declining before they embraced the trade reform measures. Such causal links are difficult to discern unless we look at the sectoral labor income shares and understand the sectoral dynamics of labor income share associated with trade reforms. We take this up in the following section.

3.2 Evidence at the Sectoral Level

In this section, we discuss some stylized facts about the labor income share at the sectoral level. For this purpose, we rely on the sectoral-level labor income share data computed by Oishi and Paul (2018) for 54 countries across five regions based on the most recent World Bank classification of countries (9 from East Asia and the Pacific, 28 from Europe and Central Asia, 8 from Latin America and the Caribbean, 2 from the Middle East and North Africa, 2 from North America, and 5 from sub-Saharan Africa). In Fig. 11, we show cross-country scatter plots between the

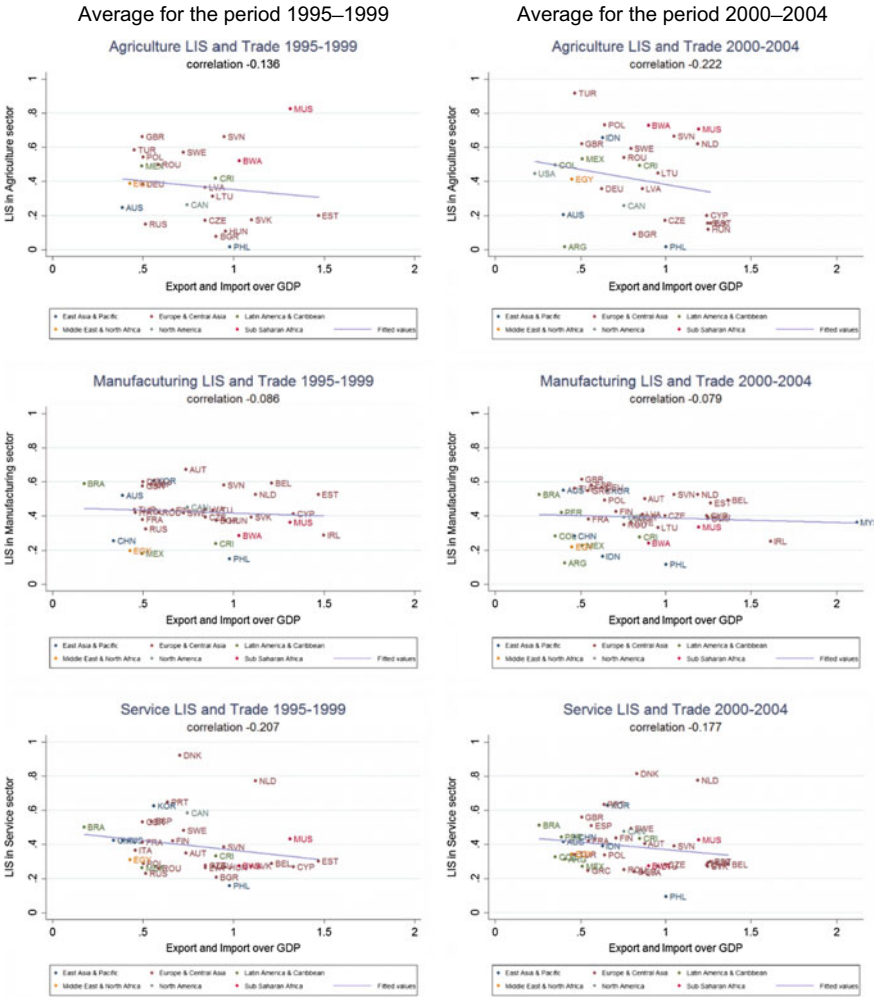

Fig. 11 Sectoral labor income share (Broad categories) and trade share of GDP. *Source* Authors' own calculations

sectoral labor income share and trade share of GDP. In the left-hand column, the plots show labor income shares for three key sectors (agriculture, manufacturing, and services)[4] and trade share of GDP averaged over the period from 1995 to 1999. In the right-hand column, we plot the same variables, but averages are taken for the period from 2000 to 2004. In each plot countries from different regions are demarcated by different colors.

[4]Services include five disaggregated sectors: WRT, TRA, FIRE, GOV, and OTH.

Overall, the results show a negative correlation between the volume of trade (as a share of GDP) and labor income shares at the key sectoral levels. The negative correlation in the manufacturing sector is somewhat weaker than in other sectors; however, such sectoral patterns of trade and factor income shares do not change over time, except for agriculture, where it almost doubled from −0.14 in the period 1995–99 to −0.22 in the period 2000–04. Countries like Turkey, Poland, and Botswana show a relatively higher share of labor income in agriculture, whereas Brazil and Austria have the highest labor income share in manufacturing. We do not find any regional bias. The same holds for the services sector, where Denmark and the Netherlands continue to have the highest labor income share.

Moving on, next we showcase the dynamic (changes over time) relationship between sectoral labor income share and trade. The plots in the left-hand column of Fig. 12 compare the changes in the average values of labor income share and trade share of GDP between two periods: 1995–97 and 2001–03. And in the right-hand column, the plots compare the same relationship between 2001–03 and 2007–09. The correlation between changes in the sectoral labor income share and trade share of GDP is negative for all the sectors and periods, except in agriculture between 2001–03 and 2007–09 where we find a positive association between changes in the labor income shares in agriculture and changes in the trade share of GDP. Since the plots show a dynamic relationship considering different time periods, it is difficult to directly compare the results with that at the level. However, the negative correlation observed both at the level and dynamics over time provide some robustness from across time and space. The bivariate plots suggest a negative correlation between labor income share at the sectoral level and trade volume, which is in line with many of the studies on this topic.

Finally, we examine the time series plots at the country level. Figure 13 shows labor income share trends for three sectors and the trade GDP ratio for four countries: the PRC (manufacturing and services), Brazil (manufacturing and services), Egypt (agriculture, manufacturing, and services), and Botswana (agriculture, manufacturing, and services). Let us first compare the trade performance of these countries. The PRC outperforms other countries in terms of the growth in trade share of GDP. While the data from the period available for these countries differ, both Brazil and Egypt show stronger trade performance from the early 2000s whereas it did not change much for Botswana and the trade share of GDP oscillated around 1. In the PRC, the labor income shares in manufacturing remained constant around 0.3, whereas the same in services steadily grew from the early 2000s and reached about 0.5 by 2008. On the other hand, in Brazil, the labor income shares trends for both sectors are similar with a slight decline in the labor income share in the manufacturing sector since 1994. For Egypt and Botswana, the labor income share in agriculture is higher than in the other sectors. In Egypt, the trade volume and labor income share in agriculture show a strong positive correlation. Overall, the time series plots from country cases suggest a more diverse picture of the relationship between trade and sectoral labor income shares.

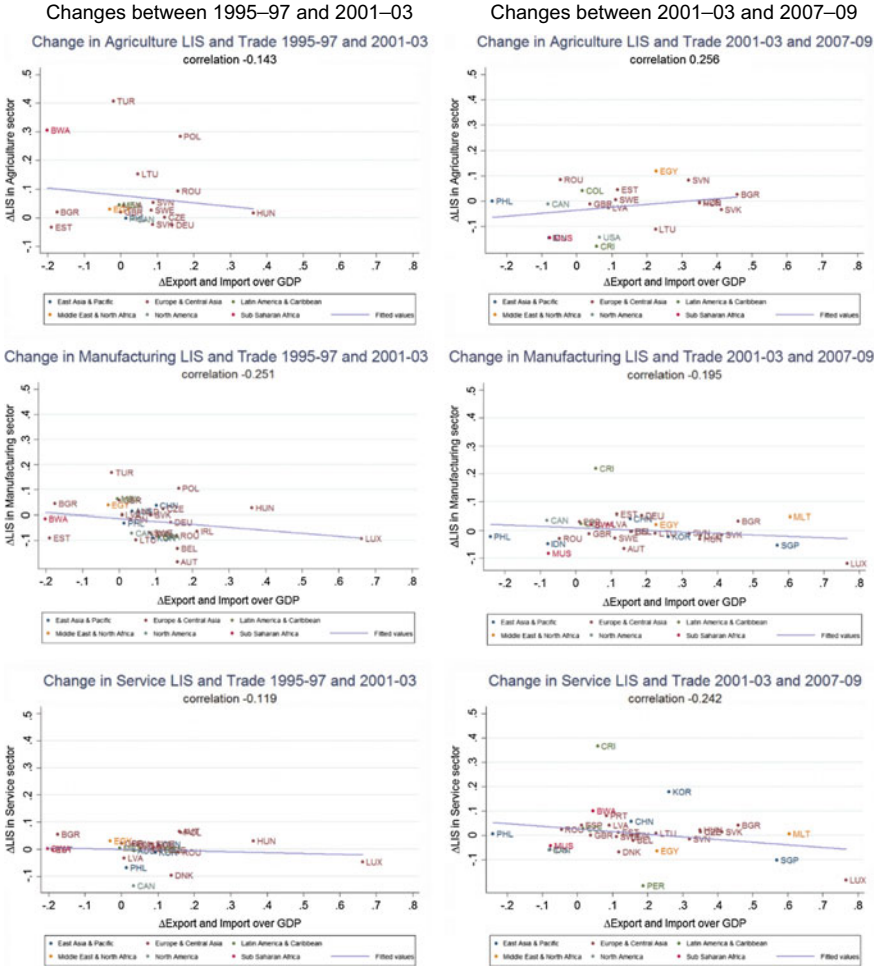

Fig. 12 Changes in Sectoral Labor Income Share and Trade Share of GDP. *Source* Authors' own calculations

To conclude, based on the descriptive analysis we find mild support for a negative correlation between labor income share and trade openness at the cross-country level. Evidence at the sectoral level provides a more nuanced picture and suggests a possible association between sectoral labor income share and trade. This prompts us to dig deeper and examine the process of structural transformation at the sectoral level as a causal mechanism between trade reforms and the labor income share.

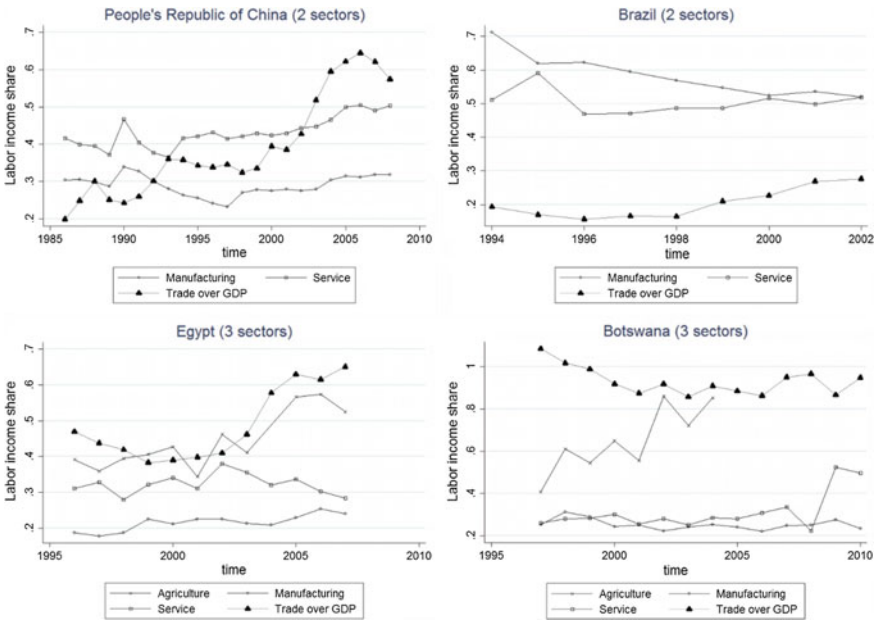

Fig. 13 Changes in Sectoral Labor Income Share and Trade Share of GDP. *Source* Authors' own calculations

4 Structural Transformation and the Labor Income Share: Descriptive Evidence

4.1 Skill-Biased Structural Transformation and the Labor Income Share

It is well documented in the literature that there has been a dramatic increase in the supply and relative wages of skilled labor over time (Acemoglu and Autor 2011). While the literature on skill-biased technical change (SBTC) argues for an increase in the demand for skill as a potential driver (Acemoglu and Autor 2011), the availability of cheaper capital equipment could also increase the demand for skilled labor with or without SBTC (Krusell et al. 2000). Extending the literature that argues for an increase in the relative demand for skilled labor, Buera et al. (2015) argue for a systematic reallocation of value-added shares toward high-skill-intensive sectors, which they term the "skill-biased structural change" (SBSC from here on). They develop a two-sector model of the SBSC process and use it to examine the rise in the skill premium in the US, and a broad panel of advanced economies, over the period 1977 to 2005. Their empirical findings across a broad panel of advanced economies suggest that increases in GDP per capita are

associated with a shift in the composition of value added to sectors that are intensive in high-skill labor.

We use the labor income share data compiled by Buera et al. (2015) from the EU KLEMS database to compare the labor income shares for high-skilled labor (college graduates and above) for the 10 key sectors (Fig. 8). Overall, the labor income shares of high-skilled workers show rising trends across the board, which supports the role of SBSC (Buera et al. 2015) in sectoral labor income share movements. We also find three parallel trends clearly emerging:

(1) high $L_S^{Skilled}$ sectors—finance, insurance, real estate, and other business; community, social, and personal services.
(2) medium $L_S^{Skilled}$ sectors—electricity, gas and water, manufacturing, wholesale and retail trade, mining and quarrying, transport, storage and communication.
(3) low $L_S^{Skilled}$ sectors—agriculture, hotels and restaurants, construction.

In a recent paper, Buera and Kaboski (2012) argue that this rising return to skill is closely related to the structural transformation from manufacturing to services. They show that it is useful to model the different roles of human capital to various activities to understand some key features of structural transformation, and labor income share trends, as we find in Fig. 14. As the economy develops, it produces services that are complex, which also creates additional incentives for market production skill accumulation. As the authors assume an upward sloping supply curve for skilled workers, the skill premium also increases.

4.2 Structural Transformation and Labor Income Share in Japan, 1970–2010

In this section we provide a snapshot of the sectoral trends in the labor income and employment share in Japan for the period from 1970 to 2010. In this period structural transformation in Japan mainly came through the growth of commerce and private sector services[5] (Fukao and Paul 2017). Between 1970 and 1990, the primary gainers in employment shares were construction, commerce and services, and machinery. However, the rate of productivity growth slowed down compared to the previous period in all sectors including commerce and services. For the first time in Japan's history, labor was moving out of most manufacturing sector industries to private sector services. At the same time, compared to the early 1970s, the aggregate labor income share in Japan decreased by approximately 10% points in the following three decades. This decline was primarily driven by services as the

[5]Private services include private medical services, private education services, private hygiene services, private research services, information and Internet-based services, work in eating and drinking places, automobile maintenance, etc.

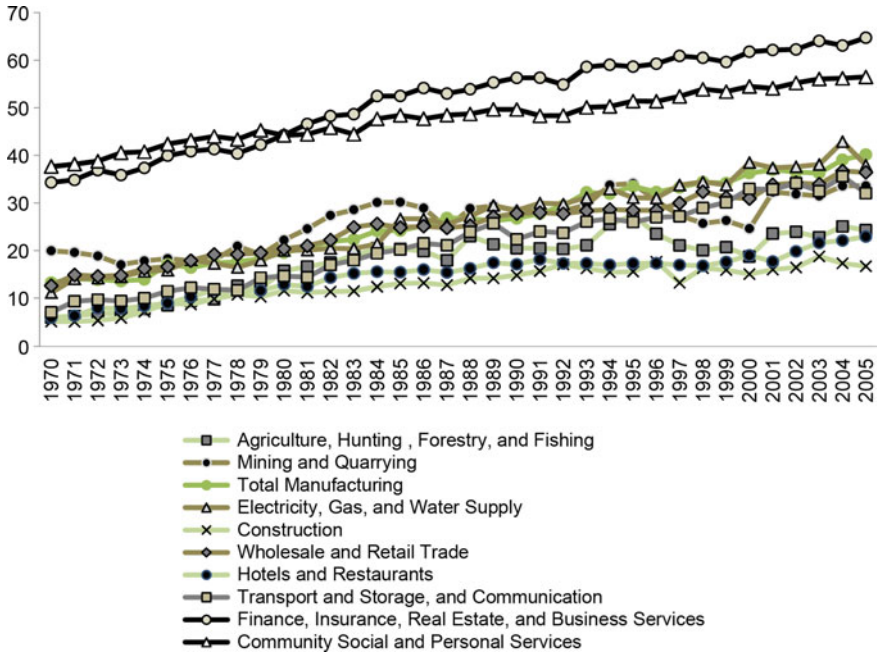

Fig. 14 Sectoral labor income share trends for high-skilled workers, 1970–2005. *Note* EU KLEMS data cover the following countries: Australia, Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Spain, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Lithuania, Latvia, Luxembourg, Malta, the Netherlands, Poland, Portugal, the Slovak Republic, Slovenia, Sweden, the United Kingdom, and the United States *Source* Authors' calculation based on data compiled by Buera et al. (2015). Original data source is EU KLEMS

labor income share in manufacturing sectors remained almost constant (Fukao and Perugini 2018). This section aims to reconcile some of these facts using a sectoral-level analysis.

4.2.1 Descriptive Evidence Using Japan Industrial Productivity (JIP) Data

We use the Japan Industrial Productivity (JIP) and the Regional Japan Industrial Productivity (R-JIP) databases compiled by RIETI (Research Institute of Economy, Trade and Industry) and Hitotsubashi University, Tokyo.[6] The latest round of the JIP database (2015) covers 108 industries for the period 1970–2012. Following

[6]See https://www.rieti.go.jp/en/database/JIP2015/#01. For a detailed account of the JIP database, see Fukao et al. (2007). JIP sectors can be easily translated into international industry classifications such as ISIC and KLEMS.

Fukao and Perugini (2018), we construct the labor income share by sector (industry) as the ratio of nominal total labor compensation to nominal value added (at current prices). Since nominal total labor compensation includes all types of remuneration, such as employee compensation and mixed income (i.e. for labor supplied by self-employed and family workers), it automatically adjusts for labor compensation of nonworkers (employees). This makes our labor income share measure less susceptible to measurement errors as highlighted by many researchers (Gollin 2002; Guerriero 2012). In addition, we use the Regional-Level Japan Industrial Productivity (R-JIP) database,[7] which consists of 23 sectors (agriculture, mining, food, textiles, pulp, chemicals, petroleum, nonmetallic minerals, primary metals, fabricated metals, machinery, electrical machinery, transport equipment, precision instruments, other manufacturing, construction, utilities (electricity, gas, and water supply), wholesale and retail trade, finance and insurance, real estate, transport and communication, private services, and government services. We merge this data set into the JIP database, mainly to facilitate the creation of the classification of sectors.

We divide 108 industries into six broad categories of sectors. *Agri* consists of agriculture, forestry, and fisheries. *Heavy manufacturing* comprises mining, chemicals, petroleum, fabricated metals, machinery, construction, and electrical machinery. *Light manufacturing* consists of food, textiles, pulp, nonmetallic minerals, primary metals, transport equipment, precision instruments, and other manufacturing. *Utilities* include electricity, gas, and water supply. *Commerce* consists of wholesale and retail trade, finance and insurance, real estate, transport, and communication. We include both private services and government services in *Services*. The left-hand panel of Fig. 15 shows labor income share trends for these six broad sectors. The labor income shares remained almost constant in heavy manufacturing and light manufacturing whereas the other sectors showed downward trends in the period from 1970 to 2010. During the same period, we observe the secular trends of structural transformation: employment shares rising in services, falling in agriculture, and remaining unchanged in manufacturing.

Despite a growth in employment shares, services experienced a decline in labor income share. To gain more insights into this topic, we compare the labor income share trends between two groups of sectors: (a) sectors that experienced rapid expansion and (b) sectors that experienced contraction in terms of employment shares between 1970 and 2010. The right-hand panel of Fig. 16 confirms the rising trend in employment shares for three fast-growing sectors: eating and drinking places, private medical services, and other business services. However, the labor income shares decline for both the eating and drinking places and private medical sectors. An increase in the employment share is likely to increase the labor income share unless the wages dramatically fall. As a next step, we examine some other factors that could be correlated with a fall in labor income share in these sectors.

[7] http://www.rieti.go.jp/en/database/r-jip.html (It should be noted that data are missing for Okinawa for the period 1955 to 1970.)

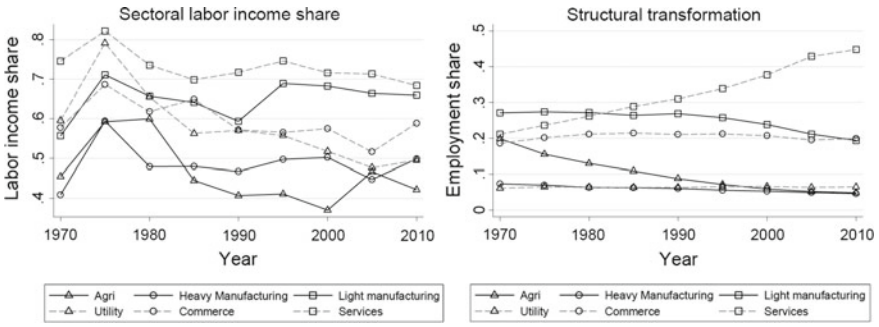

Fig. 15 Sectoral labor income and employment share in Japan, 1970–2010. *Note* Authors' calculation based on the Japan Industrial Productivity (JIP) database https://www.rieti.go.jp/en/database/JIP2015/#01, and Regional-Level Japan Industrial Productivity (R-JIP) database, http://www.rieti.go.jp/en/database/r-jip.html. The latter data set consists of 23 sectors. We divide them into six broad categories

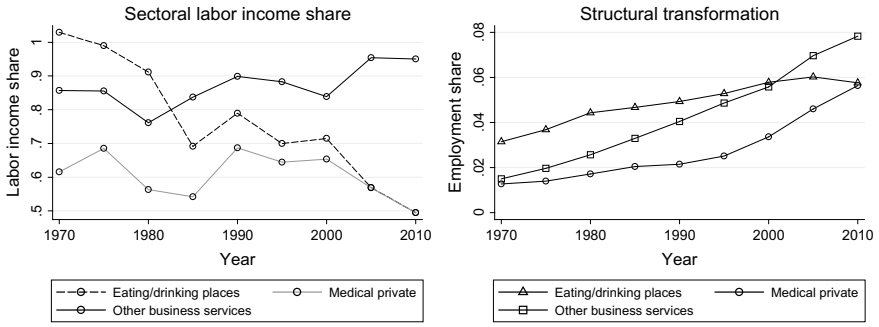

Fig. 16 Labor income and employment share in some fast-growing sectors. *Note* Authors' calculation based on the Japan Industrial Productivity (JIP) database, https://www.rieti.go.jp/en/database/JIP2015/#01

In the left-hand panel of Fig. 17, we compare the part-time employment shares. The part-time employment share in eating and drinking places rose from about 10% to nearly 50% between 1970 and 2010. The other two sectors also show an increasing trend for part-time workers but to a somewhat lesser extent. At the same time, female employment shares had been very high and became more than 75% in 2010 in private medical services. Taken together, if one can argue that if part-timers get paid less per hour and female employees face gender discrimination in wages, then a fall in labor income share in these sectors despite a growth in employment is conceivable. To conclude, a drop in the labor income share in eating and drinking places could be driven by a significant increase in part-time workers whereas a drop in the labor income share in private medical services could be due to a combination of the growth in part-time workers and an increase in the female labor force participation rate.

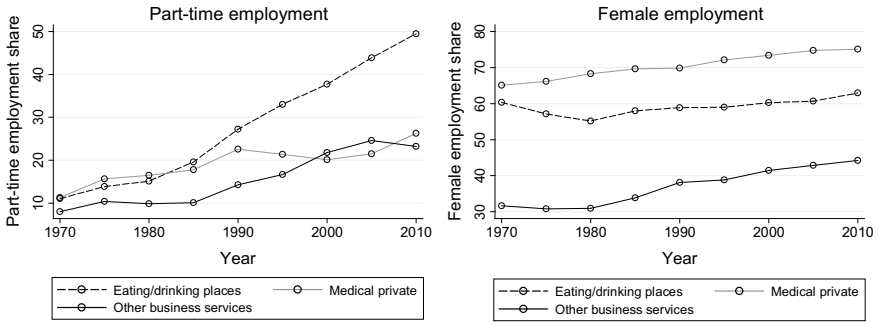

Fig. 17 Part-time and female employment shares in some fast-growing Sectors. *Note* Authors' calculation based on the Japan Industrial Productivity (JIP) database, https://www.rieti.go.jp/en/database/JIP2015/#01

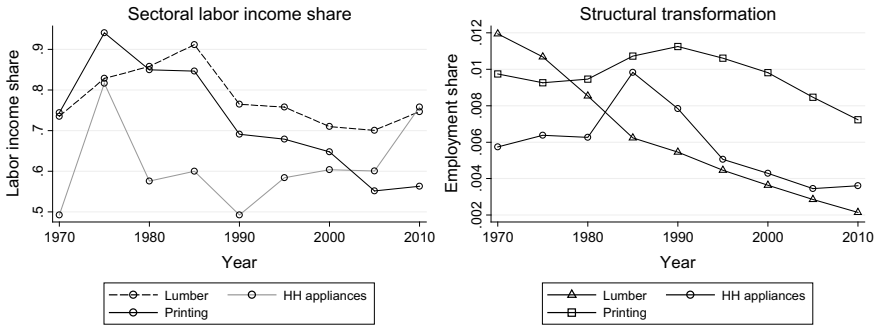

Fig. 18 Labor income and employment share for some shrinking sectors. *Note* Authors' calculation based on the Japan Industrial Productivity (JIP) database, https://www.rieti.go.jp/en/database/JIP2015/#01

We finally look at the labor income share trends in some shrinking sectors. As is evident from the right-hand panel of Fig. 18, lumber industries, printing businesses, and household appliances industries experienced a significant drop in employment shares over the period from 1970 to 2010. However, the labor income shares in household appliances industries in fact rose after 1990. The other two sectors, lumber and printing, experienced a drop in the labor income share. One can use the same logic to reconcile the puzzling outcomes on employment shares and labor income share in household appliances industries.

4.2.2 A Shift-Share Decomposition Analysis

In this section, we provide some results from a shift-share decomposition of labor income share changes between 1970 and 2010. We use a variant of the canonical

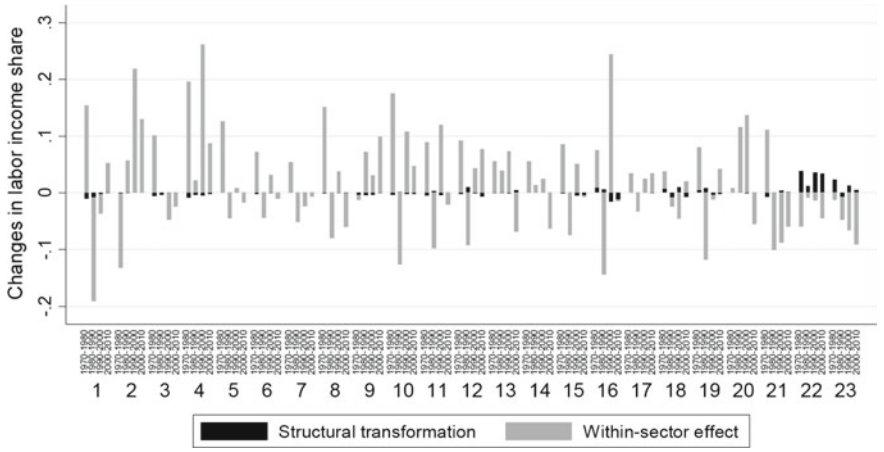

Fig. 19 Shift-share decomposition outcomes. Authors' calculation based on the Regional-Level Japan Industrial Productivity (R-JIP) database, http://www.rieti.go.jp/en/database/r-jip.html. The latter data set consists of 23 sectors. Note: 1 = agriculture, 2 = MINING, 3 = food, 4 = textiles, 5 = pulp, 6 = chemicals, 7 = petroleum, 8 = nonmetallic minerals, 9 = primary metals, 10 = fabricated metals, 11 = machinery, 12 = electrical machinery, 13 = transport equipment,14 = precision instruments, 15 = other manufacturing, 16 = construction, 17 = utilities (electricity, gas, and water supply), 18 = wholesale and retail trade, 19 = finance and insurance, 20 = real estate, 21 = transport and communication, 22 = private services, and 23 = government services

shift-share decomposition methodology (Fabricant 1942; de Vries et al. 2013) and write changes in the aggregate labor income share between t and $t+1$ as

$$\Delta LIS = \sum_i (VA_i^t)(\Delta LIS_i) + \sum_i (\Delta VA_i)(LIS_i^t), \tag{1}$$

where LIS_i is the labor income share in sector i, and LIS denotes the aggregate labor income share. Labor is reallocated across sectors between two points in time, t and $t+1$, and VA_i^t denotes the value-added share of sector i in period t. The first term on the right-hand side of Eq. (1) measures the contribution of changes in the sectoral labor income share over time whereas the second term measures the contribution of structural transformation (to put it simply, the changes in the weights of the sector). Thus, in the absence of structural transformation, the aggregate labor income share trend would simply be a weighted average of the sectoral labor income share trends.

We describe the decomposition outcomes in Fig. 19. A decomposition exercise is performed for four time periods, 1970–1980, 1980–1990, 1990–2000, and 2000–2010, and for 23 main sectors based on the R-JIP database. As is clear from Fig. 5, the contribution of structural transformation to changes in the labor income share over time for most of the sectors is negligible. Structural transformation explains a sizable variation in the labor income share only for sectors like private and government services, and to a lesser extent for wholesale and retail trade, and finance and insurance. These services sectors also experienced employment growth in

recent years. So we find mild support for the fact that the role of structural transformation in explaining the variation in sectoral labor income share also depends on the level of structural transformation in that sector.

The main goal of this section is to highlight the role of structural transformation in labor income share trends using a case study on Japan. We used JIP data to provide some descriptive evidence and analytical evidence supporting the role of change in the sectoral employment share behind changes in the sectoral labor income share. Overall, the findings suggest a limited role of structural transformation in the movement of labor income share in Japan, and the direction of changes in certain sectors is driven by part-time employment.

5 Regression Outcomes on Sectoral Labor Income Share, Trade, and Structural Transformation

In this section we discuss the regression model and outcomes both at the country and sectoral level.

5.1 Empirical Analysis at the Country Level

To elaborate on the descriptive evidence on the relationship between trade openness and labor income share trends in Sect. 3, we conduct regression analyses using cross-country panel data. While bivariate descriptive evidence may be contaminated by confounding factors that happened at the same time as trade liberalization, regressions allow us to isolate the effects of trade openness after controlling other potential drivers of the labor income share.

We constructed panel data by combining multiple secondary data sources. Data on the labor income share across countries and years are taken from the Penn World Tables (PWT). As in Sect. 3, the year of trade liberalization for each country is based on Sachs and Warners (1995) and Wacziarg and Welch (2003, 2008). A dummy variable is constructed that takes 0 for years before trade liberalization and 1 for years after trade liberalization. Other country characteristics that potentially impact the labor income share and are correlated with trade openness are retrieved from the World Development Indicators (WDI) of the World Bank. Such control variables include GDP per capita, population, the share of export and import to GDP, and the share of manufacturing, agriculture, and service value added to GDP. Since available data periods differ across countries, the constructed panel data are unbalanced. Summary statistics of the unbalanced panel data are presented in Table 3.

Table 3 Summary statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Labor income share	2,484	0.55	0.12	0.09	0.89
Trade_open	2,103	0.85	0.36	0.00	1.00
GDPPC_constant2010	2,392	17,210.44	19,709.05	209.86	111,968.30
log(GDPPC_constant2010)	2,392	8.92	1.46	5.35	11.63
POP_total	2,449	52,300,000.00	166,000,000.00	18,427.00	1,350,000,000.00
log(POP_total)	2,449	16.14	1.79	9.82	21.02
trade_GDP	2,352	82.92	57.64	8.93	441.60
MANU_VA_GDP	2,136	15.24	6.61	0.00	54.21
AGRI_VA_GDP	2,191	10.38	10.79	0.04	55.95
SERVICE_VA_GDP	2,006	54.74	14.87	−77.42	155.55

Note Authors' calculation based on the Penn World Tables (PWT) and World Development Indicators (WDI)

To identify the impact of trade liberalization, we first carry out fixed-effect (FE) estimations. We regress the labor income share on the dummy variable indicating trade liberalization status and other control variables as follows:

$$labsh_{i,t} = \alpha + \beta_1 Trade\_open_{i,t} + \boldsymbol{X}'_{\boldsymbol{i,t}}\boldsymbol{\gamma} + \varphi_i + \varepsilon_{i,t}, \tag{2}$$

where $\boldsymbol{X}'_{\boldsymbol{i,t}}$ includes GDP per capita (in log form), total population (in log form), the share of trade (export plus import) to GDP, and the share of manufacturing and agriculture value added to GDP. φ_i are country fixed effects and $\varepsilon_{i,t}$ is an error term.

We next investigate how soon the effects of trade liberalization start to impact the labor income share. Dummy variables for four periods surrounding the liberalization were introduced to further examine the timing of the labor income share response to liberalization. The specification is as follows:

$$labsh_{i,t} = \alpha + \beta_1 D_{1i,t} + \beta_2 D_{2i,t} + \beta_3 D_{3i,t} + \beta_4 D_{4i,t} + \boldsymbol{X}'_{\boldsymbol{i,t}}\boldsymbol{\gamma} + \varphi_i + \varepsilon_{i,t}, \tag{3}$$

where $D_{1i,t} = 1$ if $T-3 \le t \le T-1$ and zero otherwise; $D_{2i,t} = 1$ if $T \le t \le T+2$; $D_{3i,t} = 1$ if $T+3 \le t \le T+6$; $D_{4i,t} = 1$ if $t > T+6$; and T denotes the year of trade liberalization. The coefficients of these four dummy variables are interpreted as the mean difference in the labor income share between these years and the period preceding three years before liberalization (the base period).

Further, we shed light on potential channels through which trade liberalization impacts the labor income share. We examine whether the liberalization reforms did indeed increase the share of trade (export plus import) to GDP.

$$trade\_GDP_{i,t} = \alpha + \beta_1 Trade\_open_{i,t} + \boldsymbol{X}'_{\boldsymbol{i,t}}\boldsymbol{\gamma} + \varphi_i + \varepsilon_{i,t} \tag{4}$$

Lastly, we re-estimate the impact of trade liberalization on the labor income share using fixed-effects-instrumental-variable (FEIV) estimations to counter the possible correlation between the trade openness dummy and the error term in the model (1). We use the share of agriculture and service value added to GDP as instruments, assuming that they are correlated with trade liberalization but uncorrelated with unobservable, time-variant country characteristics. The first-stage and second-stage regressions are as follows:

$$Trade\_open_{i,t} = \alpha + \beta_1 AGRI\_VA\_GDP_{i,t} + \beta_2 SERVICE\_VA\_GDP_{i,t} + \boldsymbol{X}'_{\boldsymbol{i,t}}\boldsymbol{\gamma} + \varepsilon_{i,t} \tag{5}$$

$$labsh_{i,t} = \alpha + \beta_1 \widehat{Trade\_open}_{i,t} + \boldsymbol{X}'_{\boldsymbol{i,t}}\boldsymbol{\gamma} + \varphi_i + \varepsilon_{i,t}, \tag{6}$$

where $AGRI\_VA\_GDP_{i,t}$ and $SERVICE\_VA\_GDP_{i,t}$ are the ratio of agricultural and service value added to GDP, respectively. $\widehat{Trade\_open}_{i,t}$ is the fitted value from the regression of (5).

Table 4 Fixed effects of the labor income share

	FE	FE	FE	FE
	(1)	(2)	(3)	(4)
Trade_open	−0.018	−0.005	0.001	0.008
	[0.023]	[0.022]	[0.017]	[0.017]
lGDPPC_constant2010	−0.079***	−0.071***	−0.075***	−0.057***
	[0.013]	[0.013]	[0.013]	[0.015]
lPOP_total	−0.059*	−0.071**	−0.061*	−0.051
	[0.033]	[0.032]	[0.034]	[0.033]
trade_GDP		0	0	0
		[0.000]	[0.000]	[0.000]
MANU_VA_GDP			0	0
			[0.001]	[0.001]
AGRI_VA_GDP				0.002**
				[0.001]
_cons	2.242***	2.368***	2.237***	1.880***
	[0.491]	[0.492]	[0.525]	[0.537]
chi2				
r2	0.321	0.315	0.35	0.365
N	2,062	2,010	1,799	1,799
FE versus RE				
Sargan-Hansen statistic	51.475	49.714	48.564	46.608
P-value	0	0	0	0

*p < 0.10, **p < 0.05, ***p < 0.01

FE estimation results on the impact of trade liberalization are somewhat mixed. On average, although statistically insignificant, the labor income share of open regimes is 1.8% points lower than that of closed regimes ((1) of Table 4). After the share of trade to GDP and the shares of sectoral value added to GDP are added as additional controls, however, the impact of trade liberalization becomes small in absolute terms and statistically insignificant ((3) and (4) of Table 2).

Further, the negative effects of trade liberalization seem to have emerged in the period following several years after the liberalization. In the regressions of the labor income share on dummy variables for four periods, the coefficients of dummy variables become larger in absolute terms in the later periods ((1)–(4) of Table 5).

The effects of liberalization on the share of trade to GDP are counterintuitive. The estimated coefficients of the trade liberalization dummy take relatively large negative values, although they are statistically insignificant (Table 6).

