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Poverty Reduction for Inclusive Sustainable Growth in Developing Asia

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Economics, Law, and Institutions in Asia Pacific

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Introduction

Poverty reduction, inclusive growth, and sustainable development are inseparable, and poverty reduction is the premise for sustainable development. Poverty reduction in all its forms remains one of the most significant challenges facing humanity. The UN sustainable development goals (SDGs) are a bold commitment to finish what we started and end poverty in all forms and dimensions by 2030.

In developing Asia, rapid growth in countries and sub-regions such as China, India, and South-East Asia has lifted millions out of poverty. It can be said that almost all Asian developing countries—notably China, Thailand, Nepal, and Vietnam—have succeeded in reducing extreme poverty, but progress has been uneven (ADB, 2019). In developing Asia, more than 611 million people have been lifted out of extreme poverty from 2005 to 2015 (international poverty line of $1.90 a day[1] in 2011 purchasing power parity) (ADB, 2019). Eighty percent were in China (234 million) and India (253 million). Despite this progress, more than 260 million people remain in extreme poverty, most of them found in South Asia (202 million people) (ADB, 2019).

Although over a billion Asians have emerged from extreme poverty since 1990, there are still 836 million people living on between $1.90 and $3.20 a day as of 2015, and over one billion subsist on less than $3.20 a day. (ADB, 2018). Many people are at risk of falling back into poverty due to economic downturns and recessions, huge infrastructure deficits, inequality, rapid urbanization, corruption, environmental pressures and climate change, and limited governance and institutional capacities.

Especially most recently, in the wake of the Covid-19 pandemic and the global economic downturn, the pace of poverty reduction is decelerating, and the Covid-19 crisis risks reversing decades of progress in the fight against poverty. It is pushing millions of people back into poverty. The global pandemic's economic fallout could increase global poverty by as much as half a billion people, or 8% of the total human population. This would be the first time that poverty has increased globally in the 30 years since 1990 (Sumner et al., 2020).

Therefore, due to the current global recession, the world is not on track to end poverty by 2030. Given this situation, if we plan to achieve the no poverty target in

[1] Throughout this book, references to dollar ($) are to the US dollar (US$) unless stated otherwise.

line with the SDGs, governments need to reconsider their policies and allocate their resources for this aim.

Given the topic's importance, this book aims to provide several studies on achieving poverty reduction goals for inclusive, sustainable growth in developing Asia. The book provides several case studies and thematic studies on the roles of local businesses and trusts, international remittances and microfinance, the tourism sector, energy security and energy efficiency, and fintech in poverty reduction and inclusive growth. The chapters provide practical policy recommendations useful for shaping development policies on poverty alleviation in developing Asia and the rest of the world.

The chapters are categorized into three sections as below:

Section 1 is on social trust, tourism, local production, and poverty reduction, consisting of four chapters.

In the first chapter, Onphanhdala and Philavong examine the impact of farmer production groups' (FPG) participation in reducing inequality and poverty. They used the findings from 5,025 samples from four provinces in the Lao People's Democratic Republic (PDR) and show the tremendous positive consequence of FPGs' involvement in mitigating poverty. This chapter offers many insights into understanding cooperative development and FPGs' role in rural farmers' livelihoods. The chapter provides policy recommendations for Lao PDR and other developing nations with similar economic structures.

In the second chapter, Chutima et al. analyze the role of social trust in expanding the sharing economy. The sharing economy tends to have a significant impact on poverty reduction for inclusive growth, and one of the main requirements is social trust. The sharing economy is a relatively new economic model and is defined as a peer-to-peer (P2P) based activity. This chapter aims to answer these two questions. First, what is the role of social trust in the sharing economy? Second, what are the reasons behind sharing economy growth through the transaction cost economics (TCE) lens? This chapter found that culture and the social background is a determining factor in the level of trust. The finding from this research should fill the gap in regulating the sharing economy in emerging markets.

In Chap. 3, Boonyasana and Chinnakum assess the tourism sector's role in poverty reduction and inclusive, sustainable growth in Thailand. Tourism is one of the largest and fastest-growing sectors in the world economy, including Thailand. This chapter investigates the impact of the tourism sector on poverty reduction, inclusive growth, and sustainable growth in five regions of Thailand throughout 2009–18. The results show that the tourism sector (domestic and foreign) favors poverty reduction and reduces inequality; however, it negatively impacts the environment. This means that the government needs to take necessary policies to promote sustainable tourism, such as investment in eco-friendly infrastructure in the tourism sector to improve energy and environmental efficiency.

In Chap. 4, Intapan et al. evaluate sustainable tourism's role in poverty reduction in selected members of the Association of Southeast Asian Nations (ASEAN), including Thailand, Malaysia, and Singapore. The main conclusion from the analysis is that the relationship between tourism revenue and poverty reduction in Malaysia and

Singapore has similar patterns. In contrast, the pattern of the impact of tourism sector revenues on the poverty headcount ratio in Thailand is different from the other two countries. For Singapore and Malaysia, increasing tourism sector revenue can reduce the poverty headcount ratio in the early stages. Nevertheless, after a while, increasing tourism revenue in later stages will not reduce the poverty headcount ratio. On the other hand, Thailand's tourism revenue can reduce the poverty headcount ratio with time lags.

Section 2 focuses on the role of international remittances and microfinance in poverty reduction, and it consists of four chapters.

In Chap. 5, Chin et al. investigate the role of remittances in inclusive growth and poverty reduction in Asian low- and middle-income economies. The international remittance by immigrants to their home countries is one of the key sources of funding development in migrant-sending countries (Yoshino, Taghizadeh-Hesary and Otsuka, 2020). This chapter's empirical analysis revealed that remittances increase inclusive growth and reduce poverty in most countries studied but show mixed effects in the short run. The results also suggest that workers' remittances tend to lower poverty rates in Asian low- and middle-income countries in the early stages of economic development but increases poverty when remittances go beyond the threshold of 8% of GDP. In that phase, foreign direct investment (FDI) replaces remittances as the source of development. To this end, the chapter sheds light on the channels through which remittances foster inclusive growth and alleviate poverty and provide policy recommendations.

In Chap. 6, Gurbanov et al. study the impact of international remittances on poverty reduction in six former Soviet Union countries. The selected countries of the former Soviet Union are those that international personal remittances are equal to more than 5% of GDP, and rents from natural resources are below 10% of GDP. According to the regression results, a 10% increase in remittance inflow reduces headcount ratio, poverty gap, and poverty severity at $1.9 per day poverty line by 4.8%, 5.9%, and 6.4%, respectively. The same level of increase in remittances reduces the poverty headcount ratio by 3.3% and the poverty gap by 3.7% (at the poverty line of $3.2 per day).

In Chap. 7, Naderi shows how to utilize FinTech, specifically blockchain technology, in international remittances for poverty reduction and inclusive growth. Despite the welfare gains associated with remittances and their impact on poverty reduction, the average cost of remittances remains more than double the SDG target of 3%. Evolving technologies such as blockchain and distributed ledger technology (DLTs) can help to achieve this target. Developing Asia needs to welcome new players such as blockchain remittance companies and DLT-based applications to operate through banks, national post offices, and telecommunication companies to increase competition and lower remittance costs. This will increase the economic impacts of remittances in achieving poverty reduction and inclusive growth goals. The chapter concludes that it's crucial to utilize recent technological innovations and establish legal channels of remittance transactions.

In Chap. 8, Mohsin et al. measure the performance of poverty reduction programs in rural Pakistan. Microfinancing is an essential tool for poverty alleviation in

society to address this humanitarian problem in the world. This chapter investigates the fundamental factors contributing to poverty and exploring the efficient model of providing financial assistance to these determinants to overcome poverty. It is revealed from the empirical study that schooling level, household size, occupation, gender, and age are significant determinants of poverty. It is also observed that Zakat institutions have been developing human capital through skill development in the Vocational Training Institute, which is a very effective way to overcome poverty. This chapter concluded that human capital development through education and skill development is the best strategy to enhance income so that productive poor overwhelmed insufficiency in Pakistan's rural areas.

Section 3 is on enhancing energy security and energy efficiency for poverty reduction and inclusive growth, and it consists of three chapters.

In Chap. 9, Anancharoenkij and Chinnakum analyze energy security and economic growth's relationship with poverty reduction in selected ASEAN member states: Thailand, Indonesia, Singapore, Malaysia, the Philippines, Brunei, Vietnam, and Cambodia. To measure energy security, the authors consider five factors: availability, applicability, acceptability, affordability, and developability. The empirical results show that almost all energy security variables positively affect inclusive economic growth and poverty reduction. The authors conclude that availability, applicability, and acceptability are the crucial aspects of energy security for reducing energy poverty.

In Chap. 10, Rasoulinezhad and Taghizadeh-Hesary assess the relationship between poverty and energy transition in the Commonwealth of Independent States (CIS). The study is based on 12 member states of the CIS: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. The main findings revealed a positive relationship between poverty, income inequality, and energy transition in-country and panel group levels. Besides, it is found that the relationship of poverty with energy transition is weaker for oil producers such as Russia, Kazakhstan, and Azerbaijan. At the same time, the magnitude of this relationship is more extensive for smaller economies in the CIS region, such as Belarus and Georgia. These results confirm that using expensive energy, especially in smaller economies, will slow economic growth and elevate the poverty ratio. Hence, accessing cheap and clean energy is crucial for alleviating poverty and reaching sustainable and inclusive growth.

In Chap. 11, the last chapter, Abbas et al. measure social welfare and poverty reduction through the efficient use of energy and reduction in CO_2 emissions. For this purpose, this study applies mathematical multi-system programming using the selected European countries' data. According to the findings, there is a significant and positive relationship between social welfare and energy efficiency. Therefore, European nations have an opportunity to reduce poverty, improving people's lives, provide good health, create more jobs, and preserve the natural environment through energy efficiency. The study's outcomes can serve as a beacon for reducing poverty and improving the quality of social welfare indicators in developing Asia by following the trajectory of energy efficiency.

This book is a valuable resource for the researchers and policy makers in development. The policy recommendations are essential for Asia and the rest of the world to accelerate poverty reduction plans.

Farhad Taghizadeh-Hesary
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Naoyuki Yoshino

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Part I
Social Trust, Tourism Sector, Local Production, and Poverty Reduction

Chapter 1
Developing Policies for Local Farmer Production Groups and Their Impacts on Inequality and Poverty Reduction in Lao PDR

Phanhpakit Onphanhdala and Vanvisa Philavong

Abstract Alleviating poverty is the first aim of the Sustainable Development Goals (SDGs), which United Nations (UN) member countries aspire to achieve by 2030. This study examines the impact of farmer production groups' (FPGs) participation in reducing inequality and poverty. Findings from 5025 samples from four provinces in the Lao People's Democratic Republic (PDR) show a tremendous positive consequence of FPGs' involvement in mitigating poverty. By deriving the results through the Gini decomposition, the authors found that a 1% increase in income from agricultural sources can diminish income inequality among farming households (FHs). The outcomes of ordered probit regression demonstrate that agricultural production impacts poverty reduction by a 2% change, with statistical significance at the 1% level. Careful consideration should be given to incentives, conditions, and management details to improve FPG and agricultural cooperative (AC) decrees, as well as other AC laws regarding policy reform. Rural parts of northern Laos are exhibiting changes in numerous aspects; this study offers many insights in terms of understanding cooperative development and FPGs' role in rural farmers' livelihoods. This chapter provides policy recommendations for Lao PDR and other developing nations with similar economic structures.

Keywords Laos · Farmer production group · Agricultural cooperatives · Poverty reduction · Inequality

JEL Codes Q13 · O13 · P21

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1 Introduction

Regarding exposure to the energy sector, the Lao People's Democratic Republic (PDR) has been one of the fastest developing economies, with 7.2% annual growth over the past decade (World Bank 2020a). However, income inequality in Lao PDR is more extensive than in many states in the region. In 2019, the Gini coefficient of Laos was approximately 38.8%, while in Vietnam it was 35.7%, in Thailand it was 37.0%, and in Indonesia it was 37.7% (LSB 2020). Although the Laotian economy shows significant expansion, progress in terms of reducing poverty remains slow, implying inequality among the country's population of seven million. Approximately 9% of Laotians live in poverty on less than $1.90 per day, which is higher than in many South-East Asian nations. In 2019, less than 2% of the populations of Thailand and Vietnam lived in poverty (LSB 2020). The Laotian government is striving to eradicate this disparity and achieve sustainable development, which 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (United Nations [UN] General Assembly 1987: 43; Emas 2015). Attaining it requires inclusive growth that is distributed equitably across the state and creates opportunities for all.

Poverty alleviation is the first aim of the UN Sustainable Development Goals (SDGs), which UN member countries aspire to fulfill by 2030. Based on the Lao Expenditure and Consumption Survey (specifically the LECS5 and LECS6), the poverty headcount rate at the national poverty line (as a percentage of the population) only dropped by 6%, from 24.6% in 2012/2013 to 18.3% in 2018/2019. The national poverty line was set at 0.281 million kips per month for individual expenses ($33),[1] 0.297 million kips per month in an urban zone ($35), and 0.273 million kips per month in a rural area ($32). The poverty headcount rate in rural regions was around 23.8%, while in urban ones it was only 7%. There are disparities between the four provinces examined, which lie in the north of the country. In Luang Namtha, the poverty headcount rate was 10.5%, in Oudomxay it was 29.2%, in Phongsaly it was 8.1%, and in Bokeo it was 19.4%. Even though the agricultural sector's share of the gross domestic product (GDP) was only 17.7% in 2018 (ADB 2020), it plays an important role in employment participation. This sector employs 63.2% of Laotian laborers, suggesting the agricultural sector's role in rural development, where most people are engaged in subsistence farming and still live in poverty (World Bank 2020b).

As a pull factor, cross-border trade with China has been dominant in transforming the economy in northern Laos, specifically agricultural production. Such commerce has rapidly shifted subsistence agriculture to high-value commercial agriculture to increase smallholding farmers' incomes by offering a stable market. With the globe's second-largest economy, China's rise has remarkably changed the global economy's view. With 9% of continuous annual growth in the last two decades, China has become a hefty market for exporter nations worldwide. As the largest importer

[1] Please noted that the Lao Kip currency as the national poverty line was converted to US Dollar, based on the exchange rate in 2018 (8481 kips was roughly equal to $1).

country, China's share of global imports rose sharply from 3% in 2000 to 15% in 2018 (UNCTAD 2020). Since 2010, China has been the biggest trade partner of the Association of Southeast Asian Nations (ASEAN) for ten consecutive years (ASEAN Stats 2020). ASEAN has been China's third-largest trade partner for seven consecutive years (Xinhua 2018). Although the Covid-19 pandemic has restricted investment and trade, causing both the Chinese and global economies to slow down, China's rapid recovery and purchasing power have led to a high demand for consumption, including agricultural products. This opportunity has allowed Laos, Myanmar, and Vietnam (which are bordered by China) to increase their agricultural and food products to supply this emerging market. For example, there was a tenfold expansion in Laos' agricultural exports between 2008 and 2018. The main agricultural crops exported to China are Cavendish bananas, chilis, Chinese cabbages, maize, peanuts, pumpkins, onions, rice, sugarcane, and watermelons.

As a push factor, the Laotian government has issued various policies to boost inclusive growth relevant to the agricultural sector's expansion. Infrastructure and technology are the key areas needed to enhance the agricultural sector and people's livelihoods in rural regions (Ali and Yao 2004). Farmer production groups (FPGs) facilitate input supplies and production techniques for their members in the same production activity, and help them access information, training, markets, and credit (Onphanhdala et al. 2016). FPG participation allows smallholding farmers to gather as a group and to augment their bargaining power toward buyers or investors. For example, contract farming provides farmers with potential buyers and stable incomes, and gives buyers greater control of production. Nevertheless, smallholding farmers struggle with lower margins due to weak bargaining power because they deal with buyers individually. Farmers' bargaining power can be seen from two angles. On the one hand, it can help them to negotiate a sale based on a fair verbal or written contract in advance. On the other hand, it can facilitate their ability to control the inputs required for production (Gebert 2010). Hence, FPGs are vital to improving local farmers' livelihoods.

The authors empirically investigated poverty reduction issues, rice sufficiency level, and income inequality among smallholding farmers, determined by FPG participation in various realms. The authors relied on observations from several qualitative field surveys for in-depth analysis. They also aimed to trace the history of agricultural cooperative (AC) development in Laos and how it has unfolded over the past decade. The findings demonstrate how FPG participation impacts poverty reduction and raises income equality. The results could help the government to shape improvement strategies for FPG promotion and to create relevant policies. These include the fundamentals of FPGs and ACs, cross-border trade, and agricultural investment aimed at ongoing policy reform that is pertinent to renewing the Prime Minister Decree on Cooperatives (No 136/PM) that was issued on 5 March 2010 and paving the way to upgrade it to the status of a law.[2]

[2]There are two types of legislation in Lao PDR: legislation of general application and legislation of specific application. The legislation of general application consists of: constitution; law; resolution of the National Assembly; resolution of the National Assembly Standing Committee; presidential

Rural areas of northern Laos are changing in many regards. Within that context, this study deepens the understanding of rural livelihoods to establish a knowledge basis for future investigations on sustainable and green development in the country. The next section reviews the literature on FPG participation, poverty reduction, and income equality. The present section examines policy changes in FPGs and ACs in Lao PDR. The third section explains the methodology by employing the Gini decomposition and ordered probit regression for analysis. The fourth section covers the findings, and the last section provides a conclusion and policy recommendations.

2 Literature Review

2.1 Policy Changes in FPGs and ACs in Lao PDR

The government has made many attempts to promote FPGs and ACs since 1975. However, due to weak fundamentals and management failures, ACs collapsed and were not reestablished for over two decades (Bourdet 1995; Ducourtieux et al. 2005). The development of FPGs and ACs can be broken down into three periods. They were initially created between 1975 and 1985. The second period encompasses their growth under the New Economic Mechanism (NEM) between 1986 and 2010. In 2011, however, ACs were rebuilt through the formation of FPGs to reunite individual smallholding farmers into groups, which illustrates the original implementation and success of FPGs in the northern part of the country. Thus, the third period covers the relaunching of FPGs, and shows how ACs varied from 2011 to the present.

Before 1975, cooperatives existed as microfinance cooperatives (not as ACs), which provided their members with credit and deposit services. After the Lao government took control in 1975, cooperatives' operations became a mixture of credit providers and agricultural production. Castella and Bouahom (2014) found that the Central Leading Committee for Cooperative Development was under direct control by the prime minister until it became a department of the Ministry of Agriculture, Forestry and Cooperatives in 1983. Although the AC and FPG legislation was limited during this time, their number still increased. The number of cooperatives rose from 1356 in 1978 to 2452 in 1979, and almost hit 3000 in 1985 (Bourdet 1995; Machima and Prakash 1987). All production cooperatives were developed based on the Vietnamese model to achieve food sufficiency under the centrally planned government, which did not focus on market orientation.

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decree; decree of the government; resolution of the government; order or decision of the prime minister; order, decision or guideline of the minister or head of the organization under the supervision of the government; order, decision or guideline of the provincial governor or mayor; order, decision or instruction of the district governor or head of municipality; and regulation of the village. The legislation of specific application includes: presidential decree on the promulgation of a law; presidential decree or decision on granting an award or appointing a person for any position or a specific task; and notification.

In 1986, Lao PDR witnessed substantial structural changes in the economy, moving from a centrally planned economy to a market-oriented one. The government then accelerated agricultural production by expanding cooperatives; the number of ACs rose to 4000 to boost food security in 1986. Top-down management, inefficiency, a lack of inputs and production techniques, an absence of training and extension, and poor managerial skills among cooperative staff led to failures in 1988 (Castella and Bouahom 2014). These cooperatives then fragmented into smaller groups in terms of form and scale, such as community groups, women's credit and savings groups, and community production groups.

The government aimed to reestablish ACs many years later. The first legislation on cooperatives, the Decree on Cooperatives (No 136/PM), was issued on 5 March 2010. One year later, the first cooperative was officially registered under this decree; their number increased to three in 2013. The government assigned responsibility for managing cooperatives to the Department of Agricultural Extension and Cooperatives in the Ministry of Agriculture and Forestry, which was established at the end of 2012. During the same period, FPGs emerged independently without any official regulations, specifically in the northern provinces, to reunite individual smallholding farmers into groups. On 25 September 2014, the Decision on the Establishment of Agricultural Production Groups (No 2984/MAF) and the Decision on Cooperatives (No 2983/MAF) were promulgated. As of 2017, there were 4334 farmer groups, 582 agricultural production groups, and 22 cooperatives (Rasabandith 2019). Recently, the government created the Department of Rural Development and Cooperatives under the Ministry of Agriculture and Forestry to be responsible for assisting cooperatives and providing technical training to their members. Despite the government's efforts to advance ACs through legislation and to increase their number, the operation of ACs and FPGs faces new challenges due to a lack of practical experience among farmers and administration, as well as the weak enforcement of cooperative regulations.

There is an inconsistency between regulations and the implementation of ACs. The decree on cooperatives only stipulates the general conditions of their establishment and tasks; it does not determine specific activities, responsibilities, or management schemes. Types of cooperatives are not clearly defined under explicit categories, which should be aligned with actual actions and sectors. Cooperative promotion is only addressed broadly and specific criteria have not been provided, which makes it difficult to execute ACs efficiently. In addition, there is a lack of details on cooperative promotion, management, monitoring, investigation, and international integration. Hence, the latest revision to the decree on cooperatives was drafted in 2020, aiming to improve ACs and to pave the way forward to upgrade the decree to the status of a law.

2.2 Agricultural Development and Income Equality

Income inequality is the most concerning rural development issue in developing nations where farming is at the center of people's lives. There are many arguments about agriculture's role in income inequality. Having land is an essential factor in agricultural production. Many studies have shown that agricultural products lead to high incomes for small farming households (FHs) through contract farming. However, some researchers have argued that income from agricultural sources plays an inverse role. For example, some studies have pointed out that farm size and income have a U-shaped correlation in terms of the Gini coefficient. A reliable explanation has also demonstrated that while farm size increases from landless to medium-sized farms, a decrease in the Gini coefficient is significant. Meanwhile, all of the rest display an inverse outcome, implying that a large farm is correlated with an increase in the Gini coefficient, or results in greater income inequality (Pandey 2016).

The agricultural source of income contributes to income equality in small-scale FHs. Cuong (2011) found that, by testing a regression, fishery production significantly reduced inequality regarding income and poverty among Vietnamese farming families. From a macro perspective, Ali et al. (2013) tested the cointegration between farm output and Gini elasticity. The findings revealed that a decrease in income inequality is correlated with added agricultural value. Hence, agricultural production development is a critical factor that contributes to income equality.

However, FHs are dual-earners through both agricultural and non-agricultural activities. Studies on agriculture and inequality illustrate that non-farming income (versus farming income) seems to reduce income inequality among farming families. By testing the Gini coefficient, Sanusi et al. (2016) indicated that farming income contributes to more income inequality than non-farming income. This finding is similar to a study in Nigeria, where a 10% rise in farming income increased inequality by 2.6%, while a 10% rise in non-farming income decreased it by 2.6%. This outcome is similar to that of Findeis and Reddy (1987), who used the Gini decomposition approach to examine the correlation between non-farming income and FHs' income inequality in the US.

In sum, the link between FHs' agricultural sources of income and their overall income inequality remains uncertain. While some researchers have claimed that farming income decreases inequality, others have contested this assertion due to the change in economic structure, whereby many families no longer earn a living solely by farming. The financially driven shift from agriculture to industry has a strong foundation for job creation and a skilled labor supply. In other words, educated workers can earn a living in the industrial sector. Notwithstanding, there is a clear disparity in household (HH) earnings between agricultural and non-agricultural sources of income in developing economies. This is likely because non-agricultural income comes from renting out land, a widespread phenomenon in rural areas.

2.3 FPGs and Poverty Reduction

In many developing nations, FPGs and ACs advance farm productivity in many ways. FPGs and ACs provide inputs to their members and help them access infrastructure, markets, and credits. This strengthens farmers' production capacity and gives them the freedom to choose what crops they want to grow based on market demand. Their bargaining power toward buyers or investors is also enhanced, thereby increasing their margins. Paos (2018) examined an AC society in Zambia and revealed that members of ACs were able to increase food security and income generation.

Cooperatives provide agricultural aid to farmers in order to expand farming production, and help to reduce poverty by raising FHs' annual income. An increase in income affects HHs' decisions to adopt new techniques for production. The empirical results show that cooperative membership boosts FHs' standard of living. Membership in a group has a positive, significant impact on farmers' welfare, as shown by measuring the annual consumption expenditure per adult equivalent, according to a study on the role of AC membership among farmers in Ethiopia (Ahmed and Mesfin 2017). This study's empirical findings also confirm that collective membership leads to a 17.6–26.5% higher consumption per adult equivalent than non-membership. In another study on farming organizations' role in Middle Guinea (a region of Guinea), FHs that participated in farming groups increased their farming income to around 7,413,487 Guinean francs, or $770 per cultivation, at the 10% statistically significant level (Tolno et al, 2015). According to these empirical investigations, farming group participation plays a vital role in alleviating poverty, similar to research carried out by Ito et al. (2012) and Verhofstadt and Maertens (2014).

Many studies have been conducted on farming group participation and poverty reduction, but few have focused on Laos. Their results illustrate that being a member of a farming group can enhance local farmers' well-being. There are some studies on FPGs and ACs in Lao PDR that have tracked their development. Their findings suggest a cooperative model appropriate for the country's circumstances, and demonstrate how to upgrade farming groups to cooperatives. The key factors are social networks and power relations in improving farming group management and avoiding past mistakes (Castella et al. 2011; Castella and Bouahom 2014). Hence, this study aims to address farming groups' role in mitigating poverty and income inequality in Laos by applying the Gini decomposition and the ordered probit regression approaches. Understanding their impact will help policy makers to build a better environment to enhance the agricultural sector.

Table 1 Overview of the surveyed villages

Province	No of HHs
Luang Namtha (LNT)	1473
Oudomxay (ODX)	1030
Phongsaly (PSL)	1125
Bokeo (BK)	1397
Total	5025

Source Compiled by the authors

3 Methodology

3.1 Data Collection

This section presents data from a HH survey of four northern provinces—Luang Namtha, Oudomxay, Phongsaly, and Bokeo—conducted in 2017 by interviewing 6849 HHs. General HH information includes HH characteristics (the number of HH members, ethnicity, language group, literacy, and number of dependents), poverty status, rice sufficiency, landholding, source(s) of water, source(s) of income, total expenditure, crop production, and water usage group (WUG) participation. After cleaning and clearing outliers and identifying FHs, there were 5025 HHs in total, which were helpful for analyzing the impact of FPG participation on poverty reduction using the regression. Table 1 displays the samples.

Out of 6849 HHs on the village household masterlist (VHM), ten HHs per village were treated as stratified random samples for interviewing to accrue more details on income and expenditure. The sample household interview (SHI) was administered to 540 HHs to obtain in-depth data on HH information such as HH characteristics (the number of HH members, ethnicity, religion, and language group), poverty status, landholding, healthcare, income source(s), income level, and expenditure structure(s). After cleaning the data, there were 397 HHs for analyzing income inequality.

3.2 Data Analysis Methods

The methodology is a mixture of various approaches to examine income inequality and poverty reduction, as well as how both are determined by FPG participation across the four provinces (Luang Namtha, Oudomxay, Phongsaly, and Bokeo).

3.2.1 Income and Expenditure Structure

A descriptive analysis was performed to identify HHs' income sources, income structure, and expenditure structure by scrutinizing the 397 HH samples after cleaning the data. FHs primarily earn income from both agricultural and non-agricultural sources.

- *Agricultural* income comes from selling agricultural products such as rice, bananas, rubber, livestock, poultry, fish, and other crops.
- *Non-agricultural* income is derived from performing farm labor for other farmers, performing labor outside the farm and the village, employee salaries, selling non-timber forest products, handicrafts, business, and other sources.

Families spend money on food-rice consumption, investing in education, medical/health issues, repairing/improving/furnishing the house, clothing, electricity, cooking, transportation, social events, and other expenditures. This analysis allowed the authors to visualize HH income and the components of expenditure for the four northern provinces mentioned above.

3.2.2 The Distribution of Income

Regarding income structure, the distribution of income has received great attention across developing economies. If we can understand income distribution, we can more clearly grasp the inequality between the participation and non-participation of FPGs. Thus, the Gini decomposition is derived from measuring income distribution within samples by each income source. With this method, a component of income inequality is identified, as well as a marginal effect of which income source affects income inequality. The decomposition of the Gini coefficient (G) is based on the approach and explanation by Lerman and Yitzhaki (1985) and Lopez-Feldman (2006) and is shown in Eq. (1):

$$G = \sum_{k=1}^{K} S_k G_k R_x \tag{1}$$

S_k denotes the share of each income source from the total income [%]
G_k denotes the Gini coefficient of each income source [0 = perfect equality, 1 = perfect inequality]
R_k denotes the Gini correlations between each income category and total income
k denotes each income component (source)

The effect of a marginal change in component k, denoted as e (a percentage change in component k) and is shown in Eq. (2):

$$\frac{\partial G}{\partial e} = S_k(G_k R_k - G) \tag{2}$$

3.2.3 The Econometric Model

Ordered probit regression was performed to estimate the impact of FPG participation on poverty reduction in the four northern provinces by classifying them into three levels (e.g. poor, middle, and rich). The 5025 HH sample dataset was employed in regression analysis by comparing the four provinces. Based on the framework of previous studies reviewed earlier, the econometric model is proposed in Eq. (3):

$$y_i = \beta_0 + \beta_i x_j + \mu \tag{3}$$

y_i denotes the ordinal dependent variable
x_j denotes the independent variable
β_0 denotes the constant term
β_i denotes the model's coefficients/parameters
μ denotes the error term.

Table 2 outlines the variables used in the econometric model. The regression aimed to examine the role of FPG participation in alleviating poverty by obtaining poverty status as a proxy. The poverty line measurement in this study was developed by the Asian Development Bank (ADB) to compare the prices of goods and services purchased by the poor (ADB 2010). *Poverty status* represents the quantile of wealth based on the poverty line income. *Poor* refers to a HH with an income level below the 2001 poverty line of 85,000 kips/month/person ($10).[3] *Middle/medium* represents a HH with an income within the 2005–2009 poverty line income of 85,000–180,000 kips/month/person ($10–12). *Rich* indicates a HH with an income level above 180,000 kips/month/person ($12). The FPG participation variable was derived from FHs that joined WUGs that engage in agricultural production (including rice, crops, vegetables, rubber, and mixtures). WUGs provide the backbone for sustainability through organized operation and maintenance (O&M). They are evolving into producer groups that are able to negotiate production contracts with traders, and hence more commercially-oriented agricultural practices. The results of ordered probit regression were derived from a marginal effect to demonstrate the impact of FPG participation on rural development.

4 Empirical Results

4.1 HH Characteristics

Lao PDR is a landlocked nation in the Greater Mekong sub-region surrounded by Cambodia, China, Myanmar, Thailand, and Vietnam. Home to seven million people,

[3] Please noted that the Lao Kip currency as the poverty line by the ADB was converted to US Dollar, based on the exchange rate in 2017 (8349 kips was roughly equal to $1).

Table 2 Definitions of the variables

Variable	Definition/description
Dependent	
ps02	Poverty status '1' denotes *Poor* (HH income <2001 poverty line of 85,000 kips/month/person) '2' denotes *Middle* (HH income within 2005–2009 poverty line of 85,000–180,000 kips/month/person) '3' denotes *Rich* (HH income >180,000 kips/month/person)
Independent	
hh15	Gender of HH head '1' denotes female '0' denotes male
ag01b	Number of adult members between 18 and 60 years old [number]
hh10c	Number of HH members [number]
ed01apr	Number of HH members who have at least a primary education level
ed01bse	Number of HH members who have at least a secondary education level
ed01cun	Number of HH members with a college/university education
hh061	Ethno-linguistic dummy for the Lao-Tai group (reference)
hh062	Ethno-linguistic dummy for the Mone-Khmer group
hh063	Ethno-linguistic dummy for the Hmong-Iu Mien group
hh064	Ethno-linguistic dummy for the Tibeto-Chinese group
lh13	Total land area holding within and outside the village [ha]
wug	Membership in WUG as a proxy of FPGs '1' denotes *Yes* (participation) '0' denotes *No* (non-participation)
hh01alnt	Dummy for Luang Namtha Province (reference)
hh01aodx	Dummy for Oudomxay Province
hh01apsl	Dummy for Phongsaly Province
hh01abk	Dummy for Bokeo Province

Source Compiled by the authors

it covers 236,800 km^2, nearly 80% of which consists of mountains and plateaus. There are three distinct regions: the northern, southern, and central regions (the capital is located in the central one). Luang Namtha, Oudomxay, Phongsaly, and Bokeo provinces are in the northern uplands region and respectively cover 9325, 15,370, 16,270, and 6196 km^2. This area is characterized by a complex topography of mountains, hills, and flatlands, has an ethnically diverse population, a comparatively low population density, an incomplete public infrastructure, low levels of primary education and healthcare, and reliance on traditional swidden agriculture and forest use practices. As of 2018, the GDP per capita in Luang Namtha was $1796, in Oudomxay it was $1394, in Phongsaly it was $936, and in Bokeo it was $1859. Table 3 portrays the structure of the GDP in these provinces.

Table 3 GDP structure

	2006			2012			2018		
	Agri (%)	Indus (%)	Services (%)	Agri (%)	Indus (%)	Services (%)	Agri (%)	Indus (%)	Services (%)
LNT	63	15	22	55	20	25	49	23	28
ODX	72	3	25	50	27	23	42	33	25
PSL	56	25	19	51	28	21	49	21	30
BK	56	11	33	44	21	35	37	21	42

Source Compiled by the authors

Of the four provinces, Oudomxay has the largest population (323,252 inhabitants), followed by Bokeo (186,636), Phongsaly (186,189), and Luang Namtha (185,962). Based on the LECS6, there are disparities between the provinces: the poverty gap in Luang Namtha is 1.9%; in Oudomxay it is 6.4%, in Phongsaly it is 1.2%, and in Bokeo it is 4.2%. Bokeo's economy has relied on trade with Thailand for several decades. In 2018, its services sector expanded and accounted for around 42% of its economy due to a large amount of Chinese investment. Yet when it comes to agricultural product exports to China, Bokeo and Phongsaly were latecomers in terms of producing and trading. Meanwhile, Luang Namtha and Oudomxay were early birds in trading agricultural and timber forest products with China. Thus, farmers in these two provinces were fast adopters of FPGs and cross-border contract farming.

Table 4 presents information on HH characteristics in the four provinces: Luang Namtha (LNT), Oudomxay (ODX), Phongsaly (PSL), and Bokeo (BK), respectively. FHs are categorized under FPG participation (the FPG group) and non-FPG participation (the non-FPG group). Proportions of FPG participation among farmers in Oudomxay and Phongsaly are more significant than in Luang Namtha and Bokeo. These proportions are consistent with rice sufficiency status and poverty status. More than 20% of HHs in the FPG group have a rice surplus status, except for HHs in Luang Namtha province. On the other hand, less than 10% of HHs in the non-FPG group have a rice surplus status in Luang Namtha and Oudomxay. We tend to use rice sufficiency status to show rural HHs' wealth status, where market orientation is challenging to access. When considering wealth status, this study presents three family status levels: poor, middle, and rich. FHs engaged in FPGs seem to have escaped poverty. The percentage of poor HHs in the FPG group is between 2 and 10% across the four provinces; in Luang Namtha it is 5%, in Oudomxay it is 6%, in Phongsaly it is 2%, and in Bokeo it is 8%. These numbers are by far smaller than those of the non-FPG group, for which the figures are 12% in Luang Namtha, 19% in Oudomxay, 9% in Phongsaly, and 18% in Bokeo. The largest share of wealthy HHs that participate in FPG groups is in Phongsaly (8%), followed by Luang Namtha (7%), Bokeo (6%), and Oudomxay (5%). It is worth noting that there is a consistency between FPG participation and FHs' wealth status at different levels in different provinces.

Most HH heads are male (more than 90%)—especially in rural agricultural communities—probably due to the need for labor in farming activities and the fact that males are responsible for primary family duties, such as earning a living to support the family. The share of male HH heads is similar across the four provinces. In Phongsaly, less than 2% of the HH heads are females working in farming to support the family. When females are HH heads, those HHs seem to participate more in FPGs, except for in Luang Namtha.

A higher education corresponds with mean family sufficiency, and offers HHs the opportunity to adopt technology to have better farms. Members of FHs in the FPG group are more likely to attend school than those that do not, but the number of people who attend school is small. The proportion of literate HH members in the non-FPG group is more significant than in the FPG group in Phongsaly and Luang Namtha. However, the share of literate HH members in the non-FPG group is smaller than in the FPG group in Oudomxay and Bokeo.

Table 4 Description of the data for the four provinces (Luang Namtha, Oudomxay, Phongsaly, and Bokeo)

HH characteristics	LNT				ODX				PSL				BK			
	Non-FPG		FPG		Non-FPG		FPG		Non-FPG		FPG		Non-FPG		FPG	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
FPG	768	52.14	380	33.78	745	66.22	705	47.86	411	39.90	619	60.10	811	58.05	586	41.95
Gender of HH head																
Female	69	8.98	4	1.05	10	1.34	65	9.22	11	2.68	45	7.27	72	8.88	34	5.80
Male	699	91.02	376	98.95	735	98.66	640	90.78	400	97.32	574	92.73	739	91.12	552	94.20
No. of HH members with at least a primary education																
None	414	53.91	263	69.21	467	62.68	287	40.71	86	20.92	200	32.31	378	46.61	297	50.68
1 person	193	25.13	99	26.05	233	31.28	221	31.35	101	24.57	191	30.86	255	31.44	180	30.71
2 people	127	16.54	17	4.47	41	5.50	162	22.98	155	37.71	138	22.29	145	17.88	82	13.99
3 people	22	2.86	1	0.26	4	0.54	28	3.97	37	9.00	52	8.40	23	2.84	20	3.41
More than 4	14	1.56	–	–	–	–	7	0.99	32	7.78	38	6.13	10	1.24	7	1.19
No. of HH members with at least a secondary education																
None	500	65.10	280	73.68	537	72.08	375	53.19	193	46.96	227	36.67	458	56.54	286	48.81
1 person	155	20.18	85	22.37	180	24.16	206	29.22	130	31.63	201	32.47	221	27.28	181	30.89
2 people	91	11.85	13	3.42	25	3.32	94	13.33	66	16.06	111	17.93	99	12.22	108	18.43
3 people	14	1.82	1	0.26	3	3.36	18	2.55	14	3.41	42	6.79	24	2.96	4	0.68
More than 4	8	1.04	1	0.26	–	–	12	1.70	8	1.94	38	6.14	8	0.98	7	1.19
No. of HH members with at least a college/university education																
None	655	85.29	372	97.89	721	96.78	598	84.82	332	80.78	354	57.19	772	95.19	548	93.52
1 person	69	8.98	8	2.11	22	2.95	78	11.06	59	14.36	138	22.29	34	4.19	32	5.46

(continued)

Table 4 (continued)

HH characteristics	LNT				ODX				PSL				BK			
	Non-FPG		FPG		Non-FPG		FPG		Non-FPG		FPG		Non-FPG		FPG	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
2 people	31	4.04	–	–	2	0.27	19	2.70	18	4.38	87	14.05	4	0.49	4	0.88
3 people	11	1.43	–	–	–	–	4	0.57	1	0.24	25	4.04	1	0.12	2	0.34
More than 4	2	0.26	–	–	–	–	6	0.85	1	0.24	15	2.42	–	–	–	–
Ethno-linguistic groups																
Lao-Tai	432	56.25	239	62.89	598	80.27	465	80.00	269	65.45	580	93.70	356	43.90	398	67.92
Mone-Khmer	211	27.47	46	12.11	63	8.46	113	16.03	111	27.01	33	5.33	417	51.42	171	29.18
Hmong-Iu Mien	35	4.56	–	–	–	–	1	0.14	30	7.30	5	0.81	38	4.69	17	2.90
Tibeto-Chinese	90	11.72	95	25.00	84	11.28	27	3.83	1	0.24	1	0.16	–	–	–	–
Poverty status																
Poor	92	11.98	35	9.21	9	1.21	35	4.96	79	19.22	35	5.65	153	18.87	48	8.19
Middle	646	84.11	318	83.69	698	93.69	626	88.79	318	77.37	536	86.59	642	79.16	500	85.32
Rich	30	3.91	27	7.11	38	5.10	44	6.24	14	3.41	48	7.75	16	1.97	38	6.48
Deficiency	151	19.66	61	16.05	24	3.22	66	9.36	68	16.55	31	5.01	210	25.89	63	10.75
Sufficiency	577	75.13	272	71.58	530	71.14	524	74.33	306	74.45	433	69.95	448	55.24	394	67.24
Surplus	40	5.21	47	12.37	191	25.64	115	16.31	37	9.00	155	25.04	153	18.87	129	22.01

Source Compiled by the authors

Overall, there are more HH members with at least a primary education, at least a secondary education, and at least a college or university education in the FPG group than in the non-FPG group across all four provinces. This implies that FHs that participate in FPGs can support their HH members enrolled in school. On the other hand, higher educated HH members seem to engage in the FPG group, rather than the non-FPG group.