Finally, FEIV estimation results indicate that trade liberalization had a large negative impact on the labor income share. The first-stage regressions suggest that

Table 5 Fixed-effects regressions of the labor income share (with four period dummy variables)

	FE	FE	FE	FE
	(1)	(2)	(3)	(4)
D1	−0.031	−0.024	−0.027	−0.034
	[0.023]	[0.029]	[0.030]	[0.029]
D2	−0.042**	−0.024	−0.029	−0.029*
	[0.019]	[0.021]	[0.020]	[0.016]
D3	−0.046**	−0.024	−0.033	−0.031*
	[0.021]	[0.022]	[0.020]	[0.017]
D4	−0.068***	−0.044*	−0.051**	−0.046**
	[0.022]	[0.023]	[0.023]	[0.019]
lGDPPC_constant2010	−0.075***	−0.059***	−0.066***	−0.049***
	[0.014]	[0.014]	[0.013]	[0.014]
lPOP_total	−0.055	−0.065*	−0.048	−0.037
	[0.037]	[0.037]	[0.036]	[0.036]
trade_GDP		−0.000**	−0.000***	−0.000***
		[0.000]	[0.000]	[0.000]
MANU_VA_GDP			0	0
			[0.001]	[0.001]
AGRI_VA_GDP				0.002*
				[0.001]
_cons	2.199***	2.241***	2.016***	1.664***
	[0.549]	[0.559]	[0.550]	[0.570]
chi2				
r2	0.366	0.363	0.382	0.395
N	1,727	1,684	1,499	1,499
FE versus RE				
Sargan-Hansen statistic	58.525	53.85	59.253	57.663
P-value	0	0	0	0

*p < 0.10, **p < 0.05, ***p < 0.01

the shares of agricultural and service value added to GDP are strong predictors of trade openness ((1) of Table 7). When the trade liberalization dummy is instrumented, the estimated liberalization effects take −11.9% points ((2) of Table 7).

Summarizing this section, trade liberalization seemed to have a negative impact on the labor income share. Moreover, over the course of liberalization, the negative effects of opening up to trade would have emerged in the period following several years after the liberalization. When the trade liberalization variable is instrumented by agricultural and service value added, the negative impact is magnified. However, we could not reach a full understanding of how trade liberalization impacted the labor income share. The liberalization policy did not have a clear impact on the actual share of trade to GDP.

Table 6 Fixed effects of the share of trade to GDP

	FE	FE	FE
	(1)	(2)	(3)
Trade_open	−3.298	−1.457	−1.188
	[3.878]	[3.748]	[3.608]
lGDPPC_constant2010	30.220***	27.191***	27.879***
	[8.114]	[6.598]	[7.281]
lPOP_total	14.733**	11.563*	11.932
	[7.054]	[6.800]	[7.304]
MANU_VA_GDP		−0.323	−0.315
		[0.442]	[0.453]
AGRI_VA_GDP			0.084
			[0.456]
_cons	−428.875***	−342.084***	−355.476***
	[112.658]	[106.632]	[133.105]
chi2			
r2	0.224	0.218	0.218
N	2,010	1,799	1,799
FE versus RE			
Sargan-Hansen statistic	42.756	34.971	38.423
P-value	0	0	0

*p < 0.10, **p < 0.05, ***p < 0.01

5.2 Empirical Analysis at the Sectoral Level

To elaborate descriptive evidence on the relationship between trade openness and sectoral labor income share trends in Sect. 3.2, we conduct regression analyses using cross-country unbalanced panel data. We use sectoral labor income shares (both at the broad and disaggregated levels) as the dependent variables. The summary statistics for these variables are available in Table 8. The sectoral data are available for 10 GGDC disaggregated sectors and following the WDI database we create the broad sectors in the following manner: (1) Agriculture consisting of AGR; (2) Manufacturing sector consisting of MAN; and (3) Services consisting of WRT, TRA, FIRE, GOV, and OTH. The average (unweighted) figures (across all countries) for these broad sectors and 10 disaggregated sectors are shown in Table 3. On average, employees in the agriculture, manufacturing, and services sectors enjoy about 40% of the total income. At a more disaggregated level, GOV shows the highest share of labor income (46%) followed by MAN (41%), AGR, WRT, and TRA, each with an average of 40%. On the other hand, PU (16%) and MIN (20%) are the sectors with the lowest share of labor income. Other country characteristics that potentially impact the labor income share and are correlated with trade openness are taken from the World Development Indicators (WDI) of the

Table 7 Fixed-effects-instrumental-variable Regressions of the Labor Income Share

	First Stage (dep=Trade_open)	Second Stage (dep=labsh)
	FE or RE (1)	FE (2)
AGRI_VA_GDP	−0.014***	
	[0.002]	
SERVICE_VA_GDP	−0.002***	
	[0.001]	
Trade_open		−0.119***
		[0.027]
lGDPPC_constant2010	0.018*	−0.081***
	[0.010]	[0.005]
lPOP_total	−0.01	0.009
	[0.007]	[0.017]
trade_GDP	0	−0.000***
	[0.000]	[0.000]
_cons	1.131***	1.244***
	[0.153]	[0.242]
chi2		327,788.492
r2	0.222	
N	1,697	1,697
FE versus RE		
Sargan-Hansen statistic		8.994
P-value		0.0027

*p < 0.10, **p < 0.05, ***p < 0.01

World Bank. These control variables include GDP per capita, population, the share of export and import to GDP, and the share of manufacturing, agriculture, and service value added to GDP. Since available data periods differ across countries, the constructed panel data are unbalanced. Summary statistics of these variables are also reported in Table 8.

We use trade share of GDP as a proxy for trade openness or trade intensity. To examine the effect of structural transformation, we use sectoral valued added shares of GDP. The regression models for both the baseline and alternative specification are discussed below. We also run regressions on the different components of the sectoral labor income share measure to understand the causal channels better. With the help of panel data methods, we can address both cross-country and temporal effects.

To identify the impact of trade liberalization, we carry out fixed-effect (FE) estimations. We prefer the fixed-effects (or within) estimation in this analysis because it allows us to address the issues of endogeneity in a limited manner. We accept the fact that the correlation between the unobserved heterogeneity and the explanatory variables, caused for example by institutional factors at the sectoral

Table 8 Summary statistics (unweighted)

	Observations	Mean	Standard deviation	Min	Max
Labor income share					
Agriculture	330	0.40	0.24	0.01	0.97
Manufacturing	505	0.41	0.14	0.07	0.97
Service	495	0.39	0.16	0.06	0.97
AGR	330	0.40	0.24	0.01	0.97
MIN	493	0.20	0.15	0.00	0.95
MAN	505	0.41	0.14	0.07	0.97
PU	499	0.16	0.11	0.03	0.74
CON	451	0.32	0.22	0.03	1.00
WRT	432	0.40	0.16	0.04	0.97
TRA	468	0.40	0.16	0.09	0.97
FIRE	405	0.28	0.19	0.03	0.99
GOV	320	0.46	0.14	0.16	0.93
OTH	82	0.33	0.18	0.10	0.99
Employment (logarithm)					
AGR	545	12.62	2.19	6.28	17.58
MIN	538	9.85	2.15	1.79	14.14
MAN	549	13.36	1.79	7.74	16.49
PU	538	10.39	1.83	3.50	14.62
CON	549	12.44	1.77	6.25	15.57
WRT	549	13.41	1.86	7.26	16.92
TRA	549	12.34	1.82	5.94	15.71
FIRE	549	12.50	1.89	5.34	15.77
GOV	529	13.46	1.85	6.67	16.68
OTH	482	12.43	1.66	8.52	16.09
GDP per capita in 2010 (logarithm)	541	9.51	1.12	5.45	11.63
Trade to GDP ratio	540	0.93	0.65	0.10	4.42
Service trade to GDP ratio	510	0.23	0.28	0.02	2.12
Agriculture value added to GDP	527	5.42	5.44	0.04	41.17
Manufacturing value added to GDP	520	16.48	6.07	0.00	32.45
Service value added to GDP	495	57.17	7.67	33.37	76.02
Other sector value added to GDP	488	21.16	6.10	8.58	53.87

Source Authors' own calculations

level, cannot be directly measured. In addition, with FE estimation we can remove any time-invariant variable, which helps eliminate country-specific idiosyncrasies in the data used to compute the labor income share. We regress the labor income share on the indicators of trade liberalization, structural transformation, and other controls. The baseline model takes the form of Eq. (7):

$$LIS_{ijt} = \alpha + \varphi_i + \delta_t + \beta_1 Trade\_open_{jt} + \beta_2 StrucTrans_{ijt} + \boldsymbol{X}'_{\boldsymbol{jt}}\boldsymbol{\gamma} + \varepsilon_{i,t}, \quad (7)$$

where φ_i are country fixed effects, δ_t capture time fixed effects, $\boldsymbol{X}'_{\boldsymbol{i,t}}$ includes GDP per capita (in log form) and other controls, $Trade\_open_{jt}$ is measured by the share of trade (export plus import) to GDP, $StrucTrans_{ijt}$ are proxied by sectoral value added shares to GDP, and $\varepsilon_{i,t}$ is an error term.

As a next step, we shed light on potential channels through which trade liberalization and structural transformation impact the labor income share. The labor income share is the ratio between the total income earned by the laborers and the total income generated in the economy. The total income earned by the laborers in a sector can be affected in two ways: (a) changes in the average sectoral wages and (b) changes in the size of sectoral employment. Since wages are not PPP adjusted and as a result are more likely to generate bias in the estimation, we decide to examine the sectoral employment as a possible causal mechanism channel. In other words, our second set of regressions use log employment in each sector to find potential channels through which trade and structural transformation affect the labor income share (Eq. 8).

$$LogEmp_{ijt} = \alpha + \varphi_i + \delta_t + \beta_1 Trade\_open_{jt} + \beta_2 StrucTrans_{ijt} + \boldsymbol{X}'_{\boldsymbol{jt}}\boldsymbol{\gamma} + \varepsilon_{i,t} \quad (8)$$

In Table 9 we show the baseline model outcomes for broad sectors: agriculture, manufacturing, and services. FE estimation results suggest that trade share of GDP is negatively correlated to labor income share in all sectors; however, the estimates are statistically significant for manufacturing and services. We control for sectoral value-added shares (agriculture, services and other) with manufacturing as the omitted group. The pace of structural transformation is low in a country with a higher agriculture value-added share of GDP. The labor income share in agriculture and services is negatively correlated with the agriculture value-added share of GDP. This implies that countries at an advanced stage of structural transformation, on average, are more likely to enjoy a higher labor income share in these sectors. This could be due to a higher bargaining power for the workers. However, such effects could be dampened by the negative effect of trade, which could also be associated with substitution of labor by capital as discussed in Sect. 4.1. Richer countries enjoy a higher labor income share in services, but we find opposite results for agriculture and manufacturing. Services value-added share of GDP is positively correlated with manufacturing labor income share. This could be driven by complementarity between manufacturing and services sectors in some countries.

Table 9 Baseline models (broad sectors) of the labor income share

	Labor income share		
	Agriculture (1)	Manufacturing (2)	Service (3)
GDP per capita in 2010 (logarithm)	−0.147***	−0.112***	0.0606**
	(0.0451)	(0.0219)	(0.0257)
Trade to GDP ratio	−0.00783	−0.0602***	−0.0900***
	(0.0449)	(0.0165)	(0.0188)
Agriculture value added to GDP	−0.0226***	0.00253	−0.00907***
	(0.00573)	(0.00302)	(0.00350)
Service value added to GDP	0.00506	0.00464***	−0.00374*
	(0.00399)	(0.00171)	(0.00198)
Other sector value added to GDP	−0.00516	0.00943***	−0.00650***
	(0.00429)	(0.00195)	(0.00228)
Constant	1.734***	1.066***	0.298
	(0.409)	(0.219)	(0.256)
Observations	297	445	437
R-squared	0.137	0.206	0.079
Countries	33	47	48

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1

In Fig. 10, we extend the baseline model to disaggregated sectors. It shows outcomes for eight sectors: MIN, PU, CON, WRT, TRA, FIRE, GOV, and OTH. The last five sectors are included in services. Labor income share in GOV is higher in richer countries, but it is significantly lower in countries where services value-added share of GDP is higher. This suggests that the opposite channels are at work, and the net effect depends on how large the services sector in a rich country is. At the disaggregated level, the effect of trade is mostly negative but statistically insignificant, except for MIN and WRT. We do not find any consistent trend or relationship between structural transformation and labor income shares at the disaggregated sectoral level (Table 10).

Table 11 shows the same baseline model outcomes with alternative specification. We use service trade share of GDP instead of trade share of GDP as the proxy for trade openness. Overall, the results conform to the baseline model outcomes with original specification. Service trade share of GDP is negatively correlated with labor income share in TRA, which suggests possibilities of outsourcing of jobs, in turn lowering the labor income share in TRA in the home country. The estimated coefficients of the sectoral value-added shares of GDP are now statistically significant for more sectors at the disaggregated level.

Moving on, we next analyze the effects of structural transformation and trade on sectoral employment as a possible channel of the relationship between these factors and the sectoral labor income share. As expected, employment in agriculture is lower in richer countries. Employment in all the service sectors (such as WRT,

Table 10 Baseline models (disaggregated sectors) of the labor income share

	MIN (2)	PU (4)	CON (5)	WRT (6)
GDP per capita in 2010 (logarithm)	−0.0174	−0.0132	0.0145	−0.0310
	(0.0282)	(0.0268)	(0.0257)	(0.0264)
Trade to GDP ratio	−0.0869***	−0.0195	−0.00942	−0.0478**
	(0.0229)	(0.0214)	(0.0186)	(0.0188)
Agriculture value added to GDP	−0.00550	−0.00645*	−0.0110***	−0.0111***
	(0.00387)	(0.00372)	(0.00348)	(0.00358)
Service value added to GDP	−0.00592***	−0.00624***	−0.0113***	−0.00322
	(0.00224)	(0.00215)	(0.00198)	(0.00210)
Other sector value added to GDP	−0.00901***	−0.00238	−0.0107***	−0.000424
	(0.00253)	(0.00244)	(0.00229)	(0.00246)
Constant	1.005***	0.738***	1.111***	0.992***
	(0.287)	(0.278)	(0.256)	(0.262)
Observations	435	442	431	379
R-squared	0.112	0.036	0.091	0.064
Countries	46	47	45	44
	TRA (7)	FIRE (8)	GOV (9)	OTH (10)
GDP per capita in 2010 (logarithm)	0.00495	0.0480	0.0969***	0.0292
	(0.0309)	(0.0340)	(0.0214)	(0.146)
Trade to GDP ratio	−0.0308	−0.0159	0.0142	0.0405
	(0.0276)	(0.0304)	(0.0207)	(0.195)
Agriculture value added to GDP	0.00524	−9.08e–05	−0.00597*	0.0771***
	(0.00416)	(0.00466)	(0.00313)	(0.0226)
Service value added to GDP	−0.00352	0.00591**	−0.00505***	0.0338**
	(0.00264)	(0.00281)	(0.00175)	(0.0127)
Other sector value added to GDP	−0.000643	0.00113	−0.0107***	0.0138
	(0.00279)	(0.00325)	(0.00212)	(0.00877)
Constant	0.566*	−0.515	0.0625	−2.580*
	(0.294)	(0.330)	(0.213)	(1.524)
Observations	410	347	272	67
R-squared	0.053	0.075	0.200	0.268
Countries	47	41	33	14

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1

TRA, FIRE, GOV, and OTH) is positively correlated per capital GDP of a country. Increase in trade intensity is negatively correlated with the size of employment in most of the sectors; the estimated coefficients are statistically significant for MIN, MAN, and CON (Table 12). The results do not alter when we consider the alternative specification as shown in Table 13. Employment is positively correlated with sectoral value-added shares of GDP.

Table 11 Alternative Specification: Service Trade as a Share of GDP

	Labor income share				
	AGR (1)	MIN (2)	MAN (3)	PU (4)	CON (5)
GDP per capita in 2010 (logarithm)	−0.150***	−0.0482*	−0.119***	−0.0147	0.0222
	(0.0401)	(0.0259)	(0.0191)	(0.0254)	(0.0225)
Service trade to GDP ratio	−0.0322	−0.156***	−0.0371	0.00142	−0.0138
	(0.0652)	(0.0324)	(0.0230)	(0.0304)	(0.0260)
Agriculture value added to GDP	−0.0219***	−0.00134	0.00610**	−0.00663	−0.00906***
	(0.00570)	(0.00401)	(0.00301)	(0.00403)	(0.00347)
Service value added to GDP	0.00565	−0.00290	0.00693***	−0.00652***	−0.0103***
	(0.00395)	(0.00237)	(0.00175)	(0.00239)	(0.00199)
Other sector value added to GDP	−0.00479	−0.00723***	0.0112***	−0.00226	−0.00987***
	(0.00419)	(0.00259)	(0.00189)	(0.00261)	(0.00220)
Constant	1.722***	1.022***	0.891***	0.749***	0.951***
	(0.406)	(0.286)	(0.210)	(0.288)	(0.246)
Observations	298	420	416	417	411
R-squared	0.138	0.136	0.169	0.031	0.085
Countries	34	47	48	48	46
	Labor income share				
	WRT (6)	TRA (7)	FIRE (8)	GOV (9)	OTH (10)
GDP per capita in 2010 (logarithm)	−0.0551**	−0.00527	0.0390	0.101***	0.0598
	(0.0240)	(0.0276)	(0.0311)	(0.0200)	(0.190)
Service trade to GDP ratio	−0.0276	−0.124***	−0.0231	0.0186	0.442
	(0.0269)	(0.0342)	(0.0378)	(0.0227)	(1.116)
Agriculture value added to GDP	−0.00907**	0.00840**	0.000799	−0.00663**	0.0758***
	(0.00368)	(0.00417)	(0.00474)	(0.00312)	(0.0234)
Service value added to GDP	−0.00162	−0.000678	0.00668**	−0.00555***	0.0333**
	(0.00217)	(0.00265)	(0.00284)	(0.00178)	(0.0127)
Other sector value added to GDP	0.00167	0.00110	0.00191	−0.0109***	0.0143
	(0.00244)	(0.00270)	(0.00319)	(0.00211)	(0.00947)
Constant	1.026***	0.448	−0.503	0.0800	−2.888
	(0.260)	(0.293)	(0.334)	(0.214)	(1.910)
Observations	364	399	336	264	59
R-squared	0.046	0.084	0.074	0.195	0.273
Countries	44	47	41	33	14

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1

Table 12 Channels of change in labor income share (baseline model specification)

	Number of employments (logarithm)				
	AGR (1)	MIN (2)	MAN (3)	PU (4)	CON (5)
GDP per capita in 2010 (logarithm)	−0.557***	0.0874	−0.0200	−0.165*	0.825***
	(0.0530)	(0.125)	(0.0328)	(0.0850)	(0.0538)
Trade to GDP ratio	−0.105**	−0.274***	−0.0663***	−0.107	−0.169***
	(0.0412)	(0.101)	(0.0247)	(0.0686)	(0.0406)
Agriculture value added to GDP	0.00762	0.0581***	−0.0156***	0.0102	0.0249***
	(0.00721)	(0.0170)	(0.00443)	(0.0116)	(0.00727)
Service value added to GDP	−0.00713*	−0.000570	−0.0203***	0.00627	0.00652
	(0.00409)	(0.00967)	(0.00249)	(0.00660)	(0.00410)
Other sector value added to GDP	0.00597	0.0260**	−0.00522*	0.00979	0.0264***
	(0.00465)	(0.0111)	(0.00286)	(0.00757)	(0.00469)
Constant	18.33***	8.493***	15.05***	11.56***	3.687***
	(0.537)	(1.264)	(0.331)	(0.862)	(0.543)
Observations	483	476	487	476	487
R-squared	0.486	0.095	0.227	0.040	0.525
Countries	50	49	50	49	50
	Number of employments (logarithm)				
	WRT (6)	TRA (7)	FIRE (8)	GOV (9)	OTH (10)
GDP per capita in 2010 (logarithm)	0.351***	0.355***	1.007***	0.288***	0.452***
	(0.0347)	(0.0409)	(0.0758)	(0.0448)	(0.0538)
Trade to GDP ratio	−0.0192	−0.0428	0.0323	0.124***	0.0600
	(0.0261)	(0.0309)	(0.0571)	(0.0358)	(0.0426)
Agriculture value added to GDP	0.00933**	0.0193***	0.0181*	0.0280***	0.0147*
	(0.00468)	(0.00553)	(0.0102)	(0.00647)	(0.00784)
Service value added to GDP	0.00741***	0.000974	0.0223***	0.0147***	0.00693*
	(0.00264)	(0.00312)	(0.00577)	(0.00343)	(0.00415)
Other sector value added to GDP	0.0154***	0.0122***	0.0205***	0.0124***	0.0127***
	(0.00302)	(0.00357)	(0.00661)	(0.00397)	(0.00475)
Constant	9.359***	8.655***	1.112	9.452***	7.192***
	(0.350)	(0.413)	(0.765)	(0.464)	(0.554)
Observations	487	487	487	467	449
R-squared	0.417	0.231	0.551	0.277	0.333
Countries	50	50	50	48	46

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1

Table 13 Channels of change in labor income share (alternative specification)

	Number of employments (logarithm)				
	AGR (1)	MIN (2)	MAN (3)	PU (4)	CON (5)
GDP per capita in 2010 (logarithm)	−0.604***	−0.0722	−0.0373	−0.221***	0.722***
	(0.0490)	(0.118)	(0.0300)	(0.0810)	(0.0498)
Trade to GDP ratio	−0.000306	−0.000757	−0.00166***	4.43e–06	−0.000526
	(0.000591)	(0.00142)	(0.000361)	(0.000979)	(0.000600)
Agriculture value added to GDP	0.0114	0.0687***	−0.00938**	0.00986	0.0321***
	(0.00760)	(0.0182)	(0.00464)	(0.0125)	(0.00770)
Service value added to GDP	−0.00410	0.00813	−0.0160***	0.00649	0.0117***
	(0.00441)	(0.0106)	(0.00268)	(0.00732)	(0.00445)
Other sector value added to GDP	0.00876*	0.0311***	−0.00206	0.00998	0.0311***
	(0.00480)	(0.0117)	(0.00293)	(0.00807)	(0.00486)
Constant	18.47***	9.207***	14.90***	12.03***	4.186***
	(0.544)	(1.296)	(0.331)	(0.892)	(0.550)
Observations	454	447	458	447	458
R-squared	0.476	0.086	0.237	0.033	0.505
Countries	51	50	51	50	51
	Number of employments (logarithm)				
	WRT (6)	TRA (7)	FIRE (8)	GOV (9)	OTH (10)
GDP per capita in 2010 (logarithm)	0.341***	0.294***	0.995***	0.306***	0.452***
	(0.0318)	(0.0361)	(0.0715)	(0.0420)	(0.0507)
Trade to GDP ratio	0.000179	−0.000743*	0.00123	0.000992**	0.000469
	(0.000383)	(0.000436)	(0.000862)	(0.000500)	(0.000600)
Agriculture value added to GDP	0.0143***	0.0246***	0.0175	0.0232***	0.00767
	(0.00491)	(0.00559)	(0.0111)	(0.00684)	(0.00830)
Service value added to GDP	0.0103***	0.00542*	0.0220***	0.0116***	0.00276
	(0.00284)	(0.00323)	(0.00639)	(0.00375)	(0.00451)
Other sector value added to GDP	0.0178***	0.0149***	0.0211***	0.00824**	0.00863*
	(0.00310)	(0.00352)	(0.00698)	(0.00415)	(0.00500)
Constant	9.262***	8.950***	1.334*	9.717***	7.690***
	(0.351)	(0.399)	(0.791)	(0.473)	(0.570)
Observations	458	458	458	438	422
R-squared	0.422	0.208	0.533	0.220	0.301
Countries	51	51	51	49	47

The outcomes from Tables 7 and 8 provide mild support for the employment channel of the link between trade and labor income share. Trade affects firm productivity and employment through different channels. Differences in trade costs and trade imbalances (Smitkova 2018), lower cost of innovation with the availability of new foreign inputs (Goldberg and Pavcnik 2007), resource allocation through more productive firms through export opportunities and competition (Melitz 2003; Melitz and Ottaviano 2008)—such processes of trade adjustment also vary across countries and regions as countries open up and become a part of different trade agreements. All these point to the development of more capital-intensive technologies as the trade intensity increases, which in turn could cause a lower share of labor income if labor and capital are gross substitutes in the production function.

To conclude, the empirical evidence at the sectoral level does not allow us to claim any strong causal relationship between trade and labor income share. We find support for a negative correlation between trade openness and sectoral labor income share; however, the evidence on the relationship between the process of structural transformation and labor income share is at best mixed. Skill-biased structural transformation is likely to be positively correlated with the share of labor income predominantly in the service sectors.

6 Conclusion

There is a growing interest in examining the role of trade in the process of structural transformation. In this paper, we go one step further. Using two novel data sets at the country and sectoral level, we examine the relationship between trade, structural transformation, and labor income share. From the bivariate graphical analysis, we find weak evidence supporting a downward trend of the labor income share following the episode of trade liberalization. The cross-country regression estimates, both at the country and the sectoral level, suggest that trade liberalization is negatively correlated with the labor income share, both at the national and the sectoral level. The negative relationship in the manufacturing sector is somewhat weaker than in other sectors, and such sectoral trends in factor income shares do not alter with trade reforms change over time. While the support for a negative correlation between trade openness and sectoral labor income share is somewhat robust, the evidence on the relationship between the process of structural transformation and labor income share is at best mixed. A case study on Japan shows that a decline in some of the key services sectors could be driven by a significant increase in the part-time workers and female labor force participation rate. There is weak evidence that skill-biased structural transformation is likely to be positively correlated with the share of labor income predominantly in the service sectors.

Appendix 1: Year of Trade Liberalization and Sample Period

Country	Temporal liberalization (if applicable)	Year of liberalization	Sample period	Observation	Average LIS[a]
Middle East and North Africa					
Egypt		1995	1996–2012	17	0.381
Iran		After 2001	1994–2001	8	0.360
Iraq		After 2001	1997–2001	5	0.138
Israel		1985	1995–2013	19	0.571
Jordan		1965	1970–2009	39	0.473
Morocco	1956–64	1984	1998–2011	14	0.503
Tunisia		1989	1992–2011	20	0.510
Regional average					*0.464*
Sub-Saharan Africa					
Benin		1990	1994–1999	6	0.617
Botswana		1979	1992–2000	9	0.318
Burkina Faso		1998	1979–2011	19	0.622
Burundi		1999	1984–2010	11	0.687
Cameroon		1993	1990–1996	5	0.526
Chad		After 2001	1975–2001	8	0.520
Ivory Coast		1994	1989–2000	12	0.520
Gabon		After 2001	1972–2001	8	0.367
Guinea		1986	2003–2010	8	0.384
Kenya	1963–67	1993	2013	1	0.428
Lesotho		After 2001	1997–2001	2	0.685
Mauritania		1995	2001–2006	3	0.536
Mauritius		1968	1995–2010	16	0.470
Mozambique		1995	1996–2003	8	0.462
Niger		1994	1995–2013	19	0.570
Nigeria		After 2001	1981–2001	21	0.303
Rwanda		After 2001	1975–1989	15	0.773
Senegal		After 2001	1991–2001	11	0.388
Sierra Leone		2001	2001–2013	13	0.546
South Africa		1991	1979–2013	30	0.577
Togo		After 2001	1971	1	0.852
Tanzania		1995	1994–2013	20	0.473
Zimbabwe		After 2001	1970–1990	21	0.661
Regional average					*0.533*

(continued)

(continued)

Country	Temporal liberalization (if applicable)	Year of liberalization	Sample period	Observation	Average LIS[a]
East Asia					
Australia		1964	1970–2012	43	0.622
Hong Kong, China		Before 1950	1980–2012	33	0.489
Indonesia		1970	1995–2009	15	0.445
Japan		1964	1980–2012	33	0.644
Malaysia		1963	1970–1983	5	0.607
New Zealand		1986	1983–2013	31	0.559
People's Republic of China		After 2001	1992–2001	10	0.634
Philippines		1988	1992–2012	21	0.405
Republic of Korea		1968	1970–2014	45	0.578
Singapore		1965	1980–2010	31	0.444
Taipei, China		1963	1995–2009	15	0.500
Thailand		Before 1950	1970–2010	41	0.425
Regional average					*0.529*
Latin America and the Caribbean					
Argentina		1991	1993–2007	15	0.438
Barbados		1966	1974–1975	2	0.746
Bolivia	1956–79	1985	1970–2013	42	0.527
Brazil		1991	1992–2009	18	0.535
Chile		1976	1996–2009	14	0.446
Colombia		1986	1992–2012	21	0.685
Costa Rica	1952–61	1986	1970–2012	43	0.615
Dominican Republic		1992	1991–1996	6	0.647
Ecuador	1950–82	1991	1970–2010	26	0.561
Guatemala	1950–61	1988	2001–2012	12	0.437
Honduras	1950–61	1991	2000–2012	13	0.598
Jamaica	1962–73	1989	1970–2013	35	0.570
Mexico		1986	1993–2012	20	0.441
Nicaragua	1950–60	1991	2006–2009	4	0.556
Panama		1996	1996–2012	17	0.423
Paraguay		1989	1994–1998	5	0.523
Peru	1948–67	1991	1979–2010	30	0.409
Trinidad and Tobago		1992	1970–2009	40	0.475
Uruguay		1990	1997–2005	9	0.514

(continued)

(continued)

Country	Temporal liberalization (if applicable)	Year of liberalization	Sample period	Observation	Average LIS[a]
Venezuela	1950–59; 1989–93	1996	1997–2012	16	0.404
Regional average					*0.519*
Europe and Central Asia					
Armenia		1995	1992–2011	17	0.687
Austria		1960	1995–2013	19	0.590
Azerbaijan		1995	1995–2012	18	0.340
Belarus		After 2001	1990–2001	12	0.547
Belgium		1959	1985–2013	29	0.626
Bulgaria		1991	1995–2013	19	0.514
Croatia		After 2001	1997–2001	5	0.690
Cyprus		1960	1995–2013	19	0.507
Czech Republic		1991	1992–2014	23	0.513
Denmark		1959	1995–2014	20	0.640
Estonia		After 2001	1994–2001	8	0.639
Finland		1960	1975–2014	40	0.620
France		1959	1950–2013	64	0.704
Georgia		1996	1998–2013	16	0.399
Germany		1959	1991–2013	23	0.636
Greece		1959	2000–2013	14	0.525
Hungary		1990	1995–2013	19	0.612
Ireland		1966	1999–2013	15	0.484
Italy		1959	1980–2014	35	0.557
Kazakhstan		After 2001	1990–2001	12	0.544
Kyrgyz Republic		1994	1990–2012	23	0.622
Latvia		1993	1994–2013	20	0.571
Lithuania		1993	1995–2013	19	0.515
Luxembourg		1959	1980–2012	20	0.625
Netherlands		1959	1980–2014	35	0.643
Norway		Before 1950	1978–2013	36	0.567
Poland		1990	1995–2013	19	0.610
Portugal		Before 1950	1995–2014	20	0.634
Republic of Moldova		1994	1995–2012	16	0.602
Romania		1992	2004–2012	9	0.518
Russian Federation		After 2001	1997	1	0.702
Serbia		2001	1997–2012	16	0.633
Slovakia		1991	1993–2013	21	0.548
Slovenia		1991	1995–2013	19	0.667

(continued)

(continued)

Country	Temporal liberalization (if applicable)	Year of liberalization	Sample period	Observation	Average LIS[a]
Spain		1959	1995–2013	19	0.629
Sweden		1960	1993–2014	22	0.541
Switzerland		After 2001	1995–2012	18	0.658
TFYR of Macedonia		1994	1990–2011	19	0.654
Tajikistan		1996	2000–2010	11	0.417
Turkey	1950–59	1989	1998–2009	12	0.524
Ukraine		After 2001	1989–1995	7	0.533
United Kingdom		Before 1950	1987–2013	27	0.619
Regional average					*0.589*
South Asia					
India		After 2001	1976–2001	25	0.653
Sri Lanka	1950–56; 1977–83	1991	1983–2012	30	0.728
Regional average					*0.694*
North America					
Canada		1952	1970–2013	44	0.652
United States		Before 1950	1950–2014	65	0.629
Regional average					*0.638*

[a]Nonweighted average labor income share of the sample period
Source Wacziarg and Welch (2008) and authors' calculation

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Chapter 6
Democracy and the Labor Share of Income: A Cross-Country Analysis

Marta Guerriero

Abstract Summary statistics on the labor share of income show that between-country variation is much greater than within-country variation: functional income distribution is determined by factors which change substantially across countries but are persistent over time. This article attempts to shed some light on the long-run and political economy determinants of the labor income share. We revisit and extend previous empirical research on democratic political institutions and the labor share using a dataset of 112 countries over the period 1970–2015. Our empirical analysis shows that democracy allows workers to appropriate a higher share of national income. The evidence is robust to different indices of democracy and different periods of time, and after performing instrumental variable estimation. These results are particularly relevant today, in light of the recent global decline in the labor income share and current crisis of democracy.

Keywords Labor share · Factor income distribution · Democracy · Political economy · Institutions

JEL classification E25 · P16 · O15

1 Introduction

Despite a renewed interest in recent years (Acemoglu and Robinson 2015; Autor et al. 2017; Karabarbounis and Neiman 2013), empirical literature on the labor income share is still relatively scarce and the evidence, especially for developing countries, ambiguous (Harrison et al. 2011). Existing research identifies globalization, financialization, and technological progress (Guscina 2006; Harrison 2002; IMF 2017; Stockhammer 2017) as key drivers of the labor share of income. However, these determinants mainly explain short- and medium-term variation,

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leaving much of the change in the labor share unexplained. Summary statistics, in fact, show that between-variation in the labor share is much greater than within-variation (Guerriero 2019): functional income distribution, similarly to income inequality (Gradstein and Milanovic 2004; Li et al. 1998), appears to be determined by factors which change substantially across countries but are persistent over time.

In recent years, economists have progressively started to take interest in the persistence of inequality and the role of institutional characteristics in affecting not only economic performance but also distributional outcomes (Acemoglu and Robinson 2006; Bentolila and Saint-Paul 2003; Rodrik 1999). Institutions governing political and economic processes are believed to affect both income distribution and its persistence (Bourguignon et al. 2007; Chong and Calderón 2000; Chong and Gradstein 2007). However, despite tentative theoretical consensus that a relationship exists between political institutions and the share of labor, few empirical studies test this hypothesis, the notable exception being Rodrik (1999), who uses a cross-country panel dataset to show that democratic institutions are associated with higher wages.

This study intends to re-examine the existing literature on the relationship between democratic political systems and the labor share of income using a significantly expanded dataset covering 112 countries, both developing and developed. Our estimations consist of a set of cross-sectional regressions in which the labor share is regressed on measures of democracy. Contrary to the majority of the empirical research on democracy and factor shares, which focuses mainly on the manufacturing sector and wealthier countries (Palley 2005; Rodrik 1999), we study a large number of countries and their entire economies, to provide a complete picture of the relationship. Additionally, in extension to the existing literature, we use four different measures of democracy–dichotomous, categorical, and continuous, both censored and not–as we recognize that the definition and measurement of political democracy suffers from several problems (Bollen 1990; Schmitter and Karl 1991). Furthermore, we attempt to provide proof of a causal relationship between democracy and the labor income share by employing event-study analysis, instrumental variable estimation, and the use of lagged explanatory variables. Robust evidence shows that democratic political systems favor labor over capital.

The results of this study qualify and extend previous findings on democracy and factor income distribution. Furthermore, they contribute to the general understanding of the causes of income inequality (Daudey and García-Peñalosa 2007) and are particularly relevant for policymakers in developing and emerging countries that are concerned about reducing excessive inequalities while also sustaining employment.

The remainder of this study is organized as follows. Section 2 discusses previous theoretical and empirical literature on the relationship between democracy and the labor share of income. Section 3 explains the econometric methodology and the

data used in the analysis. Preliminary results from the analysis of descriptive statistics and bivariate relationships are presented in Sect. 4, while Sect. 5 provides the main econometric results. Concluding remarks are drawn in Sect. 6.

2 Political Institutions and the Labor Income Share: A Literature Review

2.1 Theoretical Background

Using two democracy indices and a panel dataset covering the period 1960–1994, Rodrik (1999) demonstrates that democratic political institutions are associated with higher wages in the manufacturing sector. The author argues that this happens because of multiple reasons, but in particular because democracies may directly increase the bargaining power of workers by allowing greater freedom of association and collective action in the political sphere, leading to stronger unions and higher reservation wages (Palley 2005; Rodrik 1999). Democracies may provide a political environment conducive to reforms in labor market institutions, where workers use different forms of collective action to influence the creation of labor legislation that is more partial to their interests (Kristal 2010). Consequently, because of institutional wage determination, democracies may display higher labor costs (Fields and Wan 1989; Savoia et al. 2010) and potentially higher labor income shares.

This channel is only one of the possible mechanisms via which democratic political institutions may affect wages and the labor share of income. Another possible mechanism is through redistributive platforms. Democracies are indeed believed to increase the demand for redistributive taxation (Acemoglu 2008; Acemoglu and Robinson 2006; Bollen and Jackman 1985). In democracies, political power is widely diffused. Regular, free, and fair elections allow workers to vote for parties that privilege redistributive platforms, since workers represent the majority of the population and–according to the median voter model–are fundamental to determining the tax rate (Acemoglu and Robinson 2006). In particular, this may lead to an increase in producers' taxation, a decline in entrepreneurial investment and the redistribution of income from entrepreneurs to workers, or in other words, from capital to labor. In contrast, government revenues and demand for redistribution are lower in autocracies and military dictatorships (Bates 2008).

A third mechanism can be established from the theoretical literature. Democracies may prevent entry barriers against new entrepreneurs. Entry barriers redistribute income away from labor toward capital by stopping the entry of more productive agents into entrepreneurship, and therefore reducing labor demand and wages (Acemoglu 2008). In oligarchies, the rich elite who capture the majority of

the rents also have the resources to lobby for policies which are beneficial to them but harmful to the rest of the society. They may (Li et al. 1998) use their economic power, or even direct political control, to erect significant entry barriers to market and protect themselves from expropriation. A democratic society may encourage greater competition, potentially leading to lower mark-ups on profits and higher wages, and therefore an increase in the labor income share.

In summary, three different theoretical channels help to explain how democracy may influence functional income distribution: wage-setting policies, redistribution, and regulation of entry into market.

2.2 Empirical Evidence

Although research on the labor income share is relatively limited, in the last two decades we have seen a rapid increase in empirical (especially, cross-national) investigations on its determinants (Bentolila and Saint-Paul 2003; Daudey and García-Peñalosa 2007; IMF 2017), including several studies on the role of political institutions (Palley 2005; Rodrik 1999; Young and Lawson 2014). First of all, Rodrik's (1999) article establishes that "democracies pay higher wages" by using cross-section and panel data econometric techniques. As an extension to Rodrik (1999) and using the same dataset, Palley (2005) focuses on the effect of improvements in labor standards on wages and the labor share, concluding that they are associated with better governance and reduced corruption. Finally, a recent empirical study (Young and Lawson 2014) that analyzes the effect of economic institutions (in particular, economic freedom) on the labor income share in a panel of 93 countries, includes political institutions among the control variables in the econometric model. These empirical studies focus prevalently on the manufacturing sector and use measures of labor shares which are not adjusted for self-employment income. Moreover, they use econometric techniques that do not fully address potential endogeneity problems. In addition to the above-mentioned multivariate analyses, Przeworski et al. (2000) use cross-country descriptive statistics for the period 1950–1990 to show that both dictatorships and democracies are more likely to fall when labor receives a low share (less than 25% of valued added). Furthermore, Acemoglu and Robinson (2006) find a positive bivariate correlation between the labor income share and democracy in the 1990s.

Along with the literature on democracy and the labor income share, several empirical studies analyze the impact of political institutions on personal income distribution (Chong and Calderón 2000; Chong and Gradstein 2007; Timmons 2010), often considered to be associated with functional income distribution (Atkinson 2009; Daudey and García-Peñalosa 2007).

3 Econometric Methodology, Empirical Specification, and Data

3.1 The Measurement of the Labor Income Share

'Income shares' refer to the shares of national income which reward the different factors of production. The labor income share is the share of national income compensating labor. This study constructs a dataset of the labor income share around the world following the methodologies proposed by Krueger (1999), Glyn (2009) and Gollin (2002), and using data from the UN National Accounts Statistics. The denominator of the labor share is the income aggregate, Gross Value Added at basic prices, net of fixed capital consumption and measured at factor costs. The numerator is the compensation of employees, calculated in current prices and adjusted for self-employment income. The adjustment we suggest uses data on the composition of the workforce (available from the ILO Yearbooks of Labour Statistics) and imputes average employees' compensation to all workers holding self-employment jobs excluding employers, who are assumed to earn only capital income. This avoids the risk of overestimating the labor share using the imputed wage method (Izyumov and Vahaly 2015). The compiled labor share dataset is an unbalanced panel containing 2,771 observations covering 112 countries, both developed and developing, over the period 1970–2015.

3.2 Empirical Strategy

Our analysis consists of a set of cross-sectional regressions where the labor income share is regressed on a measure of democracy as well as other controls. We choose to utilize cross-sectional, five-year averages for two main reasons: firstly, to circumvent the problem of missing data (Tebaldi and Mohan 2010); secondly, five-year averages are suitable tools when testing for long-run relationships, especially with variables–such as democracy and the labor share–which present long-term rather than short-term variation (Chong and Calderón 2000; Rodrik 1999). The data is grouped into non-overlapping five-year averages covering 10 sub-periods over the period 1970–2015. However, our analysis mainly focuses on the most recent sub-periods (2005–2009 and 2010–2014). Following Rodrik (1999), we adopt the subsequent model specification (see Eq. 1):

$$LS_{i(T-1,T)} = \beta_0 + \beta_1 Democracy_{i(T-1,T)} + \sum_k \delta_k X_{ik(T-1,T)} + \varepsilon_{i(T-1,T)} \quad (1)$$

where $LS_{i(T-1,T)}$ is the average labor income share for country i between the end of the five-year period, T, and the beginning of the five-year period, $T\text{-}1$. $Democracy_{i(T-1,T)}$ is the average political democracy for country i between times

T and *T-1*. $X_{ik(T-1,T)}$ is a vector of control variables. Following Rodrik (1999) and Palley (2005), the model controls for the natural logarithm of GDP per capita, as a proxy for structural determinants correlated to the level of economic development and to avoid capturing the effect of economic development in the coefficient of democracy. A dummy variable for oil exporters and a set of geographical/economic dummies (for East Asia, Latin America, Sub-Saharan Africa, socialist countries and OECD member states[1]) are also included. Finally, $\varepsilon_{i(T-1,T)}$ is the error term.

3.3 The Data

The explanatory variable of interest is a measure of political institutions. As there is disagreement among scholars about the proper way to measure democracy (Cheibub et al. 2010; Coppedge et al. 2008; Elkins 2000; Munck and Verkuilen 2002), we consider four alternative indicators suggested in the existing literature.

Polity IV: The first measure of democracy is derived from the Center for Systemic Peace Polity IV dataset (Jaggers and Gurr 1995; Marshall and Jaggers 2016), which contains annual democracy indicators over the period 1800–2015 for all independent countries with a population greater than 500,000. This variable has been widely used in the literature (Acemoglu et al. 2008; Barro 1996; Rodrik 1999). The Polity IV index measures a country's constraints on executive power and is subjectively coded by the authors on the basis of: intensity of political competition, regulation of political participation, competitiveness of executive recruitment, openness of executive recruitment, and constraints placed on the chief executive. Specifically, the authors construct two measures: a democracy indicator (*democ*) and an autocracy indicator (*autoc*). The combined polity score is then computed by subtracting the *autoc* score from the *democ* score and it ranges from +10 (strongly democratic) to −10 (strongly autocratic). The revised combined polity score (*polity2*), which is used in this analysis, is a modified version introduced to facilitate time series analysis. We rescale the *polity2* index to range from 0 to 1.

Freedom House: The *Freedom in the World* survey provides annual evaluations of the state of freedom in 195 countries and 14 territories for the period 1972–2015. The dataset has been extensively used in existing empirical work on the relationship between democracy and economic growth (Acemoglu et al. 2008; Barro 1996; Helliwell 1994). Derived from the work of Gastil and others (Freedom House 2017), it represents a subjective classification of freedom as experienced by individuals. It is measured according to two broad categories: political rights (*prights*, the rights which enable people to participate freely in the political process) and civil liberties (*civlib*, the rights which allow for freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy). Each country is assigned a numerical rating–on a scale from 1 to 7, where higher values

[1]The OECD sample is composed of today's OECD member countries.

signify lower freedom. Following Helliwell (1994) and Rodrik (1999), we combine the two ratings into a single index that varies from 0 to 1 (with higher values indicating greater freedom) using the transformation *[14 – civlib – prights]/12*.

Vanhanen's Index of Democratization: As noted in Benhabib et al. (2013), a feature of the Polity IV and the Freedom House indices is that their data are bounded: a substantial share of countries in the sample are designated as full democracies, and a large group of full democracies remain so throughout the entire time period considered in this study.[2] In order to address this concern, we consider a measure of democracy which, unlike the two previous indices, is not censored on the right-hand side (Benhabib et al. 2013). Compiled by Tatu Vanhanen (Vanhanen 2000; Vanhanen 2003; Vanhanen 2016), the Index of Democratization covers 195 countries over the period 1810–2014. Countries which were considered democracies decades ago can still show gains in recent years.[3] The indicator is a composite measure of two theoretical dimensions of democracy: intensity of public contestation (*competition*, measured by the smaller parties' share of votes cast in the elections) and voter's participation rights (*participation*, measured by the percentage of the population which voted in the same elections); these are combined together into an overall Index of Democratization (ID), which we then rescale to range from 0 to 1.

Democracy and Dictatorship (D/D) Revisited: One of the concerns in the debate on the measurement of democracy is related to whether democracy should be treated as a dichotomous, ordinal, or continuous variable. Bollen (1990), for example, describes the intensity of democracy as continuous by nature and regards a dichotomous index as a crude pooling of heterogeneous political regimes into a single category. On the other hand, Przeworski et al. (2000) reject the notion of a continuum and claim that a country is either democratic or not. To accommodate for the latter point of view, the fourth democracy indicator considered in this study is a dichotomous regime classification, which was first introduced in Alvarez et al. (1996) and Przeworski et al. (2000), and later revisited and extended in Cheibub et al. (2010). A regime is classified as a democracy if it meets all of the following requirements: the chief executive is chosen by popular election or by a popularly elected body, the legislature is popularly elected, there is more than one political party competing in the elections, an alternation in power under electoral rules must have taken place.

Among the control variables, data on natural logarithm of GDP per capita have been collected from the Penn World Tables 9.0 (Feenstra et al. 2015; Summers and Heston 1988). The regional dummy variables have been constructed using the geographical classification of the UN Statistics Division. Dummy variables for

[2]For example, the Polity IV score for Switzerland is equal to its maximum since 1848.

[3]For example, Switzerland's score ranges from a value of 23.04 to a value of 43.4 in the period 1970–2015.

OECD member countries and oil exporters (OPEC members) have been created by looking at the list of members of both organizations and the dummy for socialist countries by analyzing the political history of the individual countries.

4 Some Stylized Facts

4.1 Overview of the Data

Table 1 contains summary statistics for all variables utilized in this study[4] for the entire period 1970–2015. The labor share measure has been rescaled ranging from 0 to 100.

As previously mentioned, between-variation in the labor share is much larger than within-variation, suggesting that the labor share of income changes considerably across countries but is relatively persistent over time. Political institutions, which are also rather persistent, could represent a plausible explanatory factor of income distribution. For example, if we consider the binary variable of democracy/dictatorship, there are only 11 countries[5] that experience a transition from autocracy to democracy for which we possess continuous yearly data on the adjusted labor share for the period when the switch occurred.

4.2 Democracy and the Labor Income Share: A Preliminary Analysis

Table 2 presents a preliminary evaluation of the relationship between democracy and the adjusted labor share of income. It shows pair-wise correlation coefficients between the labor share, the four variables of democracy, and the other regressors in the benchmark model, for the entire period.

Firstly, the four indicators of democracy are significantly and highly correlated with each other (their correlation coefficients being always greater than 0.79). Secondly, there is a significant and positive pair-wise correlation between democracy and the labor share of national income. This correlation is relatively large (greater than 0.42) for all four variables of democracy. Thirdly, there is a positive and significant correlation (greater than 0.38) between each of the democracy indices and the control variable, natural logarithm of GDP per capita. Several studies have indeed suggested that democracy may be associated with

[4]Some of the variables presented in this table are discussed in Sect. 5.

[5]Bolivia, Chile, Ecuador, Georgia, the Kyrgyz Republic, Mexico, Peru, Senegal, the Republic of Korea, Sri Lanka, and Thailand.

Table 1 Overview of the data: summary statistics

Variable		Mean	St. Deviation	Min	Max	Observations
Year	Overall	1992.5	13.277	1970	2015	N = 6,486, n = 141, $\overline{T}$ = 46
Measures of labor share						
Unadjusted (%)	Overall	48.155	16.938	3.5103	84.5974	N = 3372
	Between		16.659	12.665	76.6105	n = 141
	Within		5.0522	15.495	70.3157	$\overline{T}$ = 23.915
Adjusted (%)	Overall	65.899	15.627	7.3938	99.7760	N = 2771
	Between		15.164	23.576	91.3094	n = 112
	Within		6.8434	35.497	95.7221	$\overline{T}$ = 24.741
Explanatory variables						
Polity IV	Overall	0.6090	0.3675	0.0000	1.0000	N = 5,358, n = 126
Freedom House	Overall	0.5894	0.3335	0.0000	1.0000	N = 5,534, n = 141
Vanhanen	Overall	0.3017	0.2791	0.0000	1.0000	N = 5,372, n = 129
D/D	Overall	0.4945	0.5000	0.0000	1.0000	N = 4,646, n = 130
GDP per capita	Overall	14,779.0	19,830.6	408.02	245,077.8	N = 5,471, n = 130
Instruments:						
Legal_uk	Overall	0.2774	0.4477	0.0000	1.0000	N = 6,302, n = 136
Legal_fr	Overall	0.5328	0.4990	0.0000	1.0000	N = 6,302, n = 136
Legal_ge	Overall	0.1460	0.3531	0.0000	1.0000	N = 6,302, n = 136
Legal_sc	Overall	0.0365	0.1875	0.0000	1.0000	N = 6,302, n = 136
Legal_so	Overall	0.0073	0.0851	0.0000	1.0000	N = 6,302, n = 136
Latitude	Overall	22.476	26.306	–41.814	67.470	N = 5,566, n = 121
Coastland	Overall	0.3519	0.3512	0.0000	1.0000	N = 5,566, n = 121
Malaria	Overall	0.5745	0.4245	0.0000	1.0000	N = 5,704, n = 124

(continued)

Table 1 (continued)

Variable		Mean	St. Deviation	Min	Max	Observations
Fractionalization	Overall	0.4424	0.2463	0.0040	1.0000	N = 5,520, n = 120
Nat. resources	Overall	6.6162	10.509	0.0000	89.596	N = 5,720, n = 141
Dummy variables						
OECD members	Overall	0.2482	0.4320	0.0000	1.0000	N = 6,486, n = 141
OPEC members	Overall	0.0922	0.2893	0.0000	1.0000	N = 6,486, n = 141
Social. countries	Overall	0.0967	0.2955	0.0000	1.0000	N = 6,486, n = 141
Latin America	Overall	0.1206	0.3256	0.0000	1.0000	N = 6,486, n = 141
Sub-Sah. Africa	Overall	0.2199	0.4142	0.0000	1.0000	N = 6,486, n = 141
East Asia	Overall	0.0780	0.2682	0.0000	1.0000	N = 6,486, n = 141

Source Author's calculations

Table 2 Overview of the data: pair-wise correlation matrix

	Adjusted LS	Polity IV	Fr. House	Vanhanen	D/D	Ln (GDP)	Oil Exporters
Adjusted LS	1.000						
Polity IV	0.4900*	1.0000					
Fr. House	0.4793*	0.8924*	1.0000				
Vanhanen	0.4589*	0.8258*	0.8322*	1.0000			
D/D	0.4235*	0.8543*	0.8267*	0.7919*	1.0000		
Ln(GDP)	–0.0540*	0.3867*	0.5163*	0.5875*	0.4188*	1.000	
Oil exporters	–0.4130*	–0.3168*	–0.3159*	–0.2705*	–0.2359*	0.1118*	1.000

Source Author's calculations. Please note: *p < 0.05

greater economic development (Acemoglu et al. 2001; Barro 1996; Przeworski et al. 2000). This correlation needs to be taken into careful consideration as it may increase the risk of collinearity between the explanatory variables in our model.

Figure 1 presents ten-year averaged bivariate scatter plots of the three continuous democracy indices and the labor share for the most recent 10-year period (2005–2014). Consistent with the correlation coefficients presented above, the relationship with the labor share is positive for all three democracy indicators.[6]

Moreover, as can be seen from Table 3 and Fig. 2, it appears that the difference between democracies and dictatorships is increasing over time, as the labor share remains almost constant on average in democracies, while it declines very rapidly in dictatorships. This preliminary result could indicate that the global decline in the labor share may be explained, at least in part, by economic changes within autocratic regimes, or by a decrease in democracy levels around the world. This latter hypothesis is supported by the findings of Freedom House (2017), according to which the number of 'free' countries in the world has been declining over the last decade. Finally, Fig. 2 seems to also suggest that the labor income share is more stable in democracies and more volatile in dictatorships.

In conclusion, a preliminary analysis of the data shows that the labor share of income is higher and more stable in democracies than in autocracies. This is consistent with the results in Rodrik (1999), which showed that democracies pay higher wages. The results are similar across all four indicators of democracy. Nonetheless, simple correlations do not allow us to infer any causal relationship. A more robust multivariate analysis needs to be carried out in order to appropriately answer our research questions.

[6]Similar relationships are found with year-by-year scatter plots.

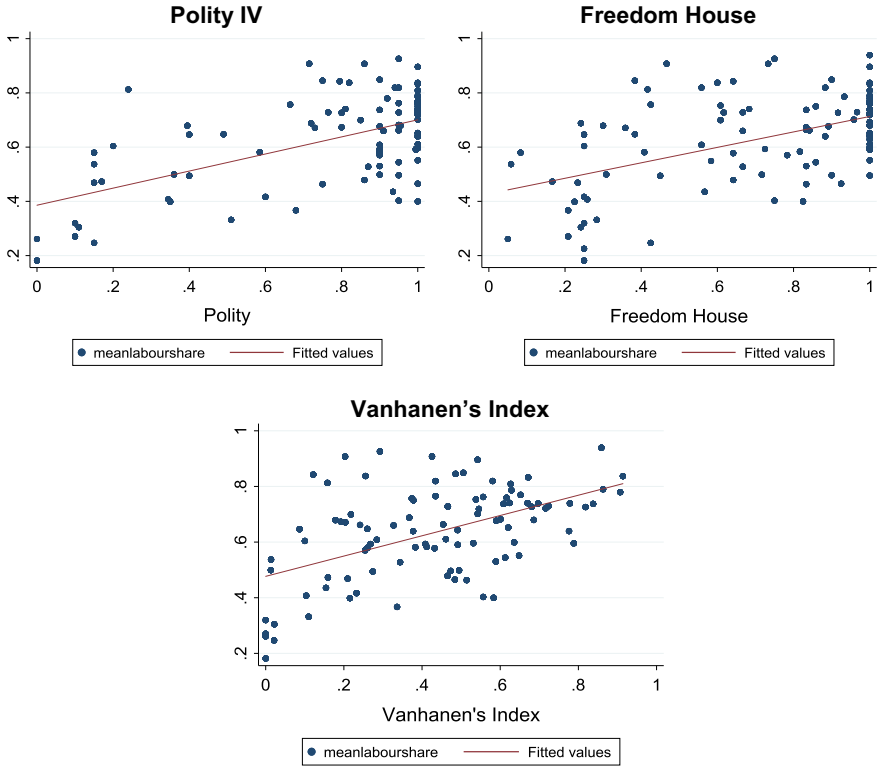

Fig. 1 Bivariate Scatter Plots: Democracy and the Labor Share, 2005–2014. *Source* Author's calculations

Table 3 Adjusted labor share averages in democracies and dictatorships

	Dictatorship	Democracy
1970–2008	57.4704	71.3392
1970s	64.4864	72.0245
1980s	64.8542	72.4788
1990s	56.8297	71.9457
2000s	50.6231	69.9678

Source Author's calculations

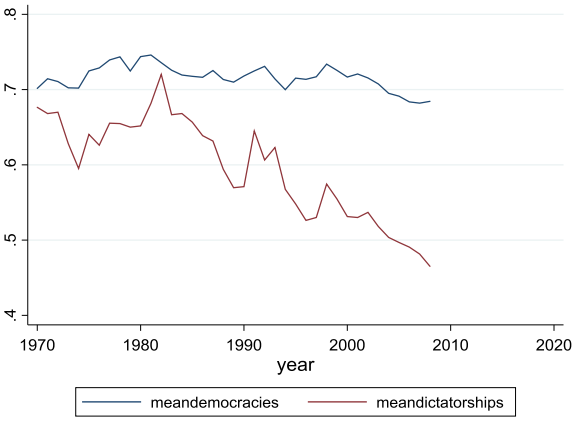

Fig. 2 Adjusted Labor Share Averages in Democracies and Dictatorships. *Source* Author's calculations

5 Econometric Results

5.1 Benchmark Estimation

Table 4 displays cross-sectional regression results for all four democracy indicators for the sub-period 2005–2009, and the three continuous indices for the most recent period (2010–2014).[7] The models presented in the table differ according to the variables used to measure democracy. The natural logarithm of GDP per capita, a dummy variable for oil exporters, regional dummies for East Asia, Sub-Saharan Africa, and Latin America, as well as dummies for socialist countries and OECD members have been introduced as controls across all specifications.[8] Heteroskedasticity robust standard errors have been utilized throughout the analysis, in order to correct for the possible presence of arbitrary heteroskedasticity of the residuals, leading to incorrect standard errors.

The first four columns show the results for the sub-period 2005–2009. Column 1 presents the results for the Polity IV index, column 2 the Freedom House index, column 3 the Vanhanen's index and column 4 the dichotomous variable of democracy/dictatorship. All coefficients on democracy are positive and strongly significant. As hypothesized, democracy has a positive and significant effect on the labor share of national income. Non-democratic regimes, where the majority of the population are disenfranchised, may be harmful for labor outcomes. The magnitudes of the coefficients vary across the four columns, indicating that a transition from an absolute dictatorship to an absolute democracy in the sub-period 2005–2009 would have corresponded to an increase of approximately 14–34 percentage

[7]No data is available for the dichotomous variable for the period 2010–2014.

[8]Only the results for oil exporters and the natural logarithm of GDP per capita are presented in the table.

Table 4 Cross-sectional results using 5-year averaged data for 2005–2009 and 2010–2014

Dep. Var.	2005–2009				2010–2014		
Adjusted LS (%)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Polity IV	25.40***				29.80***		
	(7.287)				(8.639)		
Freedom House		25.51***				32.30***	
		(7.475)				(8.643)	
Vanhanen's index			33.89***				35.27***
			(7.374)				(13.27)
D/D				13.82***			
				(4.952)			
Ln(GDP)	–5.944**	–8.180***	–7.465***	–4.684*	–4.917*	–10.04***	–6.857**
	(2.327)	(2.062)	(2.208)	(2.420)	(2.907)	(2.737)	(2.854)
Oil exporters	–6.673	–8.389	–9.960**	–13.52***	–3.749	–0.149	–8.417
	(4.992)	(5.375)	(4.427)	(4.659)	(7.361)	(6.589)	(6.522)
_cons	100.4***	123.2***	119.7***	97.62***	91.37***	141.0***	116.2***
	(24.65)	(20.08)	(21.76)	(23.91)	(30.26)	(26.33)	(29.53)
N	95	101	97	98	63	68	63
R^2	0.494	0.473	0.505	0.470	0.3597	0.3936	0.3302

Please note: Heteroskedasticity robust standard errors in parentheses. Regressions include dummies for East Asia, Latin America, Sub-Saharan Africa, socialist countries and OECD members (coefficient estimates not shown). *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source Author's calculations

points in the labor share. These effects are quantitatively comparable to those presented in Rodrik (1999).[9]

Columns 5, 6, and 7 present data for the sub-period 2010–2014 (for Polity IV, Freedom House, and Vanhanen's index, respectively). The coefficient estimates are very similar to those in columns 1, 2, and 3, in terms of sign and significance, suggesting that the effect of democracy on the labor income share has not changed in the last two sub-periods. The magnitude has increased slightly. In summary, democracy exerts a statistically significant impact on the labor share in the sample studied.

With respect to the control variables, the labor share is unsurprisingly lower in oil-producing countries, their incomes being less dependent on labor wages and more dependent on land rents. However, this result is not significant across all specifications.

GDP per capita displays a negative and significant relationship with the share of labor in national income. This result contradicts the existing literature (Palley 2005; Rodrik 1999; Young and Lawson 2014) and it can be explained by the fact that previous empirical studies use unadjusted measures of labor share, which do not account for mixed income and tend to be positively correlated to economic development because of the higher share of self-employed in poorer economies (Gollin 2002). Therefore, the unadjusted labor share is more likely to be lower in countries with lower per capita income. After appropriately adjusting for self-employment income (Bernanke and Gürkaynak 2001; Gollin 2002), the relationship between labor income share and economic development is no longer straightforward. When performing the above estimations with the unadjusted labor share,[10] the results are broadly consistent for all coefficients apart from the coefficient on economic development, displaying a positive relationship.

The negative coefficient on GDP per capita is also interesting since political institutions and economic development are correlated with each other, as can be seen from Table 2 and has often been argued in the political economy literature (Acemoglu et al 2001; Barro 1996; Przeworski et al 2000). Although there is no clear empirical consensus, a number of studies contend that democratic institutions are conducive to economic development when they secure greater stability and create broad-based opportunities for the population; simultaneously, democratic regimes are more likely to be created and consolidated in affluent societies. This correlation could potentially affect our results, leading to collinearity (on the one hand, economic development may influence the labor share through a process of 'democratization'; on the other hand, democracy, which is also growth-enhancing, may have a positive effect on the labor share of income). However, the opposing signs of the two coefficients (of democracy and GDP per capita) indicate the

[9]Rodrik's (1999) article mainly focuses on wages and not the share of labour. However, among the various estimations, the author includes a panel data regression of the impact of democracy on the labour share. His estimated coefficients range from 11 to 41.

[10]Results not presented here.

presence of two different mechanisms: once we isolate democracy from economic development, democracy has a positive effect while the impact of economic development is negative.

We conduct several robustness checks on the benchmark estimation: we include a number of control variables, perform the same estimation for different time periods and use alternative measures of labor income share.[11] The econometric results are consistent and confirm our findings that democracy is relevant to functional income distribution.

5.2 *Empirical Concern: Endogeneity*

Endogeneity is an important concern in the empirical analysis of the democracy-labor share nexus. In particular, endogeneity problems may arise from possible double causality between institutional strength and income distribution (Chong and Gradstein 2007). Various scholars have indeed argued that the distribution of income is an important determinant of whether an economy possesses "weak" or "strong" institutions (Young and Lawson 2014). Countries with a large middle class, and consequently relatively high wage levels and a large labor share, may be more likely to make a transition to democracy or to remain one (Rodrik 1999). For example, Easterly (2001) finds that a higher share of income among the middle class is associated with greater levels of democracy and political stability.

Moreover, as we know from the literature, income inequality may be linked to political instability and poor democratic development (Savoia et al 2010). A wide theoretical and empirical literature discusses the possibility of an inverted U-shaped relationship between inequality and the likelihood of transition to democracy (Acemoglu and Robinson 2006; Boix 2003; Midlarski 1999; Przeworski et al 2000). A certain degree of inequality may be required for the initiation of a democratization process, as higher inequality makes revolution–and the egalitarian promises of democracies–more attractive for the citizens. However, the higher the level of inequality, the more unbalanced the access to economic opportunities is, and the more the elites will resist democratization. The richer the elites at the top of the distribution are, the greater the extent to which they would be worse off after a prospective redistribution of political power and economic resources. For these reasons, Przeworski et al (2000) discuss the fact that both dictatorships and democracies are more likely to fall when labor receives a low share.[12]

In order to seek proof of causality, we first provide event-study evidence from countries that have experienced a significant transformation in terms of political regime. A before-and-after approach allows us to directly examine the effect of

[11]Results not presented here.

[12]According to the authors, less than 25% of value added.

Table 5 Labor shares and political regime transitions

Country	Year	Average LS (Polity IV) pre-transition	Average LS (Polity IV) post-transition	Democratization episode. Brief description
Bolivia	1982	57.26 (–6)	58.70 (+8)	Return to civilian rule. Reconvention of democratic constitution
Chile	1990	54.59 (+0.3)	56.70 (+8)	First free and fair presidential elections. End of military rule of A. Pinochet
Ecuador	1979	50.36 (–5)	51.71 (+9)	First presidential elections. End of military power
Kyrgyz Republic	2005	72.23 (–3)	67.20 (+3.3)	First Kyrgyz Revolution. End of the rule by authoritarian President A. Akayev
Senegal	2000	75.09 (–1)	75.58 (+8)	Presidential election. New constitution limiting power of prime minister and length of presidential term
Republic of Korea	1988	86.58 (–3)	87.40 (+6)	Civilian government replacing military rule
Thailand	1979	68.34 (–2.3)	77.21 (+2)	Restoration of parliamentary elections
Country	**Year**	**Average LS (Polity IV) Pre-coup**	**Average LS (Polity IV) Post-coup**	**Episode of coup d'état. Brief description**
Algeria	1992	65.24 (–2)	63.36 (–7)	Start of the Algerian civil war
Ecuador	1972	55.84 (0)	50.25 (–5)	Military coup
Fiji	1987	87.45 (+9)	78.44 (–3)	Two military coups

Source Author's calculations

political institutions on the labor share, as it partially accounts for time-invariant and country-specific factors.

Table 5 above presents specific instances of change in the labor share following transitions from dictatorship to democracy and coups d'état. Seven instances of transition to democracy have been selected, according to availability of data and the presence of a clear, rapid transition.[13] For each country, the table shows pre- and post-transition levels of the labor share and the Polity IV index (averages of three observations prior to and following the year of transition). In six cases (out of seven), the transition to democracy led to an increase in the labor income share. The only exception is the Kyrgyz Republic. However, according to the Polity IV classification, the Kyrgyz Republic did not experience a full transition in 2005, remaining an anocracy after the revolution.

[13]Where both the dichotomous variable switches from 0 to 1 and the Polity IV index exhibits a discontinuous change.

Three instances of coups d'état are also presented. They have been identified using Przeworski et al.'s (2013) Political Institutions and Political Events (PIPE) Dataset and availability of data on the labor share. In all cases, the labor income share appears to drop considerably following the coup d'état, suggesting that political stability, and not just the type of political regime, may also have an important effect on the share of labor in national income.

From the event-study evidence, it is possible to see a pattern of causality going from political regime to the labor share. However, in order to better address endogeneity, we utilize instrumental variable (IV) methods and suitable instruments for democracy. Several instrumental variables have indeed been introduced in the empirical literature on political institutions and development (Tebaldi and Mohan 2010).

Firstly, studies suggest that current variation in institutional quality can be explained by geography-related variables and their effect on historical factors (Acemoglu et al 2001; Hall and Jones 1999; McArthur and Sachs 2001). For example, geography played an important role in the creation of early institutions during colonialism, which have then shaped current modern institutions (Denoon 1983). Colonization may have acted in response to certain environmental surroundings: colonies with more favorable geographical conditions or which are geographically closer to the West were better able to replicate European-style settlements and institutions (Acemoglu et al 2001).

Other researchers (LaPorta et al 1999) argue that legal history is relevant to the political regime type. Current political institutions within a country have historical roots in the origin of its legal system.

Thirdly, it has been argued (Dulleck and Frijters 2004) that natural resources are an important determinant of institutional outcomes. A sizable natural resource sector may be associated with a failure to democratize because of the large incentives of the ruling elites to predate rich resource rents (Bates 2008). Acemoglu et al (2010) showed that greater natural resource rents make military coups more likely–see, for example, countries like Sudan, Nigeria, and Angola–and they induce more severe political moral hazard.

Finally, another branch of the institutional literature focuses on ethno-linguistic fragmentation (Alesina et al 2003; Easterly and Levine 1997; Posner 2004). Ethnic conflict is an important determinant of the political economy of many nations and it may lead to political instability and poor-quality institutions. Moreover, in ethnically fragmented communities, public goods provision may be less efficient, and participation in social activities and trust may be lower. This is particularly relevant in the developing world, where states are often "artificial" (created by previous colonialists rather than representing underlying ethnic groups), such as for example in the Middle East and in Sub-Saharan Africa, but also in South Asia after the partition of India and Pakistan (Alesina et al 2011).

Empirically, the ideas discussed above suggest that democracy could be modeled as in the following equation:

$$Democracy_{i(T-1,T)} = \gamma_0 + \sum_k \gamma_k I_{ik(T-1,T)} + \eta_{i(T-1,T)} \quad (2)$$

Where $Democracy_{i(T-1,T)}$ is the average level of democracy for country *i* between the end of the five-year period, *T*, and the beginning of the five-year period, *T-1*. $I_{ik(T-1,T)}$ is a vector of instruments: geographical variables, measures of legal origin, a measure of natural resource rents and a measure of ethno-linguistic fragmentation.[14] Finally, $\eta_{i(T-1,T)}$ is the error term.

The geographical variables are taken from Gallup et al. (1999) Geography Datasets (Center for International Development, Harvard University). We use the absolute value of the latitude of a country centroid, the proportion of a country's total land area within 100 km of the coastline and an index of malaria prevalence in the country in 1946 to capture the historical effect of geography. Legal legacy is taken from LaPorta et al. (2008) and measured by a set of dummy variables that identify the origin of the legal system: English (*legal_uk*), French (*legal_fr*), German (*legal_ge*), Scandinavian (*legal_sc*) or socialist (*legal_so*). As a measure of natural resource wealth, we employ total natural resource rents (as a percentage of GDP), derived from the World Bank. Finally, the measure of ethno-linguistic fragmentation is taken from Fearon and Laitin (2003). It consists of an index of fractionalization capturing the probability that two individuals randomly selected from the population of a country belong to two different ethno-linguistic groups (Easterly and Levine 1997).

Because of the characteristics of the variables of democracy, using a simple Two-stage Least Squares (2SLS) method for the instrumental variable estimation, as previous studies have done (Rodrik 1999; Tebaldi and Mohan 2010; Young and Lawson 2014), may lead to incorrect estimates. As previously mentioned (Benhabib et al. 2013), both the Polity IV and the Freedom House index are right-censored, with a substantial mass of countries at the boundary. Consequently, we use non-linear estimation methods in the first step[15]: a *tobit* estimation for Polity IV and Freedom House, a logistic estimation for the dichotomous variable of democracy, and a simple OLS estimation for Vanhanen's Index of Democratization, which is neither censored nor dichotomous.

[14]In addition to the above suggestions, Young and Lawson (2014) instrument democracy with a measure of a country's checks and balances (Keefer and Stasavage 2002; Keefer and Stasavage 2003). With respect to this measure, we argue that it is not exogenous, as it is itself a manifestation of the presence of democracy. For example, the extent of institutionalised constraints on the exercise of executive power is one of the components of the Polity IV index. As such, it may be correlated with the error term.

[15]Przeworski et al. (2000) use probit with the dichotomous variable of Democracy/Dictatorship. Epstein et al. (2006) and Benhabib et al (2013) use tobit with the Polity IV and the Freedom House indices. Also, Barro (1999) argues that the use of non-linear estimation would improve his approach.

Table 6 Second-stage IV estimation of the labor share on democracy. five-year averaged data (Most recent period)

Dep. Var: LS (%)	First stage: tobit 2010–2014 (1)	First stage: tobit 2010–2014 (2)	First stage: OLS 2010–2014 (3)	First stage: logit 2005–2009 (4)
Polity IV	55.24***			
	(16.56)			
Freedom house		54.95***		
		(15.03)		
Vanhanen's index			64.12***	
			(16.58)	
D/D				34.98***
				(9.962)
Ln(GDP)	–3.135	–10.26***	–4.931*	–2.551
	(2.970)	(3.085)	(2.743)	(2.561)
Oil exporters	2.254	5.036	–8.492	–10.19
	(7.849)	(6.673)	(6.316)	(6.907)
_cons	59.96*	133.6***	89.51***	68.10***
	(33.44)	(26.61)	(28.18)	(23.59)
N	56	57	56	43
R^2	0.2438	0.3207	0.2523	0.3797

Please note: Heteroskedasticity robust standard errors in parentheses. Regressions include dummies for East Asia, Latin America, Sub-Saharan Africa, socialist countries and OECD members (coefficient estimates not shown). All first-stage regressions are estimated including the following set of variables: absolute latitude, proportion of land within 100 km of the seacoast, malaria prevalence in 1946, dummies for the origin of the legal system, ethno-linguistic fragmentation, and natural resource rents. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instrumented variables: Polity IV, Freedom House index, Vanhanen's Index of Democratization, Democracy/Dictatorship
Source Author's calculations

Table 6 reports the results of the second-stage regressions[16]: columns 1–4 show that, also accounting for endogeneity, democracy is strongly and positively correlated to the labor share of income. All four coefficients on democracy are positive, significant, and larger in size compared to the simple OLS estimations. Among the controls, GDP per capita displays negative coefficients.

Another possible way to address reverse causality is to employ lagged values of the democracy variable (Rodrik 1999; Young and Lawson 2014), as it would be safe to argue that contemporaneous shocks to the labor share cannot influence prior institutional developments.

The choice of time lags is only motivated by the fact that institutional effects unfold over time. As argued by Gerring et al. (2005), political regimes are

[16]Relevant post-estimation tests have been performed, but not presented here.