Lao-Tai is the largest ethnolinguistic group followed by Mone-Khmer, Tibeto-Chinese, and Hmong-Iu Mien. The Lao-Tai ethnolinguistic group shows the most extensive participation in the FPG group at around 65–94%. Other ethnolinguistic groups have a small degree of FPG participation, which is lower than in the non-FPG group. For example, in Phongsaly, there are about 84 Tibeto-Chinese FHs in the FPG group, and about 95 in the non-FPG group. The northern part of the country's landscape is mostly mountainous, which makes it fairly challenging to grow crops due to a lack of land and irrigation access. Irrigation and drainage facilities support farming production. FHs that participate in FPGs tend to access irrigation more than other groups. Almost 90% of farmers who are members of FPGs are entrepreneurial farmers who grow crops through contract farming and sell their products at wet markets.

4.2 Income and Expenditure Structure

4.2.1 Income Structure

On average, the annual HH total income for the FPG group was around 33,500,000 kips ($4013)[4] in Luang Namtha, 47,700,000 kips in Oudomxay ($5713), 47,500,000 kips in Phongsaly ($5689), and 32,200,000 kips in Bokeo ($3857); these figures are higher than in the non-FPG group. Figure 1 presents HHs' income structure in Luang Namtha, Oudomxay, Phongsaly, and Bokeo by presenting the two primary income sources: agricultural and non-agricultural. In the FPG group, income from agricultural sources comprises around 28–45% of total income, which is larger than in the non-FPG group, except for in Phongsaly. This implies that agriculture plays a more important role in income generation among FHs that engage in FPGs.

- In Luang Namtha, individuals in the FPG group that make the highest contributions to total income work in the private or public sectors (25%), rice production (19%), and the rubber industry (17%). In this province, income from agricultural sources plays a greater role in FH income in both the FPG and non-FPG groups, accounting for around 43 and 39%, respectively.
- In Oudomxay, in the FPG group, agricultural sources of income comprise around 28% of total income, which is the lowest among all four provinces. Individuals

[4]Please noted that the Lao Kip currency as annual HH total income and annual expenditure was converted to US Dollar, based on the exchange rate in 2017 (8349 kips was roughly equal to $1).

in the FPG group that make the highest contributions to total income work in business (22%), the private or public sectors (21%), and rice production (28%).

- In Phongsaly, individuals in the FPG group that make the highest contributions to total income work in business (19%), crop planting (19%), and the sale of non-timber forest products (16%); these fields mostly relate to income from non-agricultural sources. On the other hand, income from agricultural sources makes up approximately 38% of total HH income, specifically from crop and rice planting.
- In Bokeo, in the FPG group, income from agricultural sources comprises around 45% of total income, which is the highest among all four provinces. Individuals in the FPG group who make the highest contributions to total income work in business (25%), rice production (20%), and other sectors (16%).

In these provinces, income from non-agricultural sources still plays a greater role in HHs' total income in both the FPG and non-FPG groups regarding their proportion. FH members work in agricultural production and are employed by private companies or public agencies; many of them run their own small businesses. In addition, it might

Fig. 1 HH income structure in Luang Namtha, Oudomxay, Phongsaly, and Bokeo Provinces. *Source* Compiled by the authors

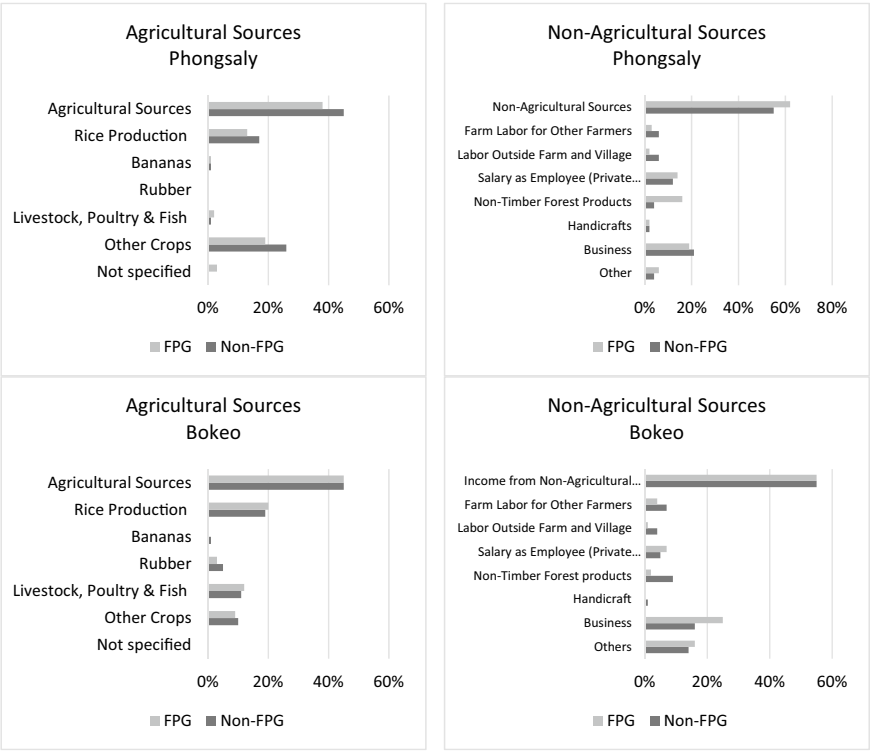

Fig. 1 (continued)

be a problem for farmers to give up on agricultural production to earn higher pay from doing business, earning a monthly salary, and other sources. However, income from agricultural sources receives more attention, especially in terms of FPG participation. It is superficial to consider this issue without delving into each component of total income, when engaging in an FPG seems to provide more opportunities to generate income. Moreover, this raises questions about whether income from agricultural or non-agricultural sources leads to income equality and poverty reduction in the long term. This will be investigated in the third sub-section by employing the Gini decomposition.

4.2.2 Expenditure Structure

Figure 2 presents the annual expenditure structure of HHs in all four provinces. On average, the total annual expenditure of HHs that engage in FPGs is approximately 13,600,000 kips in Luang Namtha ($1629), 25,000,000 kips in Oudomxay ($2994), 26,300,000 kips in Phongsaly ($3150), and 14,000,000 kips in Bokeo ($1677). Meanwhile, the total annual expenditure of HHs that do not engage in FPGs is around

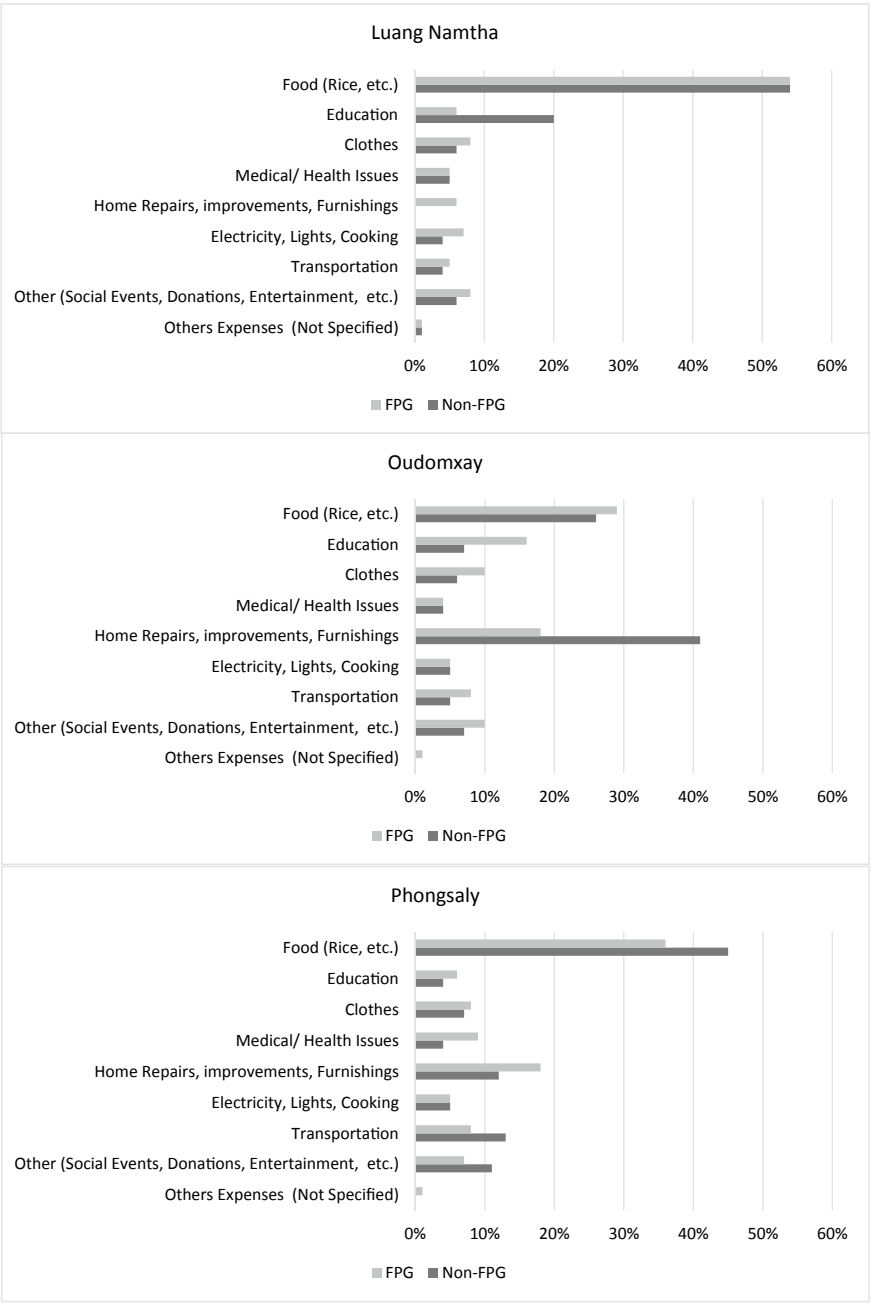

Fig. 2 HH expenditure structure in Luang Namtha, Oudomxay, Phongsaly, and Bokeo Provinces. *Source* Authors' compilation

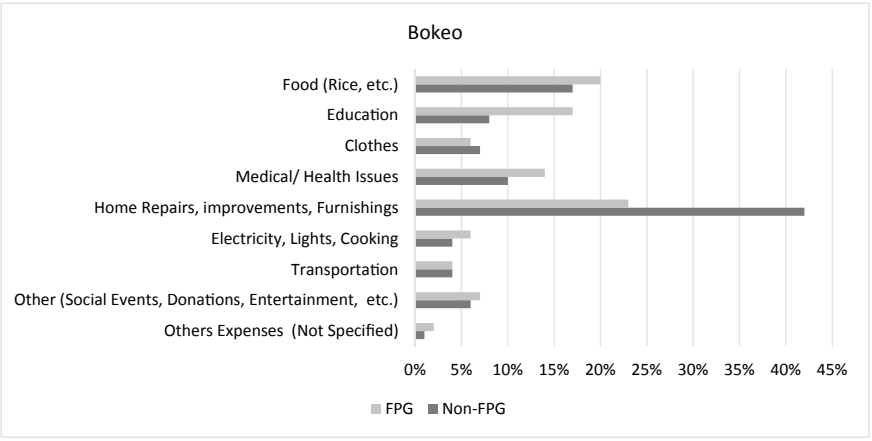

Fig. 2 (continued)

16,100,000 kips in Luang Namtha ($1928), 23,200,000 kips in Oudomxay ($2779), 13,100,000 kips in Phongsaly ($1569), and 17,800,000 kips in Bokeo ($2132).

- In Luang Namtha, seven out of 10 HHs have sufficient rice for family consumption. FHs tend to spend equally on food consumption, at around 54% in both groups. In the non-FPG group, HHs also spend around 20% on education, while the FPG group only spends 6%.
- Oudomxay and Bokeo contain diverse annual expenditure components in the FPG group. The largest expenditure is on food consumption (20–29%), followed by home maintenance (18–23%) and education (16–17%).
- In Phongsaly, the largest annual HH expenditure is on food consumption (45% in the non-FPG group and 36% in the FPG group). HH probably spend money on other food categories such as vegetables, protein-based products, and relevant foods. Following this spending, HH income goes to home maintenance. In the FPG group, this share is around 18% of total spending, which is larger than in the non-FPG group (12%).

FHs in the FPG group can produce their own food and sell the surplus for living. They spend money on home repairs, improvement, and furnishings more than in the non-FPG group. This is likely because they earn more and want to improve their living standard by enhancing the quality of their shelter and investing in their children's education. FPGs in Oudomxay and Bokeo invest more in their children's education than those in Luang Namtha and Phongsaly.

4.3 Measuring Income Inequality Using the Gini Decomposition

The Gini decomposition offers a deeper understanding of income inequality among sources of income. The empirical results are categorized into three sub-groups (both, non-FPG and FPG groups of HHs), compared across the four provinces. They are presented in Table 5 (Luang Namtha), Table 6 (Oudomxay), Table 7 (Phongsaly), and Table 8 (Bokeo), respectively.

4.3.1 Luang Namtha

- Salary from employment is the primary income source in all groups and contributes 36–49% to income inequality (column 4). Rice production accounts for 19% of total income (column 1) and only contributes 11–14% to income inequality (column 4). All income sources show nearly perfect inequality (column 2). However, rice production has the lowest Gini index, which accounts for 0.424–0.494 in all three groups. At the same time, income from handicrafts almost has the highest Gini index, which accounts for 0.980–0.990. Income from agricultural sources is moderately unequally distributed across all groups; it has a relatively weaker impact than income from non-agricultural sources on total income.
- In the FPG group, a 1% increase in income from agricultural sources decreases the Gini coefficient of total income by 0.005–0.077%, except for bananas and the rubber planting, which have an inverse outcome. Simultaneously, an equivalent change, mostly in income from non-agricultural sources, increases income inequality, except for income from farm labor and the sale of non-timber forest products (column 5).

All notes for Tables 5, 6, 7, and 8:

Sk denotes the share of each income source in total income [%]
Gk denotes the Gini coefficient of each income source [0 = perfect equality, 1 = perfect inequality]
Rk denotes the Gini correlation between each income category and total income
k denotes each income component (source)

ai01 = rice production, ai02 = bananas, ai03 = the rubber planting, ai04 = livestock, poultry and fish, ai05 = other crops, and ai06 = other agricultural sources
ni01 = performing farm labor, ni02 = labor, ni03 = employee, ni04 = the sale of non-timber forest products, ni05 = handicrafts, ni06 = business, and ni07 = other non-agricultural sources

Table 5 The decomposition of income inequality of HHs in Luang Namtha Province

	LNT	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai01	0.187	0.459	0.654	0.125	−0.062
	ai02	0.003	0.977	0.163	0.001	−0.002
	ai03	0.162	0.741	0.635	0.169	0.008
	ai04	0.037	0.844	0.215	0.015	−0.022
	ai05	0.023	0.884	0.07	0.003	−0.02
	ai06	0				
	ni01	0.07	0.788	0.034	0.004	−0.066
	ni02	0.015	0.966	0.375	0.012	−0.003
	ni03	0.29	0.804	0.807	0.418	0.128
	ni04	0.022	0.902	0.205	0.009	−0.013
	ni05	0.002	0.99	0.63	0.002	0.001
	ni06	0.138	0.901	0.734	0.203	0.065
	ni07	0.052	0.905	0.364	0.038	−0.014
	Total income		0.45			
Non-FPG						
	ai01	0.185	0.494	0.742	0.135	−0.05
	ai02	0.004	0.968	−0.182	−0.001	−0.005
	ai03	0.157	0.813	0.765	0.195	0.038
	ai04	0.035	0.886	0.18	0.011	−0.024
	ai05	0.014	0.911	−0.126	−0.003	−0.017
	ai06	0				
	ni01	0.072	0.82	0.027	0.003	−0.069
	ni02	0.016	0.959	0.28	0.009	−0.008
	ni03	0.339	0.807	0.893	0.488	0.149
	ni04	0.037	0.87	0.214	0.014	−0.023
	ni05	0.003	0.98	0.633	0.004	0.001
	ni06	0.11	0.922	0.704	0.142	0.033
	ni07	0.029	0.916	0.068	0.004	−0.026
	Total income		0.501			
FPG						
	ai01	0.189	0.424	0.561	0.113	−0.077

(continued)

Table 5 (continued)

	LNT	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai02	0.002	0.984	0.836	0.005	0.002
	ai03	0.166	0.655	0.476	0.129	−0.037
	ai04	0.039	0.801	0.266	0.021	−0.018
	ai05	0.031	0.858	0.131	0.009	−0.022
	ai06	0				
	ni01	0.068	0.755	0.057	0.007	−0.061
	ni02	0.014	0.969	0.527	0.018	0.004
	ni03	0.249	0.793	0.697	0.345	0.095
	ni04	0.01	0.911	0.292	0.007	−0.003
	ni05	0	0.984	0.016	0	0
	ni06	0.161	0.879	0.758	0.268	0.107
	ni07	0.07	0.891	0.506	0.079	0.009

Source Compiled by the authors

4.3.2 Oudomxay

- Salary from employment is the primary income source in all groups and contributes 20–38% to income inequality (column 4). Rice production accounts for 6–18% of total income (column 1) and only contributes 3–9% to income inequality (column 4). All income sources show nearly perfect inequality, except for rice and crop planting (column 2). Rice production has the lowest Gini index, which accounts for between 0.358–0.604 across all three groups. The sale of non-timber forest products has almost the highest Gini index, which accounts for 0.933–0.962. Income from agricultural sources is moderately unequally distributed among all groups; it has a relatively weaker impact than non-agricultural income on total income.
- In the FPG group, a 1% increase in income from agricultural sources (rice production, bananas, livestock, and crop planting) decreases the Gini coefficient of total income by 0.001–0.088. At the same time, an equivalent change in mostly non-agricultural sources of income increases income inequality, except for farm labor and the sale of non-timber forest products (column 5).

Table 6 The decomposition of income inequality of HHs in Oudomxay Province

	ODX	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai01	0.146	0.484	0.558	0.083	−0.063
	ai02	0.003	0.972	−0.011	0	−0.003
	ai03	0.001	0.985	0.077	0	−0.001
	ai04	0.018	0.891	0.193	0.006	−0.011
	ai05	0.087	0.7	0.041	0.005	−0.082
	ai06	0.006	0.921	−0.095	−0.001	−0.007
	ni01	0.044	0.855	0.17	0.014	−0.031
	ni02	0.031	0.909	0.198	0.012	−0.019
	ni03	0.177	0.865	0.77	0.248	0.071
	ni04	0.031	0.962	0.615	0.038	0.008
	ni05	0.04	0.896	0.615	0.046	0.006
	ni06	0.236	0.781	0.69	0.267	0.031
	ni07	0.182	0.868	0.85	0.282	0.1
	Total income		0.476			
Non-FPG						
	ai01	0.066	0.604	0.409	0.029	−0.038
	ai02	0				
	ai03	0				
	ai04	0.002	0.945	−0.532	−0.001	−0.003
	ai05	0.124	0.625	0.304	0.041	−0.083
	ai06	0.012	0.887	−0.12	−0.002	−0.014
	ni01	0.086	0.797	0.352	0.042	−0.044
	ni02	0.054	0.846	0.387	0.031	−0.023
	ni03	0.099	0.895	0.58	0.09	−0.009
	ni04	0.015	0.933	0.355	0.009	−0.006
	ni05	0.001	0.93	0.494	0.001	0
	ni06	0.281	0.837	0.919	0.378	0.097
	ni07	0.261	0.858	0.978	0.384	0.122
	Total income		0.571			
FPG						
	ai01	0.175	0.358	0.573	0.087	−0.088

(continued)

Table 6 (continued)

	ODX	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai02	0.004	0.957	−0.181	−0.002	−0.006
	ai03	0.001	0.977	−0.095	0	−0.002
	ai04	0.023	0.841	0.073	0.004	−0.02
	ai05	0.074	0.736	−0.088	−0.012	−0.085
	ai06	0.004	0.93	−0.062	−0.001	−0.004
	ni01	0.029	0.877	0.165	0.01	−0.019
	ni02	0.022	0.938	0.174	0.009	−0.013
	ni03	0.206	0.839	0.823	0.345	0.139
	ni04	0.037	0.958	0.635	0.054	0.017
	ni05	0.054	0.845	0.573	0.063	0.009
	ni06	0.219	0.74	0.514	0.202	−0.017
	ni07	0.152	0.87	0.752	0.241	0.089
	Total income		0.413			

Source Compiled by the authors

4.3.3 Phongsaly

- Business is the primary income source across all groups and contributes 22–41% to income inequality (column 4). Rice production strongly contributes to farmers' livelihoods in northern Laos. Rice production accounts for 13–17% of total income (column 1) and only contributes 2–21% to income inequality (column 4). All income sources show nearly perfect inequality (column 2). However, rice production has the lowest Gini index, which accounts for 0.428–0.598 in all three groups. The rubber plantating almost has the highest Gini index, which accounts for 0.983–0.989. Income from agricultural sources is moderately unequally distributed across all groups; it has a relatively weaker impact than non-agricultural income on total income (column 4).
- In the FPG group, a 1% increase in income from agricultural sources decreases the Gini coefficient of total income by 0.001–0.169, except for the rubber plantating and livestock, which have an inverse outcome. However, an equivalent change in mostly non-agricultural sources of income increases income inequality, except for earning a salary from performing labor outside (column 5).

Table 7 The decomposition of income inequality of HHs in Phongsaly province

	PSL	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai01	0.136	0.484	0.31	0.045	−0.091
	ai02	0.007	0.945	0.164	0.002	−0.005
	ai03	0.003	0.988	0.52	0.004	0
	ai04	0.02	0.908	0.689	0.027	0.008
	ai05	0.204	0.581	0.232	0.061	−0.144
	ai06	0.022	0.966	0.442	0.021	−0.001
	ni01	0.032	0.923	0.188	0.012	−0.02
	ni02	0.028	0.962	0.398	0.024	−0.004
	ni03	0.138	0.905	0.773	0.212	0.075
	ni04	0.135	0.938	0.849	0.237	0.102
	ni05	0.023	0.981	0.741	0.036	0.014
	ni06	0.195	0.804	0.73	0.252	0.057
	ni07	0.058	0.926	0.572	0.068	0.01
	Total income		0.454			
Non-FPG						
	ai01	0.174	0.598	0.491	0.119	−0.055
	ai02	0.005	0.951	−0.332	−0.004	−0.009
	ai03	0				
	ai04	0.01	0.875	0.282	0.006	−0.004
	ai05	0.256	0.634	0.374	0.142	−0.115
	ai06	0				
	ni01	0.061	0.792	−0.338	−0.038	−0.099
	ni02	0.064	0.949	0.656	0.093	0.029
	ni03	0.119	0.946	0.879	0.23	0.111
	ni04	0.038	0.889	0.137	0.011	−0.027
	ni05	0.024	0.961	0.574	0.031	0.007
	ni06	0.211	0.905	0.921	0.409	0.198
	ni07	0.037	0.91	0.023	0.002	−0.036
	Total income		0.43			
FPG						
	ai01	0.127	0.428	0.179	0.023	−0.104

(continued)

Table 7 (continued)

	PSL	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai02	0.008	0.935	0.107	0.002	−0.006
	ai03	0.004	0.983	0.36	0.003	−0.001
	ai04	0.022	0.896	0.667	0.031	0.009
	ai05	0.193	0.55	0.094	0.024	−0.169
	ai06	0.027	0.95	0.283	0.017	−0.01
	ni01	0.026	0.957	0.511	0.03	0.004
	ni02	0.02	0.966	0.339	0.015	−0.005
	ni03	0.142	0.884	0.695	0.206	0.064
	ni04	0.156	0.925	0.869	0.297	0.141
	ni05	0.022	0.981	0.841	0.043	0.021
	ni06	0.191	0.752	0.66	0.224	0.033
	ni07	0.063	0.915	0.619	0.084	0.021
	Total income		0.423			

Source Compiled by the authors

4.3.4 Bokeo

- Business is the primary income source in all groups and contributes 22–39% to income inequality (column 4). Rice production accounts for 19–20% of total income (column 1) and only contributes 12–14% to income inequality (column 4). All income sources show nearly perfect inequality (column 2). Rice production has the lowest Gini index, which accounts for 0.449–0.491 in all three groups. Income from non-agricultural sources almost has the highest Gini index, which accounts for 0.756–0.974. Income from agricultural sources is moderately unequally distributed among all groups; it has a relatively weaker impact than non-agricultural income on total income.
- In the FPG group, a 1% increase in income from agricultural sources decreases the Gini coefficient of total income by 0.001–0.062, except for the non-FPG group, which shows an inverse outcome. An equivalent change, mostly in income from non-agricultural sources, increases income inequality, except for income from farm labor and the sale of non-timber forest products (column 5).

The results imply that agricultural production is likely a primary sustainable source of income across all supply groups in terms of both sign and magnitude.

Table 8 The decomposition of income inequality of HHs in Bokeo province

	BK	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai01	0.198	0.468	0.703	0.135	−0.062
	ai02	0.004	0.977	0.341	0.003	−0.001
	ai03	0.036	0.953	0.434	0.031	−0.005
	ai04	0.117	0.755	0.548	0.101	−0.017
	ai05	0.095	0.811	0.641	0.103	0.008
	ai06	0				
	ni01	0.05	0.766	−0.21	−0.017	−0.066
	ni02	0.021	0.932	−0.184	−0.008	−0.029
	ni03	0.06	0.924	0.518	0.06	0
	ni04	0.042	0.938	0.768	0.063	0.021
	ni05	0.007	0.949	0.371	0.005	−0.002
	ni06	0.218	0.841	0.879	0.335	0.117
	ni07	0.152	0.853	0.699	0.189	0.037
	Total income		0.481			
Non-FPG						
	ai01	0.187	0.491	0.596	0.119	−0.068
	ai02	0.007	0.962	0.468	0.007	0
	ai03	0.048	0.947	0.503	0.05	0.002
	ai04	0.107	0.783	0.594	0.108	0.001
	ai05	0.102	0.807	0.676	0.121	0.019
	ai06	0				
	ni01	0.069	0.763	0.066	0.008	−0.061
	ni02	0.038	0.883	−0.236	−0.017	−0.055
	ni03	0.045	0.938	0.609	0.056	0.011
	ni04	0.088	0.917	0.867	0.152	0.064
	ni05	0.012	0.906	0.224	0.005	−0.007
	ni06	0.158	0.848	0.763	0.223	0.065
	ni07	0.14	0.817	0.676	0.168	0.028
	Total income		0.459			
FPG						
	ai01	0.204	0.449	0.766	0.144	−0.06

(continued)

Table 8 (continued)

	BK	Share of each income source	Gini of source (income)	Correlations between each income category and total income	Share of income inequality	Relative marginal effect
		[1]	[2]	[3]	[4]	[5]
Both	Source	Sk	Gk	Rk	Share	% change
	ai02	0.002	0.987	0.173	0.001	−0.001
	ai03	0.029	0.955	0.369	0.021	−0.008
	ai04	0.124	0.734	0.521	0.097	−0.027
	ai05	0.091	0.813	0.602	0.091	0
	ai06	0				
	ni01	0.038	0.756	−0.498	−0.029	−0.068
	ni02	0.012	0.963	−0.074	−0.002	−0.013
	ni03	0.069	0.911	0.484	0.062	−0.007
	ni04	0.015	0.936	0.553	0.016	0.001
	ni05	0.004	0.974	0.622	0.005	0.001
	ni06	0.253	0.827	0.918	0.394	0.14
	ni07	0.16	0.867	0.712	0.202	0.042
	Total income		0.489			

Source Compiled by the authors

4.4 The Role of FPGs in Poverty Reduction

To examine the impact of FPG participation on poverty reduction, an ordered probit regression was employed by comparing the four provinces: Luang Namtha (LNT), Oudomxay (ODX), Phongsaly (PSL), and Bokeo (BK), as displayed in Table 9. Marginal effects from an ordered probit indicate that participation in FPGs has a negative relationship with poor status, and a positive relationship with middle and rich status among HHs in all four provinces. For example, FHs that engage in FPGs decrease their chance of being poor by around 3.1% in Luang Namtha and 6.7% in Bokeo, with a minimum statistical significance at the 5% level. In addition, this participation significantly increases their chance of attaining a rich status, or of having a monthly income of at least 180,000 kips per person (above the $20 poverty line). This figure is about 1.2% for HHs in Luang Namtha, 1.7% for HHs in Oudomxay, and 2.0% for HHs in Bokeo, with statistical significance at the 1% level.

Land distribution enhances farmers' productivity and provides more opportunities to generate greater income. An increase of hectares in the total land area holding within and outside villages decreases FHs' chance of being deficient by approximately 3.5% in Luang Namtha, 2.1% in Oudomxay, 2.2% in Phongsaly, and 1.7% in Bokeo at the 1% level. There are inverse results for FHs with a middle and rich

Table 9 The empirical results of the impact of FPG participation on poverty reduction

Poverty status	Province	LNT			ODX			PSL			BK		
	Variables	Poor = 1	Middle = 2	Rich = 3	Poor = 1	Middle = 2	Rich = 3	Poor = 1	Middle = 2	Rich = 3	Poor = 1	Middle = 2	Rich = 3
hh15	Female HH head[a]	0.074**	−0.049**	−0.024***	0.064	−0.042	−0.022**	−0.015**	−0.034	0.049	0.115**	−0.099**	−0.016***
		−2.66	(−2.13)	(−4.30)	−1.51	(−1.23)	(−2.45)	(−1.98)	(−0.67)	−0.86	−2.89	(−2.66)	(−4.27)
ag01b	No. of adult members	−0.008	0.003	0.005	0	0	−0.002	0.009	0	0	−0.014**	0.010**	0.004**
		(−1.52)	−1.42	−1.52	−0.04	(−0.04)	(−0.04)	−0.04	−0.04	(−0.04)	(−2.10)	−2.07	−2.03
hh10c	No. of HH members	−0.002	−0.001	−0.001	−0.006	0.003	0.004	0.001	0.001	−0.002	0.012**	0.009**	−0.003*
		−0.54	−0.53	(−0.54)	(−1.19)	−1.13	−1.18	(−0.63)	−0.58	(−0.63)	−2.15	(−2.12)	(−2.08)
ed01apr	Prima education primary education	0.020***	−0.008**	−0.012***	0.022**	−0.009**	−0.012**	0.001	0	−0.001	0.009	−0.007	−0.003
		−3.59	(−2.68)	(−3.48)	−3.44	(−2.59)	(−3.34)	−0.2	−0.19	(−0.02)	−1	(−1.00)	(−0.99)
ed01bse	Secondary education	−0.002	0.001	0.001	0.001	0	−0.001	0.004	0.001	−0.006	−0.034***	0.026***	0.009***
		(−0.39)	−0.39	−0.39	−0.44	(−0.14)	(−0.14)	−0.85	−0.73	(−0.85)	(−3.91)	−3.7	−3.57
ed01cun	College/ university education	−0.011	0.004	0.007	−0.034***	0.015**	0.019***	0.008	0.003	−0.01	−0.110***	0.080***	0.030***
		(−1.29)	−1.23	−1.29	(−4.26)	−2.87	−4.12	−0.54	−0.5	(−0.54)	(−4.33)	−4.02	−3.99
hh062	Mone-Khmer[a]	0.019	−0.009	−0.01	0.167***	−0.128***	−0.040***	0.079**	−0.048*	−0.031***	0.127***	−0.099***	−0.030***
		−1.35	(−1.16)	(−0.88)	−4.58	(−3.77)	(−6.03)	−2.65	(−1.73)	(−5.63)	−6.56	(−5.80)	(−5.42)
hh063	Hmong-Iumien[a]	0.028	−0.016	−0.030***	0.264**	−0.228**	−0.036***				−0.014	0.01	0.004
		−0.65	(−0.53)	(−5.73)	−3.06	(−2.70)	(−6.01)				(−0.35)	−0.37	−0.31
hh064	Tibeto-Chiense[b]	0.117**	−0.087**	0.021***	0.36	−0.325	−0.035***	0.016	−0.001	−0.015**			
		−3.44	(−2.83)	−6.95	−0.98	(−0.89)	(−5.41)	−1.48	(−0.20)	(−2.01)			
lh13	Total land area holding	−0.035***	0.014***	0.019**	−0.021***	0.009**	0.012***	−0.022***	−0.001	0.029***	−0.017**	0.013**	0.005**
		(−7.67)	−3.53	−2.85	(−4.48)	−2.96	−4.26	(−6.01)	(−1.44)	−7.26	(−3.02)	−2.92	−2.85

(continued)

Table 9 (continued)

Poverty status	Province	LNT			ODX			PSL			BK		
	Variables	Poor = 1	Middle = 2	Rich = 3	Poor = 1	Middle = 2	Rich = 3	Poor = 1	Middle = 2	Rich = 3	Poor = 1	Middle = 2	Rich = 3
wug	FPG participation[a]	−0.031**	0.012**	0.012**	−0.031**	0.015*	0.017**	−0.008	−0.002	0.01	−0.067***	0.046***	0.020***
		(−2.99)	−2.43	−3	(−2.01)	−1.74	−2.11	(−1.29)	(−0.88)	−1.38	(−4.57)	−4.38	−3.77
cut1_cons.		−1.048***	−1.048***	−1.048***	−1.040***	−1.040***	−1.040***	−1.281***	−1.281***	−1.281***	−1.153***	−1.153***	−1.153***
		(−8.78)	(−8.78)	(−8.78)	(−7.13)	(−7.13)	(−7.13)	(−6.832)	(−6.832)	(−6.832)	(−9.08)	(−9.08)	(−9.08)
cut2_cons.		2.301***	2.301***	2.301***	2.220***	2.220***	2.220***	2.626***	2.626***	2.626***	2.088***	2.088***	2.088***
		−16.64	−16.64	−16.64	−13.4	−13.4	−13.4	−12.46	−12.46	−12.46	−14.77	−14.77	−14.77
Obs.		1463	1463	1463	1024	1024	1024	1125	1125	1125	1393	1393	1393
Peseudo r^2		0.1145	0.1145	0.1145	0.1596	0.1596	0.1596	0.193	0.193	0.193	0.1286	0.1286	0.1286

Note t-statistics in parentheses, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; [a]dy/dx = a discrete change in the dummy variable from 0 to 1
Source Calculation by the authors

status, meaning that an increase in hectares in the total land area holding within and outside villages increases FHs' chance of being wealthy by about 1.9% in Luang Namtha, 1.2% in Oudomxay, 2.9% in Phongsaly, and 0.5% in Bokeo at the 1% level.

Having more HH members between 15 and 60 years old means a bigger labor supply for agricultural production. In Bokeo, a greater number of HH members in this age range decreases the chance of being poor by around 1.4%, and increases the chance of being rich by about 0.4%, with statistical significance at the 5% level. This is similar to the situation in Luang Namtha, but this province does not show any statistically significant level. Education also plays an essential role in reducing poverty. A higher level of education is associated with a greater chance of achieving a status of wealth. In Bokeo, a larger number of HH members with at least a secondary school education decreases HHs' chance of being deficient by approximately 3.4%; it increases the chance of being rich by about 0.9% at the 1% level. A college or university education increases HHs' chance of attaining a rich status or having a monthly income of at least 180,000 kips per person (above the $20 poverty line); this figure is about 1.9% in Oudomxay and 3.0% in Bokeo, with statistical significance at the 1% level.

5 Conclusion and Policy Recommendations

Agricultural sector development plays a central role in transforming the economy in the north of Lao PDR, where most locals are farmers. As a pull factor, the Chinese market is demanding more agricultural products from its neighboring countries, including Lao PDR. This offers Laotians a chance to expand their agribusiness with this enormous market. As a push factor, the Laotian government aspires to improve the agricultural sector by reestablishing FPGs and ACs to enhance the situation of smallholding farmers, such that they can expand their production with inputs, techniques, information, and market-oriented support from FPGs.

This study found that FPG participation influences poverty reduction, rice sufficiency level, and income equality among smallholding farmers across the four provinces. The Gini decomposition outcomes confirm that a 1% increase in income from an agricultural source (specifically rice and crop production) can decrease income inequality. In contrast, non-agricultural sources of income create the opposite effect. Further, the ordered probit regression results verify that agricultural production alleviates poverty by 0.8–6.7%, and increases the chance of reaching a rich status by 1.0–2.0%, with statistical significance at the 5 and 1% levels, except for in Phongsaly province. In addition, land tenure positively impacts poverty reduction in all four provinces, with statistical significance at the 1% level. These empirical findings corroborate the role of agricultural production in producing income equality and of FPG participation in mitigating poverty.

Hence, local farmers are encouraged to join FPGs, which offer them bargaining power, inputs and training support, and market orientation, thereby strengthening their production and generating more income. The Laotian government should

promote FPGs and encourage farmers to participate in them. It should start with the ongoing policy reform related to renewing the prime minister's decree on ACs and paving the way for upgrading it to a law. Policy makers should consider management details, conditions, and improvement levels based on the circumstances of individual farmers with FPG membership and to be promoted to AC membership. It is essential to set a standard of upgrading FPGs to ACs. The Laotian government should ensure consistency between policy reform and implementation in central and local administration. For the future, practical assistance from the Laotian government is critical. This mechanism includes trade facilitation, logistics development, taxes, and related procedures to export agricultural products to China. Currently, there are few low value-added agricultural products available for export. In the future, Lao PDR should improve the quality of its products by adding value with new production techniques, new seeds, and eco-friendly goods (e.g. premium organic crops and high-value food product processing). This would help Laotian farmers to adapt, adjust, and enhance their agricultural production and quality of life.

In the early stages of FPG and AC development, membership would benefit smallholding farmers. Yet FPGs and ACs will only increase in number, but not in quality, as seen from historical failures in past decades. According to relevant information from key informant interviews and focus group discussions conducted by the authors besides this study, in many provinces in the north and south of Lao PDR in previous years, the findings of this study have been witnessed in real life. Although FPG participation helps farmers, the interviews also revealed several challenges to group participation among smallholding farmers, including inconsistencies between policy and implementation in local administrations. When comparing participation and non-participation, there is a small difference in terms of accessing credit. Thus, many farmers do not find membership appealing, mainly in the south and in some northern provinces. In this regard, recommendations for the agricultural sector's growth are offered, and are expected to be useful to researchers interested in agricultural development. Moreover, there may be insights helpful to other developing countries with similar situations.

- Some farmers will be better off farmers and some will be latecomers. Providing financial capital as an incentive for members should be justified. First, grants should go to low-income HHs in remote areas. When they increase their production and profits, this microfinance mechanism can transform into private credit schemes for middle- and high-income FHs.
- It is crucial to build strong leadership and educated committee members of groups to manage and organize activities more efficiently, which can secure the rapid launch of cooperative initiatives. Moreover, the power balance within a group is an essential asset to avoid nepotism.
- The key elements to empower communities to participate in FPGs – by linking all hierarchical levels (such as villages, districts, and provinces) – are access to information, the inclusivity and participation of poor HHs, accountability on the part of the administration and the private sector, and farmer organization capacity to mobilize resources.

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Chapter 2
The Role of Social Trust in Governing the Sharing Economy for Poverty Reduction

Vorapat Chutima, Pairach Piboonrungroj, Warattaya Chinnakum, and Ora-orn Poocharoen

Abstract Trust can be applied to many sectors, including the sharing economy. The sharing economy, a relatively new economic model, can be defined as an peer-to-peer (P2P) transactions. Online community platforms have been innovated to facilitate the sharing economy. This chapter aims to answer these two questions. First, what is the role of 'trust' in the sharing economy? Second, what are the reasons behind sharing economy growth through the transaction cost economics (TCE) lens? This research found that culture and the social background are determining factors in the level of trust. The finding from this research helps to fill the gap in regulating the sharing economy in emerging markets. Moreover, this chapter provides recommendations on how to design appropriate policy to regulate the sharing economy by using the TCE lens.

Keywords Trust · Sharing economy · Poverty reduction · Public policy · Economic governance

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1 Introduction

As the Coronavirus (Covid-19) spread globally, sharing economy has received more attention in developed and developing countries (Hossain 2020). The sharing economy is a relatively new economic model that is defined as a peer-to-peer (P2P) based activity. It was predicted that the sharing economy to be valued at $335 billion by 2025 (PriceWaterhouseCoopers 2015). However, P2P accommodation booking, like Airbnb, has dropped drastically compared to before the pandemic. Trust is one

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of the critical criteria to choose services in the sharing economy (Financial Times 2020).

Trust could be achieved when actions meet words (Chaiwat 2014). A study of trust is an interesting topic in cultural economics. According to Alesina and Giuliano (2015), cultural economics is the economics branch that studies culture or informal institutions' relation to economic outcomes. In this case, culture is defined by the preferences of the respective groups and shared beliefs. Therefore, one can study trust in terms of informal institutions to economic outcomes in a specific public policy issue. Trust as an informal institution can be applied to many areas, including the policies for promoting the sharing economy. Also, we can use the sharing economy as a tool for poverty reduction.

According to Tussyadiah and Pesonen (2016), P2P accommodation is better for selecting the desired destination or trips than traditional accommodation, such as a hotel. P2P accommodation allows tourists to select more widespread destinations, makes the length of stay longer, increases travel frequency and the number of activities that tourists can participate in at the destination. Especially if travelers want to contact locals and get unique experiences in authentic settings, the sharing economy could offer more options for tourists' transport and stay and compete with regular transportation and accommodation providers, especially taxis and hotels. Hence, Hotel News Now (2014) and Gessner (2019) showed that traditional accommodation, such as hotels, and resorts should perceive the accommodation-sharing economy as a threat since it will increase supply in the number of rooms exponentially.

According to the OECD (2016), key actors in P2P accommodation are tourists, host or service providers, sharing platforms, traditional tourism businesses, and destination communities. Also, the P2P accommodation presents opportunities to expand consumer options and grow the tourism economy and pose challenges for established operators and raise broader questions in the area, such as regulation, taxation, and consumer protection. Therefore, tourism policy makers need to understand the nature of the phenomenon and address the issue effectively (Zon 2015).

It was also found that rules and policies regulate the sharing operator only in some countries such as the US, the UK, Australia, and Japan (Oskam and Boswijk 2016). While some tourism-oriented countries, such as Thailand and Spain, ban P2P accommodation (Pandee 2018). The issues for tourism policy makers in 2020 for the sharing economy include regulation, taxation, consumer protection, the host–employee classification and competition fairness with the traditional operator (OECD 2020).

However, a lack of trust could affect the rate of sharing economy development in each country in terms of scale and speed. In new institutional economics (NIE) and from the transaction cost economics (TCE) perspective, trust or trustworthiness is related to transaction cost (Bromiley and Harris 2006). If trust is low, the transaction cost in this deal is high (Piboonrungroj and Disney 2015). Also, informal institutions in the NIE, such as culture, can affect trust between people in society, especially with different cultures. For example, people in one culture tend to have opportunistic behavior, such as making low-quality products or omit important information.

Several studies in the literature suggest that increasing trust can drive the sharing economy platform (Gray 2014; Ferrari 2016; Zamani et al. 2019). This becomes an issue in NIE in countries when social trust does not exist widely, such as Italy and Portugal (Keefer and Knack 2003). Will the sharing economy expand in these countries at the same scale and speed as in countries where social trust is widespread, such as Norway and Denmark?

This shows the importance of this research to find the role of social trust in the sharing economy through the TEC lens. The tourism sharing economy should also have a grand theory or concept to apply to regulation in every country. According to Sudhasri et al. (2019), the tourism sharing economy might be regulated at three levels. There is the national or federal level, the regional or state level, and the city level. For example, even in Germany, as an advanced economy, the city policy on transportation sharing, like Uber, is different between Berlin and Munich. Also, trust can vary between different countries. The high-level trustworthiness countries should accept the sharing economy concept with fewer obstacles.

In using the sharing economy as a tool for poverty reduction, we might see examples and evidence in various places, including Asia. This chapter aims to provide the sharing economy practice with social trust as informal institutions in Singapore, Thailand, and Vietnam to show how differences in cultural aspects affect the trust of those people and the sharing economy's development.

The following section is a review of the related literature. Section 3 is on the role of trust as an informal institution in Asia. Section 4 is on the expansion of the sharing economy for poverty reduction in Asia, and the last section is the conclusion and policy recommendations.

2 Literature Review

2.1 Trust and Cultural Economics

Cultural economics is the branch of economics that studies the relation of culture to economic outcomes (Alesina and Giuliano 2015). Here, 'culture' is defined by shared beliefs and preferences of respective groups. Programmatic issues include whether and how much culture matters regarding economic outcomes and their relation to institutions. As a growing field in behavioral economics, the role of culture in economic behavior is increasingly being demonstrated to cause significant differentials in decision-making and the management and valuation of assets. Recent research demonstrates that cultural variables determine many economical choices—they even affect the speed of development and nations' wealth. Researchers are now striving to understand the mechanisms better. Trust, as one of the topics in cultural economics, becomes valuable to study.

According to Chaiwat (2014), generalized trust refers to trust in society members; it may be distinguished from a particularized trust, which corresponds to trust in the

family and close friends. Generalized trust is an essential aspect of civic culture. It has been linked to various positive outcomes at the individual level, such as entrepreneurship, volunteering, self-rated health, and happiness. According to Chaiwat (2014), generalized trust correlates with self-rated health and happiness.

However, trust has a few undertones. The meanings of trust ordinarily allude to a circumstance portrayed by the accompanying perspectives: one gathering (trustor) is happy to depend on the activities of another gathering (trustee); the circumstance is coordinated to what is to come. Likewise, the trustor (deliberately or forcedly) deserts authority over the activities performed by the trustee. As a result, the trustor is dubious about different activities; they can just create and assess desires (Arteaga 2020). The vulnerability includes the danger of disappointment or mischief to the trustor if the trustee does carry on as wanted. Trust can be credited to connections between individuals. With regards to the connection between individuals and innovation, the attribution of trust involves contest. The deliberate position shows that trust can be legitimately credited to human associations with complex advancements.

Trust in the economic perspective is treated as a clarification of a distinction between real human conduct and expected human conduct (Williamson 1993). One example here is well illustrated in the work of Yoshino and Taghizadeh-Hesary (2014) about Hometown Investment Trust Funds (HIT Funds) in Japan, which became a new form of financial intermediation between the people in a region as lenders and small and medium-sized enterprises (SMEs) as borrowers. In financial terms, trust can clarify a distinction between the Nash equilibrium and the watched balance. Such a methodology can be applied to people just as social orders. It has been asserted that a more elevated level of social trust is decidedly connected with the monetary turn of events. Even though the first idea of 'high trust' and 'low trust' social orders may not hold, it has been broadly acknowledged and exhibited that social trust benefits the economy and that a low degree of trust hinders development.

The promotion of web-based business opens the conversation about trust in the economy to new difficulties while simultaneously raising the significance of trust and comprehending client choice to trust. For instance, the buyer and the seller have been dis-intermediated by innovation. On the other hand, websites could be made to persuade the purchaser to confide in the dealer, paying little heed to, for example, the merchant's genuine dependability (Menard and Shirley 2005).

2.2 New Institutional Economics and Poverty Reduction

NIE is an economic viewpoint that endeavors to broaden economics by concentrating on the organizations (social and legitimate standards and rules) that underlie monetary action and with investigation of past prior institutional economics and neoclassical economics. It may be viewed as a widening venture to incorporate perspectives barred in neoclassical economics. It rediscovers parts of the old-style political economy. It has its foundations in two articles by Ronald Coase, 'The nature of the firm' (1937) and 'The problem of social cost' (1960). In the last mentioned, the Coase

Table 1 Categories and main contributors in NIE

Categories	Main contributors in NIE	Contents
Property rights	Ronald Coase	Theoretical and legal ownership of resources and how they can be used
Transaction costs	Douglas North	Expenses incurred when buying or selling a good or service
Opportunism	Oliver Williamson	Practice of taking advantage of circumstances
Social capital	Elinor Orstrom	Set of shared values that allow individuals to work together in a group

Source Summarized from Menard and Shirley (2005)

hypothesis (as it was in this manner named) maintains that without exchange costs, elective property right assignments can equally disguise clashes and externalities. In this manner, near institutional examination emerging from such assignments is required to make proposals about productive disguise of externalities and institutional structures, including law and economics (Menard and Shirley 2005).

Examinations are presently based on an increasingly mind-boggling set of methodological standards and rules. They work inside an adjusted neoclassical system in considering both proficiency and appropriation issues, rather than 'conventional', 'old', or 'unique' institutional economics, which is incredulous of standard neoclassical economics. The term 'new institutional economics' was coined by Oliver Williamson in 1975. Some of the numerous perspectives in current investigations are listed in Table 1.

Williamson (1993) portrays four degrees of social examination. The first worries about the social hypothesis, explicitly the degree of embeddedness and casual guidelines. The second is centered on institutional conditions and formal principles. It utilizes the financial aspects of property rights and positive political hypothesis. The third spotlights administration and the collaborations of on-screen characters inside exchange cost financial aspects, 'the play of the game'. Williamson (2010) gives the case of agreements between gatherings to clarify it. Finally, the fourth is represented by neoclassical economics; it is the portion of assets and business. NIE is centered on levels two and three. Although no single, generally acknowledged arrangement of definitions has been developed, most researchers exploring under the methodological standards and measures follow North's (1992) outline among foundations and associations. Establishments are the 'rules of the game', both the legitimate formal principles and the casually accepted practices that administer singular conduct and structure social connections (institutional systems). Associations, paradoxically, are those gatherings of individuals and the administration game plans they make to coordinate their group activity against different groups performing likewise as associations. To upgrade their potential for endurance, associations endeavor to obtain ranges of abilities that offer the best yield on target objectives, such as benefit boost or voter turnout.

2.3 Transaction Cost Economics

In economics and related subjects, a transaction cost is an expense in making any monetary exchange while taking an interest in a market. In *Transaction Costs, Institutions and Economic Performance*, North (1992) contends that organizations, comprehended as the arrangement of rules in the general public, are key in the assurance of exchange costs. In this sense, foundations that encourage low exchange costs, help financial development. North (1992) states that four factors involve exchange costs (see Table 2).

Transaction costs can be divided into three broad categories (see Table 3). For instance, the purchaser of a trade-in vehicle faces a wide range of exchange costs. The inquiry costs are the expenses of finding a vehicle and deciding the vehicle's condition. The dealing costs are the expenses of arranging a cost with the merchant. The policing and authorization guarantee that the merchant conveys the vehicle in the guaranteed condition (North 1992).

Table 2 Four factors that comprise transaction costs

Factor	Explanation
Measurement	The estimation of all angles in the exchange
Enforcement	The requirement for a fair outsider to guarantee that neither one of the parties reneges on their piece of the arrangement
Ideological attitudes and perceptions	Ideological perspectives and observations epitomize every individual's arrangement of qualities, which impacts their understanding of the world
Market size	Influences the prejudice or unbiasedness of exchanges

Source North (1992)

Table 3 Three categories of transaction cost

Categories	Explanation
Search and information costs	Costs, for example, in confirming that the cost ones get, which has the least cost, and so on
Bargaining and decision costs	Costs required to go to a worthy concurrence with the other party to the exchange, drawing up a fitting agreement, etc. On resource markets, the exchange cost is some capacity of the separation between the offer and inquiry
Policing and enforcement costs	Expenses of ensuring the other party adheres to the particulars of the agreement and making a suitable move (frequently through the lawful framework) if this turns out not to be the situation

Source North (1992)

3 Economic Benefits of Sharing Economy

The concept of a sharing economy for poverty reduction and for distributing income is not new; it is seen in a homestay that the hosts share their property in the city and rural area (Vandenberg 2006; Sriwichailamphan 2017). However, Bakker and Twining-Ward (2018) recommend a meaning of the sharing economy as 'a method of distributing goods and services that contrasts from the traditional model of partnerships recruiting representatives and offering items to buyers'.

In the sharing economy, people can lease or offer their advantages, for example vehicles, houses, and individual opportunity, to others in a distributed manner. As indicated by the synopsis from the money crashers site by Sudhasri et al. (2019), the sharing economy can be separated into eight classes: (1) P2P lending, (2) crowdfunding, (3) transportation sharing, (4) P2P accommodation, (5) coworking, (6) reselling and trading, (7) knowledge or talent sharing, and (8) special services. From a welfare economic point of view, contributions in the sharing economy are substitute products to traditional models by bringing more rivalry, a solution to the underutilized resource issue by sharing interest costs and an extra maximizer to social welfare by bringing Pareto optimality (Peters 2015). The framework for a sharing economy can be represented as in Fig. 1.

The sharing economy is a method of buying goods and services that contrasts with the traditional model of an association recruiting workers to make items to offer to purchasers. In the sharing economy, people share their vehicles, homes, and an

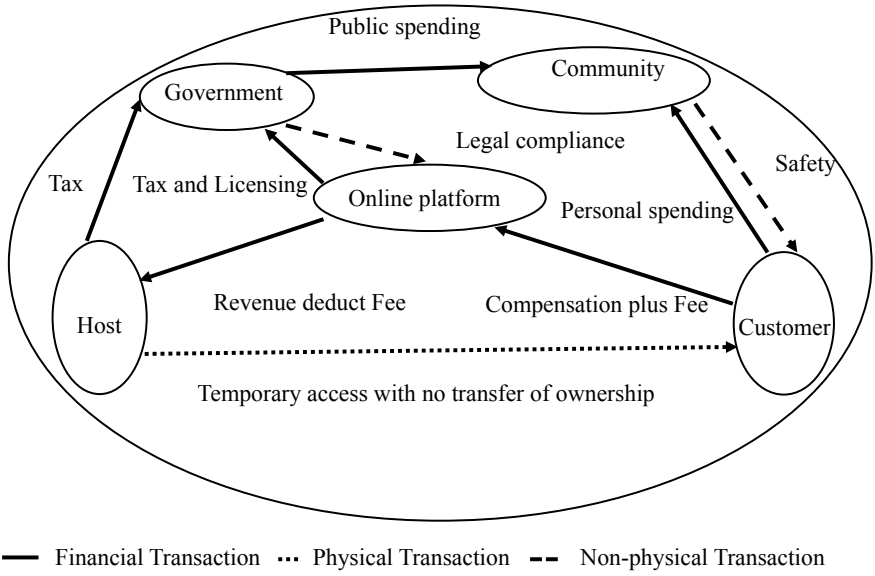

Fig. 1 A generic framework for sharing economy. *Source* Adapted from Ranjbari et al. (2018)

individual opportunity to others in a distributed manner (Ranjbari et al. 2018). There are two principal kinds of sharing economy undertaking (see Table 4).

In business applications, the sharing economy can be considered as a showcasing procedure instead of a genuine 'sharing economy' practice; for instance, the Airbnb platform has now and again been portrayed as a platform for people to 'share' additional rooms in their homes, yet as a general rule the space is leased, not shared. It was discovered that Airbnb postings furthermore are regularly possessed by a professional property business owner (Yaraghi and Ravi 2017).

In most cases, the sharing economy depends on the hosts' desire to share yet, to make a trade, hosts need to take a greater risk. The sharing economy platforms state they are focused on building and approving, including makers, providers, clients, or members. Past confiding in others (i.e. friends), the clients of a sharing economy platform additionally need to believe in the platform itself. The sharing economy has resulted from a few profound technology, economic, political and social developments (Dolnicar 2020; see Table 5).

At the individual sharing level, the expulsion of a higher overhead business delegate (e.g. a taxi organization) with a lower cost innovation stage diminishes the exchange for the client while likewise creating extra providers to vie for the business, further decreasing expenses. Customers would then spend more on different merchandise and enterprises in different parts of the economy. Traditional economics contend that a development that brings down the expense of goods and services by and large speaks to a net economic benefit (Kim 2019).

Therefore, in the same way as with other new advances and business developments, this pattern is troublesome to existing plans of action and presents difficulties for governments and regulators. For instance, should the organizations involved in the innovation stage be at risk from providers' activities in their system? Should people in their system be treated as workers, getting advantages, e.g. medicinal services and

Table 4 Two main types of sharing economy enterprise

Types of sharing economy	How goods and services are shared	Example platform
Initiative	For free	Couchsurfing
Commercial	With fee	Airbnb; FoodPanda

Source Yaraghi and Ravi (2017)

Table 5 Expansion factors in sharing economy

Name of aspect	Explanation
Technology aspect	The growth of social media and the low cost of mobile phones
Economic aspect	Ways found to reduce fixed costs
Political aspect	Macroeconomic austerity
Social aspect	Personal economic materialism

Source Dolnicar (2020)

retirement plans? Suppose customers generally are higher salaried people while the hosts are lower paid people. Will the administrations' lower cost (and subsequently lower pay of the hosts) compound pay imbalance? These are among the numerous inquiries the on-request economy presents.

Regarding the history of the sharing economy online platform for the travel industry, Airbnb was set up in 2008, while Uber and Grab were set up in 2009 and 2012 respectrively. Nonetheless, eBay was viewed as the primary sharing economy online platform. The sharing economy as we know it is still in its infancy.

4 Economic Governance of Sharing Economy

In NIE, economic governance is the decision-making and policy-regulating process that will effect the internal economic system (Williamson 1993). Also, the governance structure can be in a collaborative format. There are a wide range of types of collaborative governance as, e.g. consensus building and collaborative network:

- *Consensus building*: A cycle where partners construct an agreement on activities to address explicit public approach issues. Network visioning is where individuals from network manufacturers agree on the depictions of the network's ideal future and on activities to help make objectives for the future a reality (Bradley 2012).
- *Collaborative network*: This framework is intended to achieve greater arrangement among network needs, techniques of administration offices, need results, and asset portion. It is additionally intended to achieve building social capital; combination of human help conveyance; and interconnected techniques for relationship building, learning cycles, and estimation and displaying among the members (Bradley 2012).

The aim of collaborative governance is to improve the general practice and adequacy of policy implementation (Emerson et al. 2012). The upsides of viable synergistic administration are that it empowers a superior and shared comprehension of complex issues, including numerous partners, and permits these partners to cooperate and concur on arrangements. It can help strategy creators distinguish and target issues and convey activity all the more adequately. Partners that are engaged with building up an answer are more disposed to acknowledge headings given or choices made. It would thus be able to fill in as an approach to distinguish strategy arrangements that have more prominent footing in the network (Peters 2015). Furthermore, it can contribute new viewpoints on issues and strategy arrangements and, consequently, offer better approaches to actualize methodologies for change. For public authorities who work in organizations and their boards, collaborative governance can fill in as a method of truly permitting a more extensive cluster of thoughts and proposals in the arrangement cycle. It might likewise be utilized to test thoughts and break down reactions before usage. For the individuals who are not engaged with formal government, it permits them to all the more likely comprehend the inward

Table 6 Comparison among common, sharing economy and market

Common	Sharing economy	Market
No ownership	Temporary access with no transfer of ownership	Full ownership
No property right	NA	Full property right

Source Concluded from Williamson (1993), Emerson et al. (2012) and Peters (2015)

operations of government and convey more impact in the dynamic cycle. It likewise empowers them to see past government organizations being just a vehicle for administration conveyance (Peters and Zittoun 2016).

We can summarize from the five relevant theories above that if we see the sharing economy with an NIE perspective, we might find that it is between common and market (see Table 6).

5 The Role of Social Trust as an Informal Institution in Asia

Trust in individuals and institutions usually expresses the beliefs about the predictability of actions (Chaiwat 2014). Predictive stability is fundamental in the interaction between individuals in a society. If a society can process the information originating from its environment and itself and predict the problems and their solutions, it can stay on its desired path of development (Chaiwat 2014). Alesina and Giuliano (2015) distinguish between three different elements of trust (see Table 7).

The contractual trust may initially be ascribed to family members or people from the same ethnic group with whom the business person has mutual social obligations (Alesina and Giuliano 2015). In unstable and risky environments, such as Africa, competence trust may be as important as contractual trust. Arteaga (2020) goes further than Alesina and Giuliano's (2015) three elements and adds two levels to the issue of trust by laying out the advantages and disadvantages of what he calls

Table 7 Topology of trust

Topology of trust	Definition	Example
Contractual trust	The businessman will act honorably	Both parties will act as written in the contract
Competence trust	The businessman has sufficient technical and organizational capacity and capital or creditworthiness to fulfill his obligations	Both parties have ability to fulfil the contract
Goodwill trust	Mutual expectations of open commitment to each other. Goodwill trust is the basis for long-run collaboration	Both parties care for long term commitment

Source Alesina and Giuliano (2015)

'high and low trust'. According to Arteaga, the advantages of 'high trust' are: (1) lower administration costs, higher institutional, and reliability; (2) large and efficient organizations. On the other hand, the disadvantages of 'low trust' are: (1) corruption and trade with influence; (2) small and inefficient organizations.

However, if we divide trust into generalized trust and particularized trust, we can see a picture that applies in every society. The level of these two kinds of trust depends on the historical and cultural background. Developed countries tend to have a higher generalized trust, which will reflect from less corruption, higher civil participation, and high democratic involvement. Also, countries such as the Scandinavian countries tend to have high generalized trust as well (Alesina and Giuliano 2015).

According to the historical and cultural background, people in Asia, except for Japan, South Korea, Taiwan, and Singapore, tend to have a low generalized trust but have high particularized trust. This can be seen in opportunistic behavior with people from outside their families or their groups. This can explain the country's development level and many cultural aspects, such as religion, belief, traditions, and norms (Chaiwat 2014). For example, if we take Singapore, Thailand, and Vietnam for the study, we can start with the cultural and economic analysis shown in Table 8.

We can see transaction costs from both ways: generalized trust and the combination of transaction cost (search and information cost, bargaining and decision cost and policing and enforcement cost). We found that in developing countries such as Thailand and Vietnam, the high transaction cost comes from both opportunistic behaviors with people outside the group and the cost of obtaining important information (Williamson 2010). Therefore, the policy makers in these countries need to find tools to decrease transaction costs. In this chapter, we consider the sharing economy as that tool.

Table 8 Cultural and economic analysis

Cultural aspect	Singapore	Thailand	Vietnam
Established year	1959 AD	1238 AD	Around 700 BC
Main population (%)	Chinese 74	Thai 95	Vietnamese 85
Government	Democracy	Democracy	Communism
Property right	Full	Full	Limited
Economic structure	Service	Agriculture	Agriculture
Generalized trust	High	Low	Low
Particularized trust	Low	High	High
Transaction cost	Low	High	High
Economic growth	High	Low	Low

Source McCann et al. (2004) and Chaiwat (2014)

6 The Expansion of the Sharing Economy for Poverty Reduction in Asia

Since trust is a significant perspective in the sharing economy, it is worth contemplating the framework to advance trust in the sharing economy. We may apply the idea of administration for imparting economy to the development of sharing practices—incorporating those in the field of government assistance (Lima and Filho 2019). In this sort of contribution, residents are viewed as beneficiaries of administrations and co-makers and clients together. Also, it is speaks to a method of sparing time and monetary assets for public organizations, as it lessens the work for direct suppliers of administration (Ma et al. 2018).

Developing enthusiasm for the capability of the sharing economy to empower distributed financial action has been catalyzed by the business examples of overcoming adversity of Airbnb and Uber (Penn and Wihbey 2016). Supporters contend that distributed 'sharing' platforms empower residents to share, loan, sell, and lease assets on a remarkable scale on the web. By empowering these practices, such platforms can advance more proficient utilization of underutilized assets, diminish the natural effects of utilization, and fabricate social connections between peers (Yaraghi and Ravi 2017). From a supportability point of view, there is increasing proof that the sharing economy's financial effects and openings are significant. Yet, the ecological effects are right now muddled and trying to evaluate the social effects could be antagonistic and problematic. In this regard, concerns revolve around the sharing economy super platforms, for example, Airbnb and Uber, with the ability to bypass different types of guideline and reduce workers' rights globally (Oskam and Boswijk 2016).

In like manner, sharing economy platforms have been furiously reprimanded openly in the media for giving a lot of capacity to their corporate proprietors, who are contended to zero in exclusively or essentially on the monetary main concern, giving sparse consideration to social and ecological effects (Albescu and Maniu 2017). Regularly sharing this evaluation and utilizing the term platform cooperatives, activists and scholastics have supported democratizing the administration of sharing economy platforms as a way to make a more economical sharing economy. In this specific circumstance, democratization is not just expected to help understand the capability of sharing economy platforms to create natural advantages by decreasing material utilization and testing consumerist societies (Akbar and Tracogna 2018). Democratization is also expected to add to understanding the supportability objective of social value by restricting the unfavorable social effects of platforms (as examined above) and by supporting a fairer appropriation of the worth created inside the sharing economy. Generally, there is a belief that the development of these new models of platform administration may add worth to the sharing economy, whereby social and natural qualities are elevated notwithstanding the more instrumental estimations of the industrialist economy (Arteaga 2020). In general, the sharing economy requires a few key ingredients, such as trust and credibility, shareable assets, idle capacity, a critical mass of participants, digital payments and tailored/clear regulations with

regard to safety, insurance, and taxation. Other aspects such as affordability, literacy, and appropriate technology are likely to be particularly important for developing countries (Retamal and Dominish 2017).

In Asia's case, especially South-East Asia, the sharing economy can be promoted in various businesses such as transportation, accommodation, and financial service. From the knowledge in trust as an informal institution, we might predict that Singapore has higher generalized social trust, while Thailand and Vietnam have high particularized trust. This can be applied to predicting the expansion of the sharing economy for poverty reduction. Singapore's sharing economy will benefit from shared business that requires high generalized trust, such as accommodation and financial service, while in Thailand and Vietnam investors should focus on shared businesses that do not require high generalized trust and need low capital investment, such as transportation, food delivery, and cleaning service. The framework for sharing economy governance is based on trust and cultural economics knowledge, which are reflected in property rights with temporary access and no transfer of ownership (Yaraghi and Ravi 2017).

Poor people in Singapore, Thailand, and Vietnam can benefit from a sharing economy when we set the same standard where they do not have high capital. Therefore, it will be transportation, food delivery, and cleaning services. For example, a middle-class man can order food far away from a food delivery platform; then the rider will get food from a street food vendor to the middle-class man's office. It will then generate income and help reduce the poverty reduction for the rider and street food vendor. The decision-making process in this case related to the transaction cost where the searching cost is high (Retamal and Dominish 2017).

We can take another example of how trust can be used with the sharing economy for poverty reduction, with the Lam Chang Temple community in Chiang Mai, Thailand. The sharing economy business in this community consists of accommodation, transportation, and food that is aimed at foreign travelers. Chiang Mai, the largest city in the north of Thailand, is well known among foreign travelers as a hub for good local experience at affordable prices.

We conducted an interview with Mr. Bringkop Vora-urai, the president of the Chiang Mai Musician Singers Actors Association, about the initiative to use trust in the community as a tool to develop a sharing economy for poverty reduction in the Lam Chang Temple community in Chiang Mai, Thailand. Here is the result of the interview.

The Lam Chang Temple community is located around Lam Chang Temple, which was established around 1292–1296 AD inside Chiang Mai City Moat. Lam Chang Temple community residents have a business in accommodation, transportation, and food for travelers. Before Covid-19, the community residents had their businesses present in several sharing economy platforms, such as Airbnb, Grab, and Food Panda. However, the number is still low in accommodation compared to intermediary platforms such as Traveloka.

What Mr. Vora-urai and this initiative tried to do was to collect all residents' information with regard to accommodation, transportation, and food. Then, they made an info mapping and database for foreign musicians and foreign audiences at

the ‘Music on Street’ event during December 2019. This initiative’s output became a cornerstone for sharing economy development in the Lam Chang Temple community, where the residents could put their properties on sharing economy platforms and get better returns.

The other example is a food district near the Chiang Mai Old Governor Office inside Chiang Mai City Moat. Seven famous street food restaurants in Chiang Mai are registered to food delivery platforms such as Food Panda and Grab Food. Before Covid-19, this food district had limited parking space, and a food delivery app is a good source for increasing revenue. During Covid-19, Chiang Mai people who were in lockdown or lived a distance away could order food through the food delivery app. Therefore, the revenue for these restaurants become stable. In this case, all parties (supplier, customer, platform, government, and community) benefit from the sharing economy in food delivery, and this helped income generation and poverty reduction.

From all these examples, in case of poverty reduction and inclusive sustainable growth from a sharing economy where people do not have money to invest, they might consider trust in the physical community or what in Williamson (1993) is called informal institutions. This leads to a framework of trust in the sharing economy, as in the examples mentioned above. Trust in the sharing economy can be divided into five aspects: trust in the supplier, the customer, the platform, the community, and the government.

7 Conclusions and Policy Recommendations

This chapter followed two objectives: to investigate the role of ‘trust’ in the sharing economy and the reasons behind sharing economy growth through a transaction cost economics (TCE) lens. We have found that trust in the sharing economy consists of trust in suppliers, customers, the platform, the community, and the government. Also, we have found through the TCE lens that sharing economy growth comes from trust in the community or culture, and the norm of that community can stimulate the expansion of the sharing economy. We have reviewed relevant concepts: social trust, new institutional economics, transaction cost economics, sharing economy, and economic governance. We found that the sharing economy principals are culture and the market.

In terms of poverty reduction and inclusive, sustainable growth, a sharing economy can be seen in various businesses from those that are labor-intensive to those that are capital-intensive. For poor people to benefit from the sharing economy, they might start from labor-intensive businesses such as cleaning services, food delivery, and transportation. When they have some money to invest in capital, they can go to capital-intensive businesses such as P2P lending and P2P accommodation. By these steps, poor people can gain knowledge and become familiar with the sharing economy model and make their life grow sustainably.

Also, poor people should consider the trust level in their community; if their community has low generalized trust, it would be hard to make people trust them easily. They might need to decrease their service fee to compensate for the low trust.

We give three examples in this chapter of utilizing trust and the sharing economy for poverty reduction and inclusive, sustainable growth in Asia. The review of the examples shows the following. First, that poor people in Singapore, Thailand, and Vietnam could be riders for food delivery applications such as Grab and FoodPanda to generate income. Second, the Lamchang community in Chiang Mai tries to educate people in their community to be familiar with the sharing economy. Last, the street food restaurant in Chiang Mai City Moat is an income generator in normal times and an income stabilizer during Covid-19 lockdown.

The findings from this research should answer how one area can use trustworthiness in finding public policy issues and investment focus for the right sectors in the sharing economy. This research contributes to sharing economy development emerging markets in Asia or other regions to develop the industry based on generalized trust or particular trust. In the community or country that was seen as having low generalized trust, it seems impossible to have sharing economy businesses that require high trustworthiness. Therefore, national or local government should invest in sharing economy businesses that do not require high trustworthiness, such as food delivery or cleaning service, and have a proper private company to do those high trustworthiness businesses with full regulation. Future research in this area could fill the knowledge gap for how to regulate the sharing economy for suppliers and consumers

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Chapter 3
Developing the Tourism Sector for Poverty Reduction and Inclusive Sustainable Growth in Thailand

Pimonpun Boonyasana and Warattaya Chinnakum

Abstract Tourism is one of the largest and fastest-growing sectors in the world economy, including Thailand. Various studies focus on the impact of tourism development on economic growth, but few studies have examined the empirical impact of tourism on poverty reduction, inclusive and sustainable growth. This chapter investigates the impact of the tourism sector on poverty reduction, inclusive growth, and sustainable growth in five regions of Thailand throughout 2009–18. The Generalized Method of Moments (GMM) was employed. The results show that the tourism sector (domestic and foreign) favors poverty reduction and reduces inequality; however, it negatively impacts the environment. This means that the government needs to adopt policies to promote sustainable tourism, such as investment in eco-friendly infrastructure in the tourism sector to improve energy and environmental efficiency and at the same time create jobs for local economies.

Keywords Tourism · Poverty reduction · Sustainable development · Thailand · Inclusive growth

JEL Codes Q01 · O10 · Z30 · Z32 · I30

1 Introduction

Tourism is one of the key sectors now driving Thailand's economy, as it accounted for 12.3% of GDP in 2018 compared to only 5.3% in 2009. Tourism income reached THB 2.698 trillion in 2018, with THB 1.626 trillion coming from international tourists and THB 1072 billion from the domestic tourists (Ministry of Tourism and Sports 2020).

The tourism industry of Thailand is an essential source of employment, which generated 5.9 million jobs or 11.60% of total employment in 2018. Its share in the total employment increased continuously over the 2010–2018 period (Fig. 1).

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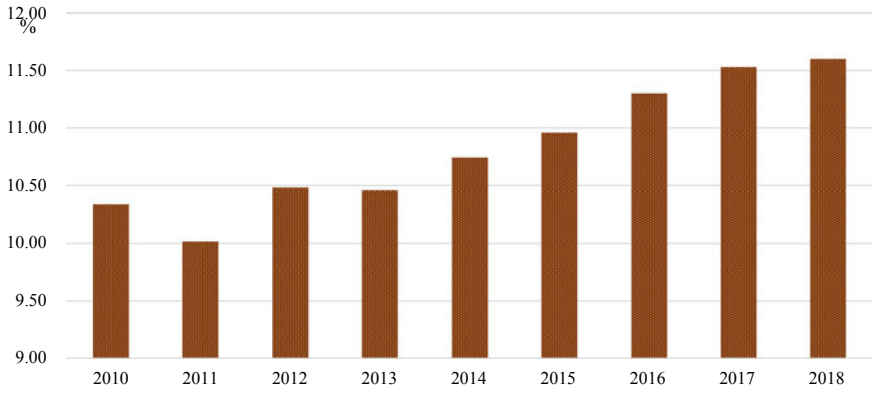

Fig. 1 Share of persons employed in the tourism industry to the total employment. *Source* Ministry of Tourism and Sports (2020)

Thailand's tourism industry has become a key factor in boosting economic growth, creating jobs, and reducing poverty. According to the Sustainable Development Goals (SDGs), tourism contributes to national income and individual income through job creation at the community and local levels. It can be related to national poverty reduction strategies. It is also related to the SDG1, to end poverty in all forms everywhere (United Nations 2020a). Poverty eradication has been a global goal and a challenge for researchers, policy makers, local government, and international organizations, namely, the World Bank, the United Nations, and the United Nations World Tourism Organization (UNWTO, 2017). Ashley and Roe (2002) pointed out that the tourism industry can be labor-intensive, and labor is a vital asset of poor people. However, there exists a paucity of empirical evidence from testing whether tourism is effective in reducing poverty, especially in tourism-intensive countries, including Thailand. Figure 2 showed the national poverty headcount ratio compared with the total tourism revenue of Thailand, revealing a sharp decline in the poverty headcount ratio from 17.88% in 2009 to 9.85% in 2018, while the international tourist revenue of Thailand is continuing to increase from THB 0.59 trillion in 2009 to THB 1.87 trillion in 2018, or a growth of 16.05% on average between 2009 and 2018.

In Thailand, as in most developing countries, there are substantial regional differences in the level of poverty. The south of Thailand has been the most impoverished region, followed by the northeast, the north, the central region, and Bangkok, respectively. Besides, nearly one half (48%) of all northeasterners were poor, compared to 6% of Bangkok residents in 1988. By 2018, the incidence of poverty had declined in all regions. However, considering the rates of poverty reduction in Fig. 3, one can observe that the northeast and the south did not experience the rapid poverty reduction, as did the north, the central region, and Bangkok. Therefore, regional disparity in poverty reduction exists in Thailand, leading to big challenges for Thailand's policy makers.

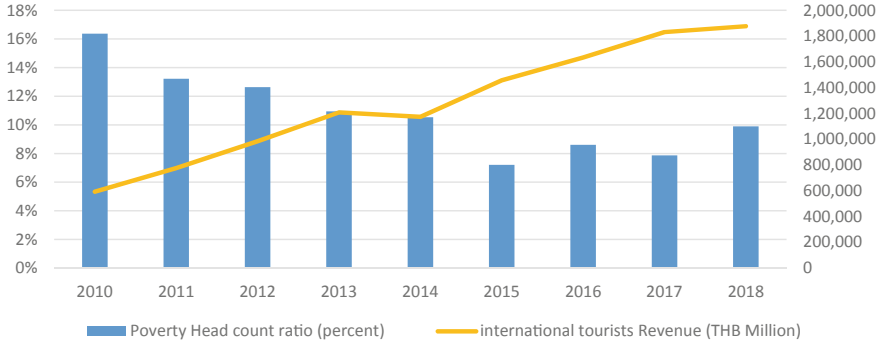

Fig. 2 National poverty headcount ratio (at national poverty line) and international tourists revenue of Thailand. *Note* National poverty headcount ratio is the percentage of the population living below the national poverty lines. National estimates are based on population-weighted sub-group estimates from household surveys. *Source* National Statistical Office (2020) and Ministry of Tourism and Sports (2020)

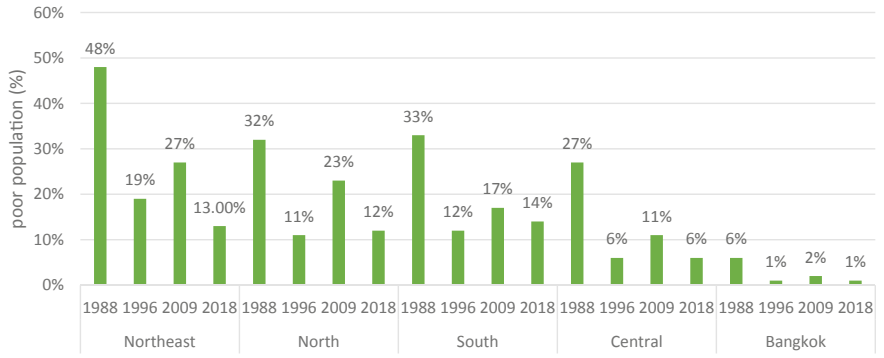

Fig. 3 Headcount ratio (at national poverty line) by region 1988, 1996, 2009 and 2018. *Source* National Statistical Office (2020)

Until recently, the impact of tourism on poverty eradication had attracted only a small group of researchers into doing tourism studies. The previous studies consist of case studies and small sample group, and the results remain mixed (see for example, Barling 2005; Chok et al. 2007; Muhanna 2007; Scheyvens 2007; Zhao and Ritchie 2007; Saayman et al. 2012; Li et al. 2016; Kim et al. 2016; Untong and Guntawongwan 2020; Khan et al. 2020). Untong and Guntawongwan (2020) studied the impact of European and Chinese tourists' expenditure on various economic sectors in the Thai economy. They found that the increase in Chinese tourists and European tourists led to an increase in the demand for goods and services in both the tourism sector and the non-tourism sector, such as banking and insurance. Similarly, Khan et al. (2020) analyzed the causal relationship between tourism, poverty, economic growth, foreign direct investment, and agricultural product in Pakistan. They found

the effects of tourism in contributing to poverty eradication and economic growth. Their results also pointed out that tourism positively impacted the agricultural sector, which is the main economic sector of Pakistan. However, some studies like that of Kim et al. (2016) found that tourism can reduce poverty only in low-income countries, but it will increase poverty in middle- and high-income countries, including Thailand. Besides, Wattanakuljarus and Coxhead (2018) found that the growth of international tourist expenditure raises aggregate household income but worsens its distribution.

In general, it also is well documented in the previous literature that the tourism sector plays an important role in economic growth, employment opportunities, raising income from abroad, and socio-economic development. However, the tourism sector is often blamed for its negative impact on income inequality and the environment. The income from the tourism sector can stimulate trade, income, and entrepreneurship, especially for large business sectors. Increasing the number of tourist arrivals leads to an increase in tourism activities that can be related to resources usage. Therefore, this study aims to analyze the impact of tourism development on poverty reduction, inclusive growth, and sustainable growth. This study also considers informal employment, one of the independent variables affecting poverty since the informal sector is essential in developing countries, including Thailand. According to a National Statistical Office's survey (NSO 2018), about 21.2 million workers, or 55.3% of total employment, were employed in the informal sector. Therefore, informal employment forms a larger share of the workforce, and the role of informal employment in reducing poverty and increasing inclusive and sustainable growth could be considered.

There are three main contributions of this study. First, there are few studies that investigate the impact of tourism on income inequality and CO_2 emissions. This chapter seeks to contribute to the understanding of tourism resilience in poverty reduction, inclusive growth and sustainable growth by empirically linking tourism with the poverty ratio, income inequality, and CO_2 emissions. The findings in this study also suggested that the tourism industry is inclusive, sustainable, and benefits the poorest household. Second, this study compares the effect of inbound tourism and that of domestic tourism in reducing poverty in Thailand and inclusive, sustainable growth. In the past, policy makers often focus on increasing international tourist revenues to encourage economic growth and poverty reduction. However, this study found that, by comparing coefficients, domestic tourism receipts have a greater impact on the poverty ratio than international tourism receipts. Lastly, informal employment is the largest share of employment in developing countries such as Thailand, but no relationship has been established between informal employment and poverty reduction, inclusive growth, and sustainable growth. This study revealed the impact of informal employment on poverty ratio, income inequality, and CO_2 emissions.

This chapter is divided into six sections. Section 1 is the introduction. Section 2 presents the literature review. Section 3 presents information on the model and the variables used in data analysis. Furthermore, in Sect. 4, the main results of this research are presented. The final section shows the main conclusion of the research and policy recommendation.

2 Literature Review

2.1 Determinants of Poverty Reduction

The eradication of poverty continues to be a priority for policy makers worldwide. The theoretical and empirical literature on the determinants of poverty is well established. It is generally believed that economic growth is directly related to poverty reduction. Several studies have analyzed the impacts of economic growth on poverty alleviation, such as Contreras (2003), Krongkaew and Kakwani (2003), Adams (2004), Tambunan (2005), Tsai and Huang (2007), Huang et al. (2008), Fanta and Upadhyay (2009), Suryahadi et al. (2009), Agrawal (2010), Montalvo and Ravallion (2010), Perera and Lee (2013), Almås and Johnsen (2018), and Roganović and Stankov (2018). The empirical findings of these more recent studies tend to suggest economic growth results in poverty reduction. However, some studies considered whether economic growth alone was sufficient for poverty alleviation. For example, Mulok et al. (2012) examined the relationship between poverty reduction and economic growth in Malaysia and found that growth is necessary but not sufficient for poverty reduction.

While the literature on poverty is vast, the specific focus on tourism as a poverty reduction tool is limited. On the theoretical ground, Mitchell and Ashley (2009) pointed out that tourism affects poverty through three channels: direct, secondary, and dynamic effects, but there is a lack of empirical evidence to measure the magnitude in the literature on tourism and poverty reduction. Winters et al. (2013) explained that there are three channels for tourism to affect poverty. The first channel, direct impact, refers to whether the poor gain directly benefits from their own business or as workers employed in a tourism company. The secondary channel refers to the impact of the spending of the receipts earned within the sector and also the purchase of goods and services from the non-tourism sector, such as banking. Finally, the dynamic channel of tourism on poverty refers to the benefits that the tourism sector provides by inducing more investment in infrastructure, facility, and labor skills. This, in turn, will have an impact on economic growth and poverty reduction.

On the empirical level, several studies found that tourism development helps alleviate poverty, such as Croes and Vanegas (2008) for Nicaragua; Jiang et al. (2011) for Asia-Pacific, Caribbean, and Africa; Mahadevan et al. (2016) for Indonesia; Llorca-Rodríguez et al. (2017) for Peru; Liu et al. (2017), Qin et al. (2019), and Zhao and Xia (2019) for China; Folarin and Adeniyi (2019) for Sub-Saharan African; Khan et al. (2020) for Pakistan; Torabi et al. (2020) for Iran; Odhiambo and Zyl (2012) and Toerien (2020) for South Africa; and Ponce et al. (2020) for Ecuador. However, Croes (2014) found that tourism can reduce poverty only in low-income countries while it will increase poverty in the middle- or high-income countries. Few studies compared the magnitude of effects of inbound tourism with that of domestic tourism. Llorca-Rodríguez et al. (2018) did so. They found that both inbound tourism and domestic tourism have significant effects on the alleviation of poverty. However, the impacts of domestic tourism on poverty is much higher than inbound tourism.