Table 7 Lagged democracy and the labor share

Dep. Var: LS (%) (2010–2014)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polity IV (2005–2009)	33.86***							
	(8.856)							
Polity IV (1970–2009)		39.97***						
		(6.424)						
Fr. house (2005–2009)			33.78***					
			(9.601)					
Fr. house (1970–2009)				44.40***				
				(8.894)				
Vanhanen (2005–2009)					40.91***			
					(9.919)			
Vanhanen (1970–2009)						56.50***		
						(9.773)		
D/D (2005–2009)							16.64***	
							(5.527)	
D/D (1970–2009)								21.58***
								(5.406)
Ln(GDP)	–5.540*	–7.437***	–10.11***	–10.54***	–8.244***	–9.016***	–4.999	–6.627**
	(2.882)	(2.655)	(2.714)	(2.587)	(2.845)	(2.809)	(3.108)	(2.988)
Oil exporters	–0.451	–1.987	–0.419	–0.297	–3.368	–2.204	–7.519	–7.626
	(7.093)	(4.896)	(6.658)	(5.440)	(5.877)	(5.150)	(6.231)	(5.602)
_cons	95.79***	114.3***	140.7***	141.5***	128.7***	134.7***	102.7***	118.3***
	(29.88)	(27.35)	(26.02)	(25.06)	(28.20)	(28.11)	(30.36)	(29.40)
N	62	64	68	69	63	63	64	64
R^2	0.3873	0.5030	0.3923	0.4896	0.3817	0.4395	0.3444	0.3925

Please note: Heteroskedasticity robust standard errors in parentheses. Regressions include dummies for East Asia, Latin America, Sub-Saharan Africa, socialist countries and OECD members (coefficient estimates not shown). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source Author's calculations

"historically informed phenomena" rather than "contemporary variables" (p. 325) and should be considered as *stocks* instead of *levels*. Democracy and dictatorship may originate from deep legacies, which extend for several years.

In order to both control for endogeneity and for the accumulated effect of 'historical legacies', we use two different alternatives: a one-period lag of the democracy variable and the average of democracy for the entire period preceding the relevant sub-period. Table 7 displays cross-sectional regression results for all four democracy indicators. In column 1, we regress the average labor share for the sub-period 2010–2014 on the average of the Polity IV variable in the preceding sub-period (2005–2009) and the other controls. Columns 3, 5, and 7 present the results for the Freedom House index, the Vanhanen's Index of Democratization and the dichotomous variable of democracy. As expected, the estimated coefficients on democracy are positive and strongly significant. Moreover, they are larger in magnitude compared to the coefficients estimated in Table 4. This means that the lagged effect of democracy on the labor income share is actually larger than the contemporaneous effect. It is indeed plausible that labor contracts and capital structure do not adjust immediately to institutional quality.

Columns 2, 4, 6 and 8 display the results of the 'historical legacy' of democracy: the transition from an absolute dictatorship to an absolute democracy in the 40 years prior to 2010 corresponds to an increase of at least 20 percentage points in the labor share in the period 2010–2014. These results are robust to the use of all variables of democracy: all coefficients on lagged democracy are positive, strongly significant, and larger in size compared to the contemporaneous data.

In summary, these results help us to tackle the reverse causality issue and reinforce the argument that democracy has a positive and significant influence on the labor share of income. Our instrumental variable estimation confirms the results obtained in Table 4. Moreover, democracy also has a positive and significant lagged effect on the labor income share. This effect is larger in size compared to the contemporaneous effect. This result corroborates a vast literature maintaining that there is a considerable time lag between institutional change and its impact.

6 Concluding Remarks

This study investigates the political economy determinants of the labor share of income and, in particular, it studies the association between democratic political regimes and the labor share. Its fundamental aim is to revisit and extend previous evidence on the relationship between democracy and the labor income share with the use of a significantly expanded dataset covering 112 countries, both developing and developed.

Our empirical results find that democratic political systems favor labor over capital. The evidence is robust across different specifications, utilizing different indices of democracy and different periods of time. Moreover, confirmation of the

presence of a causal relationship is obtained through event-study evidence, the use of lagged regressors and instrumental variable estimation.

These results support earlier literature on democracy and income distribution. They are particularly relevant today, in light of the recent global decline in the labor income share and current crisis of democracy. According to Freedom House (2017), political rights and civil liberties today are at their lowest level in the last 12 years. Simultaneously, several studies document a decline in the labor income share in recent decades (IMF 2017; Karabarbounis and Neiman 2013; Stockhammer 2017).

Our results are especially insightful for policymakers who are concerned about reducing excessive inequalities while also sustaining employment. On a socio-political level, a low labor share may jeopardize socio-political stability if workers perceive that they are not receiving a 'fair' share of the wealth they help to produce. On an economic level, it may threaten the sustainability of economic expansion and hamper wage-based household consumption (Atkinson 2009).

As possible avenues of research extending these results, it would be useful to 'disaggregate' democratic and autocratic regimes, in order to analyze how different regimes produce different effects on the labor share. As the literature suggests, differences in the *type* of political regimes may influence a large number of economic outcomes (Wright 2008). Moreover, further investigation could be conducted to test for democracy's channels of influence, to better understand how political institutions influence the labor income share as well as the ways in which political institutions interact with other types of institutions, formal or informal, to generate complex dynamics (Amendola et al. 2013). Furthermore, as shown in the event-study evidence, not just the type of political regime, but also its stability seems to influence the labor share–therefore, it would be interesting to further explore this relationship.

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Part II
The Drivers of Labor Income Share

Chapter 7
Trade, Labor Share, and Productivity in India's Industries

Dibyendu Maiti

Abstract This paper explores whether trade can explain a part of the sharp decline in the labor share of Indian formal industries from around 30% in 1980 to less than 10% in 2014. Decline in strikes and lockouts, reduced labor time lost from disputes per factory and increased use of contract workers in all major states in India are signs of reduced bargaining power. In order to estimate the influence of trade, the mark-up and bargaining power affecting the labor share and resultant productivity is derived. A semi-parametric approach is applied on a 3-digit level of industrial data over major states during 1998–2014 to regress Solow residual (the proxy for productivity) on trade share along with its interaction terms capturing market imperfections. The results confirm that trade, by dampening the bargaining power of labor, reduces labor share and hence raises productivity. It is argued that the joint effects of market size and competition arising out of trade cannot dominate the adverse effect of specialization in the presence of unions. The degree of specialization or comparative advantage that appears due to the increased market share of the most productive firms, who require fewer workers, thereby reducing the demand for workers with the trade. The drop in demand weakens bargaining power and shifts away distributive share from workers. But the competitive policy encouraging entry can negate such adverse effects of trade, to a large extent.

Keywords Trade · Market imperfections · Labor share and productivity growth
JEL classification D24 · F16 · L11

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1 Introduction

While trade is assumed to affect the labor and product market conditions through the effects of market size, competition, and specialization as per the contemporary literature (see Neary 2016), this paper attempts to investigate whether it influences the labor share and the resultant productivity growth of the industrial sector. During the first four decades after independence, India could not grow at a decent rate in spite of its potential, due to the presence of various inefficiencies and rigidities faced by the economy. The industrial sector was highly monopolized by a limited number of firms and the formal labor market engaged in the industrial sector was fairly rigid. These two problems have been highlighted by a large group of scholars and practitioners as inefficiencies that were critically affecting the industrial growth of the economy during this period. When the economy started facing problems of high inflation, low foreign reserves, and slow growth, along with high unemployment, India was forced to liberalize its economy vigorously from the early 1990s. In the process, the licensing system was gradually removed, trade barriers were slowly phased down, public investment was withdrawn from many core economic and productive activities, the exchange rates were gradually pegged out, and so on. These reform measures were undertaken on the assumption that they would encourage trade and thereby improve competition, raise transparency, and remove rigidities and inefficiencies in the product and labor markets. In other words, the trade reform was expected to affect the product market competition and labor market rigidity, leading to a change in labor share and resultant productivity growth.

When we look at the trend of a sample of developed and developing economies in Asia for the period from 1960 to 2015 (Fig. 1), the labor share begins to fall in all economies systemically from around the late 1980s to early 1990s. This is the period when trade grew at a faster rate. No doubt, trade redistributes the allocation of resources and thereby changes the resultant factor payments in such a way that must affect the distributive share of labor, specifically when the markets are imperfect. This is because the market conditions in both product and factor markets are expected to be influenced by trade. Using cross-country analysis, recent theoretical works (Neary 2016; Maiti 2018) have showed that trade weakens the bargaining power of workers when the specialization effect arising out of international trade under heterogeneous productivity distributions between the trading partners dominates over the joint effects of market size and competition in a setting of heterogeneous firms. Now, the question is whether it explains the trend of labor share and the resultant productivity growth.

Of course, if labor share declines, the productivity, measured as Solow residual, is supposed to thrive. This paper attempts to investigate this conjecture in the Indian context using disaggregated level of industrial data by estimating parameters that show the degree of product and labor market powers and further examine its resultant effects on the productivity. The Indian formal labor market is considered to be highly rigid, alongside being one of the largest informal sectors in the world.

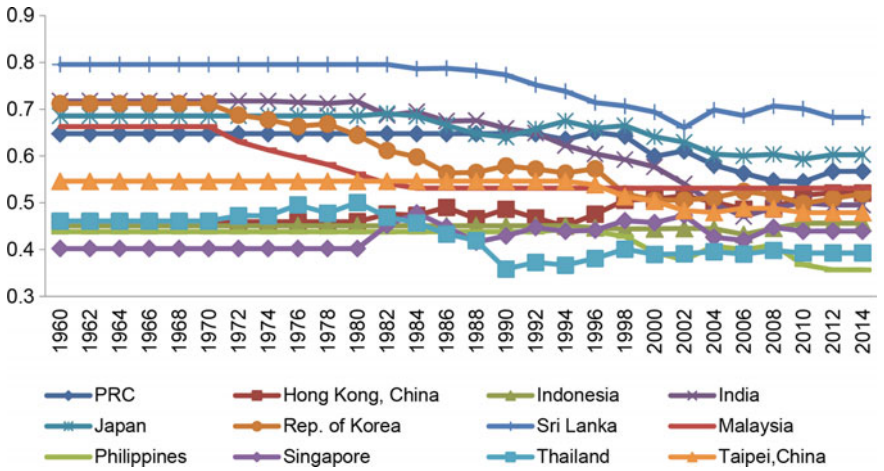

Fig. 1 Labor share in selected asian economies, 1960–2014 (%) *Source* Penn World Table Version 9.0

The favorable labor regulations that encourage this rigidity are subjected to be investigated for their tolerance with the trade exposure. Recently, the policy makers have begun the process of bringing flexibility in the labor regulations by removing the clauses encouraging rigidity (Bhattacharjea 2019). This work aims to investigate any justification for such additional reform measures.

It is evident that the labor share of workers working in the industrial sector has been declining sharply in most countries, including in the developed world. Many of these countries had rigid labor laws. A recent study conducted by IMF shows a downward trend in labor share in most of the countries, which has led to the recognition that it appears to be a major economic and social issue at the present time. In the advanced economies, labor income shares began to trend down from the 1980s, reaching their lowest level in the entire past half century prior to the global financial crisis of 2008–2009, and have not recovered materially since then (Dao et al. 2017). According to an ILO (2017) study, the share of national income, defined by total earnings for all employees and self-employed, has declined in Europe from 75% of national income in the 1970s to 65%. OECD countries have also experienced a sharp fall from 64 to 59% during this period (Sweeney 2017). In a sample of 54 emerging market and developing economies, the labor share declined in 32 economies, which accounted for about 70% of their GDPs. It was also observed that the sharpest decline in the labor share was in manufacturing, followed by transportation and communication. Some sectors (food and accommodation, agriculture) witnessed an increase. However, the sharpest decline was observed in agriculture among the emerging market and developing economies (Dao et al. 2017). The declining labor share of national income is, of course, accompanied by the huge rise in the share going to the owners of capital and a small elite number of employees within the labor force. After the global financial crisis,

when unemployment shot up substantially all over the world, it became a growing concern to investigate the driving forces working behind it. Several explanations have been put forward to explain this decline. They are technological progress, global integration, offshoring, fiscal and market reforms, etc. These factors are not strictly disjointed from each other, as the effect of technological progress is at the core of the analysis.

The distributive conflict between labor and capital is an age-old debate in the subject. Arrow et al. (1961) argue that if capital is highly substitutable for labor and the elasticity of substitution between them is larger than one, a decline in the relative cost of capital drives firms to substitute capital in place of labor to such a high degree that, despite the lower cost of capital, the labor share of income declines. Technological progress led by information and telecommunications innovations and automations, in addition, seems to be doing the same thing in the current phase of development. Even when the capital goods price declines due to these technological innovations, such technology substitutes workers disproportionately so that the labor share falls faster (Karabarbounis and Neiman 2014). Piketty (2014) offers an accumulation view, suggesting that an increase in aggregate savings relative to national incomes, for a variety of reasons, has raised capital-to-output ratios. Acemoglu and Restrepo (2018) point out that automation of some tasks that were previously performed by labor causes a permanent reduction in the labor share. Autor et al. (2017) and Kehrig and Vincent (2017) further argue that the rising industry concentration and the growing dominance of superstar firms are responsible for the fall. Various measures of fiscal reform (like tax concessions) also encourage industrial activities and hence raise inter-country competition to attract capital in a globalized world (Rodrik 1998). The increased offshoring and participation in global value chain, on the other hand, have fueled the declining trend (Feenstra and Hanson 1997).

As far as the issues relating to international trade are concerned, views on how trade affects the labor market are quite mixed. One set of scholars suggests that unionization rates and laborers' bargaining power might have declined as a result of trade integration (Rodrik 1997; Elsby et al. 2013) and this essentially causes a drop in labor share. However, the empirical evidence from cross-country analysis does not accept this view unambiguously. Slaughter (2001) finds very mixed evidence using four-digit industry-level data from the US. Similar results are also found by Brock and Dobbelaerre (2006) and Arbache (2004) respectively for Belgium and Brazil. But, Dumont et al. (2006) find substantial bargaining power of workers in five European countries.

If we specifically look at the Indian case, the dominant view of existing research seems to suggest that the presence of labor market rigidity in the concerned region and industry is critical for the resultant labor share. Using the three-digit level industry data from India, Ahsan and Mitra (2014) suggest that trade liberalization led to an increase in the share of wages in total revenue for small on average, labor-intensive firms, but a reduction in this share in the case of larger, less labor-intensive firms. On the other hand, Dutta (2007) showed that workers employed in industries with high tariffs received higher wages than apparently

identical workers in low-tariff industries during 1983–2000. Moreover, Gupta and Helble (2018) observed that import tariff reductions have reduced labor share only in labor-rigid regions.

Therefore, the Indian growth and productivity debate is very much centered on how the industrial regulations have evolved across regions. In spite of significant growth of the Indian economy, it has been largely argued that the economy could not reap the potential benefits due to the presence of labor market rigidity. Some regions have been left behind the others for the same reason. Rigid labor legislation in Indian economy has been criticized by a number of scholars as one of the responsible factors behind the slow employment growth of manufacturing sector even in the post-reform period. The Industrial Disputes Act, 1947, has been the key in this regard. According to this act, the central government has designed the general guidelines of labor relations in the country and placed them in the hands of state governments for the effective implementation and necessary amendments in a federal democratic setting. This framework has resulted in significant variation of labor regulations and/or their enforcement across Indian states (Besley and Burgess 2004 and Hasan et al. 2007). Some states have gradually amended the Act in such a way that they favor workers, while others did that favored employers. Besley and Burgess (2004) looked at the way the states have amended and coded them to provide a proxy for labor market rigidity. Based on this, they classified the Indian states into pro-workers, neutral, and pro-employer by looking at the direction of the amendment made in the labor legislation by each state government. The study found that the states that amended the regulations in favor of employers have grown faster than others. Similarly, the effect of delicensing (from capacity utilization, new plants and products, known as License Raj in India) has been found favorable for accelerating industrial growth of the economy, but unequal across regions due to the variation in the labor market rigidity (Aghion et al. 2008).

This work was extremely influential among academic scholars as well as policy makers. A large amount of works have been undertaken thereafter that applied the Besley and Burgess index to investigate the differential impact of various economic and social outcomes across the regions. For example, Hasan et al. (2007) showed that trade has successfully reduced poverty at a higher rate in the pro-employer states than in pro-worker states. On the other hand, Topalova (2007) observed that the economic integration leads to further growth in income inequality and an increase in the number of poor people in developing economies (specially in India), and therefore the benefits of liberalization may be realized at a substantial social cost unless additional policies are devised to redistribute some of the gains from the winners to the losers.

However, they further assumed that the regulatory systems of each regional government are so effective that the labor market rigidity is highly regulated by 'de-jury' measure of the legislative amendments and does not depend on any other market condition and 'de facto' measure. Several scholars have criticized such methods of coding and indexation of legislative reforms by simply looking at the direction of legislative amendments. It is criticized that they have been confined into a narrow area of legislative measures affecting labor market outcomes. They

could not even capture the number of other important legislations affecting Indian labor market conditions; rather what they considered are not relevant for labor regulation, to a large extent (Bhattacherjea 2009). Following this criticism, Ahsan and Pages (2009) attempted to modify the index by limiting themselves within the relevant area of legislations concerning labor relations and implementations. Even then, they could not overcome this problem. In an alternative work, Dougherty (2009) also attempted to construct an index taking the responses from state government officials on a schedule of 50 questions. However, they face a different problem by depending upon subjective judgment of labour market functioning. One of the major limitations of the existing literature, therefore, is that the form of labor legislation is over-emphasized, but its functioning, which underlies the local social, economic, and political institutions, has been grossly neglected. Recently, Bhattacharjea (2019) looked at all of them and argued that none of their works is able to capture the actual degree of labor relations effectively. He investigated the actual status of regulations, which were coded by Besley and Burgess (2004) and others. Strikingly, he finds that a number of regulations passed by a state government were put on hold or stayed in the court for several years. Hence, effectively one should not count a change in the coding from the date of legislative approval, rather it should be from the date when it was officially implemented. After correcting all of them as per the date of effective implementation, Bhattacharjea (2019) finds that there is not much variation in the labor rigidity index that can explain the difference in regional growth across states. This opens up some room to find out an alternative way of measuring the rigidity to understand the industrial dynamics across regions using actual industrial statistics. With this backdrop, the current paper attempts to explicitly show how the dynamics of product and labor markets conditions affected the organized industrial sector in India during the period from 1998 to 2014 in response to trade.

The rest of the paper is organized as follows. Section 2 provides an account of productivity growth in India. Section 3 summarizes the theoretical literature on trade and labor share. Then, the empirical framework of estimation of mark-up and bargaining power of the labor share are discussed in Sect. 4. Section 5 ends with concluding remarks.

2 Indian Economy and Productivity Growth

During the last two and a half decades, the Indian economy has maintained a significant growth rate and often exceeded the growth rate of the Chinese economy, in spite of the Global Economic Crisis in the late 2000s. According to the World Bank Development Indicators, while GDP grew roughly at 5% during the latter half of the 1980s, it reached up to 9.7% in 2010, and India still maintained a growth rate of around 7–8% during 2010–2017. The share of the manufacturing sector's contribution remained between 14 and 18% in this period. The high growth in recent years has encouraged scholars to investigate the role of productivity growth in the

country. For a long time, the economy could not achieve a decent growth rate. The contribution of secondary sectors in GDP has gone up from 20% in 1970 to 28.4% in 2010. After independence in 1947, the country emphasized the achievement of self-reliance through import substitution along with large-scale industrialization driven by direct and indirect public sector participation. But, this approach and strategy for industrialization, by protecting the national economy from the outside world, could not lift up the economic growth much during the four decades after independence. Rather, it was responsible for the industrial deceleration during the mid-1960s to the late 1970s. This approach has been severely criticized by many scholars and hence believed to be the root cause for the poor economic growth during this period after independence (e.g., Bhagwati and Srinivasan 1975; Bhalotra 1998). Gradually, India started adopting liberalized industrial, trade, and development policies since mid-1985. When the foreign exchange reserves gradually fell to an abnormally low level, a crisis hit the economy badly in the early 1990s and inflation crossed over into double-digits. The economy was forced to liberalize overall economic policies on all fronts, including financial and external sectors, considering that the gradual reduction of trade barriers, dis-investment in public sector, de-reservation of small-scale industries, delicensing of industrial activities, private sector expansion, reduction of the barriers on foreign capital, financial sector autonomy, exchange rate convertibility, etc. would bring the economy out of these problems permanently. The principal philosophy behind such reform policies was laid on the promotion of competitiveness so that it could reduce market imperfections and encourage optimal use of labor and other resources that are essentially required to accelerate productivity growth. The market forces without much government intervention are assumed to be playing a pivotal role in overcoming problems to achieve higher growth rates. It can be argued that the increased international competition raises domestic production for export and pushes up the incentive to invest more on productivity improvement.

In the post-1991 period, India moved away from the regime of trade protection to that of liberalization. The average tariff rate started to decline since the mid-1980s. The rate registers an upward rising trend in the early-1980s up to 1985 and then declines sharply. The tariff rates were very high pre-1991, reaching the highest of over 100% in the year 1985, followed by a gradual decline thereafter. The average tariff rate has sharply dropped from 79.2% in 1991 to 12.5% in 2006 and to less than 10% in the next 7–8 years. On the other hand, the pre-1991 FDI inflow figures are almost negligible in terms of total capital formation in the country. But, FDI inflow started to rise thereafter with certain degree of ups and bounce. It was around $0.07 billion during 1980–1990 and then reached $20.3 billion in 2006. After the crisis there was a drop and now it has stagnated in recent years, according to World Development Indicators figures. However, total FDI accounts for still nearly 1% of GDP. Therefore, the impact of tariff reduction on the economy would be more powerful than that of FDI flows during the period of study.

The arguments behind changes in productivity growth and its contribution to the economic growth of India after economic reform are distinctively divided into two

groups. One group suggests that the reform has encouraged productivity growth, while other holds the opposite view. However, the results are influenced by the methods used and the factors applied for decomposition. Isaksson (2007) derives total factor productivity growth applying data envelope analysis and compares it for 112 countries (including India) over the span of 1960–2000. According to the estimate, TFP growth does not show an encouraging improvement for Indian economy. It grew at 0.7% during 1960–2000 when output rose by 4.97% per year. According to a more recent study, undertaken by Li and Treichel (2012), it increased from around 1% growth in 1980 to 1.5% in 2010. Substantial improvement has taken place in the productivity growth in the country.

However, the result of productivity growth is highly sensitive to the method used in the estimation. Earlier, Ahluwalia (1991) showed that the productivity growth was very slow before 1980 and turned around thereafter. Balakrishnan and Pushpangadan (1994) criticized this further, arguing that the productivity growth was slow even during the 1980s. According to them, productivity, being estimated by deflating respective prices (i.e., double deflation method) rather than using single deflator, provides a right and unbiased estimate. Since the study undertaken by Ahluwalia (1991) was based on the single deflation method, the estimate provided therein was biased. But none of these studies could show any impact of trade reform after 1990s. A number of studies find that productivity surged in the manufacturing sector in India after the 1980s (Unel 2003). In particular, Unel (2003) argues that productivity has grown at a rate higher in the post-reform period than that in 1980s. Kumar (2006) and Balakrishnan et al. (2006) find that the productivity has improved in the post-reform period. The improvement in technical efficiency as well as technical progress, in response to competitiveness, has been playing a responsible role behind the productivity growth. Milner et al. (2007) also find an increase in productivity growth on average and for the majority of manufacturing industries. A rise of competitiveness is directly and indirectly found to be the most influential factor behind the increase in productivity growth. According to Madsen et al. (2009), the productivity growth rate increased annually by 1.1% points during 1960–2005 in India. A marginal improvement was further observed in some other works during the 2000s (Sehgal and Sharma 2010; Kathuria et al. 2010).

At the same time, there are other studies which do not find an encouraging figure of productivity growth in the post-reform period. The estimates of productivity growth reported in the study of others (e.g., Goldar 2003; Goldar and Kumari 2003) indicate a fall, and this is during the period when the economy has grown consistently at a higher rate. Suboptimal use of capacity and decreasing returns to technology have been a few responsible factors noted for this. Two issues have emerged as being important in recent years–the inability of the manufacturing sector to contribute substantially to the overall growth and the service sector-led-growth acceleration during 1990s (Eichengreen and Gupta 2011, 2013). There are studies that draw upon sectoral perspectives, in particular, the sub-sectors of manufacturing, that find evidence of factor accumulation rather than productivity growth in growth accounting (Das 2004). However, all these studies have ignored the issues of market imperfection on the dynamics of productivity and its

estimation. At first, Balakrishnan et al. (2006) have accounted for the influence of product market competition in the productivity estimation for the Indian manufacturing sector and attempted to eliminate product market conditions from the derivation in the Indian context. The study found an improvement in the productivity growth in response to a rise in the competition after trade reforms. Maiti (2013) finds that the trade reform improves productivity once market imperfections are eliminated. Hence, the literature holds diverse opinions, but the issue of market imperfection becomes an integral part in the discussion of production growth. If trade affects product and factor markets significantly, the present paper aims to see its implication for labor share and the resultant productivity change.

3 Trade and Labor Share

A large volume of theoretical literature related to the effect of trade on the distributive share holds a favorable view for the workers. The Ricardian framework is ill-suited to address this question. This is because all national income accrues to labor under the competitive environment. However, under a similar market environment the Heckscher-Ohlin trade theory argues that the degree of comparative advantage due to factor abundance favors the workers after trade if the labor is the abundant factor of the economy. Heckscher and Ohlin believed that the benefits are mutually conflictive between the factor owners and between the trading partners and depend on the degree of factor abundance (i.e., comparative advantage) in a perfectively competitive environment (Jones 1965). The second generation is of the view that, even if trade takes place between two countries under similar conditions it could still improve the distributive share of workers (in real terms) if the joint effect of market size and competition reduce the price level sufficiently as compared to that of autarky. Krugman (1980) offers a pioneering framework, using Dixit-Stiglitz utility setting of differentiated goods in a monopolistically competitive environment, to analyze such gains from trade between similar countries that occurs through these two effects. The worker is expected to be better off in real terms after trade, as the competitive force depresses the product price. According to the third generation of trade theories, Krugman framework was criticized in that it either relies on partial equilibrium analysis or assumes homogeneity to a large extent. If the firms are assumed to be heterogeneous in terms of productivities, the Krugman effects of competition and scale seem to be absent in the gains from trade (Melitz 2003). This leads us to incorporate variable mark-ups across industries (McMalman 2018). Melitz (2003) and Yeaple (2005) elegantly adopted the framework of monopolistic competition (Dixit and Stiglitz 1977) to show the selection effect of productive firms, heterogeneity in terms of productivities. In the presence of heterogeneous firms in terms of productivities as well as labor market imperfection, such favorable impact of trade on the wage and distributive share of workers has not been uniform across all sectors and types of labor, and becomes ambiguous at the aggregate level. It depends not only on the relative strength of

market size and competition effects, but also on the extent of labor reallocation within and across industries (Melitz and Ottaviano 2008). Unlike the conventional argument, the contemporary research believes that trade makes differential impacts on the mark-up across industries and the resultant demand from workers. More importantly, this further allows us to capture variable mark-up of pro-competition effects. Broadly, there are two forces of pro-competitive effects. At the firm level, trade liberalization intensifies foreign competition, reducing the market power of local producers and forcing them to decrease their mark-ups (Melitz and Ottaviano 2008; Arkolakis et al. 2015). Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) provided empirical supports for lowering mark-up dispersion associated with less extensive distortion across firms. On the other hand, Edmond et al. (2015) and Arkolakis et al. (2015) point out the negative possibility of pro-competitive effects of trade liberalization that occurs through reallocation of labor toward more productive exporting firms. This could allow the firms to internalize a drop in trade costs and charge higher mark-ups. As a result, whether trade liberalization leads to a rise in welfare gains or losses depends on the joint movement of labor reallocation and mark-up distribution. The opening of trade leads to a larger increase in the zero-profit cutoff in this tradition and this results in a rise of average productivity in the comparative advantage sector than in the disadvantage sector. This influences the real reward of each factor by changing product variety (as in Helpman and Krugman 1985) and the reward may rise with average productivity in each sector (Melitz and Redding 2014). Hence, it is quite possible that trade liberalization can raise rather than reduce the real reward of the scarce factor (as seen in the Stolper-Samuelson model). In a setting of variable mark-ups, Melitz and Ottaviano (2008) argue that sectors with tougher competition have a downward shift in distribution of mark-ups across firms. In parallel, there are other frameworks that attempted to show the effect of trade using heterogeneity and variable mark-up. Contemporary research by those who model labor market frictions is engaged in explaining why the wage would vary across firms using heterogeneity. They tried with workforce composition (Yeaple 2005), search and matching frictions (Davidson et al. 2008), and efficiency wages (Amiti and Davis 2012). In an interesting study, Helpman and Itskhoki (2010) show that the differences in labor market institutions across countries and industries providing a source of comparative advantage and this shapes the impact of trade liberalization on aggregate unemployment. A reduction in labor market rigidity increases the gains from trade. However, these models are silent on the effect of trade on labor share in the presence of unemployment.

The fourth generation of theories believe that firm heterogeneity under a monopolistically competitive environment, although it becomes the workhorse for modern trade theories to find answers to various questions arising out of trade, fails to accommodate strategic competition that exists in oligopolistic markets (Neary 2016). When trade takes place between two countries, the strategic competition raises the market size but reduces the share in the domestic market. These two forces could go against each other. On top of this, the outputs of most productive firms would be selected by the competition (comparative advantage effects) and this

leads to shrinking of the market share for labor-intensive industries. This competition effect, along with comparative advantage, could dominate the market size effect in determining the net demand from labor and hence wage can rise. The wage rise could be so high that it may improve the distributive share of workers. Neary (2016) demonstrates in a generalized oligopoly structure that if the competition and comparative advantage effects dominate the market size effect of trade under identical situation between trading partners, the net effect could lead to a rise in the share. Maiti (2018) introduces labor market imperfection in this framework and finds that trade can reduce the bargaining power of workers, along with the increased competition that explains a drop in labor share. However, a competitive domestic policy encouraging entry could improve the labor share and negate the adverse effect of pure trade effects.

4 Empirical Analysis

4.1 Descriptive

Let us now look at the industrial and labor market dynamics in response to international trade during the last two decades of the Indian economy. The dynamics of labor markets must have been reflected in the distributive share of industrial workers. Indian labor legislation is argued to be quite rigid and has received criticism from a group of scholars (discussed above). According to them, it is one of the most important factors responsible for the slow employment growth experienced in the manufacturing sector during the period of study. Without any substantial amendments to the central regulation along with the presence of variations in the state legislation, there are signs of declining bargaining power in all types of states—neutral, pro-workers and pro-employer states (as defined by Besley and Burgess 2004).

Labor share, measured as a percentage of gross value addition (GVA), drastically dropped from 28.0% in 1980 to 10% in 2007–08 in the industrial sector and then marginally increased to 12% during 2015–2016 (see Fig. 2). The decline of wage share could be due to either a drop in wage and rise in market price, or a rise in productivity. Whatever may be the reason, the drop itself seems to represent the weakening bargaining position of workers, who are engaged in the industrial sector because the drop encourages the residual surplus. The share has been presented state-wise for two periods, 1999–2004 and 2005–2014 (see Fig. 2). It accounts for a sharp decline in all the major states, including the so-called pro-employer and pro-employee states. The rate of decline was faster during 1999–2004. Labor share seems to have converged during this period across states. West Bengal, the state famously known as a labor-rigid state according to the Besley Burgess measure, also shows a sharp declining trend and has registered a fall to a level lower than some other pro-employer states in 2004–2005. Andhra Pradesh has an unsettling

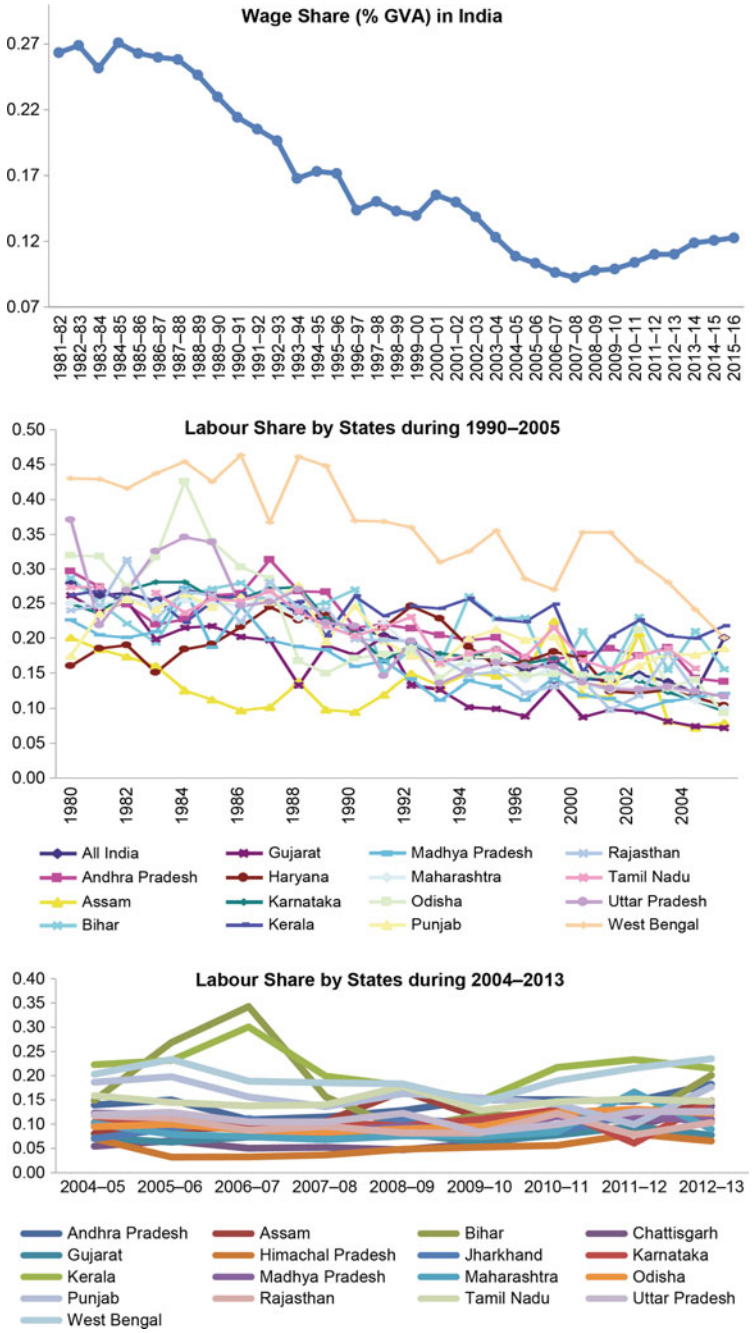

Fig. 2 Labor share in indian industries, 1980–2016 *Source* Maiti (2014); Annual Survey of Industries, CSO, Government of India

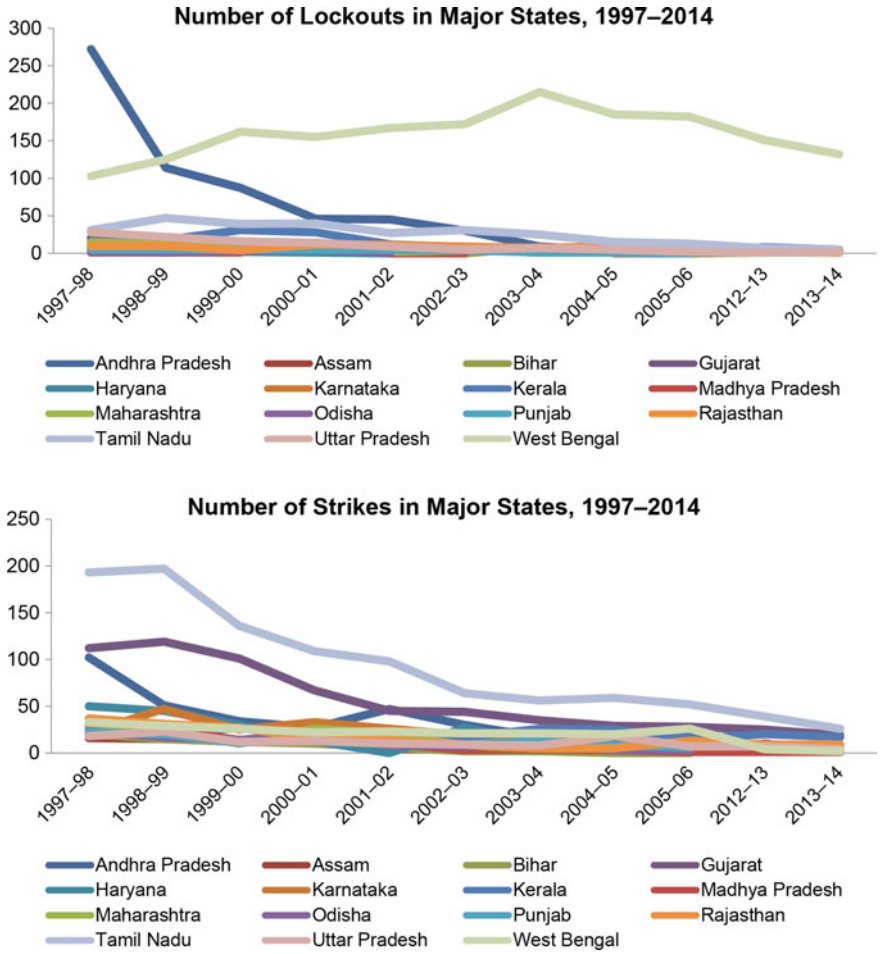

Fig. 3 Number of lockout and strikes in major states of india, 1997–2014 *Source* Indian Labour Year Books (Government of India, Ministry of Labour and Employment)

graph, but shows a decreasing secular trend after 2002–2003. However, the trend after 2008 shows a bit of improvement for some states. The drop in price due to economic recession and international oil price might have raised the wage in real terms.