The domestic tourism industry may be serviced largely by local people and supplied mainly from the local markets.

Unemployment and underemployment are the main causes of poverty. For the poor, labor is the only asset they can use to raise their standard of living and well-being. Therefore, the creation of employment opportunities is crucial for enhancing economic growth, achieving poverty reduction, and sustainable development. The growth process of poverty reduction does not depend only on the economic growth rate, but also on the ability of the poor to respond to the increased demand for productive labor. Given the importance of employment on poverty reduction, a few studies are focusing on the impact of employment especially in the informal sector on poverty reduction; for example, Ponce et al. (2020) revealed that an increase in informal-sector employment will lead to an increase in the poverty headcount ratio. In contrast, Zhao (2009) observed the poor gain from tourism through self-employment in small-scale tourism-related businesses.

2.2 Determinants of Inclusive and Sustainable Growth

Inclusive growth is economic growth that is distributed fairly across society and creates opportunities for all. The Gini coefficient was initially used as an index to judge the level of income inequality and inclusive growth (OECD 2015). Previous research suggests that economic growth and poverty reduction might have an impact on inclusive growth, such as Tabassum and Majeed (2008), Ota (2017), and Breunig and Majeed (2020). Minimal literature has been observed related to the tourism and income inequality association. In the available studies, mixed results are found,. Some empirical studies found a positive association and some researchers indicated a negative relationship. For the positive relationship or tourism increases income inequality, Bartik (1991) found that tourism increases local economic growth and raises inflation and local property values, leading to an increase in income inequality. Tisdell and Wen (1997) revealed that tourism increases regional inequality among the various provinces in China. Lee and Chang (2008) examined the patterns and trends of income inequality for tourism services-dependent countries. The analysis revealed that in the US tourism services-dependent countries have greater income inequality than non-tourism service-dependent countries. Alam and Paramati (2016) found that tourism increases income inequality for 49 developing countries. However, if the tourism inflows doubled from the current level, it would reduce the income inequality in the economies. Raza and Shah (2017) examined the relationship between tourism and income inequality in the top 43 tourist arrival countries. They found that tourism revenue will increase income inequality. For the negative association, Li et al. (2016) found that tourism can reduce regional income inequality in China. The results are consistent with previous studies by Eugenio-Martín et al. (2004), Lee and Chang (2008), Proença and Soukiazis (2008), and Haddad et al. (2013).

Sustainable growth refers to growth that it is possible to sustain without causing environmental problems. CO_2 emissions are often used as an indicator for sustainable

growth in the previous literatures. Several studies focused on the impact of economic growth on CO_2 emissions. For example, Al-mulali et al. (2015) studied the effect of economic growth, renewable energy consumption, and financial development on CO_2 emissions in 18 Latin America and Caribbean countries. The results indicated an inverted U-shape relationship between CO_2 and GDP. This is similar to Aye and Edoja (2017), who studied the effect of economic growth on CO_2 emissions of 31 developing countries. Their results indicate that economic growth has a negative effect on CO_2 emissions in the low-growth regimes but a positive effect in the high-growth regimes. A paper by Abid (2015) investigated the impact of economic growth on carbon emissions and found that economic growth has a negative effect on the environment in Tunisia. Another recent paper by Baloch et al. (2020) somehow empirically tested the impact of poverty and income inequality on CO_2 emissions. The study suggested that increasing poverty and income inequality contribute to increasing CO_2 emissions.

With climate change and global warming, various studies focus on the relationship between tourism and the environment. Zaman et al. (2015) examined the long-run linkages among tourism transportation expenditures, CO_2 emissions, energy consumption, and growth factors of 11 transition economies. Their results showed that international tourism transportation expenditures have a significantly positive relationship with CO_2 emissions, which implies that higher international tourism transportation expenditures as a result of increased tourism demand increases CO_2 emissions. Dogan and Aslan (2017) examined the linkages between emissions, economic growth, and tourism in 25 European Union counties. Their empirical results suggested that economic growth and tourism reduce emissions.

3 Empirical Model and Data

3.1 Empirical Model

This study examines the impact of domestic and inbound tourism on poverty, including inclusive and sustainable growth across five regions of Thailand between 2009 and 2018. This analysis employs the Generalized Method of Moments (GMM) estimator, adjusted to allow for error cross-section dependence, recently proposed by Sarafidis et al. (2009). Cross-Sectional (CD) Pesaran (2015), which accounts for the presence of cross-sectional dependence, was also employed and this study uses the Hansen J-statistic test to account for the over-identifying restrictions (Baum et al. 2007). All variables were transformed into a logarithm to obtain coefficients in the form of elasticities. Therefore, three models that represented the poverty reduction model, the inclusive growth model, and the sustainable growth model can be written as follows:

$$POV_{it} = \alpha_0 + \alpha_1 * lnDOMETOUR_{it} + \alpha_2 * lnINTERTOUR_{it}$$

$$+ \alpha_3 * GRGRPPC_{it} + \alpha_4 * GINI_{it} + \alpha_5 * lnINFORMALWORKER_{it} + \alpha_6 * lnCO2_{it} + \varepsilon_{1it} \quad (1)$$

$$GINI_{it} = \gamma_0 + \gamma_1 * lnDOMETOUR_{it} + \gamma_2 * lnINTERTOUR_{it} + \gamma_3 * GRGRPPC_{it} + \gamma_4 * POV_{it} + \gamma_5 * lnINFORMALWORKER_{it} + \gamma_6 * lnCO2_{it} + \varepsilon_{2it} \quad (2)$$

$$lnCO2_{it} = \beta_0 + \beta_1 * lnDOMETOUR_{it} + \beta_2 * lnINTERTOUR_{it} + \beta_3 * GRGRPPC_{it} + \beta_4 * POV_{it} + \beta_5 * lnINFORMALWORKER_{it} + \beta_6 * GINI + \varepsilon_{3it} \quad (3)$$

where i indexes region and t indexes periods. POV_{it} denotes the poverty ratio which is measured, firstly, by the proportion of people below the national poverty line as a percentage of the whole population, that is by the headcount ratio (HCR_{it}). Secondly, this study uses the poverty gap ($POVG_{it}$), that is the mean shortfall in income or consumption from the poverty line expressed as a percentage of the poverty line. This measure relates to the depth of poverty. Thirdly, the poverty severity ratio ($SEVERITY_{it}$), which is calculated by averaging the square of the poverty gap ratio. $lnDOMETOUR_{it}$ and $lnINTERTOUR_{it}$ denote the natural logarithm of domestic tourism receipts for region i in year t and the natural logarithm of international tourism receipts for region i in year t, respectively. $GRGRPPC_{it}$ is the growth rate of real gross regional product per capita for region i in year t. This variable is a proxy for economic growth. $GINI_{it}$ is the Gini coefficient, which is the most commonly used measure of income inequality. The Gini coefficient also represents the inclusive growth (Yoshino et al. 2017). $lnCO2_{it}$ is the natural logarithm of CO_2 emissions per capita. This variable is a measure of environmental sustainability; the lower this variable, the higher the growth would be. $lnINFORMALWORKER_{it}$ is the natural logarithm of the number of informal sector employment. The variable ε_{1it}, ε_{2it} and ε_{3it} are random error term assumed to be normally distributed with zero mean and constant variance. Finally, α_i, γ_i, and β_i are the coefficients of the model.

Our choice of these variables is motivated by the poverty literature and comparability with previous studies of tourism, poverty, inclusive growth, and sustainable growth.

3.2 Data

This study is based on a panel dataset covering five regions in Thailand over the period from 2009 to 2018. The availability of data dictates the length of this period. The regions are northern Thailand, central Thailand, southern Thailand, northeastern Thailand, and Bangkok. The data were from the country tables published by the

Ministry of Tourism and Sports (2020) and the National Statistical Office (2020). Some variables were converted into natural logarithms before the empirical analysis.

Table 1 gives the summary statistics for the data that were used in this analysis. We present statistics that are calculated using the observations in the sample of five regions over the period from 2009 to 2018.

Table 2 reports the correlation coefficients matrix among variables, displaying the significant negative correlation between poverty ratio and tourism receipts. Gross regional product and tourism receipts are positively correlated. Table 2 also shows that the correlation between domestic tourism receipts and Gini coefficient is negative while the relationship between international tourism receipts and Gini coefficient is positive. This implies that domestic tourism contributes to boosting economic growth, reducing poverty and reducing income inequality. However, these results does not indicate causality between the two variables.

Table 1 Descriptive statistics, 2009–2018

Variable	Unit	Mean	Standard deviation	Minimum	Maximum
Headcount ratio	%	10.89	27.71	1.06	6.68
Poverty gap ratio	%	2.06	1.65	0.2	5.7
Poverty severity ratio	%	0.78	0.61	0.1	1.9
Domestic tourism receipts	Millions Baht	183,973.46	612,304.67	25,715.91	147,643.77
International tourism receipts	Millions Baht	168,377.74	664,129.59	628.38	207,353.12
The growth rate of Real Gross Regional Product per capita	%	2.982	3.462	−7.635	8.962
Gini coefficient	%	34.340	1.996	31.000	40.000
The number of informal sector employment	Thousand persons	4,595.85	10,297.08	1,245.76	2,596.51
CO_2 emissions per capita	Metric tons	242,276.4	17,918.87	208,270.5	263,392.4
HCR_{it}		2.104	0.882	0.058	3.322
$POVG_{it}$		2.06	1.65	0.2	5.7
$SEVERITY_{it}$		0.78	0.61	0.1	1.9
$lnDOMETOUR_{it}$		11.809	0.820	10.155	13.325
$lnINTERTOUR_{it}$		10.657	2.084	6.443	13.406
$GRGRPPC_{it}$		2.982	3.462	−7.635	8.962
$GINI_{it}$		34.340	1.996	31.000	40.000
$lnINFORMALWORKER_{it}$		15.167	0.627	14.035	16.147
$ln\ CO2_{it}$		12.395	0.076	12.247	12.481

Source Authors' compilation.

Table 2 Pearson's correlation results

Variable	HCR_{it}	$POVERTYGAP_{it}$	$SEVERITY_{it}$	$lnINTERTOUR_{it}$	$lnDOMETOUR_{it}$	$GRGRP_{it}$	$lnCO2_{it}$	$GINI_{it}$	$lnINFORMALWORKER_{it}$
HCR_{it}	1.000								
$POVERTYGAP_{it}$	0.685	1.000							
$SEVERITY_{it}$	0.759	0.921	1.000						
$lnINTERTOUR_{it}$	−0.488	−0.345	−0.405	1.000					
$lnDOMETOUR_{it}$	−0.704	−0.658	−0.769	0.389	1.000				
$GRGRP_{it}$	−0.884	−0.654	−0.752	0.563	0.821	1.000			
$lnCO2_{it}$	−0.284	−0.383	−0.452	0.041	0.493	0.093	1.000		
$GINI_{it}$	0.375	0.434	0.461	0.073	−0.514	−0.221	−0.572	1.000	
$lnINFORMALWORKER_{it}$	0.775	0.565	0.612	−0.867	−0.505	−0.795	−0.042	−0.035	1.000

Source Authors' calculation

4 Empirical Results

Tables 3, 4 and 5 report the GMM estimates of model (1), (2), and (3), respectively. According to Table 3, for the poverty measure this study employs three dependent variables, namely headcount ratio, poverty gap ratio, and poverty severity ratio, that are traditionally used to measure poverty. The empirical results show that domestic tourism receipts and international tourism receipts have significant negative impacts on the three poverty indices at the 10% level of significance. This results imply that both domestic tourism and international tourism will reduce poverty. Moreover, domestic tourism receipts have a larger absolute magnitude of the poverty ratio effect than does international tourism receipts.

Specifically, the results show that domestic tourism receipts have a negative and statistically significant impact on the headcount ratio and poverty gap ratio. The impact of the domestic tourism receipts on the poverty headcount ratio is 0.579, implying that a 10% increase in the domestic tourism receipts will lead to a 5.79% decrease in the headcount ratio as other things are held constant. This result is similar to those of Garza-Rodriguez (2019), who estimated poverty reduction's elasticity to be −0.46 for Mexico, and Vanegas et al. (2015), who estimated the elasticity of poverty reduction to be −0.58 for Costa Rica and −0.64 for Nicaragua. The result also shows that a 10% increase in the domestic tourism receipts will lead to a 12.93% decrease in the poverty gap ratio as other things are held constant. This result implies that domestic tourism growth can reduce the poverty gap and the poor earn more to

Table 3 Tourism and poverty

Dependent variable	Headcount ratio		Poverty gap ratio		Poverty severity ratio	
Variable	Coefficient	*P*-value	Coefficient	*P*-value	Coefficient	*P*-value
Constant	−22.891	0.444	140.519*	0.087	53.972*	0.070
$lnDOMETOUR_{it}$	−0.579**	0.013	−1.293*	0.077	−0.278	0.198
$lnINTERTOUR_{it}$	−0.188**	0.019	−0.831**	0.012	−0.236***	0.004
$GRGRPPC_{it}$	−0.904**	0.021	1.846	0.159	0.345	0.314
$GINI_{it}$	0.258***	0.000	0.024	0.863	0.013	0.786
$lnINFORMALWORKER_{it}$	1.385***	0.005	4.599**	0.014	1.326***	0.003
$lnCO2_{it}$	0.270	0.872	18.003***	0.002	6.193**	0.003
$Adjusted - R^2$	0.918		0.682		0.742	
Breusch-Pagan	21.132**	0.020	27.524***	0.002	44.453***	0.000
Pesaran LM	2.489**	0.010	3.918***	0.000	7.704***	0.000
Pesaran CD	0.953**	0.034	10.525**	0.029	2.825*	0.077
Hansen J test	32.509	0.679	33.634	0.100	21.692	0.153

Source Authors' calculation

Note ***, ** and * stands for rejecting the null hypothesis of no cointegration at the 1, 5, and 10% significance level, respectively. Hansen J test refers to the null hypothesis that overidentifying restrictions is asymptotically distributed as chi2 under the null of instrument validity

Table 4 Tourism and inclusive growth

	Headcount ratio		Poverty gap ratio		Poverty severity ratio	
Variable	Coefficient	*P*-value	Coefficient	*P*-value	Coefficient	*P*-value
Constant	26.277***	0.000	171.806***	0.000	-113.127	0.541
$lnDOMETOUR_{it}$	−0.482	0.212	−0.966**	0.015	−2.997*	0.088
$lnINTERTOUR_{it}$	−0.814**	0.024	−0.239	0.374	−0.538**	0.046
$GRGRPPC_{it}$	0.013	0.870	0.023	0.725	3.479	0.139
$lnINFORMALWORKER_{it}$	6.358***	0.001	2.528**	0.039	1.600	0.300
$lnCO2_{it}$	−9.918**	0.019	−6.908*	0.057	9.119	0.509
HCR_{it}	2.583***	0.002				
$POVG_{it}$			0.996*	0.053		
$SEVERITY_{it}$					1.207**	0.016
$Adjusted - R^2$	0.655		0.441		0.333	
Breusch-Pagan	13.094	0.218	14.188	0.165	10.558	0.393
Pesaran LM	0.692	0.489	0.936	0.349	0.125	0.901
Pesaran CD	0.664	0.507	−0.907	0.365	−0.736	0.462
HS test	36.795	0.478	33.540	0.632	34.376	0.592

Source Authors' calculation

Note Dependent variable = GINI coefficient. ***, ** and * stands for rejecting the null hypothesis of no cointegration at the 1, 5, and 10% significance level, respectively. Hansen J test refers to the null hypothesis that overidentifying restrictions is asymptotically distributed as chi2 under the null of instrument validity

the extent that they earn enough to bring them over the poverty line. This result is similar to Njoya and Seetaram (2018), Mahadevan and Suardi (2019), and Zhao and Xia (2019), who found that tourism expansion assists poor households to move close to the poverty line.

In referring to the empirical results reported in Table 3, this study take note of a significantly negative relationship between international tourism receipts and poverty ratio for all measures of poverty. The respective elasticities of 0.188 for headcount ratio, 0.831 for poverty gap ratio, and 0.236 for poverty severity ratio, indicates that a 1% increase in the international tourism receipts results in a 0.188% decrease in the headcount ratio, and a 1% increase in the international tourism receipts results in a 0.831% decrease in the poverty gap ratio whereas a 1% increase in the international tourist receipts results in 0.236% decrease in the poverty severity ratio. These results imply that higher income from international tourist tends to lower poverty rates and that international tourism is a benefit to the poor people of Thailand.

This investigation discovers that a 10% increase in gross regional product decreases the headcount ratio by 9.04%. This result implies that economic growth will reduce only the poverty headcount ratio. In this respect, our results seem consistent with those of Fanta and Upadhyay (2009), who studied the relationships among

Table 5 Tourism and sustainable growth

	Headcount ratio		Poverty gap ratio		Poverty severity ratio	
Variable	Coefficient	*P*-value	Coefficient	*P*-value	Coefficient	*P*-value
Constant	15.321***	0.000	17.114***	0.000	12.482***	0.000
$lnDOMETOUR_{it}$	0.047**	0.024	0.076*	0.062	0.017	0.134
$lnINTERTOUR_{it}$	0.013**	0.038	0.023*	0.091	0.018***	0.002
$GRGRPPC_{it}$	−0.088***	0.001	−0.158**	0.011	−0.004**	0.036
$GINI_{it}$	−1.670***	0.001	−2.133***	0.001	−2.303**	0.015
$lnINFORMALWORKER_{it}$	−0.115***	0.001	−0.185**	0.018	0.051	0.212
HCR_{it}	0.002	0.394				
$POVG_{it}$			−0.001	0.934		
$SEVERITY_{it}$					−0.057***	0.002
$Adjusted - R^2$	0.247		0.325		0.214	
Breusch-Pagan	70.348***	0.000	71.024***	0.000	70.663***	0.000
Pesaran LM	13.494***	0.000	13.645***	0.000	13.565***	0.000
Pesaran CD	8.349***	0.000	8.408***	0.000	8.388***	0.000
HS test	32.509	0.679	21.895	0.111	22.174	0.103

Note Dependent variable = CO_2 emissions per capita. ***, ** and * stands for rejecting the null hypothesis of no cointegration at the 1, 5, and 10% significance level, respectively. Hansen J test refers to the null hypothesis that overidentifying restrictions is asymptotically distributed as chi2 under the null of instrument validity

economic growth, inequality, and poverty in 16 African countries, and Perera and Lee (2013) who confirmed that economic growth led to poverty reduction in Asia.

This investigation discovers that a 1% increase in the Gini coefficient increases the headcount ratio by 0.258%. This result implies that a change in income distribution will affect the headcount ratio. However, the change in income distribution does not effect the measure of the depth and severity of poverty.

The results from Table 3 also show that informal employment has a positive and statistically significant impact on the headcount ratio, poverty gap ratio, and poverty severity ratio. This implies that the increase in informal employment corresponds to the shrinking of income and the social safety net and the increase in the number of people living below the national poverty line. This result is similar to the finding by Ponce et al. (2020).

Lastly, the results show that CO_2 emissions per capita positively and statistically significantly impact the poverty gap and severity ratio. A 1% increase in CO_2 emissions per capita will increase the poverty gap ratio and severity ratio by 18.003 and 6.193%, respectively. This result implies that an increase in environmental degradation would cause an increase in poverty.

The results of the analysis of the impact of tourism on inclusive growth are presented in Table 4. As may be expected, the Gini coefficient has a negative linkage with domestic tourism receipts, international tourist receipts, and CO_2 emissions

per capita at the 10% level of significance. These results imply that both domestic tourism receipts and international tourism receipts will reduce income inequality. These effects indicate that the tourism industry is inclusive and benefits the poorest household of Thailand. The study of Mahadevan et al. (2016) in the context of Indonesia, Alam and Paramati (2016) in developing countries, and Raza and Shah (2017) in the top 43 tourist arrival countries also reported the same results. However, it contrasts with the work of Li et al. (2013) and Haddad et al. (2013) who reported the negative relationship.

In addition, the results found that an increase in informal employment would have increased the income inequality. Informal activities may provide employment to lower-income workers but are harmful to income distribution.

In Table 4, this study presents the empirical results for the three measurements of poverty, i.e. the headcount ratio, the poverty gap ratio, and the poverty severity ratio. The results show that the headcount ratio, the poverty gap ratio and the poverty severity ratio have a positive and statistically significant impact on the Gini coefficient at the 5% level of significance. The impact of the headcount ratio on the Gini coefficient is 2.583 implying that a 1% point increase in the headcount ratio will lead to a 2.583% increases in the Gini coefficient as other things are held constant. This investigation discovers that a 1% increase in the poverty gap ratio increases the Gini coefficient by 0.996%. A 1% increase in the poverty severity ratio will lead to an increase in the Gini coefficient by 1.207%.

According to Table 5, the Gini coefficient is the essential determinant of CO_2 emissions per capita. These results also indicate that an increase in the number of tourists (domestic tourists and international tourists) raises CO_2 per capita. Increasing tourist arrivals and revenues increases the tourism sector's activities, such as transportation, resulting in higher fossil fuel consumption and more carbon emissions. This situation indicates that the rise in tourism activities causes environmental degradation.

The results also found that economic growth, the Gini coefficient, informal employment, and the poverty severity ratio have a negative and statistically significant effect on CO_2 emissions per capita at 5% level. This implies that when economic growth continues, people will spend their incomes on improving the environment by improving air quality and cleaning water, which is in line with the environmental Kuznets curve theory.

5 Conclusions and Policy Recommendations

Tourism is a crucial factor for enhancing economic growth and improving residents' quality of life in many developing countries, including Thailand. However, using tourism as a sustainable development tool depends on the impact of tourism demand on poverty, inclusive, and sustainable growth. Therefore, this study aimed to investigate the impact of tourism on poverty, income inequality and CO_2 emissions in five regions of Thailand for the period 2009–2018. For this purpose, the study applied

the Generalized Method of Moments (GMM) estimation to avoid inconsistency and endogeneity problems.

The results reveal that domestic tourism receipts have a negative and statistically significant impact on the headcount ratio and the poverty gap ratio. Domestic tourism receipts' negative impact on the headcount ratio is equivalent to saying that an increase in domestic tourism will reduce the number of people below the national poverty line and the mean income of the poor falls below the poverty line. Our results are similar to the findings of Garza-Rodriguez (2019), Vanegas et al. (2015), Njoya and Seetaram (2018), Mahadevan and Suardi (2019), and Zhao and Xia (2019) in providing a view that domestic tourism is an important factor for poverty reduction. The results also indicate that an increase in international tourism receipts contribute to a decrease in the poverty headcount ratio, the poverty gap ratio, and the severity poverty ratio. The negative impact of the gross regional product on the poverty headcount ratio implies that the poor benefit more from economic growth. Finally, the positive impact of informal employment on the headcount ratio, the poverty gap, and the severity gap mean an increase in informal employment will link to the increased risk of becoming poor or remaining poor for economically disadvantaged workers, making them more vulnerable and deepening poverty. Policy makers should focus on policy that can enhance their income security, such as public work programs and employment guarantee schemes.

The empirical results present that the Gini coefficient have a negative linkage with domestic tourism receipts, international tourist receipts, and CO_2 emissions per capita at the 10% level of significance. These effects indicate that the tourism industry is inclusive and benefit the poorest households of Thailand. The results show that an increase in informal employment would have increased income inequality. Since the informal sector is an alternative for those low-skilled workers who cannot find a job in the formal sector and therefore are willing to accept lower pay, this confirms a negative relationship between the informal sector and income inequality.

For sustainable growth, the investigations indicate that domestic tourism receipts and international tourist receipts increase CO_2 emissions per capita. The findings suggest that a green growth policy, such as investment in eco-friendly infrastructure in the tourism sector to secure energy and environmental efficiency and emission control technologies, will improve sustainable growth. The results also present that the increase in income growth will reduce CO_2 emissions per capita.

It has been established by this study that extensive tourism income growth coupled with increasing employment security leads to more poverty reduction that contributes towards a higher level of inclusive growth and sustainable growth. The findings have important practical and policy implications. For the tourist-intensive economies, it calls for developing sustainable tourism, such as providing employment opportunities in urban and rural areas, creating quality jobs, and developing business and regional development opportunities. The policy also focuses on investment in clean and renewable energy infrastructure in the tourism sector. This policy relates to SDG targets 8 and 9, which aim 'by 2030, [to] devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products'. Besides, its related to SDG target 12.b. which aims to 'develop and implement

tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products' (United Nations 2020b).

The main limitation of this study is the small sample size. Moreover, scholars in future research are encouraged to use another indicator of inclusive growth, such as the ratio of income of the 10% rich over 10% poor; this could help guide tourism policies for encouraging inclusive growth in developing countries.

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Chapter 4
Sustainable Tourism and Poverty Reduction in Selected ASEAN Member Countries

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Abstract Examining the impact of revenues from the tourism sector on poverty reduction in selected members of the Association of Southeast Asian Nations (ASEAN), including Thailand, Malaysia, and Singapore, is the primary objective of this study. The Bayesian Structural Time Series (BSTS) model and the regression kink design (RKD or RK design) were employed to identify the causal effects between tourism revenues and the poverty headcount ratio during 2009–2019. The main conclusion from the analysis is that the relationship between tourism revenue and poverty reduction (in the form of the poverty headcount ratio) in Malaysia and Singapore have similar patterns. In contrast, the pattern of the impact of tourism revenues on the poverty headcount ratio in Thailand is different from the other two countries. For Singapore and Malaysia, increasing tourism revenue can reduce the poverty headcount ratio in the early stages. Nevertheless, after a while, increasing tourism revenue in later stages will not reduce the poverty headcount ratio. On the other hand, Thailand's tourism revenue can reduce the poverty headcount ratio with time lags. However, in the early stages, Thailand's tourism revenue could not reduce the poverty headcount ratio.

Keywords I14 · I15 · I32

1 Introduction

Tourism is the source of revenue for both the guest and the host countries. The travel and tourism sector globally grew at 4.6%, much faster than the rest of the economy, according to the World Travel Tourism Council's (WTTC) Economic Impact Research. For the Association of Southeast Asian Nations (ASEAN), the Tourism Strategic Plan of the Association of Southeast Asian Nations (ASEAN) had been prepared as the ASEAN Tourism Marketing Strategy (ATMS). The primary purpose of the ATMS is to maintain the growth of the number of inward foreign

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tourists to take advantage of the increased income from tourism for contributing to economic and social goals in each member state.

For Thailand, the Tourism Authority of Thailand conducted a study of Thai Tourism Scenario 2020. They found that tourism patterns have changed with the increased number of business tourists and the emergence of the elderly group caused by changes in the world population structure. The value of Tourism Direct Gross Domestic Product (TDGDP) in Thailand is 5.45% of its total GDP. The growing number of tourists, both domestic and international, has generated tremendous income for the country. In 2019, foreign tourists generated an income of about 1.93 trillion baht (about US $64 billion), representing a 3.05% increase from the previous year's level.

Meanwhile, the income from domestic tourism increased by 1.18%, making the tourism sector's total revenue in Thailand in 2019 grow by 2.37%. As mentioned above, there has been substantial growth in revenue from both domestic and international tourism sectors. This statement indicates that paying by tourists in the tourism sector is another form of bringing large sums of money into the domestic economy. The substantial growth of tourism receipts from domestic and international tourists is indeed synonymous with an enormous sum of money flowing to many parties involved in the domestic economy. Thus, the importance of the tourism industry in Thailand was discussed in the Twelfth National Economic and Social Development Plan for 2017–2021 (Office of the National Economic and Social Development Board, 2017). Since the Plan also stresses the country's Sustainable Development Goals (SDGs), one of its intentions is to amend laws to achieve balanced and sustainable development in the tourism industry.

For the current year, the World Tourism Organization (UNWTO) forecast there would be 1.6 billion foreign visitors in 2020 globally. One of the regions that has become a popular tourist destination is South-East Asia. The Covid-19 pandemic has caused a 22% fall in international tourist arrivals during the first quarter of 2020, the latest data from UNWTO shows (www.unwto.org/news/covid-19-international-tourist-numbers-could-fall-60-80-in-2020).

In Thailand's case, the total arrivals of international tourists in the first quarter of 2020 were approximately 8.3 million, which accounted for a 23% decrease, generating tourism revenue of 4.4 hundred billion baht or down by 21%. The impact included the cancellation of hotel rooms and flights to Thailand. In the second quarter, it is expected that the number of foreign travelers will continue to contract by 30% or approximately 6.3 million people. For domestic travel, in the first quarter of 2020, the slowdown in the national economy from last year in conjunction with an increase of the particulate material (PM) 2.5 (hazardous ultra-fine dust) level blanketing many regions and the outbreak situation of the Covid-19 resulted in the stagnation in the market overall. The number of those traveling was 33.58 million people, down by 5%, generating 2.64 hundred billion baht income, which accounted for a 4% decrease. In the second quarter, it is predicted that the slow economic recovery will cause Thai travelers to be cautious about their spending with the ongoing fear of virus infection, which overall will result in a 4% contraction of visitors or about 40.31 million people.

Tantrakarnapa et al. (2020) stated that the number of tourists and their activities were significantly associated with the number of infected, confirmed Covid-19 cases.

For Malaysia, the tourism sector's importance has been highlighted since the year 2008 when it encountered the economic crisis. In such a situation, the tourism sector's added revenue could help the country during the great recession. Moreover, Malaysia is ranked ninth in the list of the most visited countries by UNWTO. Since then, the Malaysian government has tried to push up Malaysia's tourism to reduce its dependence on export-only income. Tourism revenue has become one of Malaysia's main source of income.

For Singapore, one of the most prominent industries and contributors to the Singapore economy is the tourism sector. Singapore's foreign tourists in 2017 accounted for more than three times the total Singapore population. According to the Singapore Tourism Board in 2019, the number of tourists was approximately 19.1 million people with a tourism income of S$27.1 billion.

In 2020, Thailand and other countries worldwide encountered problems from Covid-19, but the main source of income for many countries still depends on the tourism sector. The people involved in the tourism sectors have turned their attention to a more sustainable form of tourism since sustainability is an important policy to stimulate tourism in the long term.

Furthermore, the tourism industry can be linked to national poverty reduction plans. Although tourism is a business that can generate much income for the country, it also negatively impacts the natural resources and environment. As a result, the United Nations' Sustainable Development Goals (SDGs) are set to meet the criteria for developing 'sustainable tourism' globally. The tourism industry has the potential to reduce poverty levels in an environmentally sustainable way.

Understanding the effects of tourism income on poverty reduction in Thailand, Malaysia, and Singapore is the main objective of this study. The regression kink model was used to study causality effects.

The remaining parts of the chapter are arranged as follows: the literature review is discussed in Sect. 2, Sect. 3 demonstrates data and methodology, Sect. 4 is on empirical results. Finally, Sect. 5 describes the conclusions and policy recommendations.

2 Literature Review

Several studies have shown that increased tourism efficiency has a beneficial effect on developing and developed countries' economic development (Higham 2000; Harasarn and Chancharat 2014). Harasarn and Chancharat (2014) investigated the long-run and short-run relationships between tourism income and tourism demand. Their cointegration test result explained that the relationship between arrivals and tourism income could be built over the long term. These results can be applied to improve tourism and stimulate the country's economic growth for those who formulate tourism policies.

Moreover, most of the earlier studies showed the tourism sector to affect economic development positively. Tourism in the ASEAN countries has been studied by many researchers (Cruz 2003; Ardra and Martawardaya 2017). Ardra and Martawardaya (2017) indicated that the ASEAN countries believe tourism can positively affect GDP and poverty reduction. This is the reason that most ASEAN countries support government policies to promote the tourism sector. Based on the research results, it is recommended to continue promoting tourism while studying the best practices in developing the tourism sector strategies to foster positive relationships. For Malaysia, the importance of tourism has been studied extensively (Hamzah 2004; Habibi et al. 2009; Hanafiah and Harun 2010; Tang and Tan 2013; Mosbah and Saleh 2014). Hanafiah and Harun (2010) examined the tourism demand in Malaysia. The finding revealed that, despite the region's economic crisis, the Malaysian government could sustain the economy by using the tourism sector through international tourists. There exists a vast tourism development potential in Malaysia (Mosbah and Saleh 2014). Many researchers have explored the importance of the tourism sector for Singapore since several decades ago (Heng and Low 1990; Khan et al. 2005; Lee 2008). The relationship between tourism and short-run and long-term economic development was studied by Lee (2008). The finding supported the idea that the economy was the driver of the expansion of the tourism sector. In other words, the expansion of tourism is driven by the economy rather than the idea of tourism-led growth. Moreover, Lean et al. (2014) also examined the tourism and economic growth nexus in more recent years, comparing Malaysia and Singapore. Their findings support Malaysia's economic-driven tourism growth hypothesis while supporting the tourism-led economic growth hypothesis for Singapore.

Furthermore, some researchers focused on the sustainability of the tourism industry. Many studies have been done on tourism sustainability in various parts worldwide (Casagrandi and Rinaldi 2002; Gössling et al. 2002; Weaver 2006; Saarinen 2006). Weaver (2006) indicated that it is difficult to formulate a policy that guarantees tourism maintenance for a long time without adversely affecting the environment. Previous studies have confirmed that sustainability has become a policy focus in the tourism sector. Several past studies investigated the implications of tourism on the reduction of poverty (Goodwin 2007; Scheyvens and Momsen 2008; Croes and Vanegas 2008; Blake et al. 2008; Spenceley and Meyer 2012, 2017). The issue concerning tourism and poverty has been studied in many areas around the world such as Fiji, Vietnam, Tanzania, Mauritius, Ghana, Mexico, Costa Rica, Nicaragua, etc. (Nathanael and Joseph 2003; Sharpley and Naidoo 2010; Holden et al. 2011; Scheyvens and Russell 2012; Truong et al. 2014; Vanegas et al. 2015; Garza-Rodriguez 2019; Folarin and Adeniyi 2020). Scheyvens and Russell (2012) investigated the relationship between tourism and poverty in Fiji and found that despite the increase in the number of tourists, poverty continued to rise. Tourism and poverty in Vietnam was studied by Truong et al. (2014). They showed that most local people consider that tourism can help alleviate poverty. Tourism and poverty in Ghana was studied by Holden et al. (2011). Their findings showed that the focus on the use of tourism for macroeconomic benefits is not necessarily beneficial to the poor. The issue of poverty in Malaysia has been studied extensively (Roslan

2001; Abidin and Rasiah 2009; Hatta and Ali 2013). Roslan (2001) examined income inequality and poverty in Malaysia. It was argued that government intervention under the New Economic Policy had successfully shaped economic growth and development. Whereas for Singapore, study in terms of poverty reduction from tourism has been relatively limited until recent years (Suryadinata and Beng 1997; Donaldson et al. 2013; Ng 2013). Donaldson et al. (2013) suggested that financial measures remain an easy and effective way to evaluate the population's needs.

Since the importance of tourism for economic growth is not questionable, the Covid-19 outbreak, which has evolved into a pandemic, has prompted many studies about the covid-19's impacts on the tourism sector (Abiad et al. 2020; Elengoe 2020; Foo et al. 2020; Karim et al. 2020; Pornphol and Chittayasothorn 2020; Qiu et al. 2020; Shorey et al. 2020; Suntronwong et al. 2020; Tantrakarnapa Bhopdhornangkul and Nakhaapakorn 2020; Uğur and Akbıyık 2020; Wong et al. 2020; Woo 2020). Uğur and Akbıyık (2020) studied the impacts of Covid-19 on the global tourism industry. They found that the tourism sector is easily affected by global crises as the travelers decide to cancel or delay their trips with the spread of the news, and travel insurance has become a hot topic. This study aimed to present the reactions of travelers during the Covid-19 pandemic. Meanwhile, Abiad et al. (2020) investigated the economic impact of the Covid-19 outbreak on developing Asia. Their findings indicate that the tourism arrivals and receipts in many developing Asian economies are expected to decline sharply due to numerous travel bans and precautionary behavior.

As for the poverty reduction issue in ASEAN community, the context and the situations of the poverty were discussed in a report by the International Fund for Agricultural Development (IFAD). The report in 2011 states that 53% of South-East Asia's population, or approximately 569 million people, live in poverty. Moreover, approximately 18% of people in ASEAN region suffer from severe poverty. Fifty-four percent of ASEAN's population live in rural areas, and 62% of the poor live in rural areas. Also, when compared with other regions, it was found that the ASEAN has the second-highest proportion of the population living in the rural areas after Sub-Saharan Africa. Some of the ASEAN's rural problems are due to the lack of areas necessary for life and over-rapid development. The shortage is defined as a lack of utilities and infrastructure. This shortage creates a barrier for the poor to access the basic infrastructure. The rapid development flow resulted in converting agricultural, forestry, and coastal areas for rural residents into industrial areas and commercial areas. Moreover, the government's policy in agriculture sector is beneficial mainly for big investors. It caused land loss from local farmers to companies that tend to use high technology instead of hiring farmers.

Due to low economic opportunities in rural areas and lower quality of life, there is more immigration to the urban area in ASEAN. This resulted in urban poverty due to a large number of inhabitants. This causes housing systems, safe drinking water, electricity, sanitation, and other services to remain inadequate for the immigrant population.

Tackling poverty in the ASEAN Community is defined in the ASEAN Socio-Cultural Community (ASCC) Plan, which consists of multifaceted cooperation. Issues relating to the elimination of poverty are present in a subset of areas such

as human development, protection and social welfare, justice and rights, promoting environmental sustainability, narrowing the gap of development. First, human development has several related elements, namely promoting appropriate employment and the building of entrepreneurial skills for women, youth, the elderly, and disabled persons. Second, in the area of protection and social welfare, sub-elements are: eradicating poverty, promoting food security and safety, accessing health care and promoting healthy livelihoods, and enhancing the control of communicable diseases. Third, justice and rights will focus on protecting and promoting migrant workers. Fourth, the environmental sustainability promotion will focus on promoting the quality of living standards in ASEAN urban areas. Last, reducing the development gap is to try to make the ASEAN region develop together so as not to create too much inequality.

In practice, ASEAN has established a Framework Action Plan on Rural Development and Poverty Eradication. The operations of the Framework Action Plan on Rural Development and Poverty Eradication include sustainable rural development, the maintenance of food security in the wake of climate change, the development of the public utilities and human resources in the rural areas, and the promotion of education in rural areas. The sustainable rural development approaches include the establishment of a cooperative system as a financial option for household or small-scale agriculture, land tenure reform, the access to and the management of the natural resources by poor people. Maintaining food security under climate change can be done by growing a wide variety of indigenous crops that provide resilience and can also help preserve biodiversity and ensure food security instead of high-risk monocultures. The development of public utilities and human resources in rural areas may involve using information technology as a tool to address poverty or empower village leaders, village youth, and rural women to participate in livelihood development and generate income. Promoting education in rural development includes promoting a volunteer system to exchange knowledge from examples of success based on the wisdom and culture of indigenous people or local people. These plans are to be followed to reduce and ultimately eliminate poverty in the ASEAN region. In reality, poverty is not a quick and easy problem. At the same time, the poverty problem is a challenging as well as time-consuming problem to solve.

As for the poverty reduction issue in Singapore, there may not be much study because Singapore is considered a new-born country. Previously, Singapore was part of the Malaysian Federation, but split as an independent country in 1965. Fifty years ago, Singapore's image was one of poverty. Most workers were working-class, working around the port. Singapore is a country that lacks natural resources. Moreover, there were many problems, such as communist threats, racial issues, trade union protests, a high unemployment rate, the lack of housing for citizens, and the general public lack of education. In 1965, Singapore's development started to survive politically and economically.

Developing the country's workforce and establishing a robust education system are the core of Singapore's early development plans. In the past five decades to the present, Singapore is regarded as the most successful example of the twentieth century in major developments in the country. The examples of key developments in

Singapore include rapid economic growth, population productivity, improvement of people's quality of life and the quality of education systems, and building housing for citizens. Many reasons, such as a small population, caused Singapore's success in developing the country. This causes efficient and economic public management, such as in the provision of social services or infrastructure development, which makes it differ from large countries such as India or Brazil. One of the main reasons for Singapore's success in rapid development is government institutions and organizations' moral principles. Singapore is well known for building moral institutional and governmental organizations. This makes it the most investment-friendly country in the world. Such institutions include an efficient and high-quality bureaucracy, fair justice under the law, political leaders of great virtue, and social unity—all of which are factors contributing to political stability. This success can be seen in its ranking as the least corrupt country. This demonstrates Singapore's upholding of the integrity of governance. Some past studies (Donaldson et al. 2013; Ng 2013) also focused on the context of poverty in Singapore. Donaldson et al. (2013) suggested financial measures are an easy and effective way to assess the population's requirements.