When we look at the 'de facto' measure of labor rigidity, there is a clear trend of its decline. The number of lockouts by states has registered a decline during this period (see Fig. 3). West Bengal registers a rise in number of lockouts from 1997 up to 2004–05 and shows a gradual decline thereafter. The other pro-worker regions like Kerala and West Bengal have experienced a drop in the frequency of strikes and hence offered a scope to readjust labor and factor uses (Maiti 2013). Strikes happen to be the dominant factor behind lockouts. It is evident that the number of

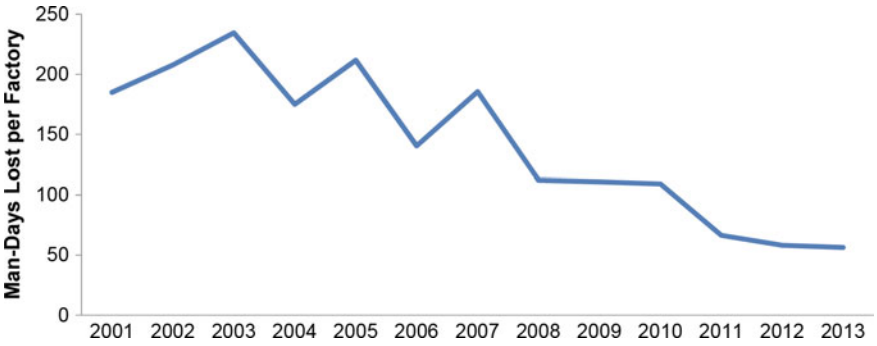

Fig. 4 Number of man-days lost per factory in India, 2001–2013 *Source* Annual Survey of Industries, CSO, Government of India

disputes arising due to workers' strikes registers a declining trend in most of the Indian states. Moreover, the number of man-days lost per factory in India due to such strikes has declined in 2013 to one-fourth of the number seen in the early 2000s (see Fig. 4).

This decline is further reflected in the growing use of contract workers. The proportion of contract workers in total workers has increased in all major states during 1998–2005 (see Fig. 5). Andhra Pradesh, Bihar, Gujarat, Haryana, and Maharashtra are the largest employers of contract labor as a proportion of total workers, implying that they register a lower density of labor unions in these states. The absolute increase in the proportion of contract labor in total workers has been the highest in Andhra Pradesh, followed by Kerala and Madhya Pradesh. Interestingly, most of them are known as pro-employer or flexible states as per the definition offered by Besley and Burgess (2004). However, there has been

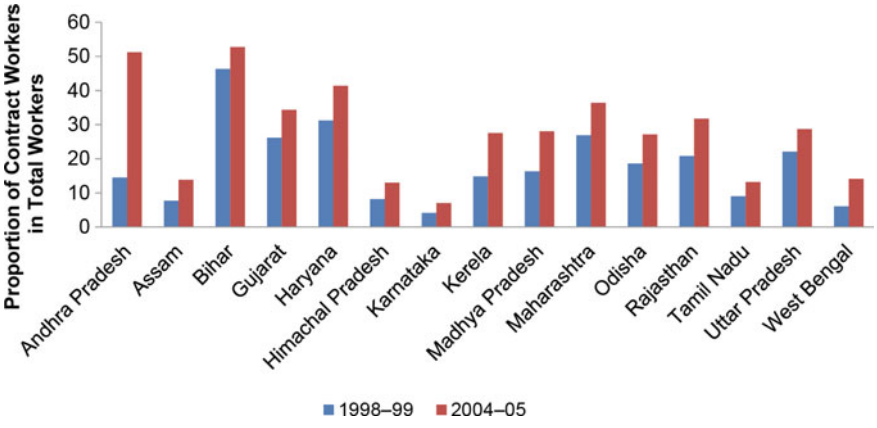

Fig. 5 Contract workers as a proportion of total workers in major states, 1998–1999 and 2004–2005 (%) *Source* Annual Survey of Industries, CSO, Government of India

significant variation in the use of contract labor across states. These trend graphs support the inference of a decline in workers' bargaining power during the study period.

Now, the most important question here is whether the existing legislative framework in India is conducive for such changes in employment and allows substitutions between factors of production in practice. The existing legislative set-up in India still provides ways for the firms to change factor composition gradually. When the labor turnover rate tends to rise under more competition, workers prefer to change the workplace frequently for better opportunities. In such situations, it may be difficult for a firm to change the wage, technology, and employment combination. Moreover, since the probability of getting employment in another firm with the entry of new firms in the post-reform period seems to rise (especially for skilled and formal workers), they would be less rigid. The existing labor laws in India also provide some autonomy to firms to retrench labor under changed market conditions. For example, the Industrial Disputes Acts (1951) in India do not put any binding conditions on retrenchment of labor on a firm that hires less than 100 workers. Similarly, the Factory Act (1947) in India is not applicable to a firm which hires less than ten workers. These laws allow the firms to transfer the competitive pressure on in-house workers either by firing them or by contracting outside instantaneously.

Mere existence of strong legislation is not sufficient for a higher order of rigidity in the labor market, especially in India with the current socio-political environment. It is not just legislation, but also enforcement which is crucial to see the extent to which firms are deterred by labor legislation. A field-level study by Maiti (2009) has shown that a firm easily finds ways to by-pass the labor laws and regulations applicable to the formal sector. A formal sector firm also enjoys legislative support for the use of flexible laborers on a contractual basis as per the Contract Labor Regulations Acts (1970) in India. In the presence of such a legislative framework, a firm can change the employment compositions, at least in the medium-run. Moreover, one of the arguments, made by Besley and Burgess (2004), is that capital moves out of the rigid states to the flexible states as per their explanation. It is also evident that the share of state capital has not changed much during 1998–2016, except in a few states (Fig. 6). Maharashtra and Gujarat have retained the top two positions for the largest capital shares as a percentage of total capital in the country among major states during this period. Uttar Pradesh has experienced the largest drop even though it is defined as a pro-employer state. Orissa, belonging to the group of rigid states as per their measure, showed substantial accumulation of capital. This suggests that mere existence of legislation does not matter much for labor rigidity. Market dynamics also seem to play a role when the efficacy of implementing legislations is weak. Even though the above-mentioned figures indicate some informative trends, the degree of market imperfections is estimated econometrically from the disaggregated industrial statistics to obtain conclusive results.

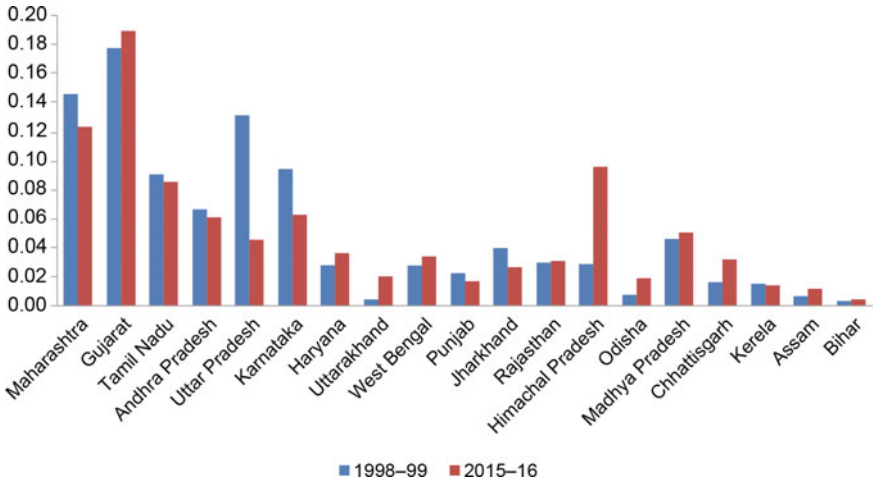

Fig. 6 State capital share as a percentage of total capital (%) *Source* shares calculated using fixed capital figures from the annual survey of industries, CSO, government of India

4.2 Empirical Framework

Let us now turn to the econometric estimation of the model using Indian disaggregated industry-level information. It is not straightforward to demonstrate the effect of each channel originating from trade on labor share. The theory deals with how trade affects wages and distributive shares at the aggregate level through market size, competition, and specialization effects. This has to be estimated at the aggregate level. The main empirical question that needs to be answered is whether trade affects the labor share through the change in product and labor market imperfections. We confine ourselves to the Cobb-Douglas form of production function as it has the specific property that relates the factor elasticities with its shares, accommodating the terms containing market imperfections. Essentially, this helps to include the parameters influencing market imperfections that establish the relationship between actual labor share and labor elasticity along with bargaining power and mark-up. One can also derive the link between the residue (i.e., productivity) and the labor share.

Using the Cobb-Douglas specification, one can easily estimate productivity growth by simply deriving residual change after subtracting factor contributions from output change. While subtracting factor contribution, factor shares are used in practice with the assumption that perfect competition prevails in both product and labor markets. Under perfect competition, the factor share is exactly equal to factor elasticity. However, they would differ from each other by the presence of market imperfections. Note that the higher the factor share, the lower the residue would be. Since labor share is assumed to be driven by the degree of bargaining power and mark-up, one can estimate their changes in response to trade and the effect of trade

on labor share, and the resultant productivity growth can be demonstrated with a bit of modification. A general form of industry-level production function is assumed to find an expression for labor share affecting the residue and then two market imperfection terms with the interaction of trade are added to this. We assume an industry-level production function of i-th industry at t-th period with a mix of factors for s-th state as follows (using log Cobb-Douglas form):

$$lnQ_{ist} = q_{ist} = a_{ist} + \alpha_L l_{ist} + \alpha_K k_{ist} \tag{1}$$

The smaller letter represents logarithmic form. Here, α_L and α_K are respectively capital and labor elasticities. Taking derivative with respect to l_{ist}, we get labor elasticity as follows (ignoring subscript):

$$\frac{\partial q}{\partial l} = \alpha_L \tag{2}$$

This expression of labor elasticity represents labor share when there is no market imperfection, where $a_L = \frac{wL}{PQ} = s_L$ assuming wage is paid according to their value of marginal products and P being price of final goods. If the production function is assumed to be homogeneous of degree λ for all factors (or, $\alpha_L + \alpha_K = \lambda$), we can express the Solow Residue, by taking logarithmic value and totally differentiating, as follows:

$$(q - k) - \alpha_L(l - k) = \lambda k + a \tag{3}$$

Note that the residual change is the sum of capital accumulation explaining returns to scale (λ) and an unexplained random term (a). This term can be considered as a proxy for productivity or residual growth.

If market imperfections prevail only in the product market, the wage is not paid according to the value of marginal physical product, rather is equal to the value of revenue product. Then, the factor share would be different from the elasticity. If the price over marginal cost is defined by, μ then $s_L = \mu s_L^M$. Here, s_L represents the labor share where the product market is imperfect. Since the firm tends to raise the price over the marginal cost having greater power, the labor share would be lower than that under perfect competition, depending on the degree of market power.

When the imperfections prevail both in the product and labor markets, a rise in bargaining power of workers tends to reduce the labor share. The union derives a relatively higher wage than that in the competitive market depending on their bargaining power. Formally, we can derive the relationship between them. Let us assume that $\overline{L}$ is the total number of workers available in the economy, w_0 is the alternative wage of workers outside the firm and θ is the bargaining power of the union, the wage can be derived from the following Nash bargaining power. Let us assume that L is the total number of workers available in the economy, w_0 is the alternative wage of workers outside the firm and θ is the bargaining power of the union, the union wage can be derived from the following Nash bargaining equation

$$max_{w,L}\Omega = \left(Lw + (\overline{L} - L)w_0 - \overline{L}w_0\right)^{\theta}(PQ - wL)^{1-\theta}$$

Differentiating with respect to wage and employment, substituting $\frac{\partial(PQ)}{\partial L} = \frac{P\partial Q}{\mu \partial L}$, where $\mu = \frac{e}{e-1}$ and $e = \frac{P}{Q}\frac{dQ}{dP}$, then rearranging the terms, we get:

$$s_L = \mu\left[s_L^U + \frac{1-\theta}{\theta}\left(s_L^U - 1\right)\right]$$

Where s_L^U represents actual labor share in the presence of both product and labor market imperfections. Note that when $\theta = 0$ and $\mu = 1$, then $s_L^U = s_L$. The difference between them would essentially be captured by the values of θ and μ. This is expressed as follows (see Dobbelaere 2004 and Maiti 2013):

$$s_L^U = \theta + \frac{1-\theta}{\mu}\alpha_L$$

Note that when $\theta = 0$ and $\mu = 1$, then $s_L^U = s_L$ and when $\theta = 0$ and when $\mu > 1$, then $\mu s_L^M = s_L$. The first term on the left-hand side captures the extent of deviation due to labor market rigidity and the last term represents the same due to the mark-up. The higher the value of μ, the greater the deviation would be and the higher the value of θ, the lower the difference. Replacing α_L by s_L^U in order to capture the influence of degree of market imperfections, we find the revised expression for the residual growth as follows:

$$(q-k) - s_L^U(l-k) = \left(1 - \frac{1}{\mu}\right)(q-k) + \frac{\lambda}{\mu}k + \frac{\theta}{1-\theta}\left(s_L^U - 1\right)(l-k) + \frac{a}{\mu}$$

Let us define the residue used in the above expression as $SR = (q-k) - s_L^U(l-k)$. The change of this expression can be considered as the proxy for productivity growth. If the degree of product market power is expressed as $\beta = \frac{P-MC}{P}$ (known as Lerner Index), then $\beta = 1 - \frac{1}{\mu}$. We also define $LR = q - k$ and $BR = \left(s_L^U - 1\right)(l-k)$. Here, $(l-k)$ shows the labor demand for each unit of capital, and $(s_L^U - 1)$ shows the wage bill or cost of labor as a proportion of total costs. Hence this definition of *BR* captures the effective bargaining power of labor. Using these specifications, we can express this equation in such a way so this could be estimated econometrically.

$$SR_{ist} = \beta LR_{ist} + \frac{\lambda}{\mu}k_{ist} + \frac{\theta}{1-\theta}BR_{ist} + (1-\beta)a_{ist}$$

Note that the parameters from this expression using disaggregate level of industrial statistics can be estimated easily. The higher the value of *LR,* the higher *SR* would be, and the higher the value of *BR,* the lower *SR* would be. Hence, β and

θ can be treated as the degrees of market and labor bargaining powers respectively. This is the most efficient way to derive the effect of market imperfection affecting the residue or productivity. It is also interesting to report that these powers can easily be estimated without considering actual price and wage information, which is quite difficult to get. Here, a captures level of technology. Since only a part of the technology effect can be observed, it creates an endogeneity problem in the estimation. Hence, this problem needs to be address while estimating the model econometrically.

4.3 Estimation Method

Since a firm usually observes a part of productivity before selecting the factors of production, the simple regression results would be misleading. Therefore, the simple pooled and fixed effect panel regression techniques also cannot be applied here. Olley and Pakes (1996) suggest using investment (or gross fixed capital formation) as a proxy for the unobserved technology shock. However, this is further criticized by Levinsohn and Petrin (2003) on several grounds. This investment proxy is only valid for non-zero observations. Pronounced adjustment costs force most firms in developing countries like India, Turkey, Colombia, Mexico, and Indonesia to report zero-investment. With the zero-investment figure, it violates the invertibility condition required in the estimation process. Therefore, they recommend using intermediate inputs to avoid such problems. Moreover, the adjustment costs generate kink points in the investment demand function, leaving the possibility of high correlation between the regressors and error term. If it is less costly to adjust intermediate inputs, it would respond more fully to the technology term. This apart, since intermediate inputs are state variables, it serves as an excellent link between the estimation strategy and economic theory. In the present study, we apply the methodology offered by Levinshon and Petrin (2003, referred as *LP* hereafter) for robustness checking with a bit of modification. The intermediate inputs are represented by material costs and fuel usages as better proxies. These two components, in fact, are equal to the total intermediate inputs of production, and we checked that the actual estimate with the use of total inputs is almost identical to that of our proxy variables.

With the use of these proxies, the derivation of the parameters from the regression model may not be straightforward. The estimation procedure involves two steps to deal with the simultaneity problem. Firstly, the disturbance term of equation is broken into two parts i.e. the observed and unobserved terms. ω is the observed part and u is the random disturbance term. The expectation of future productivity (i.e., observed term) increases in its contemporaneous values of stock (log-capital) and proxy variables (gross fixed capital formation or material costs and fuels, denoted as m). In other words, we can write the unknown function for optimal decision as $m = m(k, \omega)$. Inverting this function, we write further as $\omega = h(k, m)$

and therefore, $\emptyset = \frac{\lambda}{\mu} + h(k, m)$. Here, a third order polynomial $\emptyset$ in m and k including a constant term has been used to define this unknown function. Once this is estimated as $\widetilde{\emptyset}$, we write the modified expression of Solow residual as follows:

$$SR_{ist} = \beta LR_{ist} + \frac{\theta}{1-\theta} BR_{ist} + \widetilde{\emptyset}_{ist} + u_{ist}$$

This expression is slightly different from the forms used in Levinshion-Petrin (Maiti 2013). First, this estimates the coefficients of *LR* and BR. Then, the coefficients of k can be recovered from the residuals, defined as $V_{ist} = SR_{ist} - \widetilde{\beta} LR_{ist} - \frac{\widetilde{\theta}}{1-\theta} BR_{ist}$. After the estimation of the first stage and deriving the residue, the following expression:

$$V_{ist} = \frac{\lambda}{\mu} k_{ist} + g\left(\widetilde{\emptyset}_{ist-1} - \frac{\lambda}{\mu} k_{ist-1}\right) + v_{ist} + u_{ist}$$

Again, g is an unknown function and approximated to a third order polynomial for its estimation. Note that the above-method of estimation from unknown non-linear specification relies on an iteration process through bootstrapping with an initially specified distribution. Usually, the number iterations in this literature is 50. But, the number of iterations has been raised to 250 here. The estimation of this stage suggests that the contribution of k and instruments are eliminated from the residue derived in the first stage and the rest is influenced by technology. Applying this two-stage method, one can estimate the residual growth influenced by market conditions along with the change in technology and returns to scale. Note that we can add the interaction terms of trade share (tr_sh) with LR and BR in order to see the effects of trade on the labor share and its resultant implication on residual or productivity change.

4.4 Results

Disaggregated information at three-digit level of industries for fifteen major states during 1998–2014 was obtained from the Annual Survey of Industries, Government of India. Since a major change in industrial classification has taken place between 1998 and 2008, a perfect matching of industrial codes between those revisions with HS codes has been really difficult. Moreover, matching of HS codes with Indian industrial codes is also quite challenging. However, such matching was done for the study period. Hence, our sample has been confined to the period of 1998–2008 for running the regressions. In order to estimate the mark-up and labor bargaining power affecting the residual, we use the method proposed by Levinsohn and Petrin (2003) and applied by Maiti (2013) in a similar context. When material costs and fuels were used as instruments, we find that the coefficient of LR is statistically

Table 1 Effect of mark-up and labor bargaining on productivity

Variables	(1)	(2)	(3)	(4)	(5)
	SR	SR	SR (flex = 1)	SR (flex = 0)	SR
LR	0.683***	0.705***	0.646***	0.722***	0.726***
	(0.024)	(0.019)	(0.033)	(0.035)	(0.026)
BR	–0.747***	–0.747***	–0.762***	–0.733***	–0.737***
	(0.008)	(0.007)	(0.011)	(0.012)	(0.008)
BR*flex					–0.018*
					(0.010)
LR*flex					–0.092**
					(0.037)
K	0.045***	0.047***	0.019	0.066***	0.043***
	(0.013)	(0.015)	(0.018)	(0.023)	(0.014)
Instruments	Materials, Fuel	GFCF	Materials, Fuel	Materials, Fuel	Materials, Fuel
Observations	4,482	4,250	1,990	2,492	4,482

Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; SR – Solow Residual, LR – lerner term, BR – bargaining term, flex – flexible states
Source Author

significant and positive (see Table 1). This suggests that the industries holding sufficient market power contribute more to the surplus. On the other hand, the coefficient of BR is statistically significant but negative. It indicates that the workers' bargaining power is taking away a part from SR.

Now, a new variable called 'flex' is created in order to see the difference in the parameters between flexible and rigid states. We define, 'flex' = 1 for pro-employer and neutral states and zero otherwise (using Besley and Burgess 2004 definition). The coefficient of the interaction term between *BR* and 'flex' is statistically significant and negative, indicating that the residue is lower in the flexible states due to higher bargaining power. When the bargaining power or labor demand (BR) is high in a state in response to the increased demand in those states, workers negotiate for higher wages. So, wage share will rise, leading to a fall in Solow residual. When the same regression is run separately for both types of states, the coefficient of BR turns out to be higher in the case of flexible states. The same result is found in this case as well. This suggests that the labor market rigidity does not depend only on the legislation, but also on the effective implementation of legislation as well as the actual market conditions. Moreover, the definition of flexible states could also be wrong (as commented by Bhattacharjea 2019).

In order to investigate the effect of trade on the degree of market imperfections and the resultant Solow residual, we have added interaction terms of trade share (tr_sh) with *LR* and *BR* (see Table 2). The trade share variable is defined as the ratio of the volume of exports and imports to the real value of output. The coefficient of interaction term between *BR* and trade share is positive and significant, suggesting

Table 2 Effect of trade with mark-up and labor bargaining on productivity

Variables	(1)	(2)	(3)	(4)	(5)
	SR	SR	SR	SR	SR
LR	0.251**	0.248*	0.682***	0.251**	0.248*
	(0.127)	(0.127)	(0.035)	(0.128)	(0.128)
BR	–0.799***	–0.799***	–0.787***	–0.799***	–0.799***
	(0.012)	(0.012)	(0.012)	(0.014)	(0.013)
LR*Trade share	0.040***	0.040***		0.040***	0.040***
	(0.011)	(0.010)		(0.011)	(0.011)
BR*Trade share	0.006***	0.006***	0.004***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FDI				0.000**	0.000**
				(0.000)	(0.000)
Development expenditure				0.001	0.001
				(0.003)	(0.004)
Literacy rate				0.003	0.003
				(0.002)	(0.002)
Road density				–0.004	–0.004
				(0.009)	(0.011)
Capital (K)	0.049***	0.049***	0.050***	0.048***	0.049***
	(0.015)	(0.016)	(0.011)	(0.016)	(0.016)
LR*Trade share*Flex		0.001	0.003		0.001
		(0.003)	(0.004)		(0.003)
BR*Trade share*Flex		0.000	0.001		–0.000
		(0.001)	(0.001)		(0.001)
Model	LP	LP	LP	LP	LP
Observations	3,791	3,791	3,791	3,791	3,791

Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, Model – method suggested by Levinshon and Petrin (2003), same as previous table
Source Authors

that trade reduces the bargaining power and hence raises the residue or productivity. Moreover, the interaction terms of BR with trade share and 'flex' is insignificant. This indicates that the effect of trade in the flexible states is not different from the effect in rigid states. This is different from what Gupta and Helble (2018) claimed. The coefficient of the interaction term of trade share with *LR* is also positive and significant, indicating that trade reinforces the effect of *LR* on the residue. This further suggests that a rise in competitiveness in the production essentially reduces mark-up and thereby improves labor share. Moreover, the interaction terms of *LR* with trade share and 'flex' is insignificant. Several other controls like FDI, Development Expenditure, Literacy Rate, Road Density, etc. are included in the

final regression to account for the infrastructure, education, and development scenario of the states, but all our results still hold. Therefore, we can safely conclude that trade weakens the bargaining power of workers in India and it does not depend much on the legislative form of the state.

5 Concluding Remarks

By changing both product and labor market conditions, the international trade affects the distributive share of labor. This paper investigates whether trade significantly redistributed the cost-price margin between workers and firms in the Indian economy during the last one and a half decades and explains the declining labor share. India experienced almost a 20% drop in labor share during the last two decades. Scholars argue that the share declines more in the states which hold pro-workers labor legislation than those with pro-employer legislations. In other works, the degree of labor rigidity depends heavily on the labor legislation and the market conditions do not affect it much. In contrast to those arguments, we find that the number of strikes and lockouts, as well as man-days lost per factory from such lockouts have declined substantially during this period in all the major states. Moreover, the share of contract labor has increased in all the major states in India irrespective of their degree of labor legislations. These are signs of a gradual decline in labor bargaining power over time in India. Note that such changes in the so-called pro-employer states are not different from pro-employee states. Therefore, we rely on econometric methods to estimate the degree of mark-up and labor bargaining power attached to the actual labor share from the disaggregated level of industrial statistics and see how they have changed with exposure to trade. The approach, suggested by Levinsohn and Petrin (2003), has been applied to regress trade share along with their interaction terms capturing labor and product market imperfections on the Solow Residue (the proxy for productivity). We find a drop in labor bargaining power with the interaction of trade. This is more in the so-called pro-employer states than that in others, suggesting that the labor legislation does not matter unless it is effective enough. Moreover, the term capturing the mark-up seems to have increased with the trade. Hence, a drop in bargaining power, along with a rise in mark-up explain the gradual decline in labor share. The lower labor share raises the residual or productivity. We argue that the specialization effect, arising out of heterogeneity in productivity distribution between trading partners out-weights the joint effects of market size and competition, depressing the demand for labor and hence their bargaining power. So, the market conditions play a greater role than the existence of labor legislation. This suggests that legislative reform is not necessary for the workers' welfare. Rather, competitive policies that encourage entry can both benefit workers and increase economic growth.

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Chapter 8
What Explains the Increase in the Labor Income Share in Malaysia?

Allen Ng, Theng Theng Tan and Zhai Gen Tan

Abstract Labor income shares have been falling in many advanced and emerging economies within the last few decades, partly as a result of a combination of impacts from technology and increased global integration. This in turn is associated with the relatively slow growth of wages, especially for medium-skilled workers, and the worsening of the income inequality in these economies. In contrast, Malaysia's labor income share has been increasing since 2005, together with a reduction in income inequality. We investigate this development by exploring the differences in trends of the labor income shares across different economic sectors and firm sizes and identifying factors that could explain the increase in the labor income share in Malaysia. We find that the increase is mainly due to the growing importance of more traditional service subsectors and SMEs in the economy. This in turn is associated with greater reliance on low-skilled foreign workers during this period. These findings have important policy implications for Malaysia, including the potential trade-off between driving labor productivity and fostering inclusiveness. This contrarian trend offers insights that could be relevant to the experiences of, and policy choices available to, other emerging economies facing deindustrialization.

Keywords Labor income share · Foreign workers · Technology · Deindustrialization

JEL Classification E25 · J30 · J61 · O3

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1 Introduction

One of the defining developments in the global economy over the past few decades has been the declining share of national income that accrues to labor.[1] True for most advanced economies and many emerging economies, the explanation for this development is the decoupling of productivity growth and growth in real wages, especially for medium-skilled workers, and is associated with the worsening of income inequality in these economies. Research has found this development to have been due in large part to the combination of impacts from technology and the consequences of increased global integration (Dao et al. 2017; IMF 2017).

In contrast to the global trend, Malaysia's labor income share has been increasing since the official statistics became available in 2005, together with a reduction in income inequality. This paper attempts to provide an explanation for this situation in Malaysia. Overall, we find that the increase is mainly a result of the growing importance of the more traditional service subsectors and SMEs in the economy. This in turn is associated with greater reliance on low-skilled foreign workers and the lower degree of technology adoption in Malaysia during this period. These findings have important policy implications for Malaysia in the future, including a potential trade-off between driving productivity and fostering inclusiveness. This contrarian trend also offers interesting insights that could be relevant to the experiences of, and policy choices available to, other emerging economies facing deindustrialization.

The next part of the paper outlines the overall development in the share of labor income in Malaysia since 2005. Section 3 investigates the data in greater depth, using shift-share analysis to ascertain whether the change is attributable to changes within each economic sector or changes in the relative shares of different economic sectors in the overall Malaysian economy. We repeat the shift-share analysis for different firm sizes. In Sect. 4, we conduct panel regression estimation to identify the underlying factors that could explain the increase in the labor income share in Malaysia. Section 5 concludes.

2 Labor Income Share in Malaysia

2.1 Trends Since 2005

The Department of Statistics, Malaysia (DOSM) has published the nominal gross domestic product by income (GDPI) each year since 2005. The income-based approach decomposes the GDP by measuring the total income that production activity generates for owners of capital, for labor, and for the government. The compensation of employees (CoE) component is the income that it generates for

[1] As, for example, Dao et al. (2017) and the IMF (2017) documented.

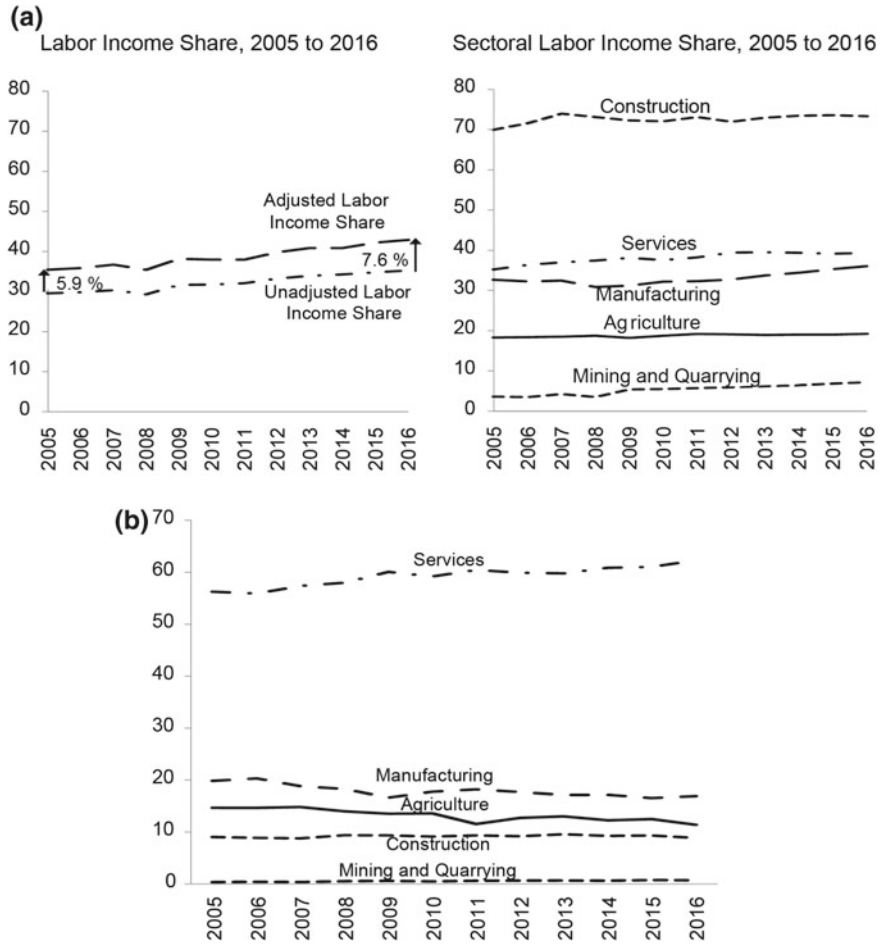

Fig. 1 **a** National and sectoral labor income share, 2005–2016 (%). **b** Share of total employment by sector, 2005–2016 (%). *Source* DOSM (various years), authors' calculations

labor, which includes wages and salaries and contributions to employment-related social insurance schemes. The labor income share (LIS) is the proportion of CoE within the total GDP, measuring the share of income for labor in the total income generated. For this paper, the primary source of data is the DOSM's GDPI. Appendix 1 provides further details of the data sources.

The LIS calculated from CoE in the GDPI excludes income that own account workers earn. As the Bank Negara Malaysia (2014, 23–28) discussed, it is possible to adjust this by estimating the LIS from own account workers, based on Gollin's (2002) work. Figure 1a shows that the unadjusted LIS increased from 29.5% in 2005 to 35.3% in 2016 (a 5.71 percentage point increase), while the adjusted LIS,

which includes income for own account workers, increased from 35.4% in 2005 to 42.9% in 2016 (a 7.45 percentage point increase).

Figure 1a also shows that the LIS in all 5 major economic sectors increased between 2005 and 2016.[2] Notably, the service sector—which is by far the largest sector in terms of employment—experienced an increase in the LIS of 4.12 percentage points in this period, the largest increase in the LIS across the 5 major sectors. This corresponded to the increase in the share of employment in the service sector from 56.2% of the overall economy in 2005 to 62.2% in 2016. With the exception of mining and quarrying, in which the share of employment in the total economy remained below 1.0%, all other major economic sectors experienced a decline in the employment share (Fig. 1b). The second-largest major sector in terms of employment, manufacturing, witnessed its share declining from 19.8% in 2005 to 16.9% in 2016.

A corollary of the increase in the LIS is the positive divergence between the real wage per worker and the labor productivity. This is necessarily true according to the definition of the LIS. An increase in the LIS implies that more of the national income, in real terms, accrues to labor than with a change in the value-added per worker. Figure 2 shows that the increase in the overall LIS is parallel to the greater increase in the real wage compared with labor productivity. Overall, the real wage per worker increased by 44.2% from 2005 to 2016, but labor productivity increased only by 19.1%. By sector, this is clearly visible in the service sector, in which the real wage per worker increased by 44.7% while labor productivity increased only by 29.5%. Similarly, for the manufacturing sector, the real wage per worker increased by 38.2% compared with labor productivity, which increased by 25.3%. While the real wage per worker and labor productivity for the mining and quarrying sector decreased, the former fell less than the latter.

In terms of labor skill levels, the largest change in the LIS between 2010 and 2016 is attributable to workers in the semi-skilled category. Figure 3 shows the estimated breakdown of the LIS (unadjusted for own account workers) by workers of different skill levels.[3] The LIS for high-skilled workers decreased from 17.2% in 2010 to 15.9% in 2011 before increasing to 18.0% in 2016. The LIS of semi-skilled workers increased from 12.7% in 2010 to 15.4% in 2013 but subsequently decreased to 14.9% in 2016. The LIS of low-skilled workers increased from 1.8% in 2010 to 2.5% in 2015 before falling to 2.4% in 2016. In absolute terms, the LIS for semi-skilled workers increased the most by 2.16 percentage points, while the LIS for low-skilled workers increased the least by 0.62 percentage points.

[2]As the employment numbers for own account workers for each sector are not available, we do not calculate the LIS adjustment for own account workers.

[3]We estimate the compensation of employees by skill level by estimating the compensation of employees from the mean wages and population of workers of different skill levels. We estimate the LIS by dividing the estimated compensation of employees by the nominal GDP. Appendix 2 provides details of the categories of worker by skill level.

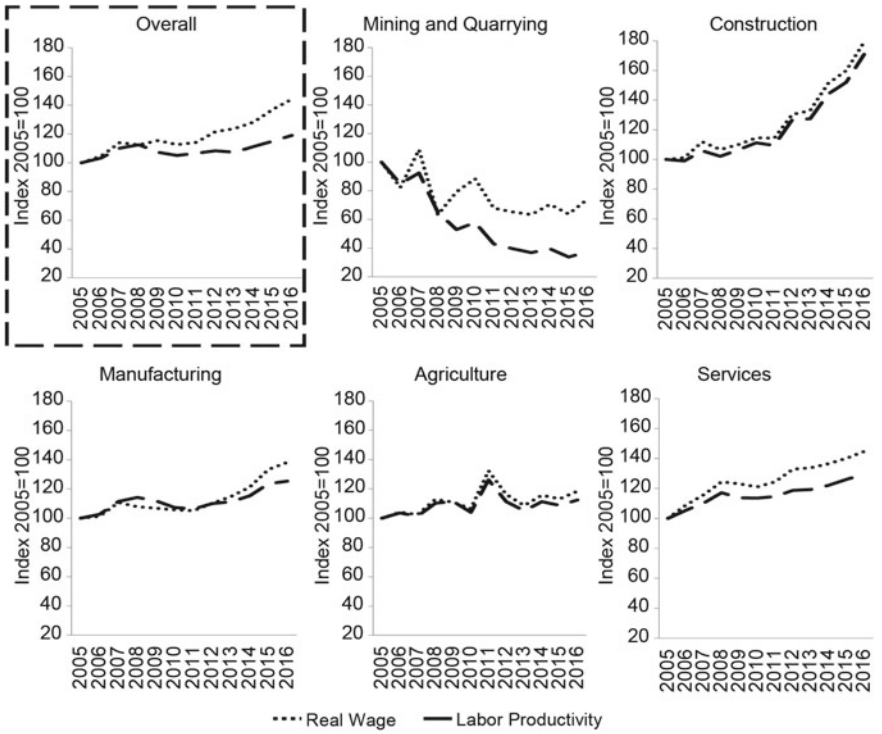

Fig. 2 Real wage per worker and labor productivity, 2005–2016. *Source* DOSM (various years), authors' calculations

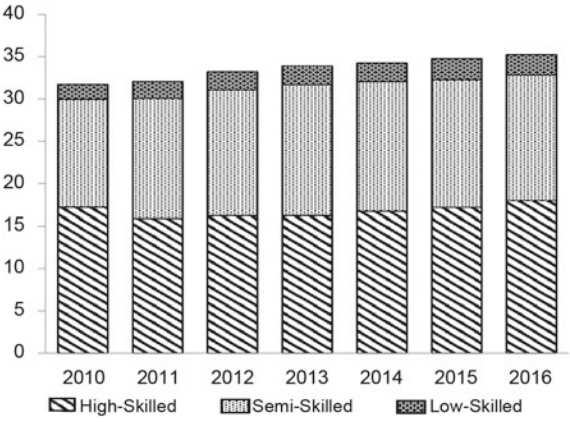

Fig. 3 Labor income share by skill level, 2010–2016 (%). *Source* DOSM (various years), authors' calculations

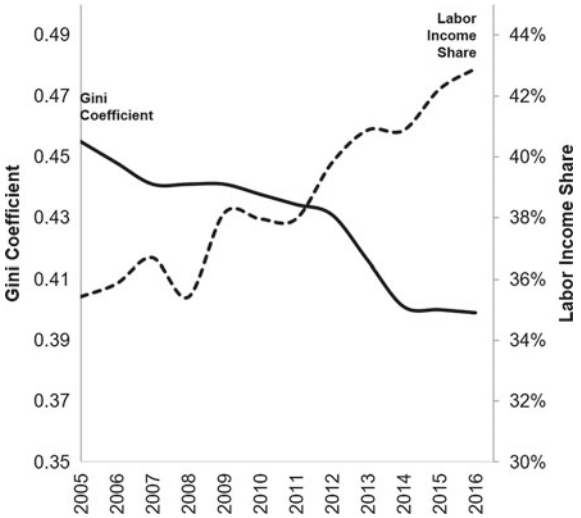

Fig. 4 Gini coefficient and labor income share, 2005–2016. *Source* DOSM (various years), authors' calculations

2.2 Co-movement with Income Inequality

The increase in the LIS has corresponded to the decrease in income inequality in Malaysia. Figure 4 shows that the Gini coefficient decreased from 0.455 in 2005 to 0.399 in 2016. We should note that it is not necessary for an increase in the LIS to correspond to a decrease in income inequality but that, generally, income for labor is more equally shared across different income classes than income for owners of capital. Globally, research has found using the Gini coefficient that the trend of a lower LIS correlates strongly with higher income inequality (IMF 2017). As shown here, the reverse trend has been true for Malaysia—an increase in the LIS corresponding to a reduction in income inequality.

3 Shift-Share Analysis

3.1 By Economic Sectors

To analyze the nature of the increase in the LIS further, we conduct a shift-share analysis to determine whether we can explain the change internally within the economic sectors via wage structure changes or via resource reallocation between sectors by the form of GDP share changes. We measure the former using the within effect and the latter using the between effect. We perform shift-share analysis of the unadjusted

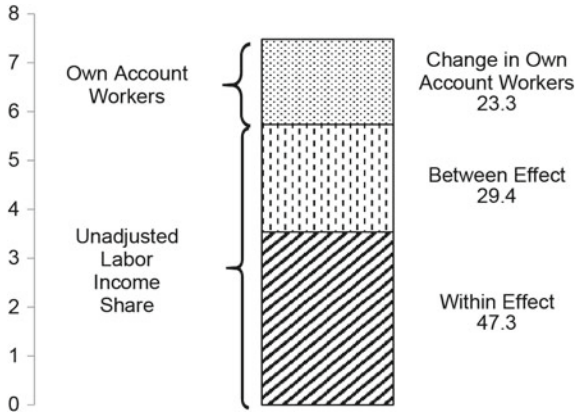

Fig. 5 Shift-share analysis, 2005–2016 (%). *Source* DOSM (various years)

LIS in the five major economic sectors as well as at a more granular level in various manufacturing subsectors and service subsectors. We add the change in own account workers' LIS to the shift-share analysis of the unadjusted LIS to adjust for own account workers' LIS change for the overall economy. Appendix 2 contains the methodology of the shift-share analysis of the unadjusted LIS.

The combined shift-share analysis (Fig. 5) shows that nearly half of the change in the LIS is due to change in the within effect, while another 29.4% is due to the between effect. Changes in own account workers' LIS contributed 23.3% to the overall change in the LIS.

Decomposing the within effect by the 5 major sectors, all 5 sectors contributed positively to the overall within effect (Fig. 6), cumulatively contributing a total of 3.54 percentage points. The service sector contributed the most to the within effect, with 2.24 percentage points. The manufacturing sector follows, contributing 0.75

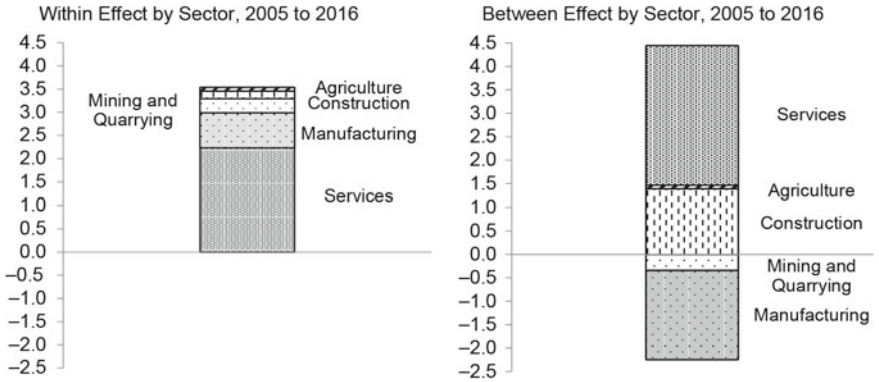

Fig. 6 Labor income share shift-share analysis by sector, 2005–2016 (%). *Source* DOSM (various years), authors' calculations

percentage points. Decomposing the between effect by sector, the service sector again contributed the most, with 2.98 percentage points. For the between effect, both the manufacturing and the mining and quarrying sectors contributed negatively to the overall change in LIS, as the shares in the GDP of these sectors declined between 2005 and 2016.

We also undertake shift-share analysis of the manufacturing and service sectors divided into smaller subsectors (Fig. 7). Unlike the previous analysis, due to the data limitation, we perform this analysis for the period 2010–2016. We divide the manufacturing sector into high-tech, mid-tech, and low-tech subsectors based on the R&D intensity of the subsectors relative to value-added and gross production. Similarly, we divide the service sector into modern services and other services, based on labor productivity. Appendix 3 provides the details of these subsectors.

All three manufacturing subsectors contributed positively to the manufacturing sector within effect but negatively to the between effect from 2005 to 2016. All three subsectors cumulatively contributed 0.94 percentage points to the within effect and −2.37 percentage points to the between effect. The high-tech manufacturing subsector contributed the most to the within effect, with 0.78 percentage points; however, it also contributed most negatively to the between effect, with −1.89 percentage points. Like other economic sectors, high-tech manufacturing experienced an increase in the LIS, but this is offset by its shrinking importance in the Malaysian economy.

For the service subsectors, both modern services and other services contributed positively to the service sector within effect, while only other services contributed positively to the between effect. Both service subsectors cumulatively contributed 0.75 percentage points to the within effect and 1.46 percentage points to the between effect. Other services contributed 0.61 percentage points to the within effect and 1.48 percentage points to the between effect.

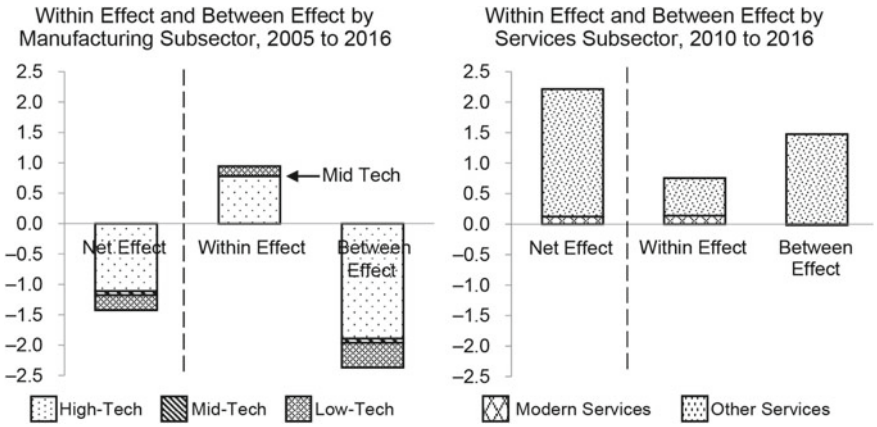

Fig. 7 Labor income share shift-share analysis by manufacturing and services subsector (%). *Source* DOSM (various years), authors' calculations

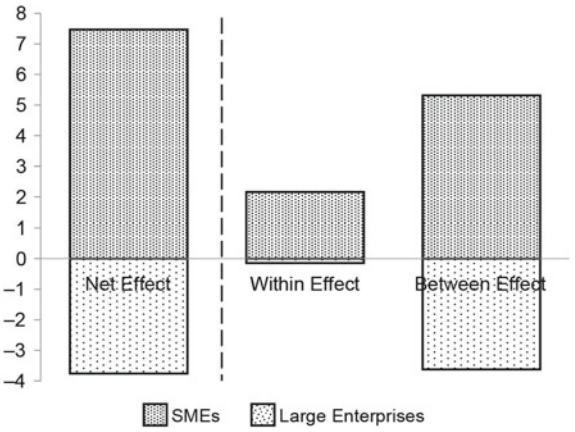

Fig. 8 Labor income share shift-share analysis by firm size, 2010–2016 (%). *Source* DOSM (various years), authors' calculations

3.2 By Firm Sizes

We also conduct shift-share analysis for the LIS by firm size between 2010 and 2015, which we categorize into small and medium enterprises (SMEs) and large enterprises.[4] SMEs contributed an overall positive net within and between effect, with 7.47 percentage points, while large enterprises made a net negative contribution of −3.76 percentage points (Fig. 8). SMEs contributed positively to the within effect, with 2.16 percentage points, while large enterprises contributed a small negative effect. SMEs also contributed positively to the between effect, with 5.31 percentage points, while large enterprises contributed negatively, with −3.62 percentage points.

3.3 Summary Findings of the Shift-Share Analysis

Overall, the shift-share analysis shows that the increase in the LIS in Malaysia is evident across most economic sectors and is not exclusively due to changes in the relative shares of the different economic sectors in the overall GDP. All the major

[4]Readers should be cautious regarding the analysis in this part due to the DOSM's change in the definition of SMEs. The definition of enterprises in the SME category changed in 2013. SME data derived from the 2011 census categorize SMEs in the manufacturing sector as enterprises with either fewer than 150 employees or less than RM25 million annual sales turnover. For other sectors, SMEs are enterprises with fewer than 50 employees or less than RM5 million annual sales turnover. For 2015, SME data derived from the 2015 census categorize SMEs in the manufacturing sector as enterprises with fewer than 200 employees or less than RM50 million annual turnover. For other sectors, SMEs are enterprises with fewer than 75 employees or less than RM20 million annual turnover.

economic sectors, including some other finer subsectors in the manufacturing and service sectors, experienced an increase in the LIS.

Most notably, the service sector is the main contributor to the increase in the LIS —with combined within and between effects of more than 5.22 percentage points for the period 2005–2016 or more than 90% of the entire increase in the overall LIS unadjusted for own account workers for Malaysia during the period. Within the service sector, this change in turn is attributable to the increased importance of the more traditional service subsectors with lower labor productivity. The shift-share analysis of firm sizes could also reflect this; it attributes the entire change in the LIS to both the within and the between effects of SMEs, with large enterprises contributing negatively to the overall LIS. It is telling that almost 90% of all the SMEs in Malaysia are in the service sectors, mainly in the more traditional subsectors.

4 Factors Affecting the Labor Income Share in Malaysia

The findings of the shift-share analysis suggest that broad-based underlying macro-economic factors, rather than sector-specific factors, could largely have driven the increase in the LIS. In this section, we proceed to focus on understanding the within effect underlying the increase in the LIS by identifying the potential factors leading to this change.

The literature has identified various important determinants, two of which researchers have commonly recognized as being crucial:

(a) *Technological advancement* has affected the LIS by reducing the relative cost of capital, thereby incentivizing firms to substitute capital for labor in their production structure. The displacement of labor in this context is more pronounced where existing jobs experience greater exposure to routinization. Empirically, these mechanisms are the major contributor to the decline in the LIS in advanced economies, given their significant reliance on capital goods and greater initial exposure to routinization.[5]

(b) *Trade and financial integration*, particularly participation in global value chains (GVCs), has decreased the LIS in both advanced and emerging and developing economies as a whole. In capital-intensive advanced economies, global integration enables firms to offshore more labor-intensive tasks to labor-intensive emerging economies, hence lowering the LIS in their production. In the recipient emerging economies, these tasks are nonetheless relatively more capital intensive than their existing tasks. Increased GVC participation

[5]See, among others, Krusell (1998) for the link between information and communication technology and the price of investment goods and Autor and Dorn (2013) and Goos, Manning, and Salomons (2014) for the role of technology in the displacement of labor.

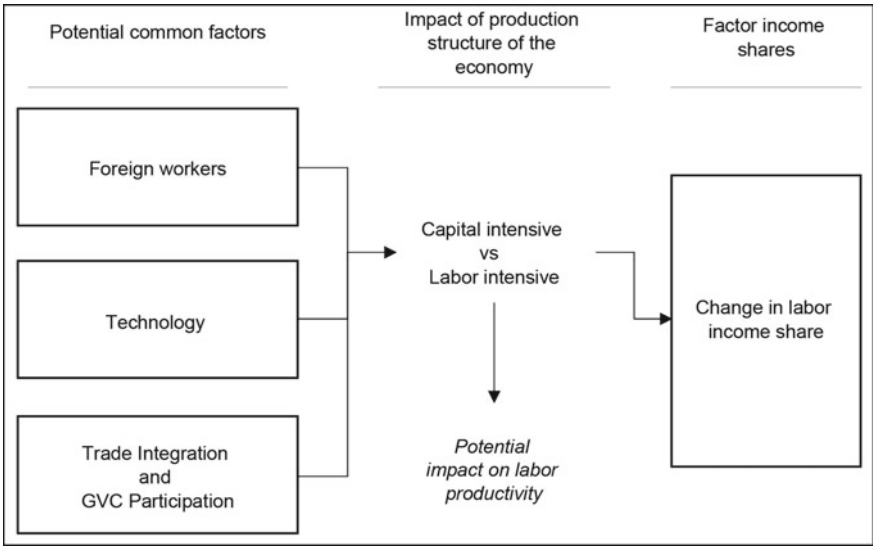

Fig. 9 The mechanism through different factors that affect the labor income share

therefore induces an increase in capital intensity—and a corresponding decrease in the LIS—in the receiving economies.[6]

Essentially, the mechanisms at play reflect the channels through which different economies influence firms' choice of production structure, contributing to their respective LIS trend. In Malaysia, we argue that another important factor could also play a role in influencing this mechanism—the reliance on foreign workers in the workforce. The availability of low-cost foreign workers in the country could reduce the relative cost of labor below what it would otherwise have been without immigration and encourage firms to employ a labor-intensive production structure, thus increasing the LIS.[7] Figure 9 summarizes and illustrates these channels and the mechanism.

[6]See, among others, Feenstra and Hanson (1997), IMF (2017), and Elsby, Hobijn, and Şahin (2013) for detailed explanations of the mechanisms at play in emerging and developing economies.

[7]For a more complete treatment of the assumption of the underlying production function behind the discussion throughout this section, refer to Appendix 4.

4.1 Model Specification

We perform a panel regression estimation to identify the key determinants of the LIS in Malaysia, using GDPI statistics and other information across 20 sectors[8] (N = 20) over the course of seven years (2010–2016; T = 7).

The dependent variable in our estimation model is the change in the LIS, whilst the explanatory variables consist of measures of the potential determinants, including changes in foreign workers' intensity as well as machine and equipment intensity (as a proxy for technological adoption).[9] Given the data limitation, there are no measures relating directly to trade or GVC participation in the model. However, we could account for the effects of trade intensity in two ways: first, we include a capital intensity variable in the model to capture said effects partially, since the variation in capital intensity across sectors mainly reflects the impact of GVC participation; second, we include a sector fixed effect—which accounts for time-invariant sector-specific heterogeneity—that could potentially control for the factor to the extent that sectors' GVC participation remains stable across time. Besides, we include changes in labor productivity as an additional independent variable. Appendix 5 outlines further details of the estimation, including the model specification and specification tests.

Figure 10 provides a cursory overview of the trends in the determinants that we use in the model across sectors. From 2010 to 2016, foreign workers' intensity clearly increased. Machine and equipment intensity, on the other hand, generally declined within the same period of time.

4.2 Results

Table 1 presents the results of our baseline regressions, with Panel A being our main focus, whilst Panel B serves as a robustness check. In particular, we find the following:

- *As expected, the change in foreign workers' intensity is strongly positively correlated with LIS change*. In almost every specification of the model, sectors that displayed a greater increase in foreign workers' intensity experienced a more pronounced increase in the LIS. By way of explanation, this is consistent with the findings of the World Bank (2015), in which foreign workers benefited semi-skilled Malaysians the most in the labor market. As Sect. 2.1 elaborated,

[8]Appendix 3 contains detailed information on the full list of 21 sectors according to the Malaysia Standard Industrial Classification (MSIC) 2008 version 1.0. For the purpose of econometric analysis, we exclude the mining and quarrying sector due to its outlying labor productivity statistics, which we can attribute to the resource-based nature of the sector.

[9]Appendix 1 provides detailed explanations for these various intensities.

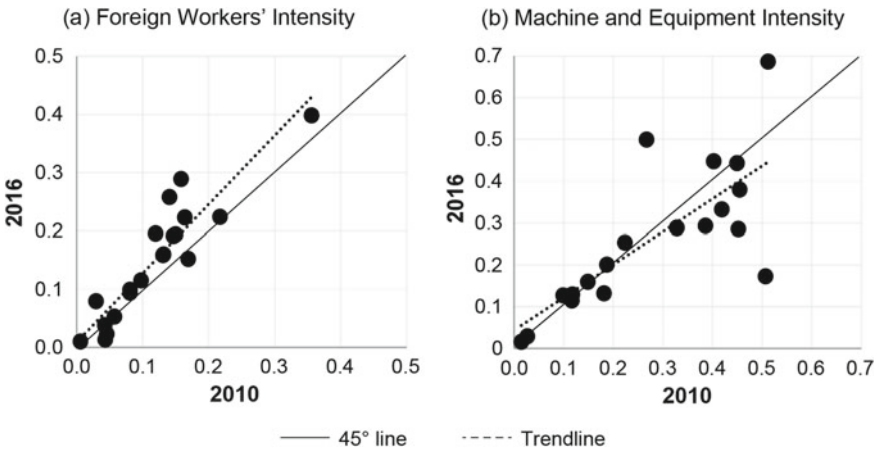

Fig. 10 Trends in potential determinants of the labor income share in Malaysia, 2010–2016. *Source* DOSM (various years), authors' calculations

the biggest increase in the LIS can be traced to the increase in those who are in the semi-skilled category.

- *The changes in machines and equipment as well as capital intensity exhibit negative coefficients, but the correlations are statistically insignificant.* The negative correlation implies that the downward trend in technological adoption that we observe could play a role in explaining Malaysia's upward LIS trend, although this trend is not statistically significant.
- *The change in labor productivity is negatively correlated with the change in the LIS.* As shown in specifications (4) and (5), sectors that experienced a decline in their labor productivity tend to witness a rise in their labor income share.

In summary, the results from the panel estimation suggest that the economic sectors that shifted to greater reliance on low-skilled foreign workers and experienced a decline in labor productivity witnessed increases in the LIS in Malaysia between 2010 and 2016.

5 Conclusion: Policy Discussion

To recap, we find that the increase in the LIS in Malaysia since 2005 was common to all the major economic sectors, with each of them experiencing increases in the LIS to various degrees. The service sector is the main contributor to the overall increase in the LIS, due to both the increase in the LIS within the service sector itself and the growing share of the service sector in the overall economy. Within the service sector, this in turn is a result of the growing share of the more traditional service subsectors rather than the modern service subsectors. Relatedly, in terms of

Table 1 Regression Results

Explanatory variables	(1)	(2)	(3)	(4)	(5)
	Panel A: Excluding the mining and quarrying sector				
Log foreign workers' intensity	0.055** (0.024)	0.056** (0.024)	0.056** (0.025)	0.043** (0.019)	0.043** (0.020)
Log machine and equipment intensity		−0.030 (0.046)	−0.039 (0.049)		−0.020 (0.033)
Log capital intensity			−0.320 (0.365)		−0.195 (0.268)
Log labor productivity				−0.452*** (0.123)	−0.449*** (0.122)
Constant	0.009*** (0.001)	0.008*** (0.001)	0.020 (0.013)	0.018*** (0.002)	0.025** (0.010)
Sector fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	120	120	120	120	120
Overall R^2	0.094	0.093	0.077	0.336	0.322
	Panel B: Including all sectors				
Log foreign workers' intensity	0.052** (0.023)	0.052** (0.023)	0.053** (0.024)	0.038* (0.019)	0.040* (0.020)
Log machine and equipment intensity		−0.033 (0.047)	−0.040 (0.046)		−0.034 (0.036)
Log capital intensity			−0.336 (0.324)		0.312 (0.263)
Log labor productivity				−0.373*** (0.123)	−0.371*** (0.121)
Constant	0.011*** (0.000)	0.010*** (0.001)	0.023* (0.012)	0.017*** (0.002)	0.028** (0.010)
Sector fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	126	126	126	126	126
Overall R^2	0.083	0.082	0.056	0.298	0.267

Notes

(1) *denotes statistical significance at the 10% level; ** at the 5% level; and *** at the 1% level

(2) The dependent variable for all the specifications is *the change in the log labor income share*

(3) Standard errors appear in parentheses. They are heteroskedasticity robust and clustered by sector

(4) All the variables, including the dependent variable, that is, the labor income share, are first differenced

firm sizes, the increase in the LIS is due entirely to the SMEs experiencing an increasing LIS as well as the growing share of SMEs in the economy. Most SMEs in the Malaysian economy are in the more traditional service subsectors. In terms of the underlying factors, the increase in the LIS in Malaysia is associated with greater reliance on low-skilled foreign workers in the period investigated. More broadly, it

is in fact not inconsistent to consider the overall increase in the LIS as an outcome of the deindustrialization of the Malaysian economy that has taken place since the early 2000s.[10]

From the increase in the LIS and the declining income inequality, it appears that, over the last decade, the growth in the Malaysian economy has become more inclusive in nature. Structurally, however, an accompanying transition has occurred away from a more capital-intensive to a more labor-intensive model—a structure that is skewed toward medium- and low-skilled workers with lower labor productivity, more traditional service subsectors rather than high-tech manufacturing, and smaller firms rather than larger enterprises.

This raises a number of important policy implications. Firstly, our findings call for more careful consideration of the use of the LIS as a macroeconomic goal. In the *Eleventh Malaysia Plan* (Economic Planning Unit (EPU) 2015), the Malaysian government explicitly targeted a higher level of the LIS by the year 2020 for Malaysia to be on par with other middle- and high-income countries.[11] It is necessary to understand the changes in the LIS alongside the broader structural changes that are occurring in the Malaysian economy. Within the current context, the increase in the LIS, while a decline in income inequality accompanies it, is tied to growth- and productivity-reducing structural change for Malaysia in the longer term. If the overarching objective is for Malaysia to become a more advanced economy, the use of the LIS as a target is clearly not a very meaningful one in this case.

Secondly, our paper highlights that policies enabling Malaysia to move toward an economy that is simultaneously productivity driven and inclusive are potentially fraught with multiple inter-linked trade-offs that could be self-defeating. For example, looking specifically at the SMEs, our results show that the increase in the LIS in recent years is attributable to SMEs—they created significant job opportunities, employing 65% of all workers in Malaysia in 2016. At the same time, SMEs lag significantly behind large enterprises in terms of productivity and investment (Fig. 11). As such, policies to raise the importance of SMEs in the economy, without a significant effort to modernize them, could have an adverse impact on the aggregate productivity and future growth potential of the overall economy.

Lastly, our results provide further evidence that Malaysia is currently deindustrializing negatively,[12] with the decline in the share of the manufacturing sector, especially in the high-tech subsector, being replaced by the more traditional service subsector rather than higher value-added modern services. This is arguably one of the most pressing economic issues for Malaysia in the long term. A comprehensive

[10]As KRI (2017) discussed.

[11]Specifically, under the objective of "reducing wage gap to improve equity," "the Government aims to increase the compensation of employees to GDP from 33.6% in 2013 to 40% in 2020, to be on the same level as other middle- and high-income countries" (EPU 2015, 5–16).

[12]For example, as Rasiah (2011) and Menon and Ng (2015) highlighted.

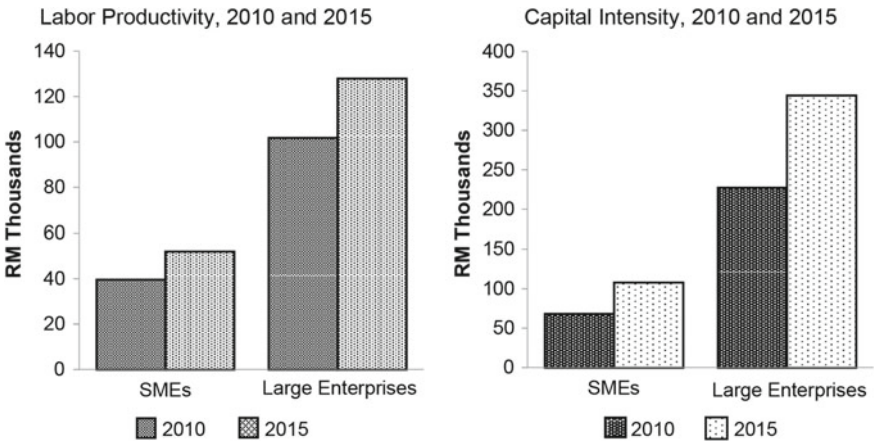

Fig. 11 Labor productivity and capital intensity by firm size, 2010 and 2015. *Source* DOSM (various years), authors' calculations

policy discussion with regard to the negative deindustrialization of Malaysia is beyond the scope of this paper, but our findings offer two important directions for policies to investigate:

- *Reliance on low-skilled foreign workers.* Our findings suggest that, beyond labor market outcomes, the increase in dependence on low-skilled foreign workers in Malaysia has important structural implications for the economy too. While not necessarily implying causality, the close empirical association between the increased reliance on foreign workers and the more general shift to labor-intensive, lower-productivity sectors warrants closer scrutiny.
- *Increased importance of SMEs to the Malaysian economy.* The structural change in the Malaysian economy is evident not just in the shift across economic sectors but also in the change toward smaller firms. As discussed above, Malaysian SMEs currently operate mainly in lower value-added services and lag behind larger enterprises in terms of productivity. This does not always have to be the case. Across many advanced economies, SMEs are not only a main source of employment but are also often the driving force behind radical innovations, which are important for economic growth and contribute more broadly to value creation by adopting innovation generated elsewhere and adapting it to different contexts (OECD 2010). A promising path that Malaysia can take advantage of to modernize its SMEs is through the use of modern technologies. Recent advances in digital technologies have significantly expanded the potential for SMEs to accelerate innovation, enhance productivity, and access larger markets (OECD 2017).

In conclusion, unlike most countries in the world, Malaysia has been experiencing an increase in the LIS. We find that this experience is consistent with the deindustrialization of the Malaysian economy, which is linked to a transition away

from a more capital-intensive to a more labor-intensive structure—with greater reliance on low-skilled foreign workers and lower labor productivity growth. This contrarian trend offers salient insights that could be relevant to the experiences of, and policy choices available to, other emerging economies facing deindustrialization.

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Appendix 1: Data Sources and Descriptions

The data that we use for calculating the various indicators come from various publications from the DOSM:

1. *National Accounts: Gross Domestic Product Income Approach*, 2010–2016
2. *National Accounts: Annual National Accounts Gross Domestic Product (GDP)*, 2005–2016
3. *National Accounts: Capital Stock Statistics*, 2010–2016
4. *Labour Force Survey*, 2005–2016
5. *Salaries & Wages Survey Report*, 2010–2016
6. *Economic Census Profile of Small and Medium Enterprises,* 2010 and 2015
7. *Economic Census*, 2010 and 2015
8. *Household Income Survey*, 2016

We define the various intensities that we use as:

1. Foreign workers' intensity: the ratio of the number of foreign workers to the total employed.
2. Capital intensity: the ratio of net real capital stock to the number of employments.
3. Machine and equipment intensity: the ratio of the machine and equipment component of the net capital stock to the total net capital stock.

Appendix 2: Shift-Share Analysis

$$\underbrace{LIS_T - LIS_0}_{\text{Total}} \approx \underbrace{\sum_i (LIS_T - LIS_0) \times W_{iT}}_{\text{Within Effect}} + \underbrace{\sum_i (W_{iT} - W_{i0}) \times L_{iT}}_{\text{Between Effect}}$$

LIS = Labor income share
W = GDP share
i = Sector
T = Final year (2016)
0 = Starting year (2005 or 2010)
Source: Adapted from Abdih and Danninger (2017).

Appendix 3: Twenty-One Economic Subsectors, Categorization of Workers by Skill Level, and Manufacturing and Service Subsectors

A. Twenty-One Economic Subsectors

Adapted from Malaysia Standard Industrial Classification (MSIC) 2008 version 1.0

1. Rubber, oil palm, livestock, and other agriculture
2. Forestry and logging
3. Fishing
4. Mining and quarrying
5. Food, beverages, and tobacco
6. Textiles, wearing apparel, and leather products
7. Wood products, furniture, paper products, and printing
8. Petroleum, chemical, rubber, and plastic products
9. Non-metallic mineral products, basic metal and fabricated metal products
10. Electrical, electronic, and optical products
11. Transport equipment, other manufacturing, and repair
12. Construction
13. Electricity, gas, steam, and air conditioning supply
14. Water supply, sewerage, waste management, and remediation activities
15. Wholesale and retail trade, repair of motor vehicles and motorcycles
16. Transportation and storage
17. Accommodation and food and beverage services

18. Information and communication
19. Financial and insurance/takaful activities
20. Real estate activities
21. Professional, scientific, and technical activities

B. High-, Medium-, and Low-Skilled Workers

Skill categorization is based on the DOSM and the Malaysia Standard Classification of Occupations (MASCO) 2013

High-Skilled Workers

1. Managers
2. Professionals
3. Technicians and associate professionals

Medium-Skilled Workers

1. Clerical support workers
2. Services and sales workers
3. Skilled agricultural, forestry, and fishery workers
4. Craft and related trade workers
5. Plant and machine operators and assemblers

Low-Skilled Workers

1. Elementary occupations

C. Low-, Medium (Mid-), and High-Tech Manufacturing

Modified in accordance with UNIDO's classification, following the OECD technology classification based on R&D intensity relative to value added and gross production (ISIC categorization)

High-Tech

1. Electrical, electronic, and optical products
2. Transport equipment, other manufacturing, and repair

Medium (Mid-) Tech

1. Petroleum, chemical, rubber, and plastic products
2. Non-metallic mineral products, basic metal and fabricated metal products

Low-Tech

1. Food, beverages, and tobacco
2. Textiles, wearing apparel, and leather products
3. Wood products, furniture, paper products, and printing

Modern Services

Following the Asian Development Bank (2013), adapted from Eichengreen and Gupta (2009) based on labor productivity (ISIC categorization)

1. Information and communication
2. Financial and insurance activities
3. Real estate activities
4. Professional, scientific, and technical activities

Appendix 4: Formal Treatment of the Relevant Production Function

This section provides a detailed explanation of some key concepts underlying the channels through which the main drivers affect the labor income share, including the production function framework and the elasticity of substitution between capital and labor. The explanation below draws from the Estrada and Valdeolivas' (2012) discussion.

The upward LIS trend observed in Malaysia—or the downward trend experienced elsewhere—signals the invalidity of unitary elasticity of substitution between capital and labor that conventional production functions, such as Cobb–Douglas, assume, as it implies a constant LIS. One way to rethink this is by considering a constant elasticity of substitution (CES) production function, which allows the elasticity of substitution between capital and labor to be different from one. In this case, should there be changes in the relative cost of either factor of production, the LIS would not be constant.

For this task, Arpaia et al. (2009) provided a comprehensive approach. Essentially, it considers and merges four production factors through a series of nested CES production functions, thus allowing for different elasticities of substitution among them.

Firstly, at the lower level of the production process is a CES function involving skilled labor (L_S) and capital (AK, where A denotes a capital-augmenting technological process), which produces the composite input, denoted X, for the subsequent production function specified later.

$$X = \{a(AK)^{\frac{\eta-1}{\eta}} + (1-a)(L_S)^{\frac{\eta-1}{\eta}}\}^{\frac{\eta-1}{\eta}}$$

η represents the elasticity of substitution between L_S and K. If η is lower (higher) than 1, it implies that an increase in the supply of capital would increase (decrease) the share of skilled labor compensation (on the production of X). In other words, an η that is lower than one means that the two production factors are complements; if it is higher than one, they are substitutes.

The second CES function involves the combination of the previous composite input (X) and unskilled labor (L_U) to generate value added (Y). ρ is the new elasticity of substitution in this function, which allows for different degrees of complementarity between capital and the two types of labor.

$$Y = \{\alpha(X)^{\frac{\rho-1}{\rho}} + (1-\alpha)(L_U)^{\frac{\rho-1}{\rho}}\}^{\frac{\rho-1}{\rho}}$$

Given the characterization of technology that the above CES production functions specify, we can infer that the LIS will depend, non-linearly, on four key variables, namely capital-augmenting technological progress, capital intensity, the unskilled–skilled labor ratio, and the capital–skilled labor ratio. How the LIS changes with respect to these variables depends on the degrees of substitutability between the different production factors laid out above. The remainder of this section focuses on explaining the conditions necessary to eventuate a positive impact on the LIS via these variables, which is what happens in Malaysia.

First, the condition for capital-augmenting technological progress to have a positive impact on the LIS is that composite input X and unskilled labor are substitutes. This implies that a negative shock of capital-augmenting technology increases the income share of unskilled labor. The income share of skilled labor, on the other hand, can either increase or decrease, since it is the product of the income share of the composite capital–skilled labor in the value added—which decreases under the previous condition—and the income share of skilled labor in the composite—the change of which depends on the elasticity of substitution between capital and skilled labor. When the two factors are complements, negative technological shocks will lead to a decrease in skilled labor's income share. However, if the degree of complementarity is lower than the degree of substitutability between the unskilled labor and the composite, the decrease will not be enough to outweigh the increase in the unskilled labor income share. As a result, the overall labor income share will increase.

Second, the conditions to yield a positive impact on the LIS through capital intensity are essentially similar to those in the previous case, for the same reasons. In fact, the theoretical model indicates that the two variables should enter the model with the same parameter.

Third, for the unskilled–skilled labor ratio to affect the LIS positively, again, composite X and unskilled labor must be substitutes. In this case, it means that an increase in the ratio increases the unskilled labor income share. As for skilled labor, two counteracting forces are at play: less skilled workers will be employed but with a higher skill premium due to the decrease in supply. The two scenarios combine to result in an overall increase in the labor income share.

Lastly, the capital–skilled labor ratio has an unambiguously positive relationship with the LIS. In other words, when the capital supply decreases below the supply of skilled labor, the relative demand for skilled labor will drop correspondingly,

exerting downward pressure on the wage premium and, thus, the labor income share of skilled labor. This mechanism, however, has no effect on the unskilled labor income share.

These conditions are important in understanding how changes in these variables led to the increase in the LIS in Malaysia during the past decade; the econometric analysis section in the paper formally establishes the relationship between these variables, except for the capital–skilled labor ratio due to the data limitation.[13]

Appendix 5: Further Details of the Econometric Analysis

This section explains in detail the econometric analysis that this study employs. The baseline estimation equation of the regression is as below:

$$Y_{it} = \alpha_i + \delta_t + \beta_1 X'_{it} + \beta_2 C_{it} + \varepsilon_{it}$$

where

(i) i denotes the sector and t denotes the year;

(ii) Y_{it} is the dependent variable, that is, the labor income share;

(iii) X'_{it} is the vector of explanatory variables of interest, including foreign workers' intensity, machine and equipment intensity, and capital intensity;

(iv) C_{it} is the additional independent variable, namely labor productivity;

(v) α_i and δ_t are sector and year fixed effects, respectively; and

(vi) ε_{it} is the error term.

The main coefficients of interest are β_1, which capture the extent to which the corresponding variation in the potential determinants can explain the variation in the labor income share. The sector and year fixed effects essentially capture industry- and year-specific economic and social confounding factors.

Specification Tests

Because the time dimension, T, of the dataset is small, we perform the Harris–Tzavalis test[14] to test for unit roots in the panel. For most of the variables, we cannot reject the hypothesis of the presence of unit roots at level; thus, we apply first differencing to obtain stationary series. We also estimate the model using

[13]Different indicators measure the three variables that this section outlines in the econometric model. Machine and equipment intensity acts as a proxy for capital-augmenting technological progress and foreign workers' intensity provides a proxy for the unskilled–skilled labor ratio (given that foreign workers in Malaysia generally occupy lower-skilled jobs than Malaysians), whereas the ratio of net capital stock to the number of employments, instead of the capital–output ratio that Estrada and Valdeolivas (2012) used, measures the capital intensity.

[14]The Harris–Tzavalis test is a unit root test that assumes that T is fixed.

standard errors clustered by industry to address the serial correlation concern in the panel. Besides, to detect the presence of random effects, we test the model for over-identifying restrictions—a Hausman-type test that is robust to heteroskedasticity and within-group correlation. The test finds no random effects in all the specifications of the model. We also test the joint significance of year-specific effects using the F-test. For all the specifications, we cannot reject the hypothesis that the year-specific effects are jointly statistically insignificant; therefore, we do not include year-specific effects in any of them.

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Chapter 9
Institutions, Deindustrialization, and Functional Income Distribution in Japan

Kyoji Fukao and Cristiano Perugini

Abstract We investigate the long-term drivers of the labor share in Japan using data from the Japanese Industrial Productivity database from 1970 to 2012. The descriptive and econometric results indicate that the decline in the labor share observed in Japan during the period of analysis was highly concentrated in the low-knowledge-intensity sectors, the employment share of which has increased remarkably. These sectors also experienced a strong increase in non-regular workers, who constitute a secondary segment of the labor market in Japan, characterized by low wages and very limited union coverage. The low level of protection of this group of workers and the increase in market power concentration have probably contributed to reducing the bargaining power of labor vis-à-vis employers and, consequently, the labor share.