The topic of poverty in Thailand has been widely studied by various researchers (Kakwani 2000; Kakwani and Krongkaew 2000; Deolalikar 2003). Poverty has been a problem in Thai society for more than 40 years. Poor people are those with inadequate income for a decent living in society, roughly 18 million persons, which make up about one third of Thailand's total population. After a period of continuous economic growth, especially during the year 1988, the number of poor people in Thailand began to decline. Later in the years 1997–2006, Thailand still had 10% of its population being poor or about 6 million people. It can be seen that the poverty headcount ratio in Thailand tends to increase. Nowadays, poverty is a major problem in Thailand. The government must take seriously the remedy of poverty that has existed for some time. The problem of poverty in Thailand in the past was not as serious as it is today. The expansion of trade causes the problem of inequality among the Thai people. Rich people are getting richer and poor people are becoming poorer. This noticeable difference between the poor and the rich arises because the current income distribution system is inefficient. The poor have lack of access to resources, products, and services and cannot meet their needs. Furthermore, Thailand's poverty problem is not just about the inability of the poor. Rather, it is a problem for the rich and the middle class who do not have a long-run view of contributing to society and just consider their own interests. In conclusion, poverty in Thai society is a problem that has been present for a long time and tends to escalate into a crisis. The increasingly significant differences in economic conditions between the poor and the rich and the middle class have resulted in the poor's living condition difficulties. This problem may eventually harm the nation. Therefore, solving the problem of poverty is an important matter that everyone in society must cooperate with. In the long run, the benefits will fall to all people in the country.

Thailand's tourism industry has become a significant factor in promoting social and economic development and reducing the current income and wealth gap between the rich and poor. Projecting the impact of the tourism sector on the economy is a form of challenge for all stakeholders. However, it is not easy to answer what

the interrelation between the tourism industry and the socio-economic setting and the environment would look like in Thailand. Poverty reduction issues in Thailand have been tackled by Fan et al. (2004), Andam et al. (2010), and Rattanaphonwong et al. (2020). For instance, Rattanaphonwong et al. (2020) aimed to develop the model for solving poverty in a community in Thailand and to verify the model with empirical data in the community-based sample. Their proposed model consisted of four variables: (1) government measures, (2) personal and household behaviors, (3) community guidelines, and (4) goals against poverty.

Furthermore, for poverty and inequality in Malaysia between 1995 and 2017, it was found that the income gap or inequality of high-income people and low-income people tended to increase. Malaysia's major economic problems are unemployment and poverty, especially the Malays in rural areas. Thus, the government is trying to develop land and building facilities and infrastructure such as roads, schools, nursing homes, and irrigation systems in the rural areas. Although these policies were successful to a degree, they could not eliminate the problem of poverty in Malaysia. From the past research in Malaysia's case, we can conclude that Malaysia's poverty has become the main focus for both the public and the private sectors to work together to tackle more poverty or inequality. There are numerous studies about Malaysia's tourism sector, but in terms of the tourism sector's role in reducing poverty in Malaysia there is a literature gap. This gap makes this research different from the research in the past. Poverty in Malaysia has been widely studied by many researchers such as Siwar et al. (2009), Ramlan and Johari (2019), Ravallion (2019), Roslan (2020), Ravallion (2020), and Lehmann (2020). Ramlan and Johari (2019) studied the factors that influenced hardcore urban poverty in Malaysia. They found that Malaysia's urban poverty became phenomenal because of urbanization's impacts when the population migration from rural to urban areas escalated. The finding indicated that marital status and education levels significantly affect hardcore urban poverty in Malaysia.

3 Data and Methodology

3.1 Dataset

The amount of tourism revenues is the most typical representative of the tourism industry. Meanwhile, the poverty headcount ratio is the poverty indicator employed as a variable to measure the poverty level. This study uses the regression kink model to analyze the relationship between the tourism revenues and the poverty, using the dataset between 2007 and 2019 from CEIC Data (CDM).

3.2 Methodology

3.2.1 Bayesian Structural Time Series Model

The Bayesian Structural Time Series (BSTS) model can be used for nowcasting economic time series. Forecasting a current value is the main objective of nowcasting models. The most difficult part in the use of the nowcasting model is the process of predictor selection. In this study, we use a structural time series model to acquire the target series. The nowcasting model consists of two parts, a time-series component and a regression component. Furthermore, the Bayesian method can be employed to estimate the joint model. The BSTS model can be defined by two equations as follows:

$$y_t = z_t^T \alpha_t + \varepsilon_t; \varepsilon_t \sim N(0, H_t) \tag{1}$$

where y_t is the observed data, and α_t is the unobserved latent state. Equation (1) is called the observation equation. The transition equation is shown as Eq. (2).

$$\alpha_{t+1} = T_t \alpha_t + R_t \eta_t; \eta_t \sim N(0, Q_t) \tag{2}$$

where ε_t, η_t are Gaussian and independent of everything else. z_t, T_t, R_t are the structural parameters.

Meanwhile, the regression component will contain the following equations:

$$y_t = \mu_t + T_t + \beta^T x_t + \varepsilon_t \tag{3}$$

$$\mu_t = \mu_{t-1} + \delta_{t-1} + u_t \tag{4}$$

$$\delta_t = \delta_{t-1} + v_t \tag{5}$$

$$T_t = -\sum_{s=1}^{s-1} T_{t-s} + w_t \tag{6}$$

where u_t, v_t, w_t are the Gaussian random noises. μ_t is the current level of the trend. δ_t is the current slope of the trend. T_t is the seasonal component. s is the set of dummy variables. S is the full season. β is the regression coefficient. x_t is the vector which shows a contemporaneous set of search queries or trends verticals. Trend verticals include any desired lags or other transformations.

The BSTS model comprises three main components, including the Kalman filter, Spike-and-slab, and Bayesian model averaging.

The Kalman filter recursively computes the predictive distribution $p(\alpha_{t+1}|y_{1:t})$ by combining $p(\alpha_t|y_{1:t-1})$ with y_t. The Kalman smoother updates the output of the

Kalman filter to produce $p(\alpha_t|y_{1:n})$, where n is the length of the time series, at each value of t. $p(\alpha_{t+1}|y_{1:t})$ and $p(\alpha_t|y_{1:n})$ are Gaussian multivariate normal distributions parameterized by mean μ_t and variance P_t. Equation (7) is a spike-and-slab prior.

$$p\left(\beta, \gamma, \sigma_\varepsilon^2\right) = p\left(\beta_\gamma|\gamma, \sigma_\varepsilon^2\right)p\left(\sigma_\varepsilon^2|\gamma\right)p(\gamma) \tag{7}$$

where $p(\gamma)$ is the spike (marginal distribution $p(\gamma)$.

The sparsity in the Bayesian paradigm can be represented by a spike-and-slab prior on the regression coefficients. When $\beta_k \neq 0$, then let $\gamma_k = 1$ and when $\beta_k = 0$, then let $\gamma_k = 0$.

An independent Bernoulli prior can be used as simply.

$$\gamma \sim \prod_{k=1}^{k} \pi_k^{\gamma k}(1-\pi_k)^{1-\gamma k} \tag{8}$$

where k is the dimension of x_t. It is useful to set $\pi_k = 0$ or $\pi_k = 1$.

We assume that all the π_k have the same value π. The conditionally conjugate pair can be expressed by the conditional priors $p\left(1/\sigma_\varepsilon^2|\gamma\right)$ and $p\left(\beta_\gamma|\sigma_\varepsilon, \gamma\right)$.

$$\beta_\gamma\left|\sigma_\varepsilon^2, \gamma \sim N\left(b_\gamma, \sigma_\varepsilon^2\left(\Omega_\gamma^{-1}\right)^{-1}\right); \frac{1}{\sigma_\varepsilon^2}\right|\gamma \sim Ga\left(\frac{v}{2}, \frac{ss}{2}\right) \tag{9}$$

where $\beta_\gamma|\sigma_\varepsilon^2, \gamma \sim N\left(b_\gamma, \sigma_\varepsilon^2\left(\Omega_\gamma^{-1}\right)^{-1}\right)$ is the mean of prior. $\frac{1}{\sigma_\varepsilon^2}|\gamma \sim Ga\left(\frac{v}{2}, \frac{ss}{2}\right)$ is the variance of prior. $Ga(r, s)$ is the gamma distribution with mean $\frac{r}{s}$ and variance $\frac{r}{s^2}$ Eq. (9) is the slab.

Conditional posterior of β and σ_ε^2 given γ

$$\beta_\gamma\left|\sigma_\varepsilon, \gamma, y^* \sim N\left(\tilde{\beta}_\gamma, \sigma_\varepsilon^2\left(\Omega_\gamma^{-1}\right)^{-1}\right); \frac{1}{\sigma_\varepsilon^2}\right|\gamma \sim Ga\left(\frac{v}{2}, \frac{ss}{2}\right) \tag{10}$$

The posterior of the BSTS model is $\beta_\gamma|\sigma_\varepsilon, \gamma, y^* \sim N\left(\tilde{\beta}_\gamma, \sigma_\varepsilon^2\left(\Omega_\gamma^{-1}\right)^{-1}\right)$.

The standard conjugate formulas can express the conditional on γ the joint posterior distribution for β and σ_ε^2. The sufficient statistics can be written as in the following:

$$\begin{aligned} v_\gamma^{-1} &= \left(x^T x\right)_\gamma + \Omega_\gamma^{-1} \\ \beta_\gamma &= \left(v_\gamma^{-1}\right)^{-1}\left(x_\gamma^T y^* + \Omega_\gamma^{-1} b_\gamma\right) \\ N &= v + n \\ ss_\gamma &= ss + y^{*T} y^* + b_\gamma^T \Omega_\gamma^{-1} b_\gamma - \tilde{\beta}_\gamma^T v_\gamma^{-1} \tilde{\beta}_\gamma \end{aligned}$$

The marginal posterior of γ

$$\gamma|y^* \sim C\left(y^*\right)\frac{\left|\Omega_\gamma^{-1}\right|^{\frac{1}{2}}p(\gamma)}{\left|v_\gamma^{-1}\right|^{\frac{1}{2}}ss_\gamma^{\frac{N}{2}-1}} \tag{11}$$

where $C(y^*)$ is a normalizing constant that relies on y^*. Equation (11) can be obtained from conjugacy, one can analytically marginalize over β_γ and $1\big/\sigma_\varepsilon^2$.

However, the stimulation of the posterior distribution of the model can be done by using Markov chain Monte Carlo (MCMC) algorithms. MCMC model can be used to simulate the posterior distribution of the model. The steps of the MCMC method include the following:

Step (1). The simulation of the latent state α from $p\left(\alpha|y,\theta,\beta,\sigma_\varepsilon^2\right)$ can be done by the simulation smoother; where θ is the parameter in the MCMC process, σ_ε^2 is the variance parameter, and β is the mean parameter.

Step (2). Simulate θ (the set of model parameters, $\theta \sim p\left(\theta|y,\alpha,\beta,\sigma_\varepsilon^2\right)$).

Step (3). Simulate β and σ_ε^2 from a Markov chain with stationary distribution $p\left(\beta,\sigma_\varepsilon^2|y,\alpha,\theta\right)$.

Let $\phi = \left(\theta,\beta,\sigma_\varepsilon^2,\alpha\right)$. Repeatedly cycling through the three steps yields a sequence of draws $\phi^{(1)},\phi^{(2)},\ldots$ from a Markov chain with stationary distribution $p(\phi|y)$, the posterior distribution of ϕ given y. The state component in Step (2) is the determinant for drawing θ in Step (2).

3.2.2 Forecasting

The posterior predictive distribution in Bayesian data analysis is fundamental for forecasting our model. The posterior predictive distribution of the set of values to be predicted $(\tilde{y})$ is

$$p(\tilde{y}|y) = \int p(\tilde{y}|\phi)p(\phi|y) \tag{12}$$

where $(\tilde{y})$ is the predicted value, y is the actual value, and p is posterior.

3.2.3 Regression Kink Model

The regression kink model is also known as the continuous threshold regression model. The threshold effects are of either continuous or discontinuous types.

The continuous threshold effects can be written in the equation form as in the following:

$$\eta = \mu_1 + \mu_2^T\rho + \delta_1(\chi - \varepsilon)_+$$

where ε is the parameter of threshold

χ is the predictor with the threshold effect

χ is the predictor with the threshold effect
ρ is a vector of additional predictors

$$(\chi - \varepsilon)_+ = \begin{cases} \chi - \varepsilon & if\ \chi > \varepsilon \\ 0 & if\ otherwise \end{cases}$$

$$(\chi - \varepsilon)_- = \begin{cases} 0 & if\ \chi > \varepsilon \\ \chi - \varepsilon & if\ otherwise \end{cases}$$

Meanwhile, the discontinuous threshold effects have two forms namely step and segmented which can be written as the equations below:

(1) Step discontinuous threshold effects model can be shown as:

$$\eta = \mu_1 + \mu_2^T \rho + \delta_1 I(\chi > \varepsilon)$$

(2) Segmented discontinuous threshold effects model can be shown as:

$$\eta = \mu_1 + \mu_2^T \rho + \delta_1 (\chi - \varepsilon) + \lambda \chi + \delta_2 I(\chi > \varepsilon)$$

where

ε is the parameter of threshold
χ is the predictor with the threshold effect
ρ is a vector of additional predictors

$$I(\chi > \varepsilon) = \begin{cases} 1 & if\ \chi > \varepsilon \\ 0 & if\ otherwise \end{cases}$$

4 Empirical Results

4.1 Relationship Between Amount of International Tourism Revenues and Poverty Headcount Ratio in Thailand

At the beginning, the increasing revenue from foreign tourists led to an increase in the poverty headcount ratio with a gentle slope. Later, as the revenues from international tourists continued to increase, the poverty headcount ratio in the country decreased rapidly after the kink point (3.63) (see Fig. 1).

Figure 4.1 demonstrates a drastic change in the shape of the relationship between the international tourism revenues and the poverty headcount ratio which occurs at the kink-point where the international tourism revenue was equal to 3.63.

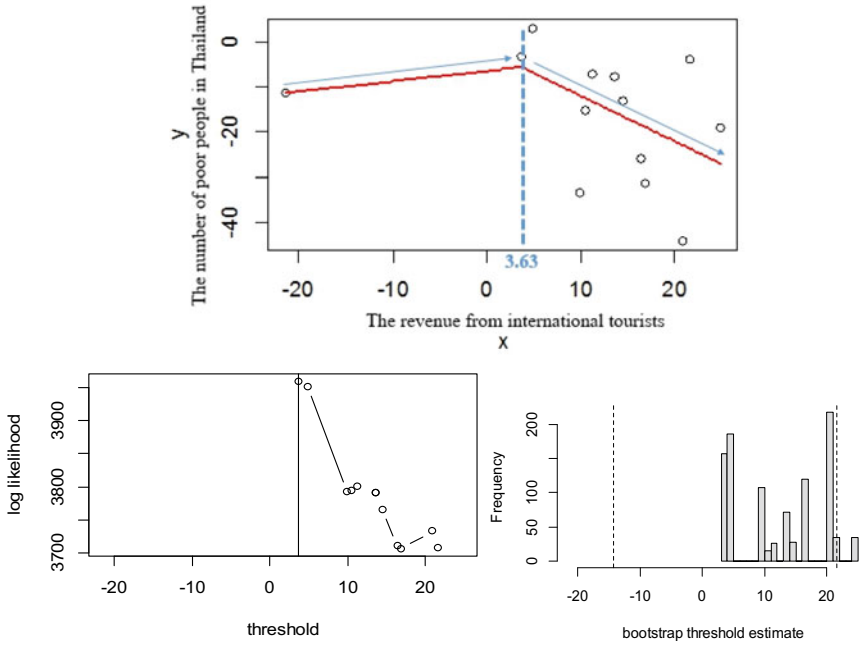

Fig. 1 The relationship between amount of international tourism revenues and poverty headcount ratio in Thailand. *Source* Author

4.2 Results of Relationship Between Amount of Domestic Tourism Revenues and Poverty Headcount Ratio in Thailand

At beginning, when the international tourism revenue is increasing, this led to the decreasing poverty headcount ratio with a gentle slope. Later, as the revenue from domestic tourists is increasing, the poverty headcount ratio tends to increase rapidly after the kink point (14.12) (see Fig. 2).

Figure 2 demonstrates a strong change in the shape of the relationship between the revenues from domestic tourists and the poverty headcount ratio occurring when the kink-point is equal to 14.12.

4.3 Relationship Between Amount of International Tourism Revenues and Poverty Headcount Ratio in Malaysia

At the beginning, the continued increase in international tourism revenues is associated with the decreasing poverty headcount ratio with a gentle slope. Then, when the

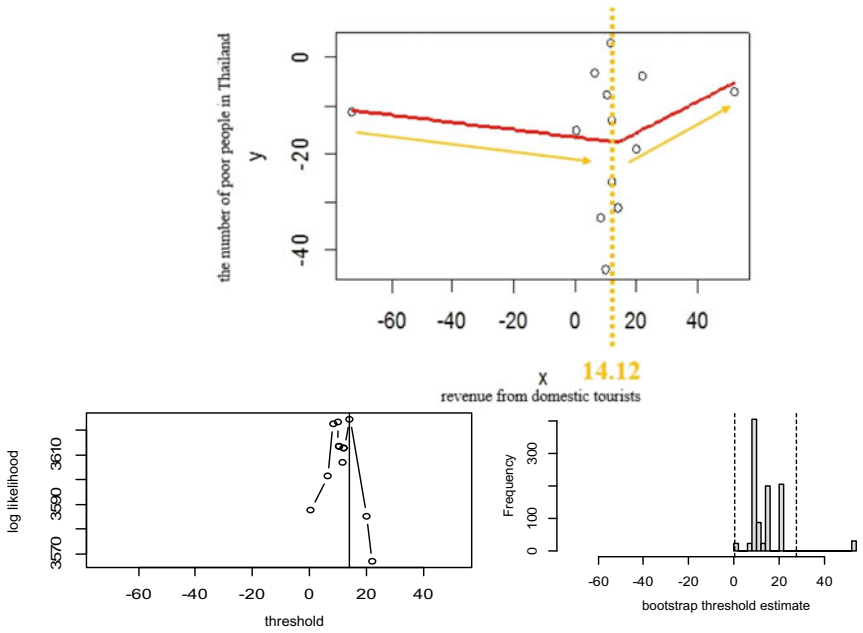

Fig. 2 The relationship between amount of tourism revenues from domestic tourists and poverty headcount ratio in Thailand. *Source* Author

tourism revenues still increase, the poverty headcount ratio increases rapidly after the kink point at 15.84 (see Fig. 3).

Figure 3 demonstrates a strong change in the shape of the relationship occurring when the kink point is equal to 15.84.

4.4 Relationship Between Amount of International Tourism Revenues and Poverty Headcount Ratio in Singapore

For Singapore, increasing international tourism revenues can lead to a decrease in the poverty headcount ratio only at the beginning of time. Then, the poverty headcount ratio tends to increase after the kink point at 0.38 (see Fig. 4).

Figure 4 demonstrates that a strong change in the shape of the causal relationship occurs when the kink point equal to 0.38.

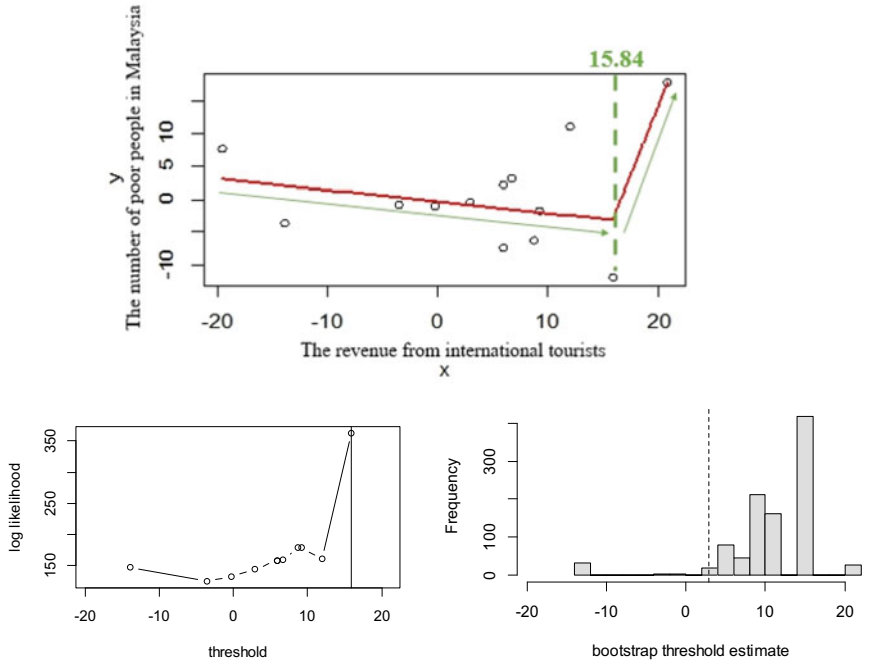

Fig. 3 The relationship between amount of international tourism revenues and poverty headcount ratio in Malaysia. *Source* Author

5 Conclusions and Policy Recommendations

5.1 Conclusions

From the empirical findings of this chapter, we can conclude that the revenues from international tourism in Thailand can reduce the poverty headcount ratio in a longer period (after the kink point), and it has a long-term impact on poverty reduction. The revenues from domestic tourism in Thailand can reduce the poverty headcount ratio at the beginning (before the kink point), and it has a short-term impact on poverty reduction. For Malaysia, the poverty headcount ratio can be reduced by increasing the revenues from international tourism before the kink point at 15.84. This means the international tourism revenue has a short-run impact on poverty reduction in Malaysia. For Singapore, the poverty headcount ratio can be decreased by increasing the revenues from international tourism before the Kink point at 0.38. For Singapore, also like Malaysia, international tourism revenue has a short-run impact on poverty reduction.

The relationship between the international tourism revenues and the poverty headcount ratio in Malaysia and that in Singapore has a similar form. The revenues from

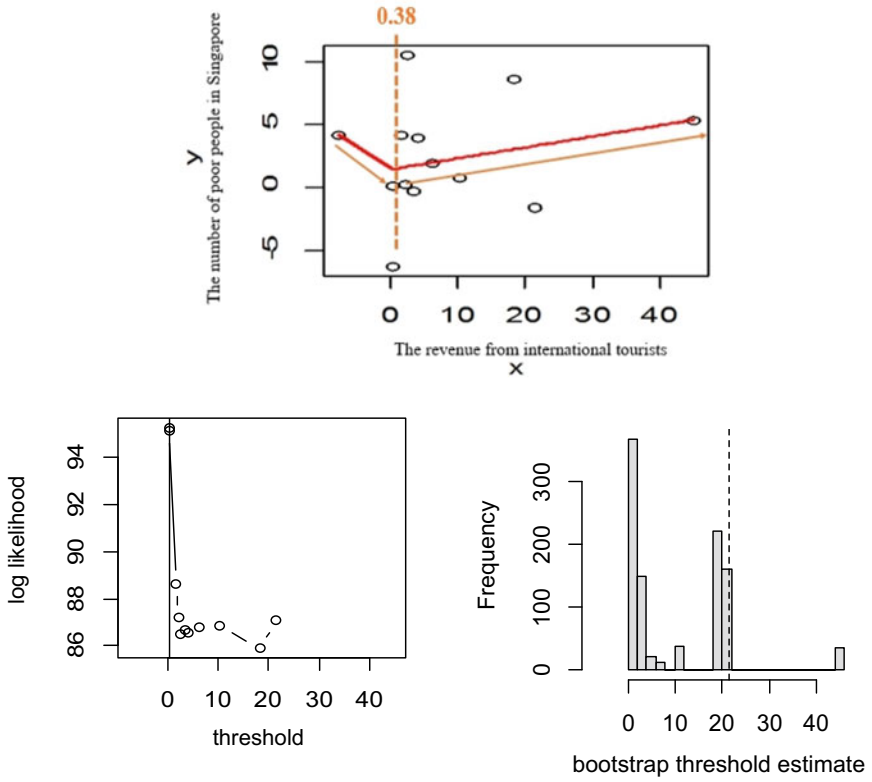

Fig. 4 The relationship between amount of international tourism revenues and poverty headcount ratio in Singapore. *Source* Author

the international tourism can reduce the poverty headcount ratio in the earlier period. Malaysia and Singapore's main difference is that the revenues from international tourism in Malaysia can reduce the poverty headcount ratio in a more extended period than Singapore.

5.2 Policy Recommendations

In making a poverty reduction policy by employing tourism policies in Thailand, at the beginning or at the initial stages of the tourism industry's development, tourism revenue from domestic tourists can be used as a catalyst to reduce the country's poverty. The income generated from international tourism should be considered as a long-term poverty reduction tool. Therefore, Thailand should focus on the income generated by foreign tourists for the long-run poverty reduction plans, as income

from foreign tourists can help reduce the country's poverty more in an extended period.

For Thailand, the Thai government has launched several campaigns to stimulate the tourism economy, both domestic and international tourism. This study shows that for Thailand, the first phase may require the use of income from domestic tourism, and the government needs to promote the domestic tourism more. After that, the foreign tourism policy will be applied accordingly. The results of this study are consistent with the Thai government's policy action during the Covid-19 crisis. Initially, to revive the tourism economy, the Thai government made a policy that is a guideline for stimulating domestic tourism, such as a project that the government launched to encourage Thai people to travel throughout the country during the period of the Covid-19 pandemic. The aim of creating a travel subsidy project in Thailand is not only to encourage people to go and travel but also to distribute money or income into the tourism industry chain as the Covid-19 crisis has affected all sectors related to the tourism industry, from attractions, hotels, to the working class in the tourism industry. Furthermore, the Thai government is also working on projects to revive the tourism economy, 'Holiday for Hero' and 'Amazing Thailand Grand Sale'. Holiday for Hero is a government-operated program to give vouchers to healthcare professionals who work in hospitals, public or private sectors, in dealing with Covid-19 to appreciate their hard work for the country. As for the Amazing Thailand Grand Sale project, it is a project that offers tourists discounts on shopping in shops or department stores—because the government recognizes that income from tourists' shopping can help stimulate the country's economy to move.

However, amid the Covid-19 crisis, Thailand proved its policy effectiveness in controlling the pandemic, which was an excellent safety sign for international tourism. Safety tourism and health tourism are the main drivers of tourism in Thailand following Covid-19. The strategic objectives of the Tourism Authority of Thailand (TAT) are two-fold: to revive the tourism sector—such as create jobs, generate income, add liquidity and encourage consumption through domestic travel—and to generate income from foreign tourists with high spending potential to create a new structural balance for sustainable tourism.

To create a new structural balance for sustainable tourism, a strategy known as R5 is used. R5 consists of Reboot, Rebuild, Rebrand, Rebound, and Rebalance. The reboot is a strategy that uses the Go Again approach and the Go Local approach. The Go Again approach promotes domestic repeat trips, increases the frequency of the target group's travel, and promotes Thailand-to-Thailand trips. The Go Local approach focuses on developing and promoting the tourism sector to support the local economies and communities. Rebuild is a strategy that uses the Go New Norm approach and the Go Digital approach. Rebuild is an approach that focuses on rebuilding, normalization, and long-term competitive enhancement. The Go New Norm approach focuses on solving problems and creating what will be a solid foundation for the tourism industry in the future. The Go Digital approach is a guideline that focuses on the development of information systems to ensure safety. Rebrand focuses on marketing communications with a new image to make Thailand a tourist destination that both Thai and foreign tourists think of and decide to travel to. Rebound

is an approach that focuses on stimulating the international tourist market to come back within a short time, especially those with high spending potential. Maintaining a quality tourist base and target audience can be achieved through the Go High approach and the Go Quality approach. The Go High approach is niche marketing, especially the health and wellness traveler segment. The Go Quality approach is to focus on a market with growth potential. Rebalance is rebalancing sustainability through the Go Responsible approach and the Go Sustainability approach. The Go Responsible approach is a focus on preserving nature that has recovered from the Covid-19 period and encouraging participation in promoting more socially and environmentally responsible tourism. The Go Sustainability approach aims to generate income from tourism based on balancing the economy, society, and environment.

For the ways to stimulate international tourism after implementing the domestic tourism policy, the member countries of ASEAN have joined forces to create a project called Bubble Travel. The concept of Bubble Travel is the opening of a country by matching tourism with countries that control the Covid-19 outbreak effectively. People between the two countries can travel without a 14-day quarantine, assuming they meet certain conditions, for example a Covid-19 test certificate. The benefit of a Travel Bubble campaign is that it will bring foreign tourists to the country. Besides, it can also increase the spending of tourists. However, suppose Thailand implement the Travel Bubble policy with other ASEAN countries. In that case, it should also consider multiple impacts, such as the risk of the recurrence of Covid-19 phase 2 and phase 3, which many countries are now facing.

In Malaysia and Singapore's case, to create a policy for poverty reduction by using the tourism sector as a tool, both countries need to create policies simultaneously and rapidly at the beginning of the time before reaching the kink point. The revenues from the tourism sector cannot be used as a tool to reduce the poverty headcount ratio after going through the kink point.

Furthermore, as a result of the situation of the Covid-19 outbreak, the economies of many Asian countries have been shut down, and one of the top-hit and worst-hit businesses is tourism businesses, such as hotels, attractions, amusement parks, and airlines. The main reason is that traveling abroad is not possible. Thus every country wants to set up a tourism policy to stimulate the speedy recovery of tourism—especially in the ASEAN, where most member countries earn their primary income from the tourism sector.

Malaysia shut down the country for more than three months after the Covid-19 crisis. After that, when the government saw that the Covid-19 pandemic in the country was improving, some borders were opened to foreign workers and medical tourists to enter the country and allow people to work as usual after the long break. The Malaysian government planned for the resurgence and stimulating the country's tourism economy, starting with the Bubble Travel plan as well. The Malaysian government is negotiating with Singapore and Brunei to allow tourists to enter without quarantine, according to a plan to stimulate tourism after the Malaysian government foresaw a continued improvement in the situation of Covid-19 in Malaysia.

For Singapore, although Singapore is considered the most developed country in ASEAN, Singapore has been hit by the Covid-19 crisis similar to the rest of ASEAN and other countries worldwide. The Singapore government has launched a campaign called 'Singapoliday' to revive the country's tourism economy. With this tourism stimulus plan, the Singapore government has partnered with organizations, both businesses and communities, to focus on stimulating domestic tourism in preparation to welcome foreign tourists when they can return to travel in the country. Furthermore, the Singapore government has taken into account changing foreign tourist behavior after Covid-19. This caused the Singapore government to plan to promote sustainable tourism. The main objective of promoting sustainable tourism in Singapore is to promote tourism, emphasizing health issues.

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Part II
Role of International Remittances and Microfinance in Poverty Reduction

Chapter 5
Leveraging Remittances to Promote Inclusive Growth and Reduce Poverty: Evidence from Low- and Middle-Income Asian Economies

Lee Chin, Hayot Berk Saydaliev, and Abdalla Sirag

Abstract This study investigated the role of remittances in inclusive growth and poverty reduction in Asian low- and middle-income economies between 1995 and 2019. The results of the dynamic panel threshold estimator and system generalized method of moments (GMM) revealed that remittances increase inclusive growth and reduce poverty in most countries studied, but show mixed effects in the short run. The results also suggest that workers' remittances tend to lower poverty rates in Asian low- and middle-income countries in the early stages of economic development but increases poverty when remittances go beyond the threshold of 8% of GDP. In that phase, foreign direct investment (FDI) replaces remittances as the source of development. To this end, our empirical paper sheds light on the channels through which remittances foster inclusive growth and alleviate poverty. This suggests that policies focusing on attracting remittance inflows should enhance the FDI absorbing environment, which is crucial in taking advantage of remittances for future developmental agendas. Policy recommendations are provided at the end of the chapter.

Keywords Remittances · Economic development · Poverty · Panel threshold

JEL Codes F24 · C23

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1 Introduction

The money migrants earn overseas and send back to their country of origin, so-called 'remittance', remains an area of interest among scholars and policy makers. In the last two decades, workers' remittances have witnessed a dramatic increase. In particular, global remittances increased from $470 billion in 1995 to $683 billion in 2019. More importantly, remittances to low- and middle-income countries (LMICs) grew from $343 billion in 1995 to $520 billion in 2019, representing a 53% growth rate. This suggests that remittances contribute to the economic development of LMICs by stimulating consumption and increasing aggregate demands. On a similar note, Yoshino et al. (2020) reported that remittances are not only beneficial for the welfare of those who receive them but also of those who engage in transactions with the recipients. It has also been observed that the inflow of remittances broadens the access of recipients to various financial services, which leads to more financial inclusion. Notably, remittances to developing economies in the last two decades have amounted to 15 times more than official transfers, 18 times more than official capital flows, and about 30% of exports (Barajas et al. 2010b). They are also worth over two times more than private capital flows (Barajas et al. 2010b) and nearly three times more than official aid flows (World Bank 2016). For developing countries, international financial remittance inflows are considered one of the key stimulating factors to better economic performance (Yoshino et al. 2020). It is suggested that remittances have more effects on the overall economy's performance especially in those at lower stage of development.

Alleviating poverty has firmly been established as a key goal of the global development agenda. In its most basic definition, poverty refers to the scenario where a population lives on less than $1.90 a day (Mundial 2018). While headcount is typically used to measure poverty, poverty depth and poverty severity are also significant measures to be considered. Poverty depth, also called the poverty gap, is defined as the average distance between poor individuals and the poverty line. The World Bank states that a poverty gap of $1.90 per day (2011 PPP) reflects the mean income or consumption shortfall from the poverty line of $1.90 per day (where the non-poor are assumed to have zero shortfall); this is articulated as a proportion of the poverty line (World Bank 2018). This poverty gap, when squared, is termed poverty severity, which represents the average of the squared distance under the poverty line in percentage. According to the (World Bank 2018), 10% of the people are living below the poverty line are in Asia.

Therefore, this study aimed to examine the influence of remittances on poverty alleviation and economic growth in Asian low- and middle-income recipient countries over the period ranging from 1995 to 2019. This study thus adds value to the literature and practice by providing a better understanding of how international remittances can mitigate poverty in Asian countries. The current study provides the following contributions to the existing literature. First, the study highlights the impact of remittance inflows on both poverty and inclusive growth. The majority of the previous studies have focused on investigating the effect of remittances on either

growth or poverty, but not both. Second, our study paid attention to the potential nonlinearity between international financial remittances and poverty, therefore the dynamic panel threshold model of Seo and Shin (2016) is utilized. To the best of our knowledge, there is a lack of a paper that employs the threshold estimation technique regarding the issue in hand.

The remainder of this chapter is structured in the following manner. The next section discusses the latest findings on international remittances and poverty, particularly in low- and middle-income Asian countries. Section 3 then summarizes the literature on remittances and poverty. Section 4 presents the methods used for analysis. The final section summarizes the main findings of the study, its policy implications, and suggestions for future work.

2 Background of Study

2.1 Recent Trends in Remittances to Asian Low- and Middle-Income Countries

Remittances have evolved into one of the most stable and substantial sources of external financial flows, increasing more steadily and often overshadowing traditional financing sources such as foreign direct investment flows (FDI) (Barajas et al. 2010a) and official aid flows (World Bank 2016) (see Fig. 1). In 2018, $683 billion in remittances were received across the globe, representing about 0.72% of the world's GDP and 27% of developing countries' GDP (World Bank 2018). Global remittances

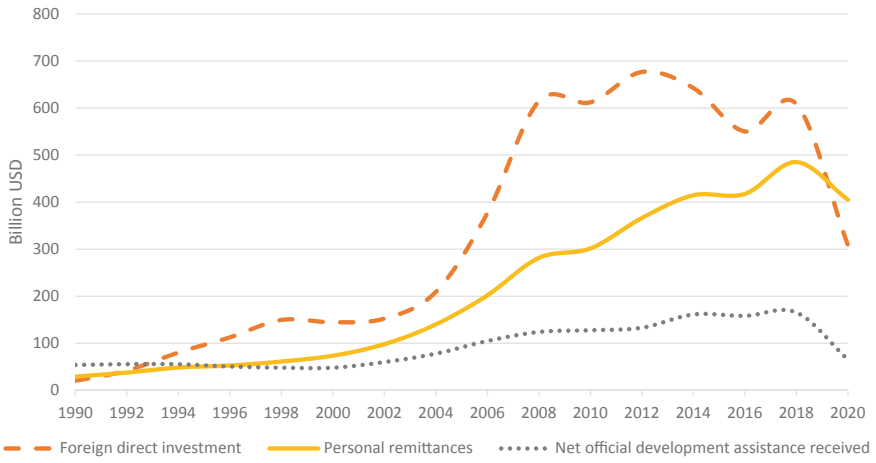

Fig. 1 Remittances inflow into low- and middle-income countries (1990–2020) (*Source* World Bank 2020)

are projected to decline sharply by around 20% in 2020 due to economic crises induced by the Covid-19 pandemic. Remittances to LMICs are also projected to fall by 19.7% to $445 billion, representing the loss of a crucial financing lifeline for many vulnerable households. Specifically, remittance flows are predicted to decrease across all World Bank Group regions, most notably in Europe and Central Asia (27.5%), followed by Sub-Saharan Africa (23.1%), South Asia (22.1%), the Middle East and North Africa (19.6%), Latin America and the Caribbean (19.3%), and East Asia and the Pacific (13%). Even with this decline, remittance flows are expected to become more important as a source of external financing for LMICs as the decrease in foreign direct investment is expected to be larger (more than 35%).

Moreover, Fig. 2 shows that remittance inflows directed to low- and middle-income countries (LMICs) have steadily grown from $343 billion in 1995 to approximately $529 billion in 2018. The increasing importance of remittances has raised the interest of academics and policy makers in LMICs' economies, given that remittances could be a valuable income source that alleviates poverty. Consistent with this line of inquiry, this research analyzes 96 recipient countries that are highly diverse in terms of development levels and remittance inflows. This motivated us to divide these sample countries by income group (see Fig. 2) and region (see Fig. 3) according to the World Bank's income classification. In particular, Fig. 3 shows that in the year 2018, the highest remittance inflow amounted to $143 billion in East Asia and Pacific, followed by $132 billion in South Asia, $89 billion in Latin America and Caribbean, $58 billion in Middle East and North Africa, $58 billion in Europe and Central Asia, and $47 billion in Sub Saharan Africa (Aga and Peria 2014).

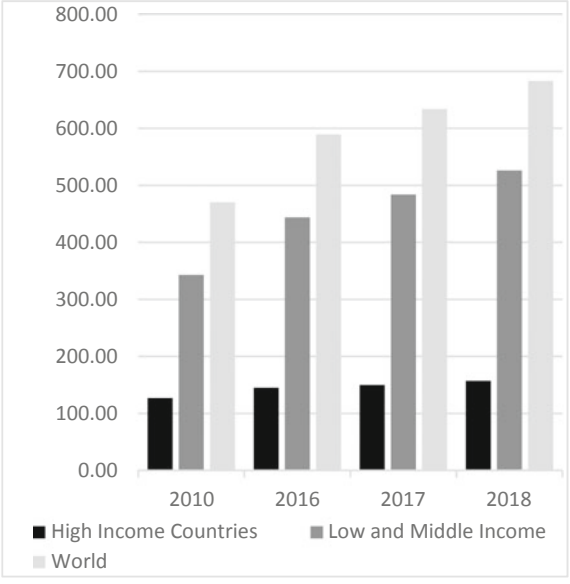

Fig. 2 Remittances (in Billion USD) inflow by income group (*Source* World Bank 2020)

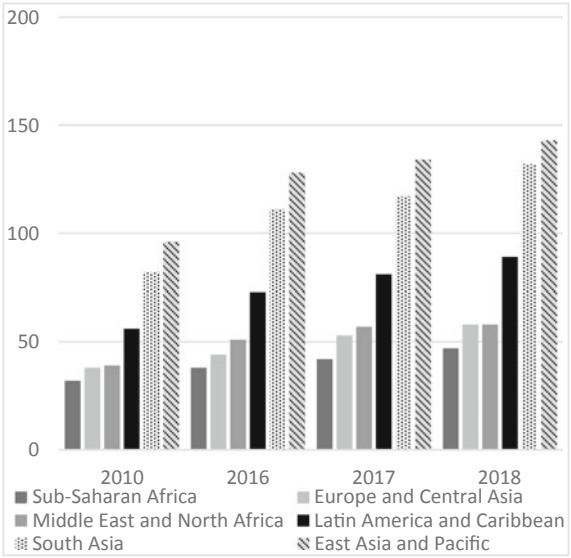

Fig. 3 Remittances inflow by region (*Source* World Bank 2020)

2.2 Recent Trends in Poverty Alleviation in Asian Low- and Middle-Income Countries

Table 1 shows 25 countries that were sorted by their remittance-to-GDP ratio in 2018. The sample consisted of two low-income and 23 middle-income countries. The highest remittance-to-GDP share in a middle-income country was 40.7% while the highest share in a low-income country was 29%, which is not surprising as higher income countries rely less on remittances. Table 1 reveals that the mean remittance-to-GDP ratio for in-group countries was 40.7%. Among middle-income countries, Tonga reported the highest remittance-to-GDP ratio (40.7%), followed by Kyrgyz (32.5%) and Moldova (16%). Georgia (11.5%), Ukraine (11.2%), and Philippines (9.75%) were in the moderate group, while China (0.17%), Kazakhstan (0.34%), and Indonesia (1.08%) had the lowest ratios. The rates of poverty (poverty headcount) and economic development (GDP per capita) for Kazakhstan were zero and 11,165.5, respectively, while these figures were 0.9 and 1090.87 for Kyrgyz. In the low-income group, Tajikistan had the highest remittance share of GDP at 29%, while Yemen reported a ratio of 13%. The poverty headcount for Tajikistan and Yemen were 4.3 and 18.8, respectively, while the GDP per capita for these countries were 1073.02 and 632.91, respectively.