Keywords Labor share · Non-regular work · Markup · Japan

JEL Classification E25 · J30 · L11 · O14

1 Introduction

The Japanese economy has experienced a long period of stagnation coupled with an unprecedented increase in economic inequality in the last decades (Minami 2008; Funabashi and Kushner 2015). Both might be related to the decrease in the share of output distributed to labor via the effects on the aggregate demand patterns and on personal income inequality resulting from higher capital incomes. Different from other economic contexts, surprisingly, the analysis of the labor share in Japan has attracted only limited attention. Agnese and Sala (2011) focused on the period

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1997–2009 and identified the main cause of the contraction in the labor share with evolutions of the labor relation systems, namely the decline in the strength of unions. Takeuchi (2005) suggested that the reasons behind the reduction in the labor share are an increase in the elasticity of substitution between labor and capital over time and a contemporaneous decrease in labor mobility and adjustments across the economy. Wakita (2006) instead paid attention to the role of depreciation in shaping the dynamics of the labor share in the years 1981–2003.

More generally speaking, the extensive literature about the dynamics of the labor share developed in the last two decades has identified a number of factors that are able to affect the labor share. The literature first connected its decrease to capital-augmenting technological change, increasing the substitutability of labor with capital (Bentolila and Saint-Paul 2003; Antràs 2004) and capital deepening (Karabarbounis and Neiman 2014; Piketty 2014; Piketty and Zucman 2014). The framework gains much explanatory power when taking labor and capital heterogeneity into account, separating high- and low-skilled workers (Arpaia et al. 2009; Elsby et al. 2013) and ICT and non-ICT capital (European Commission 2007; Lawless and Whelan 2011). The overall effect of skill-biased technological change on the labor share indeed depends on the interplay between the levels of substitutability of different types of capital and labor and on workers' relative skill premia (Karaborbonis and Neiman 2014).

The second set of explanations relates to market imperfections; when remunerations do not mirror workers' marginal productivity, the extent to which emerging rents accrue to capital or labor depends on the institutional settings that shape the bargaining power of workers vis-à-vis employers (Blanchard and Giavazzi 2003). The existing literature has emphasized particularly the role of product market competition (Azmat et al. 2012; Barkai 2016; Autor et al. 2017) and labor market institutions (Bentolila and Sain-Paul 2003; European Commission 2007; Bental and Demougin 2010; OECD 2011).

The third group of drivers of the patterns of the labor share relates to globalization. Classical trade theories predict that developed countries specialize in capital-intensive industries, and this drives the labor share downwards, provided that the elasticity of substitution is lower than one (i.e., capital and labor are gross complements) (European Commission 2007). The introduction of labor heterogeneity (high- and low-skilled labor) complicates the predictions of the model, since the overall effect on the labor share will also depend on the relative elasticity of substitution of the different types of labor with respect to capital (Guscina 2006; ILO 2011). In addition, wage-setting institutions and rigidities can alter labor/capital substitutability and the impact of internationalization patterns on the labor share (Davis 1998; Decreuse and Maarek 2011). The threat of relocating the production process (or part of it) through FDI, outsourcing, or imports of intermediate inputs is also likely to affect the labor share via changes in the labor demand, wage elasticity, and bargaining power of labor (Harrison 2002; Jaumotte and Tytell 2007). The interplay of all these factors originates many possible outcomes, and the impact of the various trajectories of globalization on the labor share is ultimately an empirical matter (see Guerriero and Sen 2012).

In this chapter, we shed light on the dynamics of the labor share in Japan over the period 1970–2012. In particular, we use JIP (Japan Industrial Productivity) data to show: (i) that the evolution of the labor share differed significantly across sectors; and (ii) how technological and institutional factors contributed to shaping its pattern over time. To achieve these aims, in the next section, we present the dataset and some preliminary descriptive evidence. We describe the empirical model and the econometric methods in Sect. 3 and our results in Sect. 4. Section 5 concludes and draws some policy implications.

2 Data and Preliminary Empirics

The data used in our empirical analysis refer to the period 1970–2012, and we extract them from the Japan Industrial Productivity (JIP) database, which the RIETI (Research Institute of Economy, Trade and Industry) and Hitotsubashi University, Tokyo, compiled. We include in our analysis all the market economy sectors with the exception of private medical, education, research, and hygiene services, which present excessively high levels of the labor share in some years. We refer to this aggregate as the total market economy (TME), consisting of 91 JIP sectors. We restrict the econometric analysis of the total labor share to 84 industries (referred to as the non-primary market economy—NPME) after having excluded primary sectors (1–6—agriculture and 7—mining). Lastly, we carry out the analysis of the drivers of the labor share for subsectors of market services (MSERV) and manufacturing (MAN) on a total of 78 sectors, after having excluded construction (JIP code 60) and utilities (62–66). We reclassify the manufacturing and market service industries according to the Eurostat classification as follows (see Appendix A for the details): medium- and medium-high-technology manufacturing sectors (MHM—23 JIP sectors), medium- and medium-low-technology manufacturing sectors (MLM—29 sectors), knowledge-intensive services (KIS—12 sectors), and less-knowledge-intensive services (LKIS—14 sectors).

We construct the labor share (S_L) as the ratio of nominal total labor compensation to nominal value added (at basic prices). The nominator includes both employee compensation and mixed income, that is, labor that self-employed and family workers supply (see Fukao and Perugini 2018 for the methodological details). JIP also provides disaggregated data on labor remuneration by the type of worker, which is particularly useful in allowing for the existing dichotomy and duality in the Japanese labor market between regular employment (with dependent, full-time, and open-ended contracts) and non-regular employment (temporary, part-time, self-employed, and family workers). For each employment type, besides the number of workers, JIP provides the average number of annual hours worked, which we use here to construct the share of non-regular employment in the total employment (L_{NR}/L). The database also supplies separately the stock of real IT and non-IT capital, which we use to build the capital intensity (on value added) variables (k_{IT}; k_{NIT}). We construct our technological change variable (TFP) starting

from the TFP annual growth rate, as an index that is equal to 100 in the initial year (1970). Another distinctive feature of our dataset is the availability of the union density (UD) rate by sector, which we estimate by dividing the total number of union member workers in each sector (from the Basic Survey on Labour Unions) by the total number of workers. As regards the variables related to globalization, we measure trade openness (Trade) as the ratio of total imports plus total exports to value added, whereas we use the input–output JIP tables to derive a proxy for "broad" offshoring (Off), which the literature has commonly used since Feenstra and Hanson (1999), that is, the ratio of imported intermediate inputs to total intermediate inputs (IMF 2007).

Lastly, our measure of markup (Mark up) is related to the classical Lerner index of market power (see Maimaiti et al. 2010), and we compute it as the ratio of the value of output (minus indirect taxes and subsidies) to variable (labor + intermediate inputs) costs at the industry level (see Badinger 2007 as an example of the use of the same index at the broad sector level for the EU).

Figure 1 shows that the labor share in Japan in the TME (top left panel), compared with the level in the early 1970s, decreased by approximately ten percentage points in the following three decades. This was the result of the first wave

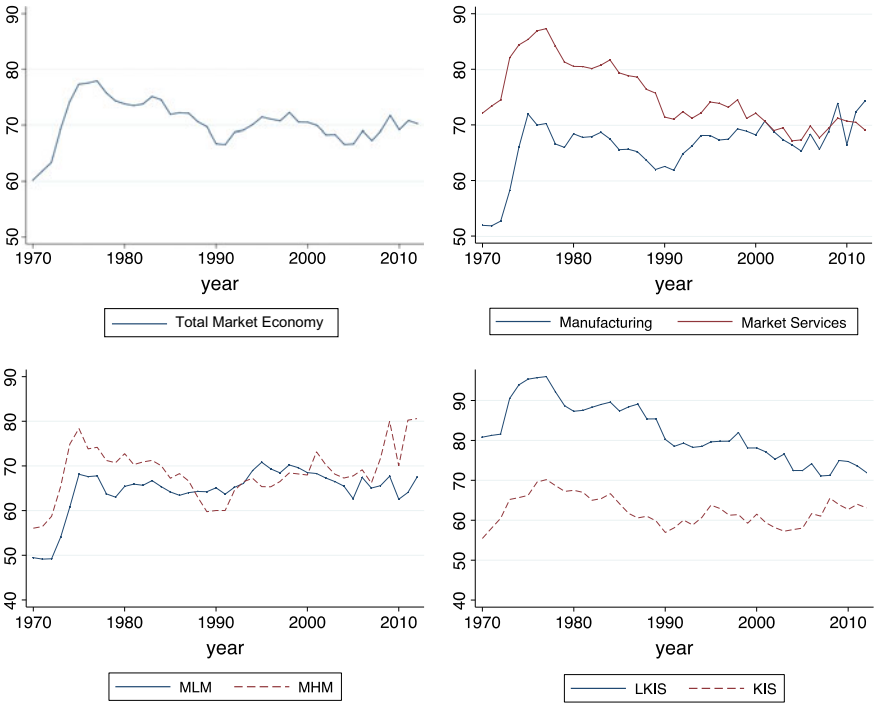

Fig. 1 Labor share in the total market economy and macro-sector aggregates. *Source* Authors' elaborations of the JIP database

of decline from the mid-1970s until the end of the 1990s, which was followed by a second wave from the late 1990s to the outburst of the 2007–2008 global crisis. The top-right panel of Fig. 1 also shows that, contrary to what happened in contexts that researchers usually compare with Japan, like the US, the decline in the labor share mainly took place in services while remaining substantially unchanged in manufacturing.

The bottom panels of Fig. 1 plot the trend over time of the S_L of the subsectors of manufacturing and services (MHM, MLM, KIS, and LKIS). The decline in the labor share in Japan took place almost exclusively in low-knowledge-intensive services, the macro-sector that experienced the largest expansion in terms of employment share and that, at the end of the period considered, accounted for over half of the total hours worked in the country (see Fukao and Perugini 2018). It is therefore apparent that any attempt to explain the pattern of the S_L in Japan needs a sectoral perspective of analysis.

3 Empirical Model and Econometric Methods

Our empirical model builds on the theoretical framework that Bentolila and Saint-Paul (2003) proposed; under the assumption of constant returns to scale, capital- and labor-augmenting technological progress, and competitive markets, they identified a one-to-one relationship between the labor share and the capital–output ratio (the so-called share capital—SK—schedule). Fukao and Perugini (2018) expanded this framework to the case of heterogeneous capital (IT and non-IT capital). They assumed that production is organized into two processes: (i) an IT capital-intensive process, which employs labor and IT capital; and (ii) a non-IT capital-intensive process, which employs labor and non-IT capital. The two processes have constant elasticities of substitution, and the elasticity of substitution between the two processes is equal to one. Under such assumptions, it is possible to express the labor share as a function of IT capital intensity (on output) and non-IT capital intensity, with changes in technological progress shifting this extended SK schedule.

The SK relationship is stable as long as the marginal product of labor is equal to the real wage. Any factor that is able to create a gap between them moves the economy *off* the schedule. As explained in the introduction, the existing literature has identified many factors that are able to play such a role. On this basis, and in view of the specificities of the Japanese economy, we relate the dynamics of the labor share to evolutions that have occurred in product and labor markets over the last decades. In particular, labor market features (see Hamaaki et al. 2012) have undergone massive changes in Japan along three main and intertwined dimensions: (i) a decline in the lifetime employment system (Ono 2010; Kawaguchi and Ueno 2013); (ii) an increase in non-regular work (Asano et al. 2013; OECD 2017a); and (iii) a huge increase in the number of women in the labor force (Inoue et al. 2016). On the product market side, both domestic and international forces have reshaped

the structural features of markets in terms of concentration, exposure to competitive pressures, and market power, giving rise to profit and markup patterns that differ significantly across sectors (Fukao and Nishioka 2017).

On this basis, our empirical model reads as follows:

$$\ln S_L^{it} = \beta_{0i} + \beta_0 \ln(C^{it}) \beta_1 \ln(k_{IT}^{it}) + \beta_2 \ln(k_{NIT}^{it}) + \gamma \ln(Z^{it}) + \vartheta^{it} \tag{1}$$

where: $k_{IT}^{it}, k_{NIT}^{it}$ correspond to $\frac{K_{IT}^{it}}{Y^{it}}, \frac{K_{NIT}^{it}}{Y^{it}}$, respectively; C^{it} is a measure of technological change that summarizes the effects of all types of technical change that are not labor augmenting; and the set (Z_{it}) includes those factors that shift the economy off the SK schedule, being able to shape the relative bargaining power of labor and capital. In our case, they include variables related to globalization (*Trade* and *Off*), market competition (*Mark up*), and labor market institutional factors (*UD* and the importance of non-regular work to the total hours worked—$L^h{}_{NR}/L^h$). Lastly, β_{0i} are sector fixed effects and ϑ^{it} is a residual error term.

As O'Mahony et al. (2018) noted in a similar context, Eq. 1 represents a static model and its estimated coefficients can be interpreted as long-run elasticities. However, when the time dimension is large, as in our case (1970–2012), the estimation of a static model may suffer from limitations due to the bias in the coefficients produced by non-stationarity of the time series. The standard approach to addressing such issues is to rewrite the equations as autoregressive distributed lag processes: ARDL(p, q). In our case, and assuming for simplicity a maximum lag order of one, the model reads:

$$\ln S_L^{it} = \alpha_{0i} + \alpha_1 \ln S_L^{it-1} + \alpha_2 \ln(C^{it}) + \alpha_3 \ln(C^{it-1}) + \alpha_4 \ln(k_{IT}^{it}) + \alpha_5 \ln(k_{IT}^{it-1}) + \alpha_6 \ln(k_{NIT}^{it}) + \alpha_7 \ln(k_{NIT}^{it-1}) + \varphi_1 \ln(Z^{it}) + \varphi_2 \ln(Z^{it-1}) + \vartheta^{it} \tag{2}$$

We can reformulate Eq. (2) as an error, or equilibrium, correction model (ECM) as follows:

$$\Delta \ln S_L^{it} = \gamma_{0i} + \gamma_1 \Delta \ln(C^{it}) + \gamma_2 \Delta \ln(k_{IT}^{it}) + \gamma_3 \Delta \ln(k_{NIT}^{it}) + \phi_1 \ln(Z^{it}) + \gamma_4 \ln S_L^{it-1} + \gamma_5 \ln(C^{it-1}) + \gamma_6 \ln(k_{IT}^{it-1}) + \gamma_7 \ln(k_{NIT}^{it-1}) + \phi_2 \ln(Z^{it-1}) + \vartheta^{it} \tag{3}$$

Equation (3) represents the empirical specification that we estimate using the augmented mean group (AMG) estimator that Eberhardt and Teal (2010) proposed. The estimator is part of the panel time series literature, which emphasizes: (i) possible non-stationarity of the processes; (ii) cross-sectional dependence, that is, the possible correlation in the disturbances across sectors; and (iii) slope, not just group time-invariant, parameter heterogeneity (Eberhardt 2013). Like other mean group (MG) approaches (Pesaran and Smith 1995; Pesaran 2006), the AMG

estimator first estimates N group-specific ordinary least-squares regressions and then averages the estimated coefficients across groups. We control for cross-sectional dependence with the inclusion of a common dynamic effect, which in the AMG we obtain in the first-step estimation of a pooled regression model augmented with year dummies, resulting from first-difference ordinary least squares. The coefficients on the (differenced) year dummies represent an estimated cross-group average of the evolution of unobservables over time (the common dynamic process). We include this in the group-specific regression model, along with an intercept that captures time-invariant fixed effects. Lastly, we average the group-specific model parameters across the panel. By combining the parameters of Eq. (3), we can derive estimates of the long-run relationships between the explanatory variables and the S_L. As an example, the long-run effect (or co-integration parameter) of IT capital intensity on the labor share corresponds to $\gamma^L_{ITk} = -(\gamma_6/\gamma_4)$, while for non-IT capital intensity it is $\gamma^L_{NITk} = -(\gamma_7/\gamma_4)$. The coefficient of the lagged dependent variable (the labor share) γ_4 describes the speed of adjustment toward the long-run equilibrium, and inference regarding this parameter provides information on the presence of a long-run equilibrium relationship (Eberhardt and Presbitero 2015).

4 Results

Before presenting the results of the estimation of our empirical models, we show some tests aimed at checking the presence of cross-sectional dependence (CD) and non-stationarity (Table 1), which strongly support the choice of the estimation method that we described in Sect. 3. We test for cross-sectional dependence using the Pesaran (2004) CD test; in macro panel data, it may arise from globally common shocks with heterogeneous impacts across panels or be the result of spillover

Table 1 Tests for unit roots and cross-sectional dependence (NPME)

	Unit root test		CSD	
	Z (t-Bar)	P-value	CD test	P-value
S_L	1.686	(0.954)	34.10	(0.000)
k_{IT}	1.098	(0.864)	207.14	(0.000)
k_{NIT}	0.056	(0.522)	31.96	(0.000)
C (TFP)	−2.537	(0.006)	26.12	(0.000)
L^h_{NR}/L^h (h)	0.816	(0.793)	118.79	(0.000)
UD	−4.597	(0.000)	118.15	(0.000)
Trade	−0.778	(0.218)	127.23	(0.000)
Off	−2.081	(0.019)	207.34	(0.000)
Markup	0.340	(0.633)	43.71	(0.000)

Notes Markup: 1970 = 1; TFP: 1970 = 100
Source Authors' elaborations of the JIP database

effects (Eberhardt and Teal 2011). The evidence that Table 1 provides shows that we cannot accept the null hypothesis of cross-sectional independence. To check the presence of unit roots, we perform the CADF test that Pesaran (2003) proposed, designed for heterogeneous panels with cross-sectional dependence (see Lewandowski 2007). We eliminate cross-sectional dependence by augmenting the standard Dickey–Fuller (DF) or the augmented DF regressions with the cross-section averages of lagged levels and the first differences of the individual series. The null hypothesis assumes that all series are non-stationary, and the results in Table 1 indicate that we cannot reject it, the only exceptions being the variables UD and Off. Again, as a preliminary step, we run Pedroni's panel cointegration tests, which clearly suggest rejection of the null hypothesis of no cointegration (Pedroni 1999).

Table 2 presents the results of our estimates (long-run coefficients and the coefficient for the lagged level of the labor share). The lagged S_L-level variable is statistically significant in all the models that we estimate, confirming the existence of an error correction; the large size of the coefficient, a common feature in this estimation environment (Imbs et al. 2005), suggests a relatively high speed of adjustment to the long-run equilibrium.

As regards the SK schedule, the results indicate high substitutability between labor and non-IT capital in both manufacturing and services. However, in manufacturing, the elasticity of substitution exceeds the value of 1 (which would identify the Cobb–Douglas case) first in medium–low-technology sectors in which, on the contrary, IT capital is complementary to labor. As regards market services, the negative sign of non-IT capital (i.e., an elasticity of substitution with labor higher than one) is driven by the knowledge-intensive segment (KIS). On the contrary, IT capital is complementary to labor in low-knowledge-intensive tertiary market industries. The TFP is mostly insignificant; this result is not unexpected, considering the inclusion in the model of different types of capital (which capture the embodied technological change) and of other variables—in particular the market power of firms—that capture factors that would otherwise converge with the coefficient of the TFP.

As regards the labor market variables, the share of non-regular workers plays a negative role in the total S_L, and low-knowledge-intensive services drive this effect. This is likely to be the result, first, of the composition effect of the particularly large presence of irregular workers in LKI services, as Fig. 2 clearly describes; in LKI services, non-regular labor accounts for about 35% of the total hours worked compared with significantly lower levels of KISs and manufacturing. We should consider this fact along with the increase in the regular/non-regular workers' wage gap, which basically tripled over the period considered in all sectors (see also OECD 2017a).

In view of the employment share that LKI industries achieved in most recent years, it is not surprising that what happens in these sectors affects the labor share of aggregate services and of the total economy. However, we cannot rule out the possibility that the massive presence and availability of non-regular workers in such industries also adversely affects the bargaining power of regular workers, provided

Table 2 Long-run drivers of the total labor share in Japan (1970–2012)

	NPME	MAN	MLM	MHM	MSERV	LKIS	KIS
k_{IT}	0.053*	0.059	0.113***	0.044	0.015	0.086*	0.049
	(0.031)	(0.043)	(0.037)	(0.078)	(0.036)	(0.050)	(0.110)
k_{NIT}	−0.036***	−0.065***	−0.048***	−0.052	−0.048**	−0.023	−0.062**
	(0.013)	(0.019)	(0.016)	(0.036)	(0.020)	(0.024)	(0.031)
C (TFP)	0.054	0.151	0.242*	−0.121	−0.008	0.164*	−0.033
	(0.079)	(0.110)	(0.125)	(0.182)	(0.097)	(0.093)	(0.304)
$L^h{}_{NR}/L^h$	−0.041**	−0.013	−0.009	−0.000	−0.080**	−0.168***	−0.019
	(0.020)	(0.025)	(0.030)	(0.050)	(0.039)	(0.063)	(0.046)
UD	−0.097***	−0.117**	−0.069	−0.170**	−0.045	−0.107**	−0.001
	(0.034)	(0.048)	(0.053)	(0.072)	(0.045)	(0.046)	(0.091)
Trade	−0.021***	0.008	−0.002	−0.010	−0.013*	−0.015***	−0.025
	(0.006)	(0.013)	(0.015)	(0.020)	(0.007)	(0.005)	(0.020)
Off	0.005	−0.004	−0.006	−0.025	0.027**	0.009	0.051*
	(0.009)	(0.013)	(0.022)	(0.020)	(0.012)	(0.021)	(0.027)
Markup	−2.657***	−3.146***	−3.167***	−3.306***	−1.743***	−1.543***	−1.715***
	(0.223)	(0.237)	(0.315)	(0.351)	(0.308)	(0.125)	(0.324)
ECM	−0.696***	−0.727***	−0.735***	−0.737***	−0.583***	−0.642***	−0.550***
	(0.034)	(0.036)	(0.044)	(0.056)	(0.067)	(0.108)	(0.067)
RMSE	0.0277	0.0326	0.0327	0.0317	0.0126	0.0093	0.0145
Wald chi^2	1,318.28***	1,635.49***	911.17***	938.95***	402.68***	61,069.86***	226.73***
Obs.	3,528	2,184	1,218	966	1,092	588	504
Groups	84	52	29	23	26	14	12

Notes RMSE is the root mean squared error test (sigma); we compute the average long-run coefficients from the ECM results; and we calculate the standard errors via the delta method

Source Authors' elaborations of the JIP database

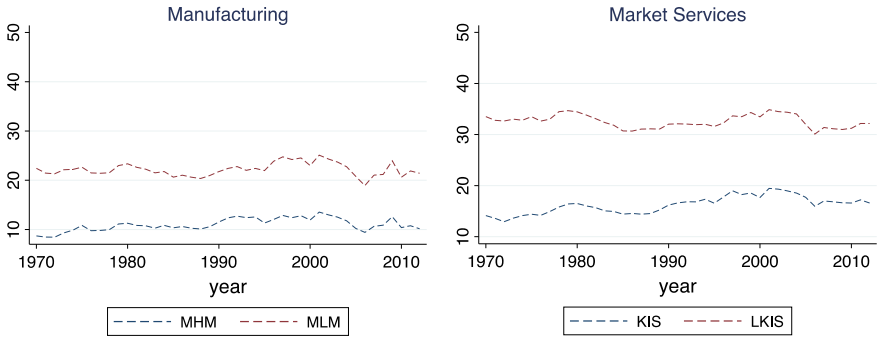

Fig. 2 Shares of hours worked: non-regular work in macro-sectors of manufacturing and services. *Source* Authors' elaborations of the JIP database

that the two types of work have a high rate of substitutability. The fact that, in those sectors in which non-regular work is more intensive (LKI services and ML manufacturing), the wage rates of regular workers experienced significantly weaker growth than those in other sectors with a lower presence of non-regular workers corroborates this descriptively (see Fig. 3). This is also probably related to a significant extent to changes on the labor market supply side, namely the massive entrance of women into the labor force, concentrated markedly in LKI services, in which they accounted for over 40% of the hours worked in the most recent years compared with less than 35% in KISs and less than 30% in manufacturing.

Stronger unions are associated in our results with a smaller labor share. The explanations for this outcome can relate to the Japanese labor relations model, the declining unionization rate, and the labor market evolutions in the past decades. The Japanese employment system is characterized by strong decentralization of the role of unions at the company level, and principles of cooperation with the management rather than conflict and antagonism mainly inspire union activities (Fujimura 2012).

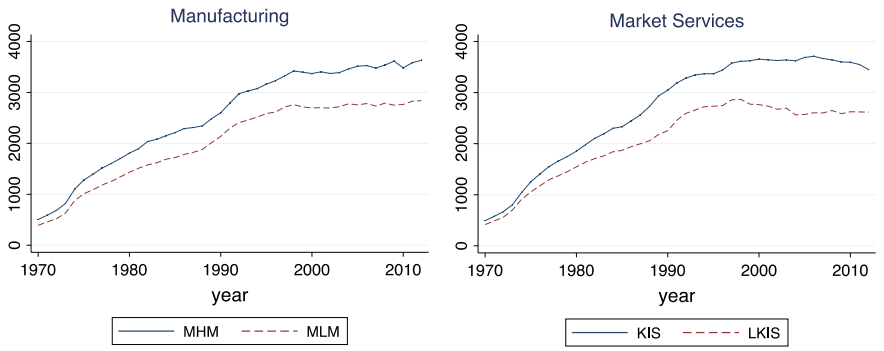

Fig. 3 Regular/non-regular hourly wage gap, lkis services. *Source* Authors' elaborations of the JIP database

Enterprise unions in Japan have also primarily organized themselves around regular employees, and the increase in non-regular workers over time has significantly reduced the coverage of the company workforce in discussions with the management. The resulting asymmetry of the action of unions might induce, wherever possible, the substitution of regular jobs with less rigid and cheaper labor or with a type of capital. The evolution of the peculiar bargaining systems of Japan (*Shunto*) might also have contributed to shaping this effect. The *Shunto* system was traditionally based on annual wage negotiations between enterprise unions and employers, which took place in the spring and involved two key parameters: wage revision and bonuses (see Komiya and Yasui 1984). Due to adverse economic conditions, unions have been focusing increasingly on protecting the existing pay structures and jobs rather than on wage growth (see OECD 2017b); bonus bargaining, the only form of negotiations on remuneration that survived, concerns non-regular workers to a much more limited extent (Kato 2016).

While the variables related to globalization seem to offer rather limited insights, the proxy for market competition emerges as a key driver of the labor share. The two results are not unrelated, since it is not unlikely that the markup indicator also depicts the market environment that increasing competitive pressures resulting from globalization forces shape (the correlation between "trade" and "markup" amounts to −0.32, which is significant at 1%). The negative sign and the magnitude of the coefficient clearly indicate that, when firms are able to produce extra profits, rent-sharing patterns develop in a direction that is detrimental to workers. This does not come as a surprise, given the labor market evolutions that we have already described, which all acted against the bargaining position of a specific segment of labor. Our evidence is consistent with expectations based on the existing theoretical and empirical literature on the effects of market competition on the labor share (Bentolila and Saint-Paul 2003; Barkai 2016; Autor et al. 2017) and provides new corroborating evidence. The evolution of the markup by subsectors suggests that its impact was particularly significant in low-knowledge-intensive sectors, therefore deepening the (already) disadvantaged position of labor in this part of the economy.

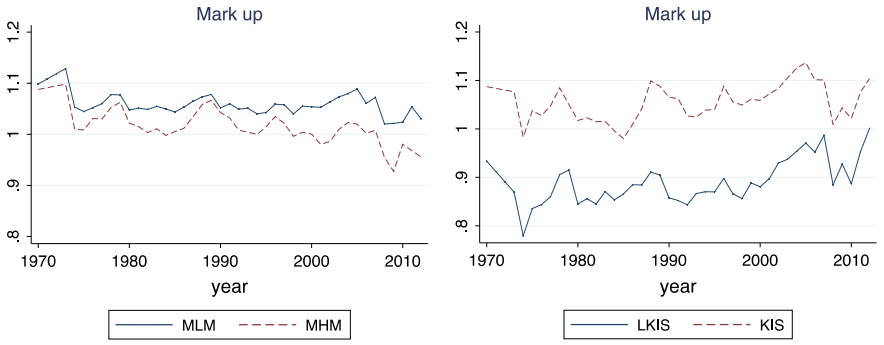

Fig. 4 Markup in macro-sectors of manufacturing and services. *Source* Authors' elaborations of the JIP database

Figure 4 shows that, while competition in manufacturing (especially medium-high technology) increased, the opposite holds for services, particularly LKISs. This evidence, taken together with the sharp decrease in self-employment and family work (from 25.5% in 1970 to 10% in total market services and from 30% to 11% in LKISs) addresses the possibility of a remarkable process of market concentration in those segments, such as retail trade (see Matsuura and Motohashi 2005) and hotels and restaurants (Høj and Wise 2004), which significantly increased their employment share over time.

5 Final Remarks and Policy Advice

This chapter dealt with the long-run drivers of the labor share in Japan. We based the analysis on JIP data for the period 1970–2012 and provided a detailed sector-level picture of how technological factors, labor, and product market institutions affected the share of output accruing to labor. Our results indicate that the decline in the labor share that Japan experienced during the four decades considered concentrated highly in the low-knowledge-intensity sectors, the employment share of which has increased over time and reached over 50% of the total hours worked. This part of the Japanese economy has some particular features, which our econometric analysis indicates as being possible explanations for the decline in the labor share. LKI services experienced a remarkable increase in non-regular workers; this is a secondary segment of the labor market in Japan, characterized by low wages and very limited union coverage/protection. The presence of this type of workers is favored by the intrinsic characteristics of these industries, in which the accumulation of knowledge is relatively less important and regular and non-regular labor are highly substitutable, with consequent effects on the equilibrium wages of both labor market segments. Low-knowledge-intensity services are also the part of the economy in which the market power of firms has increased remarkably as a result of a process of concentration that has occurred over the last decades, when, for example, large firms in the trade sectors replaced small family businesses, gaining market power and bargaining power vis-à-vis labor.

The decline in the labor share in Japan therefore seems to relate to a significant extent to the convergence in some segments of the economy of adverse circumstances originating in market forces, structural changes, and labor and product market institutions. Policy makers who are willing to address the issues connected to the decrease in the labor share should target primarily these secondary labor segments, implementing measures that are able to reduce asymmetries in terms of labor protection and representation. At the same time, they should devote attention to preserving high enough levels of market competition to prevent employers from gaining excessive bargaining power and further compressing labor remuneration.

Appendix A: Industry Aggregates

Industry aggregate	
TME	Total market economy: all JIP sectors excluding housing (72), private education (80), private research (81), private medical (82), and private hygiene (83)
NPME	Non-primary market economy: ME minus primary sectors (1–6) and mining (7)
MAN	Manufacturing: JIP sectors 8–59
MLM	Medium- and medium-low-technology manufacturing: JIP sectors: 8–22, 30–41, and 58–59
MHM	Medium- and medium-high-technology manufacturing: JIP sectors: 23–29 and 42–57
MSERV	Market services: JIP sectors: 61, 67–71, 73–79, and 85–97
LKIS	Less-knowledge-intensive services: JIP sectors: 67–68, 71, 73–74, 77, 79, 86–88, and 94–97
KIS	Knowledge-intensive services: JIP sectors: 61, 69–70, 75–76, 78, 85, and 89–93

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Chapter 10
A Microeconomic Analysis of the Declining Labor Share in Japan

Kyoji Fukao, Koji Ito and Cristiano Perugini

Abstract The labor share in Japan has been declining significantly over the last three decades, accompanied by persistent stagnation and an unprecedented increase in economic inequalities. Since these dynamics are likely to be interrelated, understanding the drivers of the labor share might contribute significantly to the Japanese economic and policy debate. Surprisingly, the existing literature on the labor share in Japan is rather limited and confined to country or industry studies. We first attempt to analyze the drivers of the labor share in Japan at the firm level. To this aim, we employ a panel of manufacturing firms from the Basic Survey of Japanese Business Structure and Activities, spanning from 2001 to 2012. By means of panel data estimators, we show how, besides technological variables, firms' labor share depends significantly on the share of regular workers, on the importance of firms' international engagement, and on various institutional settings of the product and labor markets.

Keywords Labor share · Firm-level analysis · Japan · Panel data

JEL Classification D33 · F61 · J30 · L11

1 Introduction

The empirical evidence of the latest decades has challenged what researchers previously regarded as one of the stylized facts of modern economic growth, that is, the constancy of factors' shares of income (Kaldor 1961). The decline in the labor

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share (LS), which started during the 1970s in most developed countries, has stimulated extensive research efforts to provide possible explanations and adequate policy responses. Research has identified the drivers of such dynamics as factors related to the production function (technological change and inputs' elasticity of substitution), the consequences of increased globalization of markets for firms' structure and organization, and institutional factors affecting the relative bargaining power of capital and labor. Despite the purely microeconomic nature of the potential drivers of the labor share, empirical research has so far focused mainly on the aggregate (country or sector) level. A few notable exceptions exist. Berkovitz et al. (2017) studied the evolution of the labor share over the period 1998–2007 for a sample of Chinese firms, associating the decline primarily with institutional factors, namely market reforms in the state sector and product market deregulation; in addition, the increasing importance of large "superstar" firms, with relevant market power and a small labor share, is an important explanation for the decline. In an earlier paper, the same authors (Berkovitz et al. 2015) distinguished the drivers of the decline in the labor share in the manufacturing sector into the increasing market power and capital intensity of Chinese firms and the decreasing political pressure on state-owned firms. Hwang and Lee (2015) explored the drivers of the labor share of firms in the Republic of Korea during the period 2005–2011 and found that, besides the factors related to production technology and market power, employees' bargaining power and the corporate labor strategy are pivotal in explaining the heterogeneity in the labor share. Within the European context, Siegenthaler and Stucki (2015) examined a sample of Swiss firms between 2001 and 2010 and identified the share of workers using ICT as the main factor behind the declining labor share. Kyyra and Maliranta (2008), using Finnish plant-level data (from 1974 to 2001), found that the labor share was virtually constant within firms, while its aggregate decline was related to a compositional shift from high- to low-labor-share plants. Bockerman and Maliranta (2012) obtained similar outcomes for Finland by aggregating establishment-level data to the industry level. Growiec (2012), analyzing a sample of Polish firms for the period 1995–2008, concluded that sector-specific factors, such as changes in the ownership structure and human capital accumulation, explain a large fraction of the observed downward trend in the labor share. Dall'Aglio et al. (2015) analyzed the medium- and short-run dynamics of the labor share in Italian firms from 2004 to 2007. They found that the capital–output ratio plays a key role in both the short and the medium run; in addition, an increase in the markup over production costs and the implementation of technical progress have positive effects on the labor share in the short run and negative effects in the medium run. Lastly, more exposure to international competition reduces the labor share in the short run, probably favoring the bargaining power of entrepreneurs relative to employees and leading to wage moderation. Lastly, Perugini et al. (2017), using a sample of firms from 6 EU countries, showed that the labor share decreases for firms engaged in internationalization processes, but this effect is not related to differences in the composition of the labor force, technological factors, and firms' market power.

Our paper contributes to this literature relying on data for Japanese manufacturing firms for the period 2001–2012. This is the first microeconomic-level analysis for this country, for which empirical evidence on the labor share movements is quite limited (see Takeuchi 2005; Wakita 2006; Agnese and Sala 2011; Fukao and Perugini 2018). While studying the microeconomic drivers of the labor share, we focus on a comprehensive set of aspects related to technology, factors' intensity, internationalization patterns, and the composition of the workforce. We also exploit the sectoral detail of our data to allow for industry-specific employment features and product and labor market institutional settings.

We organize the paper as follows. In the next Sect. 2, we provide a bird's eye view of the relevant literature on the drivers of the labor share. Section 3 describes the empirical modeling approach and methods. In Sect. 4, we illustrate the dataset and provide some preliminary descriptive evidence, while, in Sect. 5, we present the results of our estimations. Section 6 summarizes and concludes.

2 The Drivers of the Labor Share: Literature Background

The literature provides various explanations for the decline in the labor share that, despite often being conceptually separated, are in fact closely related to each other. Factors' productivity and, in the presence of market frictions, their relative bargaining power ultimately determine the distribution of income that the production process generates. This implies that all possible drivers of the income share accruing to workers (or, complementarily, to capital and profits) are mutually related. Technological change, for example, has been increasingly capital augmenting, and this has resulted in more capital-intensive production processes; this could explain, along with greater substitutability of labor with capital, the decrease in the labor share (Bentolila and Saint-Paul 2003; Lawless and Whelan 2011). The macroeconomic evidence emphasizes that capital deepening is the main factor driving the decline in the labor share, provided that the elasticity of substitution between capital and labor is larger than one (Karabarbounis and Neiman 2014; Piketty 2014; Piketty and Zucman 2014). It is possible to extend this baseline conceptual structure in various directions. First, not all studies have agreed on the level of the elasticity of substitution, with some of them arguing that capital and labor are gross complements instead of substitutes (Antràs 2004). More importantly, the framework gains much in explanatory power when taking labor heterogeneity into account. It is indeed possible to include high- and low-skilled workers separately in the production function (a general CES type to guarantee flexibility in the elasticity of substitution) and for their elasticity of substitution to differ (Arpaia et al. 2009; Elsby et al. 2013). In this way, it is possible to model and empirically estimate the consequences of skill-biased technological change in terms of both skilled/unskilled relative demand and prices. Many studies have found that technological change, which the introduction of innovation and communication technologies (ICTs) induces, explains a remarkable proportion of the aggregate or

sector-level labor share decline (e.g., European Commission 2007; Lawless and Whelan 2011). However, as much as ICT is likely to replace low- and medium-skilled labor, it might also be complementary to high-skilled labor (Acemoglu and Autor 2011). Hence, the overall effect of skill-biased technological change on the labor share depends on the interplay between different types of labor complementarity/substitutability levels and their relative skill premia. Karabarbounis and Neiman (2014) documented that the change in the relative prices of ICT compared with other assets, along with possible complementarities between ICT and high-skilled labor, explains a large fraction of the variation in the labor share. Also related to the ICT/skills debate is the potential impact of organizational change, which tends to be biased toward high-skilled labor (Caroli and Van Reenen 2001; Piva et al. 2005).