Table 1 Background of the 25 sampled countries ranked by remittance-to-GDP ratio

Countries	Income	MWR %		MWR		GDPPC		Poverty G		Poverty H	
		2010	2018	2010	2018	2010	2018	2010	2018	2010	2018
Tonga	M	29.14	40.7	52.81	183.29	3279.46	4054.94	0.7	0.2	2.8	1
Kyrgyz Republic	M	0.16	32.51	2.24	2688.57	654.31	1090.87	11.2	0.1	42.1	0.9
Tajikistan	L	6.43	29.02	78.56	2183.34	415.46	1073.02	8.2	1	30.8	4.8
Moldova	M	13.78	16.04	177.58	1837.62	1446.63	3527.37	10.9	0	35.7	0
Kosovo	M	17.49	15.56	621.91	1235.73	1851.06	4276.92	0.1	0.1	1.7	0.2
Uzbekistan	M	5.18	15.1	897.62	7609.61	979.01	2373.54	23.1	22.1	62	62.1
Yemen, Rep.	L	13.34	13.67	1288	3770.58	1168.69	632.91	1.8	4.5	9.8	18.8
Armenia	M	9.53	11.94	182.16	1488.02	1403.03	4406.71	4.4	0.4	19.3	2.1
Georgia	M	6.74	11.56	205.93	2034.29	1633.54	4734.38	7	1.2	19.4	4.5
Ukraine	M	1.34	11.23	419	14,694	1817.97	3106.04	0.3	0	1.7	0
Philippines	M	8.28	9.75	6924	33,808.97	1668.72	3190.78	3.1	1.2	13.9	6.1
Sri Lanka	M	7.07	7.96	1154.29	7043.04	1825.14	3946.19	1.4	0.1	8.3	0.8
Pakistan	M	1.31	6.74	1075	21,193	820.23	1197.91	5.8	0.5	28.6	3.9
Vietnam	M	4.3	6.52	1340	16,000	765.19	1964.48	10.1	0.4	38	1.9
Timor-Leste	M	0.8	6.14	3.64	96.32	640.82	847.64	14.5	6.7	46	30.7
Bangladesh	M	3.69	5.68	1967.53	15,562.38	524.95	1203.22	8	2.7	34.8	14.8
Vanuatu	M	4.97	3.89	13.51	35.22	2841.33	2862.02	3.3	3.3	13.2	13.2
Mongolia	M	0.1	3.36	1.1	440.55	1600.49	4210.86	2.2	0.1	9.7	0.5
Belarus	M	0.9	2.41	114.2	1444.8	2808.57	6586.3	1.7	0	7.1	0
Bhutan	M	0.26	2.38	2.24	58.15	1119.76	3128	3.3	0.2	17.6	1.5

(continued)

Table 1 (continued)

Countries	Income	MWR %		MWR		GDPPC		Poverty G		Poverty H	
		2010	2018	2010	2018	2010	2018	2010	2018	2010	2018
Thailand	M	1.34	1.47	1696.79	7466.08	3458.35	6370.01	0.4	0	2.5	0
Lao PDR	M	0.04	1.33	0.66	238.67	672.88	1785.58	8	5.3	33.8	22.7
Indonesia	M	0.72	1.08	1190.2	11,215.34	2143.66	4284.69	9.1	0.7	39.3	4.6
Kazakhstan	M	0.37	0.34	67.47	618.04	4491.59	11,165.54	2.5	0	10.3	0
China	M	0.06	0.17	758.08	24,305.61	1767.83	7806.95	10.1	0.1	31.7	0.5

Note MWR (%) is remittance-to-GDP ratio, MWR ($) is real remittances inflow in million USD, GDPPC is Real GDP per capita, Poverty G is Poverty gap and Poverty H is poverty headcount ratio at $1.9 a day. M represents middle income group and L is for low income countries
Source World Bank Development Indicator (2018)

3 Literature Review

Scholars have emphasized the importance of remittances to reduce poverty. First, remittances indirectly affect supply by lessening recipients' budget constraints. Consumption expenditures would then increase, which subsequently generates a positive multiplier effect on the economy and reduces poverty. The second channel is through the growth effect. Remittance is argued to increase both social and physical investment. Besides, more significant savings due to remittance inflows would ensure the availability of funds for investment, which leads to better living standards; hence, remittances directly affect economic growth and poverty alleviation (Aggarwal et al. 2011; Chiodi et al. 2012; Saydaliyev et al. 2020; Yoshino et al. 2020). The third channel is the moral hazard effect. Remittance inflows may influence recipients' willingness to engage in productive economic activities. They might choose not to work due to steady remittance inflows, especially if this income is enough to cater to their basic needs and some leisure (Amuedo-Dorantes and Pozo 2004, 2010; Chami et al. 2005; Aggarwal et al. 2011; Chiodi et al. 2012). This will have negative consequences on the recipients' economy and poverty level.

The theory that demand follows financial development and supply leads to financial development clearly states the direct role of remittances in the process of financial inclusion (Mundaca 2009; Gheeraert et al. 2010; Kumar 2011; Amidu et al. 2019; Saydaliev et al. 2020). Through remittances, individuals and households have excess cash that broadens their budgets and income, creating demand for various financial services and products. Moreover, financial intermediaries' provision of adequate financial services that meet the different needs of the public encourages public access to these services in the process of receiving remitted monies. For instance, remittances motivate recipients to open bank accounts and engage other financial services, which directly increases banking liquidity and makes more funds available for loans. Via this process, remittances influence financial development and alleviate poverty.

Also, remittances help to relax receiving households' financial constraints and allow them to invest in human capital. On the other hand, the disruptive effect suggests that remittances in the absence of the father or head of the family may indirectly and inversely influence children's performance at school. Meanwhile, the substitution effect implies that children who receive remittances prefer to migrate rather than attend school or any other learning institution. Overall, the literature theorizes that remittances affect poverty via human capital.

Considering the growing value and significance of remittances, research has begun to look into how these financial flows impact the development of receiving countries. Research in this area, while limited, has shown inconsistent findings. On the one hand, there are scholars who argue that remittances affect economic development according to the stage of financial development of a country (Giuliano and Ruiz-Arranz 2009; Ramirez 2013; Benmamoun and Lehnert 2013; Sobiech 2019; Issabayev et al. 2020). In particular, Giuliano and Ruiz-Arranz (2009) and Sobiech (2019) explain that remittances exclusively benefit developing countries whose financial markets are not yet advanced. These scholars assert that in an underdeveloped financial system

with higher credit limitations, remittances are a vital source of financing for growth-enhancing activities if used productively. Likewise, Benmamoun and Lehnert (2013), in contrasting the impacts of Official Development Assistance (ODA), Foreign Direct Investment (FDI), and international remittances on recipient countries, concluded that remittances are an important determinant of economic growth, especially in low-income countries. Mundaca (2009) and Nyamongo et al. (2012) provided evidence of the positive interaction between remittances and financial depth, such that a more developed financial system strengthens the growth-enhancing effects of remittances.

Another research area of interest in remittances and economic development is the role of human capital. It is indeed necessary to examine the impact of human capital on the remittances-development link, so as to score further economic gains from remittances. Several scholars support the view that remittances promote human capital formation and thereby reduce poverty (Matano and Ramos 2018; Köllner 2013; Ngoma and Ismail 2013; Salas 2014; Hines and Simpson 2019; Arif et al. 2019; Askarov and Doucouliagos 2020). Additionally, researchers argue that extra income received from abroad in the form of remittances eases households' budget constraints and consequently prompts economic development (Acosta et al. 2008; Adams and Cuecuecha 2010; Vogel and Korinek 2012; Alcaraz et al. 2012; Di Maria and Lazarova 2012; Zhunio et al. 2012).

In terms of the impact of remittances on poverty, multiple studies (Adams and Page 2005; Adams et al. 2008; Anyanwu and Erhijakpor 2010; Imai et al. 2014; Yoshino et al. 2018) have found evidence that remittances effectively mitigate the issue of poverty, particularly in developing countries. In contrast with such evidence, scholars like Azam and Gubert (2006), Chami et al. (2005), and De Haas (2005) revealed in their studies that remittances from migrants do not always improve living standards in recipient countries. Previous studies failed to take into account the potential nonlinearity between international financial remittances and poverty. This study fills the gap by employing the threshold estimation technique regarding the issue in hand.

4 Methodology

4.1 Theoretical Model

This study adopted and modified the theoretical model of Yoshino et al. (2018) to demonstrate how remittances influence poverty and inclusive growth. According to Ratha et al. (2011) the main difference between traditional and poverty-reducing growth diagnostics is that the inclusive analysis takes the individual rather than the economy at large as the analytical starting point, and argued that the way for sustainable and inclusive growth goes through productive employment. Our analytical frameworks begin with household level. We postulated that the inflow of remittances

has an inclusive growth impact the household at the initial stage of development in low- and middle-income economies.

Assuming that in state '0' there is no remittance inflow, households would have the following distribution of income:

$$y_0 = w_0 + \varepsilon_0 \tag{1}$$

where y_0 is income, w_0 is mean wage, and $\varepsilon_0 \sim N\left(0, \sigma_0^2\right)$.

Now, assuming that there is a state '1' where individuals are more likely to face credit constraints:

$$y_1 = w_1 + \varepsilon_1 \tag{2}$$

where y_1 is income, w_1 is mean wage, and $\varepsilon_1 \sim N\left(0, \sigma_1^2\right)$.

Equations (1) and (2) illustrate the income levels in high and low remittance dependency states. Now, suppose that:

$$y_0 - y_1 = w_0 + \varepsilon_0 - w_1 - \varepsilon_1$$

If $y_0 - y_1 > 0$, then income in the bad state is less than income in the good state, such that an individual in the bad state is more likely to default. In other words, in state '1', the individual is credit constrained.

The probability that an individual would default is then:

$$P(y_0 - y_1 > 0) = P(w_0 + \varepsilon_0 - w_1 - \varepsilon_1 > 0) = P(\varepsilon_0 - \varepsilon_1 > -(w_0 - w_1))$$

$$= P\left(\frac{\varepsilon_0 - \varepsilon_1}{\sigma} > -\frac{(w_0 - w_1)}{\sigma}\right) = 1 - F(\omega) \tag{3}$$

where $F(\omega)$ is the standard normal distribution $\omega = -\frac{(w_0 - w_1)}{\sigma}$ is the standard normal variable.

$$\frac{\partial P}{\partial w_1} < 0$$

Equation (3) summarizes the main content of our model. It illustrates that the probability of poverty reduces when the mean income of population w_1 increases. In other words, if the mean income of a population falls, their financial constraints are greater.

Further, we assume that w takes the following form:

$$w = f(x, mwr) \tag{4}$$

where mwr defines migrant worker remittances and x defines other factors that affect income. Then, the partial derivative of poverty reduction w.r.t. oil is:

$$f \text{ or } mwr \leq \lambda \frac{\partial P}{\partial z_1} \frac{\partial w_1}{\partial mwr} < 0$$

$$f \text{ or } mwr > \lambda \frac{\partial P}{\partial z_1} \frac{\partial w_1}{\partial mwr} > 0$$

Equation (4) states that the increase in remittances has different effects on poverty reduction depending on the share of GDP. When $mwr \leq \lambda$, the income generating effect is $\frac{\partial P}{\partial w_1} \frac{\partial w_1}{\partial mwr} < 0$ since $\frac{\partial P}{\partial w_1} < 0$ and $\frac{\partial w_1}{\partial mwr} > 0$. When $mwr > \lambda$, the natural resource curse effect is $\frac{\partial P}{\partial w} \frac{\partial w_1}{\partial mwr} > 0$ since $\frac{\partial P}{\partial w_1} < 0$ and $\frac{\partial w_1}{\partial mwr} < 0$.

4.2 Empirical Model

Since our panel data consisted of $N > 25$ countries and $T < 25$ time periods, we employed the dynamic panel threshold method (Kremer et al. 2013), which extends the (Hansen 1999) original static panel threshold estimation model and the (Caner and Hansen 2004) cross-sectional instrumental variable (IV) threshold model. Here, the generalized method of moments (GMM) estimator was used for robustness tests without a threshold. This method was also employed because it is able to control for endogeneity issues and country-specific effects, which are the main problems in regressions using other panel data techniques. To this end, we considered a dynamic threshold model with a curve in the threshold variable:

$$y_{i,t} = \beta_0 + \beta x_{i,t} + \delta\left(q_{i,t} - \gamma\right)\mathbb{1}\left\{q_{i,t} \geq \gamma\right\} + \alpha_i + \varepsilon_{i,t},$$

where subscript $i = 1, 2, \ldots, N$ represents the banks and subscript $t = 1, 2, \ldots, T$ represents index time. $\mu_{i,t}$ is the bank-specific fixed effect, and the error term is assumed as $\varepsilon_{i,t} \sim^{iid(0,\sigma^2)}$. γ is the threshold, $q_{i,t}$ is the threshold variable, $x_{i.t}$ is an m-dimensional vector of explanatory regressors which includes $q_{i,t}$ and may also include lagged values of dependent variable $y_{i,t}$ and other endogenous variables. Applying the general dynamic panel threshold model above to our analysis of remittances, we specified the following threshold model:

$$POVERTY_{i,t} = \beta_0 + \beta_1 POVERTY_{i,t-1} + \beta_2 \mathrm{MWR_{i,t}} + \beta_3 INF_{i,t} + \beta_4 TRADE_t + \beta_5 GDP_t + \beta_6 FDI_{i,t} + \beta_7 FI_t + \beta_8 HC_t + \delta(MWR_t - \gamma)\mathbb{1}\{MWR_t \geq \gamma\} + \alpha_i + \varepsilon_{i,t},$$

where MWR_{it} is both the threshold variable and the regime-dependent regressors in our application. INF_{it} is inflation which measured by the consumer price index, GDP_{it} is real GDP per capita, $Trade$ is net export as a share of GDP, FDI is Foreign Direct inflow as a share of GDP, FI is financial inclusion, and HC is human capital denote partly endogenous control variables, where slope coefficients were assumed to be regime independent. We allowed for differences in the regime intercept δ as per Bick (2010). Following (Arellano and Bover 1995), p

lags $\log(POVERTY_{it-1}), \log(POVERTY_{it-2}), \ldots, \log(POVERTY_{it-p})$ were considered as dependent variables. β_5 and $\beta_5 + \delta$ are the regime-dependent slopes of our threshold variable MWR_t, when MWR_t is less than the threshold γ and above γ, respectively. When delta $= 0$, we recovered the linear regression model, which can be interpreted as the 'no threshold' effect.

To eliminate the bank-specific effect α_i, we took the first difference of the above model to obtain:

$$\begin{aligned}\Delta POVERTY_{i,t} = {} & \beta_1 \Delta POVERTY_{i,t-1} + \beta_2 \Delta \mathrm{MWR_{i,t}} + \beta_3 \Delta TRADE_{i,t} + \beta_4 \Delta INF_{i,t} \\ & + \beta_5 \Delta GDP_{i,t} \beta_6 \Delta FDI_{i,t} + \beta_7 \Delta FI_t + \beta_8 \Delta HC_t + \delta(MWR_t - \gamma)\mathbb{1}\{MWR_t \geq \gamma\} \\ & - \delta(MWR_{t-1} - \gamma)\mathbb{1}\{MWR_{t-1} \geq \gamma\} + \Delta\varepsilon_{i,t}.\end{aligned}$$

Before applying the dynamic panel threshold method, we verified the nonlinear link between remittances and poverty using the Linearity Test recommended by Hansen (1999) and Kremer et al. (2013). We also conducted two diagnostics tests, namely the Panel Unit Root Test and the Hansen Test, to confirm the consistency and efficiency of long-run (estimated) parameters of interest. The results of the dynamic panel threshold are valid if these two tests report insignificant p-values.

The results of the (Im et al. 2003) panel unit root test in Table 2 indicates that all the variables at the stationary level rejected the null hypothesis at the 0.01 and 0.05 significance levels for all panel time series. Next, the results of the linearity test reported in Table 3 reveal that the hypothesis of model linearity was rejected at 0.01 and 0.1 significance levels as well. These tests results imply that non-linear relations were present in our sample.

All variables were stationary at level (see Table 3), suggesting that the dynamic panel threshold was the appropriate estimator for this study's model. Therefore, the empirical results would be reliable for statistical inferences. The significance of the Wald Test and Fisher Test confirms the robustness of all our models, where the Lagrange multiplier test and the null hypothesis of the Fisher test (Lm) significantly

Table 2 Panel unit root test

Series	Poverty H	Poverty G
POVERTY	0.9991***	0.9666***
Remittances	0.5095***	0.4732***
Trade	0.4656***	0.4532***
Inflation	0.0031***	0.003***
GDP	0.0148**	0.0024**
Foreign direct investment	0.2356***	0.3432***
Financial inclusion	0.2033***	0.213***
Human capital	0.2128**	0.1014**

Note Standard errors are in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Source Compiled by authors from software

Table 3 Linearity test

Series	Poverty H	Poverty G
Lagrange multiplier (LM)	0.14	0.08*
Fisher test (Lm)	0.86	0.000***
Likelihood-ratio test (LR)	0.142	0.005***

Note Standard errors are in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source Compiled by authors from software

rejected the null hypothesis. Overall, the estimated models in Tables 2 and 3 were well-specified.

4.3 Data

This study mainly used data from the World Development Indicators (WDI) of the World Bank and the United Nations Dataset (UNDP). Data was collected for a total number of 25 countries (see Table 1) over the period 1995–2019. Data on remittances were obtained from the International Monetary Fund (IMF). The dependent variable was poverty (POVERTY), which was represented by poverty indices. It was measured using the headcount percentage (poverty incidence) and the poverty gap percentage (poverty depth). Poverty headcount (Poverty H) was calculated as the percentage of the population living below the poverty line. This study used $1.90 a day in 2011 PPP as the poverty line base. The poverty gap (Poverty G) was assessed as the average distance between the poverty line and a poor household's income (Rodrik 2012). Based on the existing literature, we included migrant workers' remittances, human capital, financial access, trade openness, inflation, and GDP per capita as explanatory variables, sourced from the WDI.

The primary regressor, migrant workers' remittances (MWR), was evaluated as the amount of cash transfers that migrants' overseas working remit to their country of origin. This variable was expected to have a significant impact on the long-run economic performance of the receiving country, thus reducing poverty (Mundaca 2009). On the one hand, remittances, by easing recipients' liquidity constraints, can positively encourage investment in human capital and financial intermediaries, thereby adjusting the long-run GDP per capita output of the recipient country (Rapoport 2002). On the other hand, remittances can have adverse effects on economic development and poverty if they are used to finance private consumption by raising the relative prices of non-traded goods and encouraging recipients to increase leisure time, thereby discouraging labor supply (Chami et al. 2005). Therefore, remittances can have a positive or negative impact on poverty.

The secondary explanatory variable is economic development (GDPPC), which refers to the GDP per capita. It is a measure of the total output of a country (GDP)

divided by the number of people in the country. The level of per capita income shows the relative economic performance of a country (Rodrik 2012).

In terms of control variables, trade openness (TO) refers to net exports and imports, inflation (INF) refers to inflation, financial inclusion (FI) refers to the portion of the population that uses formal financial services, human capital (HC) refers to the educational level of laborers, and foreign direct investment (FDI) refers to foreign direct investment.

The trade openness variable can have either a positive or negative sign. Since trade liberalization tends to widen the opportunities for economic activity, it can thus increase income and reduce poverty. Concurrently, it can very easily broaden income inequality and increase poverty instead. Nevertheless, in this study, trade openness was expected to have a negative effect on poverty. When a country opens itself to foreign countries by growing trade volume against its GDP, the relative earnings of unskilled laborers increases, links with political or bureaucratic powers decrease, and monopoly rents go down. In this way, trade liberalization and international competition encourages the country's industrial activities, and ultimately alleviates poverty (Yoshino et al. 2017).

High inflation, meanwhile, can have a negative impact on individuals' lives and poverty levels, as it stimulates price hikes and price instability. Daily living expenses like clothing, food, and housing also increase with inflation, forcing the poor to bear greater costs to survive (Yoshino et al. 2017). Next, financial inclusion (FI) is considered to be a stronghold that strengthens financial sector growth and positively affects economic growth. The human capital index (HC) signifies the skills, knowledge, and experiences owned by specific workers that are measured in relation to their cost or value to an organization or country. According to Romer (1990), human capital plays a key role in explaining the rate of output growth and poverty reduction. Finally, foreign direct investment (FDI) is assessed as a ratio of the GDP which has a positive association with economic growth and a negative association with poverty.

Based on the discussion above, the expected signs for poverty, trade openness, GDP per capita, foreign direct investment, financial inclusion, and human capital were all negative while the sign for inflation was expected to be positive (see Table 4). The sign for remittances was expected to be vague.

5 Results and Discussion

The estimation analysis' descriptive statistics for all series included in the sample are shown in Table 5. All the series showed considerable variations both across and within the sample countries. This further justified the need for a heterogeneous panel data estimation technique, which permits endogeneity issues.

The threshold estimates of remittances are presented in Table 6. The results showed that the threshold level was 8% of remittances per GDP when we used Poverty Gap as the proxy for poverty. As a robustness check, we also used an alternative proxy for our main poverty variable, i.e. poverty headcount. In this case, the

Table 4 Expected signs of coefficients of variables

Dependent variables	Proxy	Source
Poverty headcount		World Bank
Poverty gap		World Bank

Explanatory variables	Proxy	Source	Expected sign
Remittances	Share of GDP	World Bank	+/−
Trade openness	Export and import (share of GDP)	World Bank	−
Inflation	Consumer price changes	World Bank	+
Real GDP	Real GDP per capita	World Bank	−
Foreign direct investment	Foreign direct investment (share of GDP)	World Bank	−
Financial inclusion	Financial access	World Bank	−
Human capital	Human Development Index	UNDP	−

Source Compiled by authors

Table 5 Summary of descriptive statistics

Variable	Description (unit of measurement)	Mean	Overall Std. Dev.	Between Std.Dev	Within Std.Dev	Minimum	Maximum
Poverty H	Poverty headcount	14.4	16.1	13.6	8.9	0	60.7
Remittances	Remittance per capita (share of GDP)	8.1	9.1	8.1	4.4	0.1	40.1
GDP per capita	Real GDP per capita	2532.1	1873.8	1621.9	984.4	390.5	10,950.3
Human capital	Years of education by adult household members	0.64	0.08	0.07	0.04	0.43	0.84
Financial inclusion	Access to bank by adults	26.3	26.2	18.8	18.4	0.12	114.3
Inflation	Inflation CPI	15.8	31.1	17.4	25.8	0.81	236.1
FDI	Foreign direct investment (share of GDP)	3.7	3.2	2.3	2.2	−0.8	24.2
Trade	Net export (share of GDP)	85.5	33.5	29.6	16.5	27.3	196.5

Source Authors' calculation

Table 6 Threshold estimates of remittances as a share of GDP

	Poverty gap	Poverty headcount
LM test for no threshold	0.478*** (0.123)	0.679*** (0.236)
Bootstrap *p*-value	0.00305*** (0.000737)	0.00305*** (0.000632)
Threshold estimate	8.423*** (0.479)	22.65*** (4.124)

Note Standard errors are in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source Authors' calculation

threshold level was 22% of remittances per GDP. The results further indicated that the impact of remittances on poverty reduction is initially negative; however, the effect becomes positive after the threshold level. This finding puts forth a new perspective that remittances serve as leverage only in the early stage of development. In other words, countries that are heavily dependent on remittances make their economy fragile and vulnerable once the threshold is crossed. Therefore, though migration is not a substitute for development at home, it can be leveraged for initial development.

Table 7 provides the regression results using remittances as a threshold variable. All the explanatory variables were statistically significant in both Models 1 and 2. First, remittances inflow reported a negative impact on poverty variables, implying that greater remittances reduce poverty. When migrants send more money home, they directly increase the income of recipient households, which in turn reduces poverty. This finding is supported by Adams and Page (2005), Imai et al (2014), and (Yoshino et al. 2018).

The coefficient for per capita GDP was, as expected, negative and statistically significant in relation to the measures of poverty, confirming that higher income reduces poverty. This finding is consistent with the findings of Adams and Page (2005) and Yoshino et al. (2018). With regards to trade openness, the results reveal that trade openness negatively correlates with all poverty variables. This indicates that by creating more opportunities for economic activity, trade can increase income and reduce poverty. Similar findings were reported by Pradhan and Mahesh (2014) and Anetor et al. (2020).

Theory predicts that price hikes adversely influence individuals' lives and push more people into poverty. However, our results unexpectedly discovered that inflation has a significant positive effect on poverty. This may be due to the problem of aggregate price data. If inflation is mainly driven by commodities like fuel (energy), fish, meat, and footwear, which are consumed comparatively more by people in higher income groups, it is predictable that these high income groups will witness a rise in total expenditure while total expenditure for low income groups is unaffected by inflation. Paul and Sharma (2019) found that the impact of inflation is observed to be different in rural and urban areas, and inflation hurts the poor more if the rise in food prices is substantial since food constitutes a large proportion of their expenses.

Table 7 Regression results using remittances as a threshold variable

	(1)	(2)
Variables	Poverty gap	Poverty headcount
Poverty (−1)	0.545*** (0.0508)	0.771*** (0.0495)
GDP per capita	−9.80e − 05 (7.32e − 05)	−0.000341 (0.000363)
Inflation	−0.0360*** (0.0109)	−0.0924** (0.0434)
Trade	−0.0165*** (0.00419)	−0.119*** (0.0158)
Remittances	−0.406*** (0.0897)	−0.440* (0.266)
Foreign direct investment	−0.0470*** (0.0007)	−0.0434** (0.0032)
Financial inclusion	−0.0293*** (0.00312)	−0.027*** (0.0053)
Human capital	−0.086*** (0.0183)	−0.0840* (0.0167)
R^2	0.67	0.73
Heteroscedasticity test	–	–
No. of country	24	24
Degree of freedom	18	18
R^2	0.67	0.73

Note Standard errors are in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source Authors' calculation

The foreign direct investment variable had a negative and statistically significant impact on poverty measures. An increase in foreign direct investment leads to an increase in economic growth, employment, infrastructure development and, consequently, a decline in poverty. This is in line with Anetor et al.'s (2020) finding that foreign direct investment has a positive effect on poverty reduction. The negative and statistically significant effect of financial inclusion further suggests that financial inclusion promotes economic development and reduces poverty, which is consistent with (Park and Mercado 2015) finding. Consistent with Adams and Page (2005), this study also found that human capital negatively influences poverty. Education is indeed a powerful tool to promote economic development and alleviate poverty, as educated people typically enjoy higher employment and greater income-earning opportunities.

6 Concluding Remarks and Policy Implications

Using dynamic panel threshold estimation techniques on a panel dataset of 25 Asian low- and middle-income countries over the period ranging from 1995 to 2019, this study attempted to examine whether the inflow of remittances alleviates poverty and promotes inclusive growth. Our results showed that the impact of remittances on poverty reduction is initially positive, but becomes negative when the threshold level is crossed (8% of GDP). This reveals a new perspective that remittances may be useful only for the early stage of economic development; thus, countries that are heavily dependent on remittances expose their economy to threats once the threshold is crossed. We thus posit that migration is not a substitute for development at home, but can be leveraged for initial development. Our findings carry several policy implications for countries and governments. First, remittances play an important role as a stable source of household income in developing countries. Remittances can improve the credit constraints on the poor, improve the allocation of capital, and substitute for the lack of financial development in developing countries. Therefore, governments should support safe, regular, and legal labor mobility as well as global partnerships. Secondly, policy makers need to realize that a country cannot become too heavily dependent on remittances as our results indicated that once the remittances exceeded a certain threshold, it brings threats to the economy and makes it vulnerable to external shock. Hence, the policy makers need to source for alternative flows of capital, such as foreign direct investment. Finally, our results also suggest that human capital and financial inclusion help in poverty reduction. Therefore, the policy implications should devise policies that will increase the level of financial access and human capital development, so that remittances will promote economic development in their respective countries.

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Chapter 6
Remittances, Poverty Reduction and Inclusive Growth in the Resource-Poor Former Soviet Union Countries

Sarvar Gurbanov, Vusal Mammadrzayev, and Hasan Isgandar

Abstract This study researches the impact of international remittances on poverty reduction in six former Soviet Union countries. The countries where personal international remittances are equal to more than 5% of GDP and rents from natural resources are below 10% of GDP are selected as the units of measurement. This study uses a fixed effect model with robust standard errors to reveal any types of causality. According to the regression results, a 10% increase in remittance inflow reduces headcount ratio, poverty gap, and poverty severity at $1.90 per day poverty line by 4.8, 5.9 and 6.4%, respectively. In addition, the same level of increase in remittances reduces poverty headcount ratio by 3.3% and poverty gap by 3.7% at the poverty line of $3.20 per day. Additionally, pooled OLS regression results reveal that remittance inflow has a negative impact on poverty level in the above-mentioned six resource-poor countries.

Keywords Migration · Remittances · Poverty · Resource-poor countries

JEL codes F24 · P36 · R11

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1 Introduction

By considering three different migration-related Sustainable Development Goal (SDG) indicators, the World Bank's *Migration and Development Briefs* provide broad development background on remittances flows to low-income and middle-income countries (LMICs). Volume of remittances reached to $554 billion in 2019 (World Bank 2020a). For the first time in history, 2019 remittance flows to LMICs exceeded foreign direct investment (FDI) (World Bank 2019a). Whereas in the most recent *Migration and Development Brief*, the estimation of decline in the two subsequent years, 2020 and 2021, is clearly depicted. According to provided data, remittance flows will be $508 billion in 2020 and $470 billion in 2021 (World Bank 2020d). That is, just in two years, absolute decline in remittances will be around $84 billion. As a result of the Covid-19 pandemic, the World Bank (2020a) expects the sharpest remittances decline in recent history, which is estimated to be 20%. For the comparison, after the 2008 global financial crisis, the decline was just 5% in 2009. That kind of striking decline will have serious implications on poverty indicators. Global poverty is likely to increase for the first time in more than 30 years (World Bank 2020b). Baseline and downside estimations of the World Bank suggest that 88–115 million people will be pushed into extreme poverty by Covid-19 (World Bank 2020c). The importance of remittances is especially vital for the states that do not benefit from windfall gains by exploiting natural resources. By considering measurable indicators, this study investigates the remittances–poverty nexus for the following six resource-poor former Soviet Union (FSU) countries: Armenia, Georgia, Kyrgyz Republic, Moldova, Tajikistan, and Ukraine.

As the magnitude of remittances has been strikingly increasing in the last two decades, the implications of this trend for poverty reduction, inclusive growth, and sustainable development have also been much debated topics. It has been proven that, without remittances, the share of the poor in the population of different countries would have been higher, ranging between 4% to as high as 12%. To put it differently, remittance flows created an environment of sharing prosperity (World Bank 2019c). As mentioned earlier, unfortunately Covid-19 will reverse the upward trend in remittances for 2020. The World Bank estimates that in 2021 remittances will still fall short of the 2017 figure (World Bank 2020a).

In the light of all these trends, this study focuses on six former Soviet Union (FSU) countries where annual remittances total at least 5% of their economic output, while annual rents from natural resources equal less than 10% of that. As the World Bank Development Indicators dataset depicts, by the end of 2018 the received remittances as shares of GDP in Armenia, Georgia, and Ukraine hover around 11–12%. This rate is relatively higher for Moldova, Tajikistan, and Kyrgyz Republic, 16, 28.6 and 28.5%, respectively. In terms of the share of rents from natural resources in GDP, in Armenia and Tajikistan, this rate is 5.8 and 5.7%, respectively. The highest rate belongs to Kyrgyz Republic with 8.5%. For Ukraine it is only 4%. In Georgia and Moldova, natural resource rents equal to 1.1 and 0.3% of GDP (Tables 8 and 9). The IMF World Outlook Database, which updated in April 2020 estimates economic

contraction for all these countries, except Tajikistan (IMF 2020b). After the Covid-19 pandemic, ADB in June 2020 published the *Asian Development Bank Supplement*, and it estimated that Armenia, Georgia, Kyrgyz Republic, and Tajikistan will face economic contraction (ADB 2020). World Bank data shows that the lowest unemployment rate in 2019 has been recorded in Kyrgyz Republic and Moldova, 6.3 and 5.5% respectively. Among these countries, the highest unemployed rate took place in Armenia, with 17%. The Georgia, Tajikistan, and Ukraine unemployment rates have been 14.4, 11 and 8.9% respectively. Aggregate data shows that 47% of the remittances to these countries come from Russia. For Kyrgyz Republic and Tajikistan, it is 75%; Armenia and Georgia rate is roughly 60%, for Moldova and Ukraine, it is 33% (Table 8). It is also important to note that, for post-Soviet economies, Kakhkharov et al. (2017) find inverse relationship between transaction costs and officially recorded remittances. In terms of policy implications, this result means that, once transfer costs decline, the financial system may face a decrease in revenues, whereas, because of moving transfers of remittances from informal channels to formal ones, overall revenues will increase. In this case, the estimation of funds available for investment and inclusive growth, as well as sustainable development, will be more accurate.

The World Bank (2019b) suggests that currently 10% of the world population lives on $1.90 a day or less. According to the World Bank's PovcalNet database, aggregate data for all these six countries in question shows that in 1999 the poverty headcount ratio was 15.7%, whereas in 2018 it was 0.78%. The poverty gap was 4.36% in 1999, 0.18% in 2018. The squared poverty gap index was 1.9 in 1999 and reached 0.07 in 2018. With the Covid-19 outbreak, all these gains are about to evaporate, which in turn deserves revisiting the remittances and poverty relationship.

In its report on economic growth of countries, the Asian Development Bank (2019) forecasts that slow growth of the economy of Russian Federation will hinder the flow of remittances to Kyrgyz Republic and Tajikistan; remittances are also indicated as a determinant of economic growth in Armenia.

The income from oil revenues provides financial resources to support policies for alleviating poverty; resource-poor countries are deprived of this determinant as a poverty reduction source. Because of this, conducting research related to these countries is the very first contribution of this study to the existing literature. In accordance with SDG 1, which envisages to 'End poverty in all its forms everywhere' by 2030, the policy implications of this study will be meaningful too. The target of the SDG 1a is to 'Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries'; that is, remittance and its possible effects should be studied systematically for better policy implications. Furthermore, considering the importance of poverty reduction for global sustainable development (UN 2020), the role of remittances in poverty reduction becomes even more important. The IMF projects that in 2020 the global economy will contract by 4.9%, which will reverse progress in reducing extreme poverty observed in the world economy since 1990s (IMF 2020a).

Existing literature shows that Latin American and South Asian countries managed to grab the attention of many researchers for the analysis of the remittances and

poverty nexus. It is mainly because their share from the global remittances stock is relatively higher than other parts of the world. Moreover, studies related to transition and post-communist economies do not make any distinction between resource-rich and resource-poor countries. This study intends to fill the gap in this manner by employing the most up-to-date data set and making estimations on the resource-poor post-communist countries.

Migration-related SDG indicators, namely SDG indicator 17.3.2, and SDG indicator 10.c.1, that is, increasing the volume of remittances as a percentage of GDP and reducing remittance costs respectively, are still considerable sustainable development questions that require further scholarly analyses. In this manner, the contribution of this research study to existing literature can be defined in three aspects. Firstly, it is a novel research study that includes only resource-poor countries to investigate the impact of remittances on poverty reduction. The results of this study are applicable to other resource-poor countries experiencing high dependency on remittances. Secondly, after 30 years of steady decline in poverty indicators, this study coincides with the era in which millions of people will fall into the category of the extreme poor. Since 2020, global economic output will record the largest drop in eight decades and, as there is ongoing historical reversal in the poverty reduction, together with slowing inclusive growth, it will definitely have long-lasting impacts on remittances flows too (World Bank 2020c). This unusual and undesirable result requires the revisiting of the remittances–poverty relationship. The current study intends to shed additional light on this specific nexus. As will be seen in the next section, there is a considerable dominance of studies for the Latin American, South Asian and Central and Eastern European countries related to remittances and poverty relationship. In this manner, thirdly, it is the first time that, in a particular research, the correlation between poverty and remittances in the former Soviet Union (FSU) with that specific block of countries has been scrutinized. Fourthly, in tandem with SDGs 1, 8, and 10, respectively poverty reduction, inclusive and sustainable economic growth and reducing income inequalities require better insights on the allocation of remittances. This study intends to shed additional light on these related issues.

The rest of the chapter is structured as follows. In Sect. 2 we review existing literature. In Sect. 3, we introduce data and methodology. Section 4 presents empirical results and interpretations. The final section of the chapter, Sect. 5 summarizes the findings.

2 Literature Review

Existing literature on the remittances–poverty relationship is dominated by the studies considering country groups. In a United Nations Conference on Trade and Development publication the authors separately analyzed 29 developing countries out of 77, where remittances inflow equaled more than 5% of GDP (UNCTAD 2011). This finding provides additional justification for our study, which adopted the 5% threshold for remittances to GDP ratios of the countries.

Adams and Page (2005) estimate that a 10% increase in official remittances per capita generates a 3.5% decrease in the share of people living in poverty. Their dataset included 71 developing countries. Acosta et al (2007) study the relationship between the share of remittances in GDP and poverty level for 10 Latin American and Caribbean (LAC) countries. The region makes up 27% of global flow of remittances. Their estimate shows that a 1% increase in remittances to GDP ratio will reduce poverty by 0.37% in the LAC region.

Another study investigating the relationship between remittances and GDP is by Yoshino et al. (2018). The study uses the panel data for ten developing Asian countries. They found a significant impact of remittances on both the poverty gap (poverty depth) at $1.90 a day (2011 PPP) and the squared poverty gap (poverty severity): a 1% increase in remittances to GDP proportion reduces the poverty gap ratio by 22.6% and the squared poverty gap by 16%. Yoshino et al. (2018) look for the relationship using the fixed effect approach as the current study does. Tsaurai (2018) suggests that a 1% increase in remittance inflow decreases the number of people below the headcount ratio for the selected emerging markets, such as Brazil and Russia. Using the LSDV (Least Squares Dummy Variable) model with panel-corrected standard errors, Pekovic (2017) found that in transition economies, a 10% increase in remittance per capita will lead to a 4.7% decline in the poverty headcount ratio, a 5.2% and a 5.8% decline in the poverty depth (poverty gap) and poverty severity (squared poverty gap), respectively. This study does not make any distinction between countries in terms of income from natural resource.

As mentioned by Gupta et al. (2007), Imai et al. (2011), Mehedintu et al. (2019), and Comes et al. (2018), the negative sides of remittances are concerns related to the migration of the skilled labor force and the Dutch disease effects. Additionally, for the Kyrgyz Republic case, Kroeger and Anderson (2014) find a negative relationship between remittances and human capital investment. Danzer and Dietz (2018) suggest that tertiary-educated Tajik migrants are not able to transfer their human capital to the Russian economy during the financial crisis; they are more likely to work illegally. About the impact of remittances on education expenditures, Askarov and Doucouliagos (2020) suggest that remittances have no effect on household education expenditures for eastern European transition economies (Armenia, Georgia, Moldova).

In terms of domestic dynamics, Acosta et al. (2009) find that remittances can distort labor force allocation by favoring non-tradable sectors, which could be detrimental for tradable sectors, including manufacturing and could result in Dutch disease. Remittances here function as capital inflow and increase the value of the national currency. As remittances will mainly be spent on non-tradable sectors, manufacturing does not develop to its full capacity. Olearchyk and Shotter (2019) provide insight about the spending directions of the remittances in Ukraine. Distrust of local banks in this country made workers abroad invest mainly in real estate, which eventually seems to have fuelled a property boom in the domestic economy. The World Bank (2018) suggests that from 2003 to 2009, remittances fueled demand in construction and other non-tradable sectors in Armenia, which resulted in considerable job creation. To sum up the effect of remittances on economic growth, Cazachevici et al.

(2020) conducted a quantitative survey of 538 estimates reported in 95 studies and found that about 40% of studies report a positive effect. Additionally, in their survey, it is revealed that 40% of studies report no effect and 20% report a negative effect. Interestingly, studies related to Asian countries find larger effect of remittances on economic growth than those of African. That is, there is still a huge gap in the literature to identify the proper impact of remittances on inclusive growth.

Meanwhile, Comes et al. (2018) applied the method of least squares to the multi-factorial model and noticed that both remittance and foreign direct investments have a positive effect on the level of economic growth for the seven central and eastern Europe countries. In our study, all the countries for the study period ran a current account deficit. To cover the current account deficit is crucial for satisfying the derived demand for foreign hard currency. It seems that remittances play a crucial role for covering the cost of imported goods. The World Bank (2013) depicts that in 2012 remittances made up 1129% of Tajikistan's foreign exchange reserves, 118% of Armenia's and 107% of Kyrgyz Republic's. By considering the three poverty indicators for 12 Asian developing nations, Taghizadeh-Hesary et al. (2021) find that international remittances have a statistically significant impact on reducing the poverty gap ratio and the poverty severity ratio. The study employs the random-effect model of ordinary least squares (OLS) and highlights the high inflation rate as one of the causes of poverty. To reduce the cost of sending remittances, in tandem with the SDGs, Taghizadeh-Hesary et al. (2021) come up with following two policy implications: encouraging partnership between international banking services and remittance transfer operators, and creating remittance transfer systems through the use of financial technology (Fintech) and Blockchain technology. Yoshino et al. (2020) use a dataset of 22 economies of middle-income countries in East Asia and the Pacific and South Asian countries and find that, once the development stage of countries improves, FDI replaces remittances flows. Put it differently, to avoid the middle income trap, the role of remittances is supposed to gradually diminish after the early stages of development.

On country-level studies by using cointegration and causality analyses, Hatemi-J and Uddin (2013) found a long-term relationship between remittances and poverty reduction in Bangladesh. Bertoli and Marchetta (2014) discovered that remittances have a significant impact on poverty reduction in Ecuador.

3 Data and Methodology

This study uses data for six developing post-Soviet countries within the period 1990–2018 to examine the influence of the inflow of international personal remittances and some other factors including income inequality on the poverty level of the selected countries. The poverty headcount ratio and poverty gap (poverty depth) at both $1.90 (2011 PPP) and $3.20 (2011 PPP) a day, and poverty severity at $1.90 (2011 PPP) a day were used as dependent variables in the study. The inflow of personal remittances has been included as an independent variable in all model specifications. The Political

Risk Index, Democracy Index, inflation (Consumer Price Index), Gini coefficient, and GDP per capita are considered as control variables in this study. Data for the measures of poverty and Gini coefficient were acquired from the World Bank's PovcalNet database. Personal remittances, inflation, and GDP per capita are control variables, and acquired from the World Bank's World Development Indicators Online database. The Democracy Index variable, which measures the state of democracy, is taken from the Economics Intelligence Unit (EIU) database. The Political Risk Index is the aggregated average of some other indexes and is provided from the World Bank. This index assesses the stability of governments and constitutional means in countries.

In the current study, the inflow of international remittances is an independent variable and tested to have a role in the poverty reduction in the countries of interest. A higher level of remittance inflow causes economic growth by shifting aggregate demand and consumption of households. According to several recent studies as mentioned in the literature review, the magnitude of this shift is very strong among low and middle-income countries as people hardly satisfy their daily necessities due to the higher unemployment rate and lower economic activity, both at macro and micro levels. Higher demand leads to a bigger output in production and growth in income. There are many empirical studies that prove this statistically significant effect of remittances on economic growth and poverty reduction. According to Pekovic (2017), a 10% increase in remittance decreases poverty by 4.7%. The same result was found by Tsaurai (2018) and Adams and Page (2005), where a 1% increase in remittance inflow under the fixed effect approach decreases the number of people below the headcount ratio. Moreover, the role of remittances for accomplishment of inclusive growth and severe poverty reduction is constrained by the magnitude of the economic level of developing countries (Yoshino et al. 2020). By considering existing literature, empirical findings and macroeconomic models, the main hypotheses of the study are formulated as following:

Hypothesis 1 (H1) The inflow of international remittances is in a negative relation with the level of poverty in the selected countries.

As mentioned, some control variables, including economic growth, which is operationalized by GDP growth, were added to the model in order to find the impact of the independent variable on poverty by controlling all possible confounding elements. A higher economic growth rate fuels economic activity and the process of value addition. This process helps to achieve poverty alleviation by increasing household consumption if the gain from economic growth is distributed relatively equally. Kakwani (1990) finds that, if economic growth does not lead to an increase in income inequality, poverty tends to decrease faster. Current economic literature proves the statistically significant effect of GDP growth on the poverty level and income growth. According to Son and Kakwani (2004), economic growth causes a greater decrease in the poverty level if inequality is very high. In addition, the result of the study by Iradian (2005) reveals that a 1% increase in real GDP per capita growth decreases poverty by 0.32% in low income countries. The second hypothesis of this study is as follows:

Hypothesis 2 (H1) GDP growth has a negative effect on the poverty level.

Another control variable in the study is the inflation rate, which is measured by the Consumer Price Index. Although, it is well known that higher inflation lowers the unemployment rate by providing short-run incentives for production expansion, we decided to use inflation as one of the potential sources of poverty in the model. The overall increase on the overall price level as a consequence of strong aggregate demand or cost–push inflation reduces disposable income through hypothetical inflation tax and causes noteworthy decline in the real wages and purchasing power of households. As argued in the paper by Cardoso (1992), doubling inflation reduces real wages by 14% and exacerbates poverty in the countries of Latin America. Easterly and Fischer (2000) found out that a higher increase in inflation reduces the ratio of the lowest income quintile in overall distribution by 1.7%. Consequently, the hypothesis regarding inflation is as follows:

Hypothesis 3 (H1) The inflation rate has an effect on poverty measures in focus countries.

In order to analyze the influence of remittance on poverty measures, our study takes into account political and institutional factors, such as the Democracy and Political Risk Index considering their influence on poverty alleviation. Several empirical works claim that democracy has an indirect influence on economic growth through providing human capital accumulation, higher economic freedom, and a more effective business environment. A study by Mobarak (2005) found that the economic development of democratic countries is more stable compared to the ones with autocratic regimes. The democracy level of a country is negatively correlated with the volatility of its economic growth. Although, we argued about the benefits of democratic institutions and a more stable political environment in the country, their success rather depends on the existence of other complimentary socio-economic factors. The existence of democratic institutions without proper economic incentives and foundation will not be enough to reduce the poverty level and achieve higher economic development. In addition, high political risk also hinders the inflow of investment by creating an insecure business environment and vulnerable property rights. According to a study by Jensen (2008), there is a strong relationship between political institutions and the investments of multination corporations in a country. As the perception of potential risks increases, higher political risk decreases consumption and the number of economic agents who want to invest. Furthermore, including both the Democracy Index and the Political Risk Index in the same model may cause a multicollinearity problem in estimation, which leads to biased estimations. Several findings indicate that countries with more democratic institutions have lower political risk. Hence, the variance inflation factor and multicollinearity problem are used for solving this problem if it exists. The hypothesis regarding democracy and political risk variables is formulated as follows:

Hypothesis 4 (H1) The democracy level in a country impacts the poverty level in the selected countries.

Hypothesis 5 (H1) A higher political risk impacts the poverty level in the selected countries.

According to the basic conventional economic theory, the Gini coefficient, which determines the level of inequality in terms of income distribution, is considered to be in a positive relation with the poverty level. Several empirical findings reveal that, even though inequality increases as a result of economic growth, the poverty rate declines (Ravallion 2001). This reduction in poverty and higher economic growth in the aforementioned countries is significant in case of lower income inequality (World Bank 2020c). Nevertheless, the main changes to poverty over the 30 years of the dataset might originate from an increase in the mean income level rather than the inequality on income distribution. Moreover, there might be a multicollinearity problem between the GDP growth variable and Gini coefficient if the latter is included in regression tests as a control variable. The hypothesis regarding the Gini coefficient variable is formulated as follows:

Hypothesis 6 (H1) Inequality impacts poverty.

In order to find the main determinants of poverty measures by considering previous related empirical studies, the following multiple linear regression model of panel data is used in this study:

$$\begin{aligned}\log P_{it} = {} & \beta_0 + \beta_1 * \log(REM_{it}) + \beta_2 * \log(GDP_{it}) + \beta_3 * CPI_{it} \\ & + \beta_4 * \log(GC_{it}) + \beta_5 * DI_{it} + \beta_6 * PRI_{it} + u_{it} \end{aligned} \quad (1)$$

Where, P_{it} stands for poverty measures, such as the poverty headcount ratio, the poverty gap and the squared poverty gap, which are used as dependent variables on different specifications in the model.

REM_{it} is an independent variable of the model, which indicates the annual inflow of international remittances for country i at time t.

GDP_{it}, CPI_{it}, GC_{it}, DI_{it} and PRI_{it} are control variables, and they stand for Gross Domestic Product per capita, the Consumer Price Index, the Gini coefficient, the Democracy Index and the Political Risk Index of country i at time t, respectively. These five variables have been added as control variables in the model for getting an unbiased and more efficient estimator of population parameters in interest.

β_i is a row vector of coefficients and represents the true impact of independent and control variables on poverty measures. u_{it} is an aggregate term used for other possible factors that might have an impact on the dependent variables that we do not observe in the dataset.

The authors encountered a few limitations while making the sample of six countries consisting of both cross-sectional and time series component on dataset. Unfortunately, it was not possible to find data about poverty severity of $3.20 a day for selected six countries. Furthermore, the poverty, remittance inflow, and control variables in the study are not available for all years in the period under consideration. For instance, poverty indicators for Tajikistan are not available for most of the years.

This decreases the number of observations in regression analysis. The study runs regression with a minimum number of missing values as they decrease the number of observations that are included in tests. Table 1 in the appendix shows the number of missing values for all variables and countries in the dataset.

The descriptive analysis in Table 2 provides the main summary statistics of all continuous numerical variables in the model. It reveals a higher level of variability of the most variables in the model. As a higher volatility among observations may cause unreliable and biased test results by increasing the value of the mean, standard deviation, and *t*-test, the possible outliers are eliminated from analysis with the aim of having a lower value of standard deviation. Moreover, further descriptive analysis of the dataset shows that the largest value of poverty measures including five variables in the dataset is observed in Tajikistan during 1999 due to the financial crisis in Russia that negatively affected the economies of neighboring countries. Moldova, Ukraine, and Armenia have the lowest value of poverty measure during the investigated period. Additionally, the average levels of remittance inflow in absolute terms are closer to each other across all countries, except Ukraine (Tables 8 and 9).

Furthermore, one of the Gauss Markov assumptions for having accurate statistical tests and an efficient estimator is a normal distribution of variables that are used in regression. The histogram with a normal density plot of poverty measures indicates the existence of non-normal distribution due to larger variability among countries and years because of different country and region-specific economic cycles and fluctuations. Hence, a logarithmic transformation of variables is used to replace the highly skewed distributions with normal ones. This method provides more interpretable and reliable inferential statistics. Figure 1 shows that poverty measures with log-transformation is normally distributed and there are no outliers in the data. The same procedure was carried out for independent and control variables in the model with the goal of getting consistent estimators. We could not find any evidence for deviation from normality on the histograms given in Fig. 2, except the histogram of the Consumer Price Index. The histogram with the density plot reveals a higher variability of inflation level among countries and this higher variability causes positively skewed distribution.

Another potential problem in the estimation is the vulnerability of some control variables to be linearly or non-linearly dependent from others in the same model. The mentioned higher dependency especially in linear ones causes significant bias in estimation and leads to a multicollinearity problem, which in turn creates misperception about the true impact of remittance and other control variables on poverty measures. However, there is no evidence for the presence of a multicollinearity issue as the correlation coefficient of all possible pairs in Table 3 is on an acceptable range between -0.7 and 0.7.

4 Empirical Results and Interpretation

With the goal of using a more appropriate model specification in this study, the authors tested the validity of fixed and random effect models by implementing the Hausmann test. The results of the test including all poverty measures in Table 4 indicate that the fixed effect model is more suitable for all tests, except the model where the poverty gap at $3.20 per day is the dependent variable. Thus, the fixed effect model is the preferred model in regression analysis.

Before running the test to reveal the potential factors that lead to poverty reduction and inclusive growth in the six post-Soviet countries, the validity of the Gauss Markov assumptions of homoscedasticity and the serial correlation must be tested for having the best linear estimators of poverty. The Pesaran test was used for checking cross-sectional dependence or the contemporaneous correlation problem that is frequently observed in panel datasets with a long time series. The value of the Pesaran test of cross-sectional dependence in Table 4 does not support presence of the dependency hypothesis in all model specifications except the logarithmic transformation of the squared poverty gap due to the small number of common observations across the panel. The results of the Pesaran test are also supported by the separately executed Friedman tests with highly significant evidence of discernible differences across observations. Moreover, the presence of groupwise heteroscedasticity is confirmed by the Modified Wald test. The results for all model specifications indicate strong evidence against the null hypothesis where we claim the homoscedasticity or constant variance of data.

In addition, the serial correlation in our linear panel data model is checked with the Wooldridge test where we claim the non-existence of first order autocorrelation in the null hypothesis. The results of the Wooldridge test in Table 4 reveals the fact that the null hypothesis of no serial correlation is not rejected for the headcount ratio, the poverty gap, and poverty severity at $1.90 per day poverty line. However, we found strong evidence for having first order autocorrelation in model specifications with the dependent variable of headcount ratio and poverty gap at $3.20 per day. Thus, due to the presence of heteroscedasticity on poverty measures at $1.90 per day, the fixed effect ordinary least square model of linear panel dataset with panel-corrected robust standard error is used. In addition to heteroscedasticity, Driscoll and Kraay's (1998) test procedures are used for poverty measures of $3.20 per day for getting autocorrelation consistent standard errors.

Firstly, the study used the fixed effect model with robust standard errors due to the mentioned model problems to reveal any types of causality between the measures of poverty and model variables. The results of the regression illustrated in Table 5 indicate the statistically significant and negative impact of remittances inflow on all measures of poverty. As it is indicated in the alternative hypothesis, a higher value of remittances causes significant reduction in poverty measures in all model specifications for the focus countries in this study. We reject the null hypothesis of no causality at 99% confidence level. According to the regression results, if we control all other factors, a 10% increase in remittance inflow reduces the headcount poverty ratio, the

poverty gap, and poverty severity at $1.90 per day by 4.8, 5.9 and 6.4%, respectively. In addition, the same level of increase in remittances reduces the headcount ratio and the poverty gap at $3.2 per day poverty line by 3.3 and 3.7%, respectively. This confirms the importance of remittances in resource-poor countries for alleviating poverty. This result is in line with findings of Pekovic (2017) and Tsaurai (2018). Furthermore, an increase in income inequality, which is proxied with the Gini Index in our study, leads to a statistically significant increase in poverty at $3.20 per day, as hypothesized. The estimated coefficient of the GINI coefficient indicates that a 1% decrease in income inequality leads to an even larger percentage decrease in poverty. This outcome from regression once again stresses the importance of achieving a more equal distribution of income or increasing the mean income for the accomplishment of SDGs related to inclusive growth, sustainable development, and ending poverty. Thus, any potential reductions in the inequality of income distribution may help these countries to ease the negative economic and social consequences of the Covid-19 pandemic. This reduction is severe on the countries with low levels of initial inequality (World Bank 2020c). Nevertheless, this impact is not significant for some other poverty measures, such as the headcount ratio and the poverty gap at $1.90 per day. Although, the coefficients of control variables, such as GDP growth, Consumer Price Index, and Political Risk Index is consistent with our hypotheses, these variables do not have a statistically significant impact on poverty in any model specification. Contrary to our hypothesis and literature, the presence of democratic institutions is found to have a positive influence on poverty reduction, and this impact is statistically significant only in the last model, which is consistent with findings of Varshney (2000). Democracy is mostly based on direct methods, which are inefficient for poverty alleviation, compared to the indirect methods of growth-based policies. Democracy should be practiced in parallel with growth-based policies for observing a significant decrease in poverty levels and achieving sustainable development in developing countries.

As a second step, the authors estimate model coefficients by applying the conservative method of pooled OLS regression with standard errors clustered at the country level. This is for using fewer assumptions about correlation of error terms and achieving a high level of robustness. The pooled OLS regression results in Table 6 indicate that remittance inflow has a negative impact on poverty levels in the six resource-poor countries studied in this research. By fixing all other factors as constant, a 10% increase in remittances will lead to a 4.1% decrease in the headcount ratio, a 4.6% decrease in the poverty gap, a 4.7% decrease in poverty severity at $1.90 per day poverty line, and a 2.9% in the headcount ratio, a 3.3% in the poverty gap at $3.20 per day poverty line. The coefficients in all model specifications are statistically significant at 99% significance level, which is consistent with existing literature and previous regression results of the fixed effect model. Furthermore, inequality and poverty are found to be in a significant positive relation as found in previous models. Contrary to our expectations, the democracy level and Political Risk Index have an unexpected influence on poverty levels, which is in line with the findings of the fixed effect model. The levels of democracy and poverty have a negative relationship. On

other hand, alterations in GDP growth rate and the inflation level do not lead to statistically significant changes in poverty.

Additionally, separate regressions were conducted for each country while controlling the others. The coefficients of remittance and the Gini coefficient variable were still significantly correlated in all model specifications of both pooled OLS and fixed effect models. These results show the consistent and significant impact of remittances and income inequality to poverty alleviation and achievement of sustainable development in these six post-Soviet developing countries. Numerous recent studies have used the aforementioned technique, and we closely followed the methodology designed by DeFond Mark et al. (2015).

5 Conclusion

The study examines the main determinants of poverty measures in six resource-poor former Soviet countries: Armenia, Georgia, Kyrgyz Republic, Moldova, Tajikistan, and Ukraine. Remittances equal to at least 5% of GDP and natural resource rents make up less than 10% of GDP in all these countries.

According to the findings, a 10% increase in remittance inflow reduces the poverty headcount ratio, the poverty gap (poverty depth), and poverty severity by 4.8, 5.9% at $1.90 per day, and 6.4%, by 3.3 and 3.7% at $3.20 per day, respectively. As data on poverty severity of $3.20 per day are not available, this study does not include the estimation results for this measure of poverty. The second approach adopted in this study is to estimate the model coefficients by applying the conservative method of pooled OLS regression with standard errors that have been clustered at the country level for using fewer assumptions about the correlation of error terms and achieving a high level of robustness. The results of pooled OLS regression show that a 10% increase in remittances inflow leads to a 4.1% decrease in the poverty headcount ratio, 4.6% on the poverty gap and 4.7% on the squared poverty gap, all at $1.9 per day; 2.9% decrease on the headcount ratio and 3.3% on the poverty gap at $3.2.

In terms of policy implications, the high cost of remittance transfer is still a serious global problem yet to be addressed seriously. The United Nations (UN) SDG target 10c is about the transaction costs of migrant remittances. That is, the transaction costs for migrant remittances should be 3% or less by 2030. The cost of sending $200 (or equivalent in local sending currency) to LMICs has declined from 9.7% in Q1 2009 (World Bank 2019c) to 6.67% by Q2 2020 (Remittance Prices Worldwide, 2020a). Especially after the dramatic impacts of Covid-19, eradicating poverty totally by 2030 as the very first SDG will be challenging. SDG1a envisages mobilizing all the available resources to end poverty. That is, remittances are required to flow even less costly than 3% to generate poverty alleviation effects. SDG10c in tandem with SDG1a increases the importance of this study, as the current research provides additional scholarly results on considering remittances as a possible financial means for reducing poverty, especially after the Covid-19 pandemic. As high transfer costs hinder the utilization of remittances for the purpose of alleviating poverty, global

initiatives need to be stricter on transfer fees. According to Remittance Prices Worldwide (2020b), the average cost of remitting from Russia is 1.9% by Q2 2020. This experience could be an example for other remittance-sending countries. Ratha (2013) suggests that labor migrants are more willing to transfer remittances when their families experience difficulties, such as economic downturns, political and civil crises, and natural disasters. Together with our results, this kind of conclusion means that the efficient allocation of remittances for poverty alleviation is crucial in hard times. That is, high transfer costs should be considered in the light of both conclusions for all resource-poor countries.

Even though in aggregate global data remittances exceeded FDI for th efirst time ever in 2019, it has been the case for these six countries since 2008 (Fig. 3). This kind of correlation deserves in-depth and separate scholarly study. As discussed in the literature review, remittance flows with no contribution to human capital may be an untapped variable to explain the downward trend in FDI and the future of the poverty alleviation policies for these resource-poor countries. Recent studies Yoshino et al. (2020) and Taghizadeh-Hesary et al. (2021) that relate the middle income trap and remittance flows in their analyses can be mentioned in this regard.

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Author Contributions All three authors equally contributed in designing and writing this paper.

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Conflict of Interest The authors declare no conflict of interest.

Appendix

See Tables 1 and 2.

See Figs. 1 and 2.

See Tables 3, 4, 5, 6, 7, 8, 9 and Fig. 3.

Table 1 Missing values for each variable across countries

Variable\country	Armenia	Georgia	Kyrgyz Republic	Moldova	Tajikistan	Ukraine
Headcount ratio ($1.9)	11	8	11	9	23	9
Poverty gap ($1.9)	11	8	11	9	23	9
Squared poverty gap ($1.9)	11	8	11	9	23	9
Headcount ratio ($3.2)	11	7	10	8	23	10
Poverty gap ($3.2)	11	7	10	8	23	10
Inflow of Remittance	5	7	5	5	12	6
Gini coefficient	11	8	11	9	23	10
GDP	2	1	1	7	1	1
Consumer Price Index	5	6	7	3	13	4
Democracy Index	2	2	2	2	2	2
Political Risk Index	10	10	10	10	10	10

Source Authors' compilation from STATA 13

Table 2 Descriptive statistics of variables in model

Variable\country	Observations	Mean	Standard deviation	Minimum	Maximum
Headcount ratio ($1.9)	103	9.29	11.02	0	54.37
Poverty gap ($1.9)	103	2.57	3.37	0	17.51
Squared poverty gap ($1.9)	103	1.09	1.54	0	7.91
Headcount ratio ($3.2)	105	26.05	20.63	1	87.10
Poverty gap ($3.2)	105	8.35	8.51	0	40.6
Inflow of Remittance	134	1769.21	2521.72	1.02	16,493.01
Gini coefficient	102	32.83	4.87	24	46.4
GDP growth rate	161	1.33	9.96	−44.9	14.04
Consumer Price Index	136	104.26	525.22	−1.40	4734.91
Democracy Index	162	4.26	1.08	2.50	7
Political Risk Index	114	−0.23	0.52	−1.64	0.48

Source Authors' compilation from STATA 13

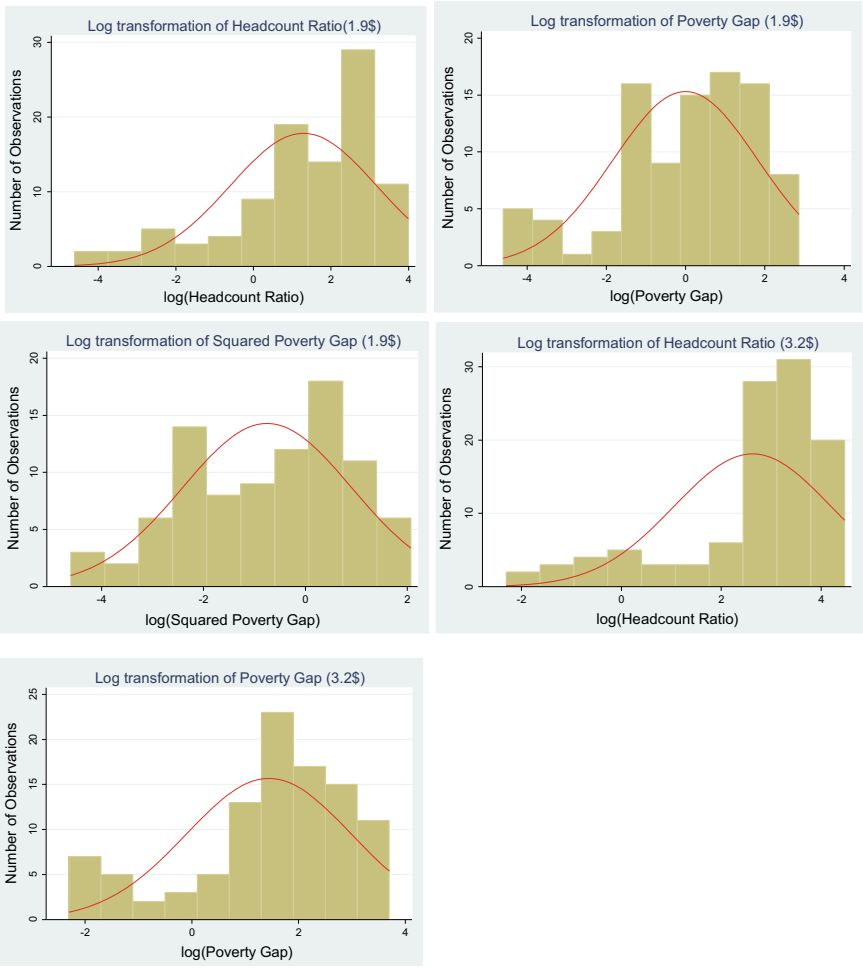

Fig. 1 Distribution of logarithmic transformation of poverty measures (*Source* Authors' compilation from STATA 13)

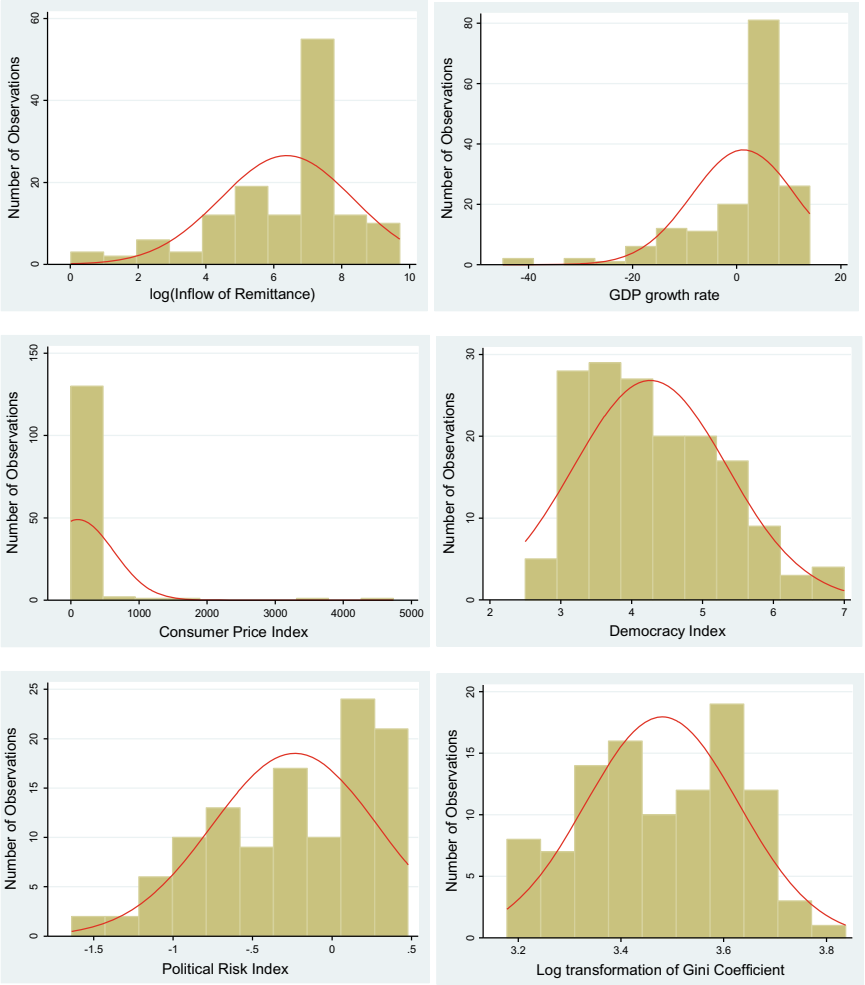

Fig. 2 Distribution of independent and control variables (*Source* Authors' compilation from STATA 13)

Table 3 Correlation matrix of independent and control variables

	Log (Remittance)	Log (Gini coefficient)	Log (GDP)	CPI	Democracy Index	Political Part. Index
Log (Remittance)	1.00					
Log (Gini coefficient)	−0.53	1.00				
Log (GDP)	−0.13	0.23	1.00			
CPI	−0.19	−0.07	−0.31	1.00		
Democracy Index	−0.31	0.03	0.17	−0.16	1.00	
Political Part. Index	0.21	−0.41	−0.10	0.26	−0.18	1.00

Source Authors' compilation from STATA

Table 4 Test results in panel data

	Log (headcount ratio $1.9)	Log (poverty gap $1.9)	Log (squared poverty gap $1.9)	Log (headcount ratio $3.2)	Log (poverty gap $3.2)
Hausmann	11.07* ($p = 0.086$)	25.11*** ($p = 0.000$)	37.54*** ($p = 0.000$)	21.90*** ($p = 0.001$)	8.74 ($p = 0.188$)
Pesaran CD	−1.10 ($p = 0.271$)	−1.39 ($p = 0.162$)	Not available	−1.43 ($p = 0.150$)	−1.01 ($p = 0.312$)
Friedman	1.06 ($p = 0.957$)	1.87 ($p = 0.867$)	2.67 ($p = 0.751$)	2.27 ($p = 0.811$)	(1.60) ($p = 0.901$)
Modified Wald	490.70*** ($p = 0.000$)	204.43*** ($p = 0.000$)	179.93*** ($p = 0.000$)	638.94*** ($p = 0.000$)	366.90*** ($p = 0.000$)
Wooldridge	1.63 ($p = 0.27$)	0.36 ($p = 0.58$)	0.023 ($p = 0.886$)	25.86*** ($p = 0.007$)	11.16** ($p = 0.028$)

***, ** and * indicate 1%, 5% and 10% significance levels respectively
Source Authors' compilation from STATA 13

Table 5 Panel regression results. Fixed effect model

Variables	Dependent variable				
	Headcount ratio at $1.9	Poverty gap at $1.9	Squared poverty gap at $1.9	Headcount ratio at $3.2	Poverty gap at $3.2
Log RE	−0.488*** (0.0782)	−0.594*** (0.0714)	−0.640*** (0.0711)	−0.334*** (0.0661)	−0.369*** (0.0659)
Log GC	5.972 (3.523)	5.389 (3.088)	5.276* (2.599)	3.962*** (0.821)	4.923*** (0.819)
Log GDP	0.00916 (0.00676)	−0.000972 (0.00651)	0.00982 (0.00867)	0.0184 (0.0124)	0.0116 (0.0125)
CPI	0.00309 (0.00856)	0.00427 (0.0121)	0.00416 (0.0130)	0.00802 (0.00743)	0.00131 (0.00748)
Democracy	0.353 (0.177)	0.246 (0.142)	0.174 (0.119)	0.218 (0.171)	0.360** (0.173)
Political Risk Index	−0.118 (0.431)	−0.218 (0.374)	−0.144 (0.271)	−0.0642 (0.256)	−0.0491 (0.254)
Constant	−17.99 (13.13)	−16.25 (11.46)	−16.19 (9.626)	−9.991*** (3.293)	−14.85*** (3.287)
Observations	82	78	73	87	83
R^2	0.728	0.758	0.744	0.684	0.739
Number of country	6	6	6	6	6

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source Authors' compilation from STATA 13

Table 6 Panel regression results. Pooled OLS regression

Dependent variable					
Variables	Headcount ratio at $1.9	Poverty gap at $1.9	Squared poverty gap at $1.9	Headcount ratio at $3.2	Poverty gap at $3.2
Log RE	−0.410***	−0.458***	−0.469***	−0.293***	−0.328***
	(0.0804)	(0.0789)	(0.0943)	(0.0698)	(0.0625)
Log GC	7.884***	8.488***	8.834***	5.523***	5.975***
	(1.025)	(1.041)	(1.157)	(0.670)	(0.618)
Log GDP	0.0124	0.00384	0.0132	0.0237*	0.0143
	(0.0172)	(0.0173)	(0.0209)	(0.0141)	(0.0128)
CPI	−0.00422	−0.00449	−0.00362	−0.000389	−0.00420
	(0.0111)	(0.0109)	(0.0137)	(0.00811)	(0.00731)
Democracy	0.729***	0.664***	0.551***	0.691***	0.685***
	(0.116)	(0.130)	(0.155)	(0.0883)	(0.0797)
Political Risk Index	−0.423**	−0.503**	−0.531**	−0.391**	−0.341**
	(0.202)	(0.212)	(0.227)	(0.166)	(0.148)
Constant	−26.74***	−29.73***	−31.46***	−17.61***	−20.15***
	(3.882)	(3.954)	(4.545)	(2.734)	(2.512)
Observations	82	78	73	87	83
R^2	0.846	0.824	0.753	0.836	0.856

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source Authors' compilation from STATA 13

Table 7 FDI and international remittances in aggregate figures

2002–2017				2007–2017		
Country name	Foreign direct investment, net inflows (BoP, current USD, billion) (1)	Personal remittances, received (current USD, billion) (2)	(2)/(1)	Foreign direct investment, net inflows (BoP, current USD, billion) (3)	Personal remittances, received (current USD, billion) (4)	(3)/(4)
Armenia	6.8	22.5	3.3	5.57	19.05	3.4
Georgia	17.7	18.2	1.0	15.06	16.27	1.1
Kyrgyz Republic	5.3	19.7	3.7	4.80	18.60	3.9
Moldova	4.2	22.8	5.4	3.46	19.19	5.5
Tajikistan	3.7	29.4	7.9	2.97	27.39	9.2
Ukraine	79.4	98.0	1.2	62.17	87.92	1.4
Total	117.1	210.5	**1.8**	94.04	188.43	**2.0**
Total – Ukraine	37.7	112.5	**2.99**	31.87	100.51	**3.2**

Source Authors' calculations based on World Development Indicators, World Bank

Table 8 Summary of data set on poverty, international remittances, FDI inflows and current account balance, 2017

Country	Personal Remittances, Received, % GDP, 2017	FDI net inflows, % of GDP, 2017	Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population) 2017, (1)	Population, Million, 2017 (2)	Current Account Balance, % of GDP, 2017	Personal remittances, received, current billion USD, 2017	FDI net inflows (BoP, current billion USD), 2017	Total natural resources rents (% of GDP), 2017	Remittances received from Russian Federation, billion USD
Armenia	13.3	2.2	1.4	2.95	−3.0	1.54	0.251	5.8	0.979
Georgia	11.9	12.1	5	3.73	−8.8	1.79	1.83	1.1	1.053
Kyrgyz Republic	32.3	−1.4	1.5	6.2	−6.8	2.49	−0.107	8.5	1.904
Moldova	16.9	1.7	0.1	3.55	−5.8	1.64	0.161	0.3	0.533
Tajikistan	31.3	2.6	4.8[a]	8.88	2.2	2.24	0.186	5.7	1.687
Ukraine	10.8	2.5	0.1[b]	44.8	−2.2	12.1	2.83	4.0	4.043
Total				70.11		21.8	5.2		10.195

[a]Data is for 2015 for Tajikistan; [b]Data is for 2016 for Ukraine

Source Authors' calculations based on World Development Indicators, World Bank

Table 9 Summary of data set on poverty, international remittances, FDI Inflows and current account balance, 2007

Country	Personal Remittances, Received, % GDP, 2007	FDI net inflows, % of GDP, 2007	Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population) 2007, (1)	Population, million, 2007 (2)	Current account balance, % of GDP, 2007	Personal remittances, received, current billion USD, 2007	FDI net inflows (BoP, current billion USD), 2007	Total natural resources rents (% of GDP), 2007
Armenia	17.9	7.3	2.8	2.9	−7.36	1.64	0.668	1.3
Georgia	8.7	18.5	11.8	3.9	−19.58	0.883	1.88	1.154
Kyrgyz Republic	18.5	5.5	9.9	5.3	−5.99	0.704	0.208	3.84
Moldova	33.9	12.2	1.1	3.6	−15.25	1.49	0.536	0.199
Tajikistan	45.5	9.7	10.4	7.1	−32.1	1.7	0.36	0.94
Ukraine	3.71	7.2	0.1	46.5	−3.7	5.29	10.2	7.9
Total				69.3		11.71	13.85	

Source Authors' calculations based on World Development Indicators, World Bank

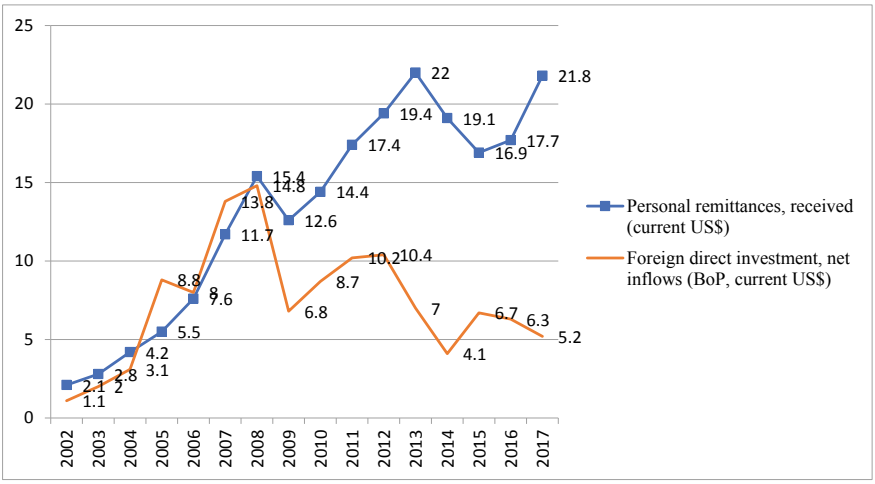

Fig. 3 Annual data on international remittances and FDI (*Source* Authors' calculations based on World Development Indicators, World Bank)

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Chapter 7
Utilizing Blockchain Technology in International Remittances for Poverty Reduction and Inclusive Growth

Niki Naderi

Abstract International remittances of migrants to their home countries offer massive potential to contribute to poverty reduction goals. However, despite the welfare gains associated with remittances and their impact on poverty reduction, the average cost of remittances remains more than double the Sustainable Development Goals (SDGs) target of 3%. However, newly evolving technologies such as blockchain and distributed ledger technology (DLTs) can help to achieve this target. To support the migration-related SDGs and poverty reduction, it is crucial to utilize recent technological innovations and establish legal channels of remittance transactions. Developing Asia requires to let new players, such as blockchain remittance companies and DLT-based applications, operate through banks, national post offices, and telecommunication companies to increase competition and lower remittance costs. This chapter explores the recent literature on the significant potential of remittances for poverty reduction and the importance of financial sector adaptation with new technological megatrends in the payments system to increase financial inclusion. Furthermore, it will investigate new business models for cost reduction and finding ways to make remittance cheaper. The chapter will provide several case studies and policy recommendations.

Keywords Remittances · Poverty reduction · Payment systems · Blockchain technology · Stablecoins · Sustainable Development

JEL Codes E42 · F24 · G15 · Q01

1 Introduction

Remittances are funds transferred between migrants (or guest workers) and their families in the home country. At present, with the exponential growth of remittance flows and their significant impact on economic development and poverty reduction,

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cross-border payments are playing an important role. However, there are many problems faced by traditional cross-border payments, such as high costs and lengthy process. Meanwhile, with the emergence of blockchain technology and cryptocurrencies, there is a possibility to utilize this technology to transfer funds by migrants worldwide to save remittance costs and processing time.

This chapter analyzes the emergence of innovative FinTech solutions in the remittance industry. It explores its capability to improve financial inclusion and alternate traditional cross-border payments to eliminate expensive intermediary costs and make remittance transaction services more efficient. This will significantly impact the efficiency and impact of remittances on poverty reduction for inclusive growth. At the same time, this chapter gives a few examples of the initiatives of remittance companies working in this field. The chapter will explore the advantages and challenges of blockchain-based transactions in the remittance market to clarify the insight for policy makers and regulators to develop initiatives for cross-border payments through regulatory clarity and offering the highest international standards of regulation specifically for the remittance industry.

Leveraging the new technologies' capabilities can potentially affect the welfare of migrants who send a portion of their incomes to their home countries' relatives. These migrants often play an essential role in their country's economic growth and household living conditions, and poverty reduction, mostly when remittances are spent on healthcare, education, and investment expenditure.

Though remittances are playing a pivotal role in economic growth and their potential to accelerate the United Nations' development agenda, the cost of remittances remains high, above the SDG target of 3%. Therefore, it is necessary to take action towards finding concrete solutions to facilitate the cross-border payments and lower the global average cost of remittances.

Additionally, given the current Covid-19 crisis, remittance flows have been experiencing a drastic decline due to lockdowns and job losses. It has also taken a devastating toll on vulnerable households dependent on remittance incomes to provide their basic needs. Therefore, based on the profound negative socio-economic impacts of the pandemic crisis, it is a matter of great urgency to take prompt action with the poorest's needs prioritized and protect them against the shock of losing remittance flows.

As the demands for digitalization and transformation of traditional cross-border payments increase, utilizing blockchain technology and its applications (stablecoins and cryptocurrencies) can potentially help the remittance industry improve speed and transparency and transaction costs. Therefore, blockchain-based solutions can have a crucial role in addressing the major limitations of current remittance services and making remittances more efficient. At the same time, compared to the traditional banking system, blockchain technology can drive SDGs in finance by bringing the world's poorest into the global economic system and providing financial transfer services to the unbanked population. This shows the importance of blockchain technology in increasing financial inclusion, especially among the disadvantaged population.

Despite the opportunities that blockchain-based digital currencies offer, there are some challenges for the broader implementation of DLT-based payment systems that need to be addressed. To address these challenges, it is needed to set appropriate global standards and agreements on common principles for utilizing blockchain technology to provide reliable payment solutions and reduce remittance costs.

The following part of the chapter is structured as follows. Sect. 2 gives the background of the study. Sect. 3 talks about leveraging blockchain in the remittance market for poverty reduction. Sect. 4 is on the advantages and challenges of blockchain-based payment systems. And, finally, Sect. 5 is on conclusion and policy recommendations.

2 Background to the Study

2.1 Importance of Remittances in Poverty Reduction

Remittances sent by migrant workers are a significant source of funds for economic growth in developing countries, such as India, Bangladesh, Sri Lanka, Pakistan, and Nepal, which are the major remittance-receiving economies in the South Asia region. Remittances promote growth in less economically developed countries by providing an alternative way to finance investment and acting as a substitute for inefficient or inexistent credit markets. Remittance flows are three times higher than official development assistance (ODA) and have reached close to the level of foreign direct investment (FDI) flows. Remittances to low and middle-income countries (LMICs) were even larger than the FDI flows in 2018. Meanwhile, the global average cost of sending $200 was 6.9% of the remittances. Considering that global remittances made up to $689 billion, including $528 billion to developing countries in 2018, the 6.9% average cost would amount to roughly $47.5 billion for remittance transaction costs, which is quite significant.

According to the World Bank's Remittance Prices Worldwide Database, The average cost was 6.8% of the number of remittances in the second quarter of 2019 (World Bank 2019a), considering that banks on average were charging 11% while post offices charged 7%. The cost was the lowest in South Asia, at around 5%, while remittance costs across many African countries and small islands in the Pacific remain above 10%.

International remittances have a statistically significant impact on reducing the poverty gap ratio and the poverty severity ratio, and there is a negative relationship between poverty and remittances (Lucas 2005; Yoshino et al. 2020). A 1% increase in international remittances as a percentage of the GDP can lead to a 22.6% decline in the poverty gap ratio and a 16.0% decline in the poverty severity ratio in the sample of ten Asian developing countries from 1981 to 2014. (Yoshino et al. 2019). The remittance flows are positively related to GDP growth. A 1% growth of remittance leads to a 0.017% growth of GDP in India (Sutradhar 2020).