More recently, research has devoted attention to another side of capital heterogeneity, distinguishing the impact on the LS of tangible and intangible capital assets. Koh et al. (2016) found that the declining trend of the labor share in the US is entirely due to the increase in the capital intensity of intellectual property products (IPPs); O'Mahony et al. (2018) showed more mixed results, with some types of intangible capital (those complementary to ICT and innovative capital) increasing the labor share and others (economic competencies) decreasing it.

Relaxing the assumption of perfectly competitive (product and input) markets opens the way to additional potential drivers of the labor share. If remuneration does not exactly mirror workers' marginal productivity, the extent to which emerging rents accrue to capital or labor becomes crucial to explaining the dynamics in the factor share of income (Blanchard and Giavazzi 2003). The economic and institutional factors shaping the bargaining power of workers vis-à-vis employers largely drive rent sharing. A firm's market power (measured by its markup) indeed determines the size of the rent. If price markups are larger than wage markups, researchers expect a lower degree of competition to decrease the labor share (Azmat et al. 2012). Barkai (2016) and Autor et al. (2017) provided evidence of a negative correlation between the market concentration and the labor share in the US. The extent of this phenomenon depends on workers' bargaining power, which in turn stems from the general macroeconomic conditions and institutional settings (European Commission 2007; Bental and Demougin 2010). In fact, the decline in labor collective organizations (union density, collective bargaining systems) and labor market regulation (employment protection, minimum wage provisions) that has characterized virtually all OECD countries in the last decades may have contributed to the decreasing trend in the labor share (see Bentolila and Saint-Paul 2003; OECD 2011).

The forces related to globalization add complexity to all the sources of labor share changes. According to the Heckscher–Ohlin (HO) model, researchers expect trade to drive specialization in production sectors that reflect countries' comparative advantage, resulting from relative factor endowments. Therefore, developed countries specialize in capital-intensive industries, and this drives the labor share downward, provided that the elasticity of substitution is lower than one (i.e., capital and labor are gross complements) (European Commission 2007). Modern versions

of the HO model distinguish between high-skilled and low-skilled labor, with the first normally being a substitute for and the second a complement to capital (Wood 1994). This complicates the predictions of the model in terms of labor share developments, since the overall effect now depends on the relative elasticity of substitution of the different types of labor with respect to capital. However, at least we can predict that international trade (including intra-industry trade) will reduce labor share as well as skill premium through its factor price equalization mechanism. The empirical evidence tends to support the predictions of the HO framework (see, for example, Guscina 2006; European Commission 2007; ILO 2011). Decreuse and Maarek (2011), drawing on Davis (1998), showed that, in countries characterized by wage rigidity, trade induces factor reallocation toward capital-intensive and low-labor-share sectors. Globalization therefore increases the aggregate elasticity of substitution between capital and labor or equivalently reduces the aggregate elasticity of the labor demand with respect to the relative factor cost. On the contrary, in free-wage countries, globalization does not alter factor allocation across sectors, and the proportion of industry value added in the GDP does not change. As a result, the aggregate labor share stays constant.

Even more relevant to our analysis of Japan is the fact that intra-industry trade between developed countries has become prevalent. This has been the result of a shift toward the production of horizontally differentiated goods, which normally leads firms to benefit from some market power and to gain an increase in their markups and profits. "*New" new trade* theories emphasize the importance of firm heterogeneity (in terms of productivity) as a key driver of the probability of entering, surviving, and producing profits in international markets in the presence of fixed general and trade linked costs, which originate economies of scale (Melitz 2003). Competitive pressure due to exposure to international trade is an important stimulus for productivity-enhancing micro-restructuring (creative destruction) within industries (e.g., Bernard et al. 2007; Lileeva 2008; Bockerman and Maliranta 2012). Knowing what drives productivity upward is therefore crucial in understanding the distributive outcomes of internationalization: if higher productivity is driven by higher capital intensity aimed at reducing labor costs, international firms will tend to have a smaller labor share. However, once again, if capital and skilled labor are complements, the final effect on the labor share will depend on the relative change in the workforce composition by skills within the firm.

Additionally, in imperfectly competitive labor markets, globalization forces tend to affect adversely the bargaining position of labor, a relatively less mobile factor of production compared to capital. Reduced barriers to trade accentuate the asymmetries between groups that can cross international borders (owners of capital and a few highly skilled workers) and those that cannot (the great majority of workers) (Rodrik 1997; Slaughter 2000). The fixed costs of relocating are indeed much larger for workers (especially unskilled ones) than for capital. Their bargaining position will consequently deteriorate due to an increase in the outside options of firms (IMF 2007). The threat of relocating the production process (or part of it) through FDI, outsourcing segments of the productive chain abroad or importing intermediate inputs, is therefore likely to compress wages and lead to a decline in the labor share.

In addition, when domestic firms in developed, high-wage countries decide to produce abroad or to offshore the most unskilled-labor-intensive segments to respond to labor cost pressures, the labor demand for low-skilled workers decreases (see, for example, Crinò 2012) and the wage elasticity grows. In fact, unskilled workers are more easily replaceable with the services of other people across national boundaries. Both factors drive the labor share downward, as various empirical studies on developed countries have shown (Harrison 2002; Guscina 2006; Jaumotte and Tytell 2007; Jayadev 2007). Hutchinson and Persyn (2012) also provided a theoretical framework in which foreign competition limits the scope for the union wage demand. Obviously, researchers expect the opposite (or no effects of internationalization/offshoring) in low-wage countries, in which workers would probably benefit from the division of labor across countries (Bassanini and Manfredi 2012). Guerriero and Sen (2012) provided empirical evidence concerning the opposite effect of trade openness on the labor share for OECD (negative) and non-OECD (positive) countries; when they distinguished between developed and developed countries, they found that the effect of openness is in both cases positive but much weaker for the advanced economies.

If heterogeneous labor is introduced into the models, the overall impact becomes unclear, because skilled workers could gain from outsourcing (Feenstra and Hanson 1999) and the overall change in the labor share depends on the relative size of the gains/losses of the two groups.

3 Empirical Model and Estimation Strategy

Our empirical model is based on the framework that Bentolila and Saint Paul (2003) proposed; they showed that, in the presence of two factors of production (K and L), and under the assumptions of constant returns to scale, capital- and labor-augmenting technical progress, and competitive markets, a unique function g exists that explains the labor share in firm i (LS^i), based on the capital–output ratio (K_i, = k_i/y_i) and on changes in the capital-augmenting technological progress (A_iK_i). This relationship—the so-called SK relationship [$LS^i = g(A_iK_i)$]—is stable as long as the marginal product of labor is equal to the real wage. The nature of our data (see Sect. 4) allows us to distinguish different types of non-labor inputs that might have different levels of substitutability with labor: tangible capital (k_T), intangible assets (expenditures on R&D and advertisement—e_{INT}), and ICT assets (expenditure on e_{ICT}). As Fukao and Perugini (2018) showed, under certain assumptions, it is possible to extend the Bentolila–Saint Paul model to more than two inputs (labor and capital) by assuming that the production activity of each firm consists of different processes (in our case, a tangible capital-intensive process, an intangible asset-intensive process, and an ICT asset-intensive process), all with constant elasticities of substitution between non-labor input and labor and with unitary elasticity of substitution between them. Under such circumstances, it is possible to express the labor share as a function of tangible capital intensity (on output),

intangible capital intensity, and ICT asset intensity, with changes in technological progress shifting this extended SK schedule. Any factor able to create a gap between the marginal product of labor and the real wage (as those explained in Sect. 2) moves the economy *off* the SK schedule.

Following Bentolila and Saint-Paul (2003), we assume a multiplicative form of the extended labor share function:

$$LS^{ijt} = g(K_T^{ijt}, E_{INT}^{ijt}, E_{ICT}^{ijt}, C^{ijt})h(Z^{ijt}) \tag{1}$$

where superscripts *i, j*, and *t* denote firms, sectors, and years, respectively, and the function $g(.)$ describes the labor share determinants strictly derived from the production function (the SK schedule). K_T^{ijt} corresponds to $\frac{k_T^{ijt}}{y^{ijt}}$; E_{INT}^{ijt} corresponds to $\frac{e_{INT}^{ijt}}{y^{ijt}}$; and E_{ICT}^{ijt} corresponds to $\frac{e_{ICT}^{ijt}}{y^{ijt}}$. Due to the data availability, we use intangible and ICT assets to approximate the relevant annual amount of real expenditures of firms. C^{ijt} is a measure of technological change that summarizes the effects of all types of technical change that are not labor augmenting (A_T, A_{INT}, A_{ICT}). The separate exponential function $h(.)$ is instead meant to account for the other potential factors (Z^{ijt}) that shift the economy *off* the SK schedule. They include internationalization patterns, employment characteristics, and product and labor market institutional factors that are able to shape the relative bargaining power of labor and capital.

Assuming that both $g(.)$ and $h(.)$ are also multiplicative and by taking logs, we can express the labor share as:

$$\begin{aligned}\ln LS^{ijt} = {} & \gamma \ln LS^{ijt-1} + \beta_0 \ln(C^{ijt}) + \beta_1 \ln(K_T^{ijt}) + \beta_2 \ln(E_{INT}^{ijt}) + \beta_3 \ln(E_{ICT}^{ijt}) + \gamma \ln(Z^{ijt}) \\ & + \alpha^i + \lambda^{jt} + \varepsilon^{ijt}\end{aligned} \tag{2}$$

where α^i are firm fixed effects, λ^{jt} is a set of industry/year dummies, and ε^{ijt} is a residual error term.

Modeling the drivers of the labor share poses some identification issues. A relevant one relates to omitted variable bias, which, despite the advantages that firm-specific intercepts guarantee in our case, might persist due to the fact that the labor share might be characterized by high within-firm inertia and therefore be time persistent. The inclusion of the lagged dependent variable among the regressors in Eq. (2) is the standard approach to address this issue. However, the presence among the right-hand side variables of the lagged $lnLS^{ijt-1}$, which is correlated with the composite error $(\alpha^i + \varepsilon^{ijt})$, leads to inconsistent parameter estimates when we account for firms' heterogeneity by means of conventional fixed- or random-effect estimators (Baltagi Badi 2001). To address this issue, we opt for the GMM estimator that Arellano and Bond (1991) proposed, which they specifically designed for situations with panels of a relatively short time dimension and many individual units, fixed individual effects implying unobserved heterogeneity, and right-hand variables that are not strictly endogenous (i.e., correlated with the past and possibly the current realization of the error).

4 Data and Summary Statistics

We use firm-level panel data from the "Basic Survey of Japanese Business Structure and Activities" (hereinafter "the survey"), conducted annually by the Ministry of Economy, Trade and Industry (METI). The survey covers all firms with at least 50 employees or 30 million yen of paid-in capital in the Japanese manufacturing, mining, and most of the service sectors. We limit our sample here to manufacturing and to the period 2001–2012, since many important variables, such as exports and imports, are not available for previous years. The questionnaire of the survey covers firms' broad activities and characteristics, such as sales, number of employees, tangible assets and intangible investment, and international activities (see Table 5 in the Appendix for the full list of variables that we use). Unfortunately, the information on workforce characteristics is quite limited, and the survey does not cover some crucial aspects (such as its composition by gender, age, education/skills, and wage levels). As a second-best choice, we exploit the detailed industry breakdown of the survey (41 subsectors of manufacturing) and use industry-level data on workforce characteristics, which we construct using the Japan Industrial Productivity (JIP) database.

Table 1 outlines some descriptive statistics of the variables used in our analysis. The size of the unbalanced panel of firms (pooled, all years) is 147,725. The average labor share (LS—labor cost over value added) during the period is 66.3%,

Table 1 Summary statistics

Variables	Observations	Mean	Std	Min.	Max.
LS	147,725	0.663	0.165	0	1
TFP	147,067	1.002	0.378	0.392	95.930
Kτ	147,725	0.258	0.341	0	60.283
E INT	147,725	0.013	0.029	0	2.324
E ICT	147,565	0.005	0.038	0	7.825
PAT (d)	147,725	0.307	0.461	0	1
REG	147,601	0.877	0.173	0	1
EXP (d)	147,725	0.318	0.466	0	1
IMP (d)	147,725	0.289	0.453	0	1
FDI (d)	147,725	0.072	0.259	0	1
FOREIGN (d)	147,725	0.092	0.289	0	1
EXP_s	147,725	0.044	0.122	0	1
IMP_s	147,565	0.031	0.099	0	2.963
FOREIGN_s	147,725	0.002	0.016	0	1
SIZE	147,725	396.766	1,607.890	50	80,840
SME (d)	147,725	0.766	0.423	0	1
PARENT (d)	147,725	0.337	0.473	0	1
FIRMAGE	147,086	43.254	18.697	0	657

Source Own elaborations on the basic survey of Japanese business structure and activities

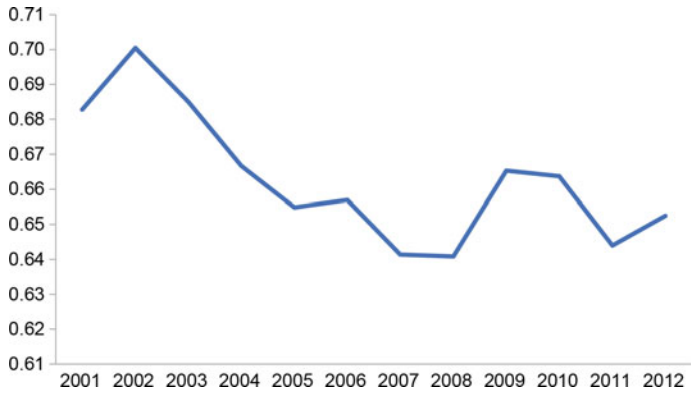

Fig. 1 Average labor share of Japanese manufacturing firms, by year. *Source* Own elaborations on the Basic Survey of Japanese Business Structure and Activities

and, consistent with the existing empirical evidence (see Fukao and Perugini 2018), it shows a clear declining trend over the period considered (Fig. 1). In particular, while the labor share fluctuated around 70% at the beginning of the 2000s, it declined in the following years to about 64%. A new declining trend in 2011 and 2012 followed the countercyclical increase observable in 2009 and 2010.

The set of technology-related indicators shows that R&D-intensive firms do not have a dominant share. The R&D expenditure to sales ratio is 0.9%, growing to 1.3% if we add expenses of other intangible assets (advertisement) (variable e_{INT}). Approximately one-third of firms develop their own patents, while the share of regular employees in total employees is close to 90%.

The variables related to internationalization indicate that firms engaged in international business are limited in number. The share of exporting and importing firms is about 32 and 29%, respectively. Firms with foreign direct investments (FDI) are even fewer (7%), while firms partially or completely owned by foreign companies amount to 9% of the total. Regarding firm size, the average number of employees is close to 400, but the proportion of small and medium enterprises (companies with 300 or fewer employees) amounts to 76.6%. About 34% of firms are subsidiaries of other companies.

5 Econometric Results

5.1 Benchmark Estimations

Table 2 reports the benchmark result of the estimation of Eq. (2). All the models include sector, year, and prefecture dummies. We present here the results of a standard fixed-effect (FE) and the Arellano–Bond (AB) GMM estimator. In particular, columns [1] and [2] report the standard FE and the FE with a lagged

Table 2 Drivers of the labor share at the firm level in Japan (2001–2012)—Internationalization pattern of firms described by means of the set of dummy variables

Estimation method	[1] FE	[2] FE	[3] AB (onestep)	[5] AB (twostep)
TFP (ln)	−0.3552***	−0.3344***	−0.3697***	−0.3630***
	[−62.78]	[−58.08]	[−46.08]	[−15.45]
Kτ (ln)	0.2016***	0.1780***	0.5356***	0.4931***
	[23.71]	[20.86]	[41.29]	[18.69]
E INT (ln)	0.4763***	0.4911***	0.5955***	0.5476***
	[12.17]	[11.83]	[11.44]	[5.25]
E ICT (ln)	0.1299***	0.1324**	0.1498**	0.1213
	[2.73]	[2.26]	[2.25]	[1.20]
PAT (d)	0.002	−0.0015	−0.0001	−0.0019
	[0.90]	[−0.69]	[−0.02]	[−0.60]
REG (ln)	0.0227***	0.0243***	0.0222***	0.0218***
	[6.58]	[7.01]	[4.93]	[5.18]
EXP (d)	0.0056**	0.0021	−0.0012	−0.0013
	[2.25]	[0.85]	[−0.36]	[−0.36]
IMP (d)	0.0063***	0.0033	0.0037	0.003
	[2.90]	[1.51]	[1.24]	[0.92]
FDI (d)	−0.0028	−0.0019	−0.0011	−0.0014
	[−0.94]	[−0.65]	[−0.27]	[−0.31]
FOREIGN (d)	−0.0111**	−0.0057	−0.0051	−0.0026
	[−2.41]	[−1.27]	[−0.73]	[−0.40]
SIZE (ln)	0.0032	0.0163***	−0.0115**	−0.0107
	[0.99]	[5.01]	[−2.10]	[−1.32]
SME (d)	−0.0095**	−0.0077**	−0.0048	−0.004
	[−2.57]	[−2.13]	[−0.93]	[−0.63]
PARENT (d)	−0.0080**	−0.0053	−0.0013	−0.001
	[−2.42]	[−1.63]	[−0.25]	[−0.18]
FIRMAGE (ln)	0.0154***	0.0156***	0.0197***	0.0244***
	[5.56]	[5.30]	[4.14]	[3.04]
LS(t−1) (ln)		0.2881***	0.3046***	0.2983***
		[103.17]	[54.18]	[30.12]
CONST	−0.7263***	−0.5989***	−0.5366***	−0.4781***
	[−8.02]	[−6.49]	[−3.74]	[−8.07]
Sector dummies	Yes	Yes	Yes	Yes
Prefecture dummies	Yes	Yes	Yes	No
Time dummies	Yes	Yes	Yes	Yes
R-squared	0.0727	0.1669		
N	145,994	126,756	112,060	112,060

FE Fixed-effect model, *AB* 'Arellano–Bond' GMM estimation
*p < 0.1, **p < 0.05, ***p < 0.01

dependent variable, respectively; columns [3] and [4] contain the one-step GMM and two-step GMM estimations, respectively.[1] A comparison of the results based on the two estimation methods shows that the signs and significance levels of most of the variables are stable. In both the FE and the AB-GMM estimation, we add the one-year lag of the labor share to the explanatory variables (in columns [2–4]). The significantly positive coefficient is consistent with the expectations and confirms a remarkable feature of persistence of the levels of the labor share over time.

Firms with high total factor productivity have a smaller labor share, a result that is in line with the evidence that previous research has produced.[2] On the other hand, the coefficients of tangible capital intensity, intangible assets' intensity, and ICT intensity are positive and significant, meaning that those factors of production are complementary to labor. As far as tangible capital is concerned, this result could be part of the explanation for the decline in the labor share in Japan, since the capital intensity has been declining in the country throughout the 2000s.[3] The positive signs of intangible and ICT assets are probably due to the facts that the firms in the sample employ the large majority of labor on a permanent and full-time basis and that regular workers in Japan are normally associated with high formal or informal (experience) skills. It is therefore plausible that the result is connected to the dynamics of high-skilled labor that firms demand. If capital, intangible, and ICT assets are close complements to high-skilled workers, the expectation is that the labor share will increase with their accumulation.

A larger proportion of regular workers is associated with a larger labor share; this is likely to be due to regular workers' wage being higher than that of non-regular workers, on average.

Surprisingly, and differing from previous research, no variable related to international activity has a significant coefficient. However, from this result only, we cannot conclude that overseas activities do not affect the labor share at all; the internationalization variables in Table 2 are dummy indicators. This means that we consider firms as companies operating abroad independent of the share of domestic/overseas activity.

In Table 3, we use continuous indicators instead of dummy variables as proxies for the internationalization patterns of firms. The results indicate that exports and foreign investment intensity decrease the labor share. Regarding the other explanatory/control variables, firm size does not provide clear indications concerning their impact on the labor share, and firm age has a positive coefficient,

[1]Due to collinearity issues, the two-step GMM model does not include prefecture dummies.

[2]We estimate the total factor productivity following the method that Olley and Pakes (1996) proposed and normalize it by subtracting the sector average of TFP in 2000. We also estimate the model using the non-normalized TFP and the normalized TFP based on the sector average of the TFP in 1995. The results are consistent with those presented in Table 2 and are available on request.

[3]In the data that we use, the average capital–labor ratio gradually increased in the late 1990s and reached its peak in 2002. After some years of relative stability, it declined steadily after 2008.

Table 3 Labor share at the firm level in Japan (2001–2012)—Internationalization pattern of firms according to the continuous variables

Estimation method	[5] FE	[6] FE	[7] AB	[8] AB
TFP (ln)	−0.3559***	−0.3349***	−0.3698***	−0.3625***
	[−62.88]	[−58.15]	[−46.10]	[−15.46]
Kτ (ln)	0.2018***	0.1781***	0.5348***	0.4925***
	[23.73]	[20.87]	[41.23]	[18.69]
E INT (ln)	0.4799***	0.4931***	0.5972***	0.5497***
	[12.27]	[11.88]	[11.47]	[5.26]
E ICT (ln)	0.1314***	0.1330**	0.1498**	0.1202
	[2.76]	[2.27]	[2.25]	[1.18]
PAT (d)	0.0025	−0.0012	0.0001	−0.0018
	[1.16]	[−0.56]	[0.04]	[−0.55]
REG (ln)	0.0231***	0.0246***	0.0225***	0.0222***
	[6.67]	[7.09]	[5.00]	[5.27]
EXP_s (ln)	−0.0907***	−0.0816***	−0.0810***	−0.0976***
	[−7.03]	[−6.27]	[−4.36]	[−3.84]
IMP_s (ln)	0.0699***	0.0418***	−0.0092	−0.0023
	[5.50]	[3.21]	[−0.47]	[−0.09]
FOREIGN_s (ln)	−0.1524***	−0.1178**	−0.1725***	−0.2109**
	[−3.24]	[−2.52]	[−2.80]	[−2.03]
SIZE (ln)	0.0051	0.0178***	−0.0087	−0.0078
	[1.57]	[5.46]	[−1.57]	[−0.97]
SME (d)	−0.0097***	−0.0077**	−0.0046	−0.004
	[−2.63]	[−2.13]	[−0.90]	[−0.64]
PARENT (d)	−0.0078**	−0.0052	−0.0011	−0.0011
	[−2.37]	[−1.59]	[−0.21]	[−0.18]
FIRMAGE (ln)	0.0155***	0.0155***	0.0198***	0.0247***
	[5.59]	[5.26]	[4.16]	[3.07]
LS(t−1) (ln)		0.2878***	0.3052***	0.2984***
		[103.08]	[54.28]	[30.15]
CONST	−0.7323***	−0.6048***	−0.5489***	−0.4907***
	[−8.09]	[−6.56]	[−3.83]	[−8.34]
Sector dummies	Yes	Yes	Yes	Yes
Prefecture dummies	Yes	Yes	Yes	No
Time dummies	Yes	Yes	Yes	Yes
R-squared	0.0731	0.1673		
N	145,994	126,756	112,060	112,060

FE Fixed-effect model, *AB* 'Arellano–Bond' GMM estimation
*p < 0.1, **p < 0.05, ***p < 0.01

implying that the labor share tends to be larger for older firms. This is probably related to the fact that aged firms tend to have older workers, who earn higher wages due to their experience or their seniority (deferred compensation), under Japan's lifetime employment system (Table 4).

5.2 *Estimation with Sector-Level Variables*

As we have already discussed in Sect. 2, many preceding studies have found that the institutional features of both the final product market and the labor market affect the labor share. To check whether these relationships exist in Japan, we add a battery of industry-level indicators to the set of explanatory variables (see Table 5 for their definition and Table 6 for some descriptive statistics). These sectoral measures, based on the information available in the JIP (Japan Industrial Productivity) database and meant to account for the institutional environment in which firms operate, are, with reference to the product market conditions: (i) the markup rate (log of sales/total cost of each sector); and (ii) an import penetration indicator, as a proxy for the level of competition due to imported goods. For the labor market, we include: (i) the share of high-skilled workers (in terms of working hours); (ii) the trade union density (the number of union members in the total number of employees); (iii) the share of female workers; and (iv) a measure of seniority of employment. All the indicators describe important characteristics of the product and labor markets in Japan (see Fukao and Perugini 2018). We run the estimates using the one-step GMM method with the inclusion of prefecture dummies and continuous variables regarding firms' international activity. Since sector-level variables are part of the set of independent variables, we do not include sector dummies in the model.

The results in Column [9] of Table 4 show that, consistent with previous works, the coefficient of the markup variable (in logs) is significant and negative, suggesting that stronger competitive pressure within a sector has the effect of increasing the labor share. In comparison with the results in Tables 2 and 3, the coefficient of TFP is considerably different, probably due to some omitted variable bias. The effect does not disappear if we saturate the model with other sector-level variables (see columns [2–6]). In column [10], we add the trade union organization rate as an explanatory variable, and its coefficient is negative and significant. However, the significance of the coefficient is not stable (see columns [12–14]), and this is may be due to the low levels and variability of the indicator.[4]

The share of high-skilled workers also shows unstable significance in our estimation; the sign is always positive but is statistically significant only in columns

[4]According to the information that the Ministry of Health, Labour and Wealth (December 2017) provided, the estimated trade union organization rate amounted to 17.1% in 2017.

Table 4 Labor share at the firm level in Japan (2001–2012) and institutional variables (at the sector level)

Estimation method	[9] AB	[10] AB	[11] AB	[12] AB	[13] AB	[14] AB
TFP (ln)	−0.2705***	−0.2724***	−0.2717***	−0.2748***	−0.2885***	−0.2963***
	[−38.04]	[−38.15]	[−38.02]	[−38.36]	[−39.59]	[−40.36]
Kτ (ln)	0.5156***	0.5160***	0.5171***	0.5239***	0.5225***	0.5262***
	[40.29]	[40.33]	[40.37]	[40.80]	[40.69]	[40.97]
E INT (ln)	0.5681***	0.5680***	0.5683***	0.5731***	0.5682***	0.5747***
	[10.86]	[10.86]	[10.86]	[10.96]	[10.86]	[10.99]
E ICT (ln)	0.1328**	0.1330**	0.1334**	0.1350**	0.1368**	0.1403**
	[1.98]	[1.99]	[1.99]	[2.02]	[2.04]	[2.10]
PAT (d)	−0.0005	−0.0005	−0.0005	−0.0003	−0.0003	−0.0004
	[−0.15]	[−0.16]	[−0.18]	[−0.11]	[−0.11]	[−0.14]
REG (ln)	0.0220***	0.0220***	0.0220***	0.0221***	0.0222***	0.0220***
	[4.87]	[4.88]	[4.88]	[4.89]	[4.91]	[4.87]
EXP_s (ln)	−0.0835***	−0.0833***	−0.0834***	−0.0833***	−0.0826***	−0.0836***
	[−4.47]	[−4.46]	[−4.46]	[−4.46]	[−4.42]	[−4.47]
IMP_s (ln)	−0.0142	−0.0144	−0.0142	−0.0135	−0.0133	−0.0131
	[−0.72]	[−0.73]	[−0.72]	[−0.69]	[−0.68]	[−0.66]
FOREIGN_s (ln)	−0.1564**	−0.1564**	−0.1548**	−0.1534**	−0.1586**	−0.1617***
	[−2.52]	[−2.52]	[−2.50]	[−2.47]	[−2.56]	[−2.61]
SIZE (ln)	0.0016	0.0013	0.0012	0.0009	0	−0.0001
	[0.29]	[0.24]	[0.22]	[0.17]	[−0.00]	[−0.02]
SME (d)	−0.0049	−0.005	−0.0049	−0.0048	−0.0049	−0.0049
	[−0.95]	[−0.95]	[−0.94]	[−0.92]	[−0.94]	[−0.94]
PARENT (d)	−0.0008	−0.0007	−0.0006	−0.0008	−0.0007	−0.0004
	[−0.15]	[−0.14]	[−0.12]	[−0.16]	[−0.13]	[−0.07]

(continued)

Table 4 (continued)

Estimation method	[9] AB	[10] AB	[11] AB	[12] AB	[13] AB	[14] AB
FIRMAGE (ln)	0.0177***	0.0176***	0.0174***	0.0180***	0.0176***	0.0175***
	[3.70]	[3.67]	[3.65]	[3.76]	[3.68]	[3.66]
MARK–UP	−0.1471***	−0.1409***	−−0.1432***	−0.1328***	−0.1045***	−0.0819***
	[−9.94]	[−9.43]	[−9.56]	[−8.83]	[−6.87]	[−5.32]
UD		−0.0100***	−0.0102***	−0.0036	0.0035	−0.0046
		[−2.98]	[−3.02]	[−1.02]	[1.00]	[−1.25]
HIGH SKILLED			0.9252**	0.1201	1.0386**	0.5441
			[2.10]	[0.27]	[2.29]	[1.19]
FEMALE				0.0450***	0.0507***	0.0325***
				[6.80]	[7.64]	[4.68]
SENIORITY					0.1529***	0.1464***
					[11.72]	[11.21]
IMPORT_PENETR						0.0217***
						[8.90]
LS(t−1) (ln)	0.3075***	0.3074***	0.3079***	0.3082***	0.3100***	0.3102***
	[54.42]	[54.39]	[54.52]	[54.58]	[54.86]	[54.91]
CONST	−0.5528***	−0.5179***	−0.8233***	−0.5274**	−0.9414***	−0.7107***
	[−3.90]	[−3.64]	[−4.05]	[−2.56]	[−4.52]	[−3.39]
Sector dummies	No	No	No	No	No	No
Prefecture dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	112,060	112,060	112,060	112,060	112,060	112,060

AB 'Arellano–Bond' GMM estimation
*p < 0.1, **p < 0.05, ***p < 0.01

[3] and [5]. One possible explanation for this result is that other explanatory variables, such as expenditures on intangibles and ICT, innovation, and internationalization activity, already account for the importance of high-skilled labor at the firm level.

In columns [13] and [14], we add the variable of seniority, which we measure as the ratio of the number of employees of different age groups (over 35 years old/under 35 years old).[5] Contrary to our expectation, the impact of the share of female workers is positive and significant (columns [13] and [14]). However, in the first place, we should note that the result does not strictly reflect a positive correlation between the firm-level share of female workers and the labor share, as the indicator is at the sector level. Second, we have to bear in mind that the share and the number of female workers in the manufacturing industry decreased in Japan during the 2000s, along with a decrease in the numbers of firms and total workers.[6] Combined with the shift to high-skilled labor that many firms made, this could mean that female workers who entered manufacturing employment held higher levels of education and attained relatively high wage positions, therefore driving the positive correlation observable between female work and the labor share.[7]

The strongly positive coefficient of the import penetration ratio is also opposite to our expectation (column [14]).[8] This is probably due to the fact that import penetration has two effects; one is to reduce employment and wages, and the other concerns firms' survival rate, sales, and value added. The result may imply that the latter effect prevailed in Japan during the 2000s. Another possible explanation is that import penetration reflects the outsourcing of unskilled-labor-intensive production processes, which increases the share of skilled workers and consequently the labor share. This would also explain why, when we add the import penetration and skilled worker variables simultaneously, the coefficient of the second variable becomes insignificant.

[5]We also estimate the model with a different age threshold (40-year-olds and 45-year-olds). The results are very similar to the ones that we present in Table 4 and are available on request.

[6]According to the "Labour Force Survey" that the Ministry of Internal Affairs and Telecommunication implemented, the number of female workers in the manufacturing industry was 4.33 million in 2002, following the application of the new industrial classification, but decreased to 3.17 million in 2012. During this period, except for 2006, it consistently decreased. During the same period, the proportion of women in manufacturing workers also declined from 33.5% to 29.5%.

[7]According to our data, the correlation coefficient between the sector-level labor share and the female employment share amounted, for the whole period, to 0.0877. On a year-by-year basis, it increased steadily over time.

[8]We also run estimates using an alternative definition of import impacts (import/output), and these largely confirm the results. Furthermore, dropping the firm-level dummy variable for imports does not make any significance difference to the outcomes that we present in Table 4.

6 Concluding Remarks

In this paper, we presented an analysis of the determinants of the labor share in Japan in the 2000s based on firm-level data. This is, to our knowledge, the first micro-level study on the labor share for this country. Our outcomes can be summarized as follows. As in many previous studies, a stable correlation between the total factor productivity and the labor share emerges. Noteworthy and original evidence is the significant and positive impact of tangible capital intensity, intangible assets, and ICT expenditures on the labor share. Regarding the role of intangible assets, our findings are consistent with those of Perugini et al. (2017), who showed that increasing investments in intangible assets, such as goodwill, brand development, and training, drive the labor share upward. They based their analysis on firm data for six EU countries (Austria, France, Germany, Hungary, Italy, and Spain), and their interpretation was that investments in intangible assets require highly skilled workers who command higher wages and therefore increase the labor share. Our results indicate that a similar mechanism might hold in Japan, with expenditure for intangible assets, such as R&D and advertisement, accompanying a higher demand for skilled workers and, through this channel, increasing the labor share.

As for internationalization activities, especially exporting, our paper is consistent with the results of previous research that has highlighted a negative impact on the labor share. However, in Japan, the effect tends to be irrelevant for firms with a small share of international activities and limited only to firms that are more active on international markets. This result might be related to the need for high-level skills and knowledge to operate abroad, which are probably internalized only by firms with international engagements exceeding a certain threshold.

Our analysis also reveals that, contrary to expectations, the proportion of female workers has a positive effect on the labor share. However, our panel data lack some important workers' information, such as education, career, and experience at the firm level. The fact that we approximate such information with variables at the sector level might be at the basis of this unexpected result. Further research is necessary on such crucial and socially sensitive aspects, by means of matched data that combine firms' and workers' information. This is one avenue in which the present research requires development.

Finally, we would like to point out the influence of institutional factors on our results, especially those related to the labor market. An important characteristic of Japan's labor market is the so-called lifetime employment and seniority system. Although the system has undergone a gradual review since the 1990s, in the 2000s, manufacturing firms characterized by this system still accounted for a large share of the total. Our analysis reflects this in the positive effects of the ratio of regular employees and seniority. A deeper analysis of the effect of country- or sector-specific institutional settings on the share of output accruing to labor at the firm level is another priority on our future research agenda.

Appendix

See Tables 5 and 6.

Table 5 List of variables, acronyms, and definitions

Label	Level	Type	Description
LS	Plant	Percentage	Cost of employees/value added
TFP	Plant	Continuous	Total Factor Productivity, estimated by Olley–Pakes Method, normalised by sector average in 2000
Kτ	Plant	Continuous	Real tangible fixed asset/real sales
E INT	Plant	Continuous	Real intangible expenditure (= R&D expenditure + real advertisement expenditure)/real sales
E ICT	Plant	Percentage	Real cost of ICT/real sales cost
PAT (d)	Plant	Binary	Company having patents developed by itself (= 1, 0 otherwise)
REG	Plant	Percentage	Regular employees/total employees
EXP (d)	Plant	Binary	Company exporting outputs abroad (= 1, 0 otherwise)
IMP (d)	Plant	Binary	Company importing inputs from foreign countries (= 1, 0 otherwise)
FDI (d)	Plant	Binary	Company having foreign subsidies (= 1, otherwise 0)
FOREIGN (d)	Plant	Binary	Company partially or completely by foreign company (= 1, otherwise 0)
EXP_s	Plant	Continuous	Export/Sales
IMP_s	Plant	Continuous	Import/Sales cost
FOREIGN_s	Plant	Continuous	Employees in foreign subsidies/total domestic employees
SIZE	Plant	Binary	Number of total domestic employees
SME (d)	Plant	Binary	Firm with 300 or fewer employees
PARENT (d)	Plant	Binary	Firm owned by other companies
FIRMAGE	Plant	Continuous	Years from the establishment of the firm
MARK-UP	Sector	Continuous	Sales/total cost
UD	Sector	Percentage	Union members/total workers
HIGH SKILLED	Sector	Percentage	Number of hours worked by high skilled workers/number of hours worked by total workers
FEMALE	Sector	Percentage	Number of female workers/total workers
SENIORITY	Sector	Continuous	Number of employed > 35 years old/ number of employed < 35 years old
IMPORT_PENETR	Sector	Continuous	Import/(Output + Import − Export)

Table 6 Summary statistics of sector variables

Variables	Observations	Mean	Std	Min.	Max.
MARK-UP	147,725	0.990	0.095	0.751	1.331
UD	147,725	30.166	19.838	7.400	94.700
HIGH SKILLED	147,725	0.330	0.003	0.318	0.336
FEMALE	147,725	0.314	0.140	0.111	0.661
SENIORITY	147,725	2.434	0.592	1.391	5.686
IMPORT_PENETR	147,725	0.144	0.125	0.004	0.723

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