According to the UN, in an analysis of 71 developing countries, remittances show significant effects on poverty alleviation: a 10% increase in per capita remittances leads to a 3.5% decline in the share of poor people in the population. Additionally, up to 80% of international remittances go towards immediate needs purchasing basic goods like food and covering healthcare expenses (United Nations 2020).

There is a direct relation in the role of remittances to reaching SDGs in a variety of scales such as household, community, local, national, and international levels.

Remittances contribute to lift recipient families out of poverty if remittances represent up to 60% of the total household income of recipient families to cover a substantial part of their daily expenses and immediate needs (IFAD 2017). This supposes that the money migrants send home is used effectively to have better education, healthcare and wellbeing, and for consumption, investment, and saving money to have a better future. In that case, remittance flows will have a significant impact on poverty reduction and are a powerful anti-poverty force in developing countries (Ratha 2013).

Given the Covid-19 pandemic crisis, the shrinkage of remittances calls for quick international collaborative action to sustain economies and safeguarding migrants and their families against the shock of losing remittance flows.

2.2 Remittance Trends in Recent Years and During the Covid-19 Pandemic

According to the World Bank Group, Asian countries experienced a sharp increase in remittance flows in 2018. Remittances to the East Asia and Pacific region grew almost 7% to $143 billion (World Bank 2019b). Remittances to the Philippines rose to $34 billion; however it was slower than the previous year due to a drop in private transfers from the Gulf Cooperation Council (GCC) countries. Flows to Indonesia increased by 25% in 2018, after a muted performance in 2017.

Remittances to South Asia grew 12% to $131 billion in 2018, double the 6% growth in 2017. The upsurge was driven by stronger economic conditions in the US and an increase in oil prices, which positively impacted external remittances from some GCC countries. In Pakistan, the inflow of remittance growth was moderate at around 7%, due to significant declines in inflows from Saudi Arabia, its largest remittance source. However, in India, the inflow of remittances grew approximately by 14%, where a flooding disaster in Kerala likely boosted the financial help that migrants sent to families (World Bank 2019b).

In Bangladesh, remittances showed a remarkable increase at 15% in 2018; however, in the wake of the Covid-19 pandemic, Bangladesh received $1.29 billion remittances in March 2020, 12.84% lower than the total received in February 2020 (Harmachi 2020).

As a result of the Covid-19 pandemic, along with the economic crisis and shutdowns, average global remittances are expected to decline dramatically by 20%.

However, East Asia and the Pacific region will see the smallest decline at 13%, while European countries will significantly decline at 27% (Bloomberg 2020).

Several remittance-dependent countries, such as those in the Pacific Islands, could see households at risk as remittance incomes decline over this period, although, a recovery of 7.5% growth is anticipated for the region in 2021 (World Bank 2020).

2.3 Utilizing Blockchain and Distributed Ledger Technology for Financial Inclusion in Cross-Border Payments

International cross-border payments have been one of the earliest and most promising applications of blockchain technologies (Mills et al. 2016). Blockchain and DLTs promise instant clearing and settlement, and immutable and transparent recording of transactions (Godfrey-Welch et al. 2018). Blockchain may enhance formalization and capitalization on remittances through promising interoperability and frictionless payments (Rella 2019).

The emergence of new FinTech has provided new opportunities to support growth and poverty reduction; in particular, blockchain technology can drive SDGs in finance. It performs more effectively than other technologies in key areas, including the promotion of transparency, cost reduction, real-time (instant) payment, and enhanced efficiency in transactions. Besides, it promotes trust among participants of a transaction without a centralized trust party.

An increase in efficiency and decreasing the total cost and time of service by cutting intermediary operators represent the second kind of benefit, that is disintermediation and less counterparty risk. There is no third party or central body involved in blockchain-based transactions; the concerned parties manage them.

In comparison to traditional financial services, blockchain technology promises to facilitate low-cost, fast and secure payment processing services by encrypted distributed ledgers that provide secure transactions without the need for centralized intermediaries, such as a correspondent bank or financial institution.

Recent technological innovations and blockchain-based companies offer a more convenient and cheaper way for migrants to remit their money to their families. It also increases the competitive pressure in the remittance market; therefore, the state of the competition itself will reduce the remittance costs in the given market. In this context, banks will feel pressure from these newly evolving ways of payments; hence, they should be able to respond by offering more efficient and similar services.

The use of blockchain technology facilitates know your customer (KYC) procedures, and the use of digital identities eases the process of customer identification along with promising an efficient, traceable, safer, and transparent cross-border payments system (Rühmann et al. 2020). It is worth mentioning that by facilitating cross-border payments and securities, trading, and streamlining regulatory barriers and processes, blockchain is likely to generate cost savings in the range of $15–20 billion by 2022 (Wildau 2015).

To date, we are witnessing that many governments are catching up on realizing the benefits of harnessing new technologies in the financial sector. Asian countries are gradually taking steps forward and easing limitations for new nonbanks' (ie independent digital banks) entrepreneurial initiatives. For example, last year Japan launched an electronic anti-money laundering settlement and allowed business operators to verify customers with documents online via email. The country is also in discussions over allowing nonbank companies to handle remittances of over 1 million yen (about $9,000) from 2021 at the earliest (Nikkei Asia 2019).

3 Leveraging Blockchain in the Remittance Market for Poverty Reduction

The high impact of remittance inflows on economic growth and poverty reduction in recipient countries raises the question of how to improve remittance services and gain the maximum benefits from remittances in the economy. For this purpose, it is essential to find more authentic payment solutions at a much lower cost. Remittances are playing a crucial role in poverty reduction. In contrast, the high cost of remittance transactions, notably in retail remittances, hinders its potential. There should be more efficient alternatives to adaptation. Therefore, exploring and leveraging innovative technologies to improve cross-border payments is one way that can potentially help in the transformation of remittances into a market frontier and boost the economy.

Migration and remittances have first-order effects on poverty on recipient countries' GDP and migrants' welfare and their families. In the wake of Covid-19, it is crucial to instantly ease remittances flow through more efficient cost-reduction channels, particularly for retail remittances. This is needed to improve financial inclusion in safeguarding the poor during this crisis, considering that remittances tend to have a critical role in stabilizing household consumption during economic shocks (Beaton et al. 2017).

Access to financial services is often tagged as a key mechanism to reduce poverty, given that a large number of the unbanked population are remittance recipients. According to a survey by the Global Findex database in 2017, 37% of adults in developing economies do not have access to mainstream financial services, while two thirds of them have a smart phone (FINDEX 2017). It is worth mentioning that globally about 1.7 billion adults do not have a bank account and around half of the unbanked population are female households in rural areas, which is quite significant (World Bank 2018).

Blockchain and DLT are being conducted to build more inclusive financial systems for disadvantaged/poor people and provide access to credit and key financial services to the unbanked population in an affordable and more convenient way, which can lift them out of poverty and strengthen the economy.

3.1 Recognizing Blockchain Technology and Its Applications' Potential

Blockchain is a distributed and open data infrastructure that is shared across a network of computers, which makes it possible to create a peer-to-peer transaction. Blockchain is a type of DLT with a specific set of features. DLT is a decentralized database monitored by various participants, and there is no central authority that acts as a monitor or arbitrator. The underlying blockchain technology with its distributed and immutable characteristics offers new ways of making cross-border payment systems more efficient.

Just after the 2008 financial crisis, blockchain was introduced as part of a proposal for Bitcoin (BTC, the world's first cryptocurrency). Satoshi Nakamoto released the first decentralized (independent of government control) cryptocurrency and drove the world's revolution into digital currency—a blockchain-based payment system allowing any two willing parties to transact directly with each other without the need for a trusted third party (Nakamoto 2008).

Blockchain most often refers to cryptocurrencies and its application for digital payment systems. However, today, blockchain technology is being applied across various industries and many projects worldwide, and has moved far beyond its original application within cryptocurrency.

Cryptocurrencies have been designed to operate as a fiat currency. BTC was the first cryptocurrency presented in the blockchain network. Blockchain allows BTC and other cryptocurrencies to operate without the need for a central body. This feature not only reduces risk but also removes many of the processing and transaction fees. Considering these characteristics and the advantages of blockchain, it can be an alternative to the existing banking and payments system. Blockchain is a novel process for remittances and brings new opportunities to solve fundamental financial sector problems, particularly in the cross-border payments and remittance industry.

To date, the evolution of cryptocurrencies has led to the emergence of new types of digital currencies such as crypto-tokens, stablecoins (SC), and central bank digital currency (CBDC). This study will focus more on SCs, considering their potential to solve the remittance industry's significant problems.

SC can be defined as a crypto-asset that aims to maintain a stable price in a benchmark (Hileman 2019). It is backed by a legal currency, such as precious metals, fiat currencies, or sometimes a basket of currencies or even another crypto-asset.

Compared to other cryptocurrencies that are volatile and not backed by any assets or not liable to any institution, SCs are more liable. They can be used as a means of exchange in business transactions to hold a stable value.

SCs have emerged as a worldwide phenomenon, with projects in North America, Europe, Asia, the Middle East, and Oceania. At present, in 2020 the Philippines, Singapore, China, and Japan are pioneer countries in Asia in developing and deregulating DLT projects (both centralized and decentralized) for cross-border payments.

SCs can transform the international cross-border payments and remittance industry, as it combines the higher transaction speed and lower cost with the stable values in the cryptocurrency market, where huge fluctuations are not uncommon. Currently, many central banks are investigating their CBDCs, which are backed by their national currencies. However, they are still in the testing phase and need further exploration of the practical issues and policy analysis. Private sector entities that design SC arrangements are expected to address a wide array of legal, regulatory, and oversight challenges and risks in the forthcoming years (G7 Working Group on Stablecoins 2019). Now, many fiat-backed or gold-back SCs are under regulation. Tether USD (USDT), Tether Gold (XAUT), USD coin (USDC), Gemini dollar (GUSD), pax gold (PAXG), digix (DGX), and JPMorgan coin (JPMC) are some typical regulated stablecoins.

3.2 Blockchain-Based Remittance Companies (Nonbank Initiatives)

In the past decade, given the significant growth in remittances and their impact on economic development, along with the demands for a more inclusive financial market and more efficient payment services, new FinTech companies are rushing into the industry and battling it out for the remittance market.

Until recently, banks were the only dominant operators in the remittance market, but now the remittance industry is shifting to a new paradigm.

In recent years, a large number of FinTech startups are creating blockchain-based remittance services, receiving licenses, and launching debit cards and mobile applications in most parts of the world, particularly in South East Asia. They are all unique in their way and offering creative solutions to remittance transfers across international borders. To date, around 90 DLT-based remittance companies are operating around the globe (Tracxn 2020).

Examples of some of the blockchain-based companies that are actively working in Asia are as follows.

TransferWise is a UK based nonbank online transaction service provider founded in 2011. The company is authorized and independently regulated by the Financial Conduct Authority (FCA). TransferWise is providing services in Europe, US, Canada, Latin America and Asia Pacific. The company has eight million users worldwide and handles over $5 billion worth of transactions every month just in Asia and the Pacific region. This company offers an online peer-to-peer payment system with lower processing costs, a competitive rate of 0.5%, by cutting out intermediary banks. It is also swift and easy to use.

InstaRem is a FinTech company founded in 2014 in Singapore and provides digital international money transfer that offers simple, safe, and cheap transactions. The company's fees are in a range of 0.25–1%. InstaRem has been rated by the World

Bank remittance site as the number one cost-effective money transfer provider from Australia and Singapore to multiple countries (Finextra 2020).

Everex was founded in 2017. It is a centralized Singapore-registered blockchain-based FinTech company, using Ethereum-based (smart contract-built) SCs named (cryptocash). The company is providing peer-to-peer remittance payment services and currency exchange along with microlending across international borders at virtually zero cost and 25 times faster than traditional transactions. Everex offers easy and fast transactions to its users and provides financial services to the unbanked population.

Deemoney is a blockchain-based FinTech company founded in 2018 based in Thailand. It is the first nonbank entity in Thailand using RippleNet (non-blockchain protocol based on Ripple Protocol Consensus Algorithm—RPCA) to provide efficient cross-border payments at a competitive rate and more comfortable and faster transfers to 180 countries and 34 currencies worldwide through its services to the web and Deemoney mobile app.

LALA World is an Asian FinTech company headquartered in Singapore, founded in 2016. LALA utilizes two types of blockchains (Ethereum and Stellar) to create a decentralized connected financial ecosystem. The company provides services to migrants and their unbanked families to easily access financial services with multiple cash-out options. The company offers a digital wallet and digital identity for its users that can be carried globally for remittance transactions and other services.

Abra is an American FinTech company founded in 2014. In the beginning, it used the US–Philippines corridor but soon expanded to cover more than 150 countries around the world. It provides peer-to-peer money transfers through an app with no fees charged by Abra. Users store digital cash (valued in any currency) in the app and use it directly on their smartphones by using a debit card or an 'Abra teller'. Abra tellers act as 'human ATMs' and are located by customers using the app. That feature lets users send money instantly to anyone just with their mobile devices, even if they do not have a bank account. It has a blockchain-based platform, but funds are denominated in US dollars and, during transactions, they are instantly settled in the local currency.

Stellar is a blockchain-based protocol founded in 2014 that has its currency named stellar lumens (XLM). The stellar network connects people and financial institutions worldwide to transfer digital currency or fiat currency. It provides cross-border payments between any pair of currencies at lower costs.

Stably is a for-profit company founded in 2017 using a centralized model that provides a SC cryptocurrency StableUSD (SUSD), which is backed by the US dollar. Users can buy the SC by making payments via bank transfer or cryptocurrency and then sending, storing, and receiving money from anywhere.

4 Advantages and Challenges of Blockchain-Based Payment Systems

Leveraging the capabilities of new technologies in the remittance industry can help millions of migrants living, working, and studying around the globe.

As mentioned in previous sections, blockchain technology can bring financial inclusion and many advantages to the remittance industry, such as lower transaction costs, better transparency, real-time payments, reducing the risk of fraud, less counterparty risk, and simplifying the payment process, as well as providing payment services to the unbanked population.

Along with the opportunities and advantages of utilizing blockchain in finance, there are also some challenges and barriers, such as complexity, security, lack of standardization, lack of awareness, and user experience, which will be mentioned later in this section. However, first, we will look at the main advantages of blockchain-based payment systems.

4.1 Advantages

Lower Transaction Costs

The decentralized characteristic of blockchain technology made it a new tool to cut costs; there is no need for third parties, and there is no need to verify data. Blockchain-based transactions are nearly costless and, depending on the transfer agents, varies around 0–1%. The cost is much lower than the current average of 7% for remittances through banks or postal services. Blockchain technology can reduce remittance costs to less than 1%, even lower than the SDG target of 3%.

Greater Transparency

One of the most attractive aspects of blockchain is its promise to operate as a 'trust machine' and enable transparency of information to make payments more transparent and systems more accountable so that transaction information cannot be altered. Therefore, every transaction remains irrevocable, and users can observe the history of all transactions. As a result, it will be harder for corrupt government officials to hide financial leakage or corruption.

Faster (Real-Time) Payments

Transactions through traditional payment services, such as banks, post offices, and telecommunication companies like Western Union and Swift, are time-consuming. They involve a lot of paperwork and many intermediaries. Therefore, the transfer of money through these channels is a lengthy process and may take days or even weeks. Blockchain-based transactions are instant and, as soon as a transaction is recorded, the recipient has access to the payment.

Cutting Intermediaries and Less Counterparty Risk.
One of the key advantages of blockchain as a decentralized ledger is that there is no point of failure; that is to say there is less counterparty risk. When the system operates as a trust machine and is a source of truth by itself, transactions are settled instantly; thus, there is no need to trust a third party to confirm transactions' correctness.

Accessibility of Financial Services to the Unbanked Population.
Access to credit and financial services is often tagged as a key mechanism to reduce poverty among 1.7 billion adults who are unbanked and cannot benefit from financial services. According to a survey in 2017, 31% of adults do not have access to a bank account and financial services around the globe (Global Findex 2017). Unbanked people rely on cash to make payments and do not have savings accounts or credit due to the direct and indirect costs or lack of documentation and trust. Blockchain-based payment services present an alternative to create an opportunity for disadvantaged groups. Blockchain payments can provide financial services for unbanked people who have a smartphone but do not yet have a bank account.

4.2 Challenges

Complexity.
Most potential adopters consider blockchain to be a highly complex technology (Kshetri 2017). That is why it is not an easy task to integrate blockchain with existing payments systems. Financial institutions need to educate themselves on this innovative technology at all levels to be able to provide more convenient and secure services for their customers. The complexity of blockchain characteristics and encryption principles is also a big issue for policy makers to explore practical policy analysis in the adoption and implementation process.

Lack of Awareness and User Experience.
The technology is at the early stage of adoption. Lack of awareness and guidance is a major factor that restrains people from using digital wallets and new remittance transfer channels. Lack of user-friendly applications is also another factor. People might get confused at the beginning due to a lack of understanding or lack of local language guidance for the application functionality; using crypto-wallets (e-wallets for DLT-based currencies), service applications, or identification processes requires specific technical knowledge. Thus the majority of users rely on third-party service providers to do the task for them. Blockchain-based payment services need to be designed as simply as possible for users who do not have a technology background.

Security and Privacy.
Although the blockchain system is more secure than traditional systems, in terms of privacy, it is an open ledger and recorded transaction data is visible for all users to view. Additionally, a new identity framework needs to be designed to protect private information and make the systems, apps, services (built on the blockchain) more secure against hacker attacks.

Lack of Cooperation and Knowledge Sharing.
The existing blockchain-based payment companies are developing their applications and standards alone. Early adopters of blockchain are reluctant to interact or work with other similar initiatives due to the competitive atmosphere of the banking industry. They can operate more efficiently and harness the network effect through collaborative solutions and common standards. The market also suffers from a lack of blockchain consortiums to tackle industry issues.

It is not easy to improve payments without coordination between the payment system operators (PSOs), payment service providers (PSPs), and third-party service providers (Bech and Hancock 2020).

Lack of Standardization and Coherent Regulations

The concept of blockchain and DLT is a novel issue for policy makers. They need to educate themselves to understand the technology and its impact on the financial sector to reduce uncertainties and build appropriate regulatory frameworks. The functioning of blockchain may also conflict with regulatory requirements. For example, unchangeable information storage on the blockchain contradicts the right to be forgotten (Beloussov 2016). To date, despite the fact that a large number of DLT-based payment companies are working across the world, there are no specific rules or coherent regulations regarding blockchain-based transactions and nonbank payment services.

Lack of Blockchain Education and Developers.
The paradigm shift in the financial sector and the restructuring of traditional systems required to engage blockchain talents and skilled developers in the transition process is a challenge. In the meantime, market demand is increasing for adequately trained people for developing and monitoring the complexity of DLT networks. Educational institutions must provide blockchain-related courses and workshops to train financial companies and individuals to alleviate market demands for blockchain-related jobs and train technicians in the blockchain area for further development. Transition to a fully digital economy without updating education systems is a sure recipe for disaster (United Nations 2020).

Lack of ATMs and Cash-Based Local Exchanges for Cryptocurrencies
Another barrier for quick adaptation of the remittance industry to blockchain-based payments is the crypto-to-fiat conversion issue and lack of local settlement cash-out providers. The use of crypto ATMs is an interesting solution for remittance payee and payers to fiat conversion and payment transactions, especially in disadvantaged areas that still lack a good internet connection. It can also be useful for the unbanked population who do not even have a smartphone.

FinTech startups like Bit2Me and MoneyFi are building new remittance systems that enable users to convert cryptocurrencies into fiat currency with ATMs. They aim to issue prepaid cards that support multiple functionalities (Binance 2019).

5 Conclusion and Policy Recommendations

Remittances are a vital source of income for millions of people worldwide and can play an essential role in achieving several SDGs. However, the high cost of remittance transactions hinders its potential. Therefore, to support the migration-related SDGs and poverty reduction, it is crucial to utilize recent technological innovations and establish legal channels of remittance transactions.

As a result of the Covid-19 pandemic, remittances will be lower, and recipient countries will experiencing economic shocks, and the number of poor people is expected to increase from the lower inflow of remittances. Therefore, there is an urgency to recover the economies and safeguard migrants and their families against the shock of losing remittance flows.

The new wave of blockchain-based nonbank initiatives have the potential to transform the remittance industry. The underlying technology of blockchain promises to improve the cross-border payments system and reduce remittances cost. It also can drive SDGs in finance by improving financial inclusion and allowing the world's poorest to access the financial system. However, it is still at an early stage of adoption and raises concerns for regulators and governments, and central bankers. There are some challenges for the global setting and implementation of standards for DLT-based payment systems, such as regulatory uncertainty and security concerns and monetary policy issues that hinder such payments' rapid development. Another limitation of the broader implementation of these new types of payments is the lack of regulatory clarity. Policy makers should educate themselves to have a clear understanding of the digital currencies underlying technologies and their impact on financial stability, to be able to reduce uncertainties and build appropriate regulatory frameworks. There will also be a need for a collaborative international approach in establishing coherent regulatory frameworks and generating knowledge for policy-making. This collaboration is needed to establish an 'international payment systems regulator' company to set a global standard and common principles for utilizing blockchain technology in cross-border payments and provide reliable payment solutions to reduce remittance costs.

We are in a race against time. With the emergence of payment innovations and blockchain technology as a megatrend in the modern financial era and the Covid-19 crisis and demands for digitalization, customer expectations are changing. Hence, the traditional financial services sector cannot continue to grow without adaptation and change to their conventional banking systems. Consequently, many countries are investigating CBDCs backed by their national currencies, although they are still in the testing phase. SCs offer an exciting new potential to transform international cross-border payments and the remittance industry. They combine the higher transaction speed and lower cost with stable values in the cryptocurrency market. It is becoming necessary to realize potential of SCs or cross-border payments as they can bring considerable advantages to the remittance industry.

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Chapter 8
Measuring the Performance of Poverty Reduction Programs in Rural Pakistan

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Abstract Microfinancing is an essential tool for poverty alleviation in society to address this humanitarian problem in the world. This study investigates the fundamental factors contributing to poverty, along with exploring the efficient model of how to provide financial assistance to these determinants to overcome poverty. The result is investigated by applying the simple logit model and logit forward conditional model to primary data that was collected during survey conduct in rural parts of Pakistan. It is revealed from the empirical analysis that schooling level, household size, occupation, gender, and age are significant determinants of poverty. It is also observed that Zakat institutions has been developing human capital through skill development in the Vocational Training Institute, which is a very effective way to overcome poverty. This chapter concluded that human capital development through education and skill development is the best strategy to enhance income so that the productive poor overwhelmed insufficiency in Pakistan's rural areas.

Keywords Poverty reduction · Rural area · Skill hand · Productive poor · Vocational Training Institute · Human capital

JEL Classification Q41 · Q47 · D63

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1 Introduction

Poverty reduction is often regarded as a philanthropic issue and remains a universal goal. The severe form of poverty, namely extreme poverty, transpires when people face deficiency of the minimum level of food and suffer hunger. Also, there is the lack of clothes to wear, the difficulty in finding shelter, facing the lack of health facilities and education services to lead a normal human life (Le and Leshan 2020). Besides, poverty occurs when people lack key abilities and, therefore lack income, educational facilities, and medical services (Agarwal et al. 2017; Olagunju et al. 2019). The social causes and consequences of poverty include feelings of lack of confidence or helplessness, inequalities in opportunities, and feelings of lack of rights such as freedom of speech. In theory, there is a link between poverty, inequality, and vulnerability in society (Félix and Belo 2019). Inequality refers to characteristics such as income distribution or consumption in the entire inhabitants (Angelsen and Kaimowitz 1999; OECD 2008). Even if a person is not necessarily poor because of vulnerability, he may fall into poverty. The vulnerability is usually related to the affected property (Sumner et al. 2020).

The United Nations has estimated that the daily cost of living in rural areas below the global poverty line is $1.90 (Roser and Ortiz-Ospina 2017) per person per household. It is also assessed that 842 million people do not have enough food to lead a healthy life in the world (World Bank 2019). Most poor and vulnerable poor live in developing and emerging regions globally (Deaton 2010). To reduce rural poverty, it is necessary to invest in full features of rural development to create the conditions and capabilities required to enhance income and assets (Miller et al. 2014; Ward 2016). Therefore, it is necessary to invest in all the features of rural development (Ravallion and Ravallion 2012).

Moreover, reducing poverty in rural areas means increasing income (Wilkins 2020). Even if the family is adversely affected, income can build and maintain assets (World Bank 2018). Given the nature of poverty reduction in rural areas, finance enables people to access some of these services, thereby increasing income and enhancing family businesses' competitiveness with more business activities. These complementary services and industries will also grow, and more rural finance will be obtained and managed in the future (Chetty et al. 2018). Managing the funds of the poor is an essential tool to eradicate poverty anywhere in the world. This is also the essential requirement of human capital development (Brown and James 2020).

Microfinance was introduced in Bangladesh as a vital tool for poverty alleviation since the 1970s. It is now assumed the right technique for poverty alleviation globally. Microfinancing is well thought off as a lively contributor for poverty alleviation in society (EPU 2016) to pulling out from poverty line since last decades in deprived regions of the world (Iqbal and Akhtar 2015). This scheme is aiding the poor in a couple of ways, i.e. supplying the funds to the unfortunate and deprived to enhance their income and helping the poor so that they must be self-sufficient to sustain their wellbeing (Iqbal et al. 2014; Medeiros et al. 2020). So, microfinance institutions (MFIs) and other poverty reduction programs need greater resources to better be able

to meet the needs of the deprived people of society. So the sustainability and survival of these programs are fundamental and critical issues as most of these institutions rely on donations, charity, aid, and funding provided by wealthy people and other agencies in favor of these trusts. This means that their assets are insufficient compared to the deprivation in society (Banerjee and Jackson 2017; Meinzen-Dick et al. 2019).

Substantial economic difficulties and enormous poverty exist in Pakistan. Therefore, these financial institutions face a severe financial problem for their survival and to maintain efficiency, productivity, profitability, and progress due to a lack of funds and resources. Due to the insufficient supply of financial and other resources, these institutions are planning to boost resources for their survival through their effective financial systems to meet the requirement of the determinants of poverty (Irwin and Nilsen 2018; Iqbal and Mohsin 2019). The government and other agencies are now focusing on studying the MFIs sector to achieve adequate service provision to the poor part of society for maximum improvement so that households can initiate entrepreneurship. The government of Pakistan is trying to provide financial assistance to charity programs by making them accountable so that the poor must get benefits from them to improve the efficiency of poverty determinants to generate money. Different factors are essential for poverty alleviation, including those identified by other researchers from time to time and region to region. Literature also provides shreds of evidence that deprivation can be controlled by providing sufficient financial resources and adequate instituitional working capital (Olopade et al. 2019). So developing countries like Pakistan have been allocating huge amounts in annual budgets to provide financial services to deprived segments of the country.

According to a survey conducted by the Planning Commission of Pakistan, 40% of people lived below the poverty line in 2008. The United Nations Development Program also conducted a research study and concluded that Pakistan faces a 54% incidence of multidimensional poverty (Mahmood et al. 2014). A recent World Bank study showed that Pakistan's poverty increased irrationally from 2008 to 2010 (Padda and Hameed 2018). It is also investigated that conflicted and fragile regions face a higher poverty ratio than other regions (Khan et al. 2016).

Pakistan achieved rapid development in the 1970s, but poverty and scarcity increased irrationally in the 2010s. According to Saboor et al. (2015), Pakistan faces a shortage in rural areas. Poverty is unequally distributed among different regions and provinces of the country and between provinces. As for Punjab, its south western region, which is beautifully landscaped, and includes with the hilly areas of the Suleymaniye mountains, the mighty Indus River, green arable land, sandy soil, and vast deserts, has been ignored and severely affected. This is facing the worst indicators of human development and wellbeing, including the lack of sanitation and education facilities. The welfare indicators in the different regions of Punjab are very different. Compared with urban areas, the rural areas are poorer. In Punjab, households in the southern and western regions face higher poverty levels and more flawed human development indicators. The region lacks education and public services (Iqbal and Akhtar 2015; Hussain et al. 2019). So, Pakistan's government has been launching different plans and strategies for poverty reduction in these areas. The government's direct poverty reduction strategy includes a plan that emphasizes allocating more

financial resources to the poor for obtaining higher output and increasing the material inputs required for human capital (Cuong 2010; Christiaensen et al. 2011; Falola and Odey 2017).

The study's primary purpose is to evaluate and estimate the efficiency of poverty reduction programs functioning in southern Punjab, as Punjab contributes more than 50% of the population in the country. Another reason behind the Punjab selection is due to the country's extremely poverty. Rural southern Punjab is facing an 84% poverty ratio (Iqbal and Akhtar 2015). This study also aims to assess the impact of Pakistan's poverty reduction programs by concentrating on estimating the impact of individuals benefiting from such programs on socio-economic characteristics.

In order to achieve its primary goal, which is to evaluate the existing poverty reduction plan to promote poverty reduction in Pakistan effectively, the subsequent research goals have been formulated:

1. have a deep understanding of the theoretical issues of poverty reduction in developing countries;
2. determine the root cause of poverty observed in Pakistan;
3. gather significant data by survey in order to evaluate the personal impact of the poverty reduction plan;
4. purposefully measure and compare the poverty situation of recipients and non-recipients of numerous poverty decreasing programs implemented in poor areas of southern Punjab;
5. determine how to contribute to the poverty reduction plan so it is more effectively generated and managed;
6. based on the experience gained in the study area and other places, use the research results to develop a demonstration plan for poverty reduction (Khandker 2005).

2 Methods of Poverty Reduction Programs

The Pakistani government has adopted different indirect strategies to ensure a higher level of employment in the country. These strategies are implemented through a macroeconomic policy framework to ensure career development, higher income, and growth opportunities. The Pakistani government has also adopted a direct strategy to allocate more financial resources to poverty-stricken areas to obtain tangible resources and other inputs to produce higher output. Zakat is an essential pillar of Islam and a means of purifying wealth to ensure that the poor's needs are taken care of. Zakat can be paid to those who belong to the eight Zakatable types designated by God in the Quran. The Pakistan Bait ul Mal, Benazir income support program, and microfinance are examples of direct strategies adopted by the Pakistani government to assist the country's poor and vulnerable (Iqbal and Akhtar 2015; Chantarat et al. 2017). The Pakistani government has initiated and has been managing different rural poverty reduction programs. We will not discuss each plan in detail, but briefly

introduce some of the plans that adopt direct strategies and fundamentally reduce poverty (Rewilak 2017).

The Zakat institution is one of the oldest concepts in Islam. It has been working in all Islamic countries, and in Pakistan under the Usher Regulations of 1980 through the local Zakat committee network. The funds generated are used for the needy, the poor, the destitute, orphans, widows, and the disabled. The Pakistan Bait-ul-Mal (PBM) has been functioning since 1992 for assisting the poorest people in the country without discriminating on grounds of skin, color, belief, religion, and gender. These services are provided to the poor in need (Seven and Coskun 2016).

Since 2008, the Benazir Income Support Program (BISP) has provided services to the poor, destitute, needy, and vulnerable as the country's main social safety net. The program aims to make the country prosper by minimizing poverty, by empowering women and providing skills and training to enhance human capital. The plan also tries to provide microloans to unemployed poor females to help them find jobs (Deen 2015; Haneef et al. 2015). Microfinance is a modern technique and a useful tool to get the poor out of the poverty trap. It can also protect vulnerable groups from falling through loopholes. Microfinance provides opportunities for self-employment. Different government organizations, non-governmental organizations, the provincial government, and local authorities have been providing this facility to the poor. The purpose of these organizations' funding is to increase the poor's access to material inputs so that people can use these funds for income-generating activities (Abate et al. 2016). To assess the effectiveness of the poverty reduction programs, it is necessary to look at different geographic regions and poverty-related programs that specialized in that region (Bandiera et al. 2017).

Although there is no specific definition of poverty, it is usually defined as a lack of control over resources (Yoshino et al. 2017). This method of measuring poverty can be called the income method because it can measure the degree of social income or consumption shortage, and poverty is a one-dimensional method of measuring poverty. If people cannot obtain enough economic resources to obtain enough goods to meet basic needs, the method defines them as the poor (Inoue 2019). Poverty can be described as hunger, lack of housing, disease, inability to see a doctor, inability to go to school, and inability to read. It can include unemployment or infant death due to impure water. Besides, it can be called powerlessness, the lack of representation, and freedom. Therefore, poverty can be described in many ways and many forms, in differnt situations and at different times (Inoue 2018).

2.1 Relative Poverty

Relative poverty is more subjective because the prevailing social standards in society dictate the judgment that is related to the definition of poverty. The poverty line varies with economic conditions, but this trend will be different over time. Since government plans are changed every year based on actual consumption rather than changes in actual value, levels must be assessed (Inoue 2018). Absolute poverty refers to the

family status and level associated with the minimum calorie intake. In this respect, the poor lack some basic needs.

2.2 Headcount Ratio (P_0)

The headcount ratio assessment measures the proportion of the population below the poverty line to the total population. Even though the headcount ratio has many flaws, it is still considered the most popular method to measure poverty.

$$\text{Poverty Head Count Ratio} POV_{0i} = POV_0(K_i) = \begin{cases} 1 \; if \; K_i < z \\ 0 \; if \; K_i \geq z \end{cases}$$

$$HC = \frac{1}{N} \sum_{i=1}^{N} POV_0(K_i) \tag{1}$$

where z shows the poverty line of household, Ki shows the consumption expenditure (equivalent) of each adult in i, and N shows the total population. To represent the entire population, they are appropriately weighted. Similar methodologies have been used in other decision-making applications, such as energy, the economy, and the environment (Mohsin et al. 2018, 2019, 2020).

2.3 Poverty Gap (P1)

The poverty gap measures the distance between poor household income and the poverty line (Yoshino et al. 2017). It displays and evaluates the average income constraints of the poor relative to the poverty line. The concept evaluates the degree of poverty while failing to measure an income distribution among poor and severe poor.

$$\text{Poverty Gap: } POV_{1i} = P_1(K_i) = \begin{cases} \left(\frac{z-K_i}{z}\right) \; if \; K_i < z \\ 0 \quad\quad if \; K_i < z \end{cases} PG = \frac{1}{N} \sum_{i=1}^{N} POV_1(K_i) \tag{2}$$

2.4 Squared Poverty Gap (P2)

The poverty gap square measuresthe severity of poor people living below the poverty line. The poverty gap squared explains, responds, and deals with the square of the

average distance between the poor's income and the poverty line. Therefore, when moving from P0 to P2, the population's poorest people will gain more weight.

$$\text{The severity of poverty: } P_{2i} = P_2(K_i) = \begin{cases} \left(\frac{z-K_i}{z}\right)^2 & if\ |K_i < z \\ 0 & if\ |K_i \geq z \end{cases} SP = \frac{1}{N}\sum_{i=1}^{N} P_2(K_i) \tag{3}$$

2.5 Measuring the Absolute Poverty Line

Although there are many poverty indicators as poverty measurement tools, discussing the absolute poverty line's estimation is relevant to this research. There are many ways to measure financial freedom because, compared with economic welfare, this is a broader concept, which only measures a person's economic condition. The well-known method of measuring economic welfare is household income. However, these methods cannot correctly show the situation due to false and forged information. Individual households did not disclose income levels for tax reasons, nor did they report income from other sources. It can be argued that income fluctuates throughout the year, but consumption remains unchanged during this period. Therefore, compared with income, consumption is considered a better welfare indicator.

After determining the degree of family financial freedom, it is necessary to calculate the number of people still in the poverty trap by calculating the basic line of poverty (Ceballos et al. 2018; Ivanic and Martin 2018). The poverty line should be based on 2,350 calories per adult. This is Pakistan's official poverty line. The family composition of the poor and the non-poor is different. Therefore, a specific standard scale is needed to use the adult equivalent scale to convert the family size to adult equivalent (Dodds 2016). Previously published studies emphasized various measurements of economic poverty:

1. Calculate the poverty line for each family or per capita (adult equivalent). In order to estimate poverty based on the equivalent of each adult, the equivalent of the adult in each family will be calculated.
2. Calculate the amount of food consumed by the family and convert it into calorie intake.
3. Convert the per capita calorie intake into adults' average calorie requirement according to a certain ratio.
4. After calculating the bundled expenditure, calculate the bundled cost.
5. It is estimated that the poverty line requires the lowest calorie intake every day.
6. Due to the different nature of urban and rural economic activities, it is necessary to calculate the specific poverty line for urban and rural areas.
7. Use the calorie expenditure function (CCF) to calculate the recommended calorie intake and convert it to the food poverty line.

This method absolutely assumes that those households that can meet the minimum calorie requirements also eat basic non-food. If they cannot reach it, increase your calorie intake. As shown in equation, the first three fifths of the population are regressed:

$$Y = \alpha + \beta_n X_n + \mu \tag{4}$$

where Y represents the monthly consumption expenditure per adult equivalent, while X represents the per day calorie intake per adult equivalent.

2.6 Poverty Line

The poverty line is the minimum level needed for an individual (family) to meet their basic needs (for example, to live a humane diet, clothing, shelter, health, and education facilities). The poverty line, the 'food (calorie intake) poverty line', is constituted by the food demand obtained from bundled consumption. The poverty line should be based on 2,350 calories per adult. This is Pakistan's official poverty line (Maltais et al. 2016).

3 Methodology and Data Collection

Primary data is applied to measure the performance of poverty alleviation institutions. A survey was conducted for information collection. The questionnaire was filled from two types of households: the non-recipients and recipients of poverty alleviation institutions. Inquiries were made about the social and economic condition of households from both groups of study. Logistic regression is applied to primary data to reach the quantitative results from raw data collected from recipients and non-recipients. In the rural zone of South Punjab, 200 households were approached in the same village of south western Punjab, having identical and matching economic conditions and circumstances (Kiendrebeogo et al. 2017).

Past literature is rich about the logistic regression model, which is supposedly an ultimate econometric model for assessing and estimating primary data results for purposeful conclusion (Randolph et al. 2007). To estimate and measure the performance of poverty reduction programs, this research study starts to identify the poverty determinants with a binary logistic model because it is considered a vital technique when the independent variable must be reserved only one of two values, as under:

$$P(y) = f(\beta X) \tag{5}$$

The logit model measures and estimates the performance of poverty reduction programs functioning in Pakistan, and of institutions contributing to the reduction in

poverty-causing factors (Otte et al. 2012). This research supposed that the chance of being poor is determined by social and economic determinants. In the occasion of binary logistics poverty position, causal response variable y* will be clear through regression connection as:

$$Y^* = \sum_{i=1}^{n} X_i + \beta_n X_n + \mu \tag{6}$$

where $\beta = [\beta_1, \beta_2, \ldots, \beta_n]$. As discussed earlier X_i are features of members of the family, and β_i the constant for the corresponding factors used in the econometric model. It is also explained through maximum likelihood techniques, which explains the correct meaning. So, this research paper used the following equation:

$$(POV) = \beta_0 + \beta_1 Y_1 + \beta_2 Y_2 + \ldots + \beta_k Y_k + \mu_i \tag{7}$$

Y_k indicates the variables, i.e. gender, occupation, business assets, land, schooling level, age, size of family, livestock, loans (see Table 1). This chapter attempts to estimate and measure poverty alleviation institutions' performance and efficiency to supply the fund to factors of poverty to identify the poverty determinants and estimate the performance of institutions so that poverty in rural Pakistan may be controlled. Error! Not a valid link. The raw data regressed in the chapter is collected through a household survey conducted from the rural zone of the south west of

Table 1 Set of variables

P =	Poverty status (probability of being non-poor)	Poor = 0, other = 1
Y1=	Gender	Male = 1, female 2
Y2=	Occupation	Unemployed = 0, employed = 1
Y3=	Schooling level	Illiterate = 0, Primary = 1, Middle = 2, secondary = 3, other = 4
Y4=	Age	Number of years
Y5=	Size of family	Number of members of the family
Y6=	Female employed	Number of female employed in the household
Y7=	Male employed	Number of males employed in the household
Y8=	Value of animal	The total amount of value of animals
Y9=	Own Land	Number of an acre of owned land
Y10=	Business assets	The total amount of value of business assets
Y11=	Saving for emergency	Total amount of savings
Y12=	Loan	The total amount of loan taken

Source Authors compilation

Punjab. The respondents delivered comprehensive facts and figures based on their best understanding and awareness about socio-economic and demographic determinants, i.e. schooling, occupation, male and female participation, livestock, business assets, land, and loans (Anderson et al. 2020).

4 Results and Discussion

4.1 Factors Causing Poverty

For complete results, the binary logit model is applied to data collected through the questionnaire to identify the vital factors contributing to poverty in rural Pakistan. The table revealed the effects that show some variables that stood with a higher level of significance at p having value equal to .000. The model describes between 31% (Cox and Snell R^2) and 51% (Nagelkerke R^2) of the absolute deviations. It is also estimated that the model appropriately categorizes between 88.10% of the circumstances.

The model is applied to the original data, and the results are derived from the original data. Table 2 shows that education level, age, employment of male and female participants, and livestock are important determinants of poverty in study areas. It can also be seen from the table that the β coefficient of family size is positively correlated with poverty. In contrast, occupation, education, male and female members, land, and loans are negatively correlated with poverty. Education level is the most basic and most important factor, which has a more significant impact on poverty reduction.

Table 2 Identifying the factors contributing to poverty

Dependent variables	β_1	Sig	Exp (β_1)
Gender	−4.560	0.234	0.443
Occupation	−0.253	0.450	0.745
Schooling level	−1.008	0.000	0.170
Age	−0.701	0.000	0.482
Size of family size	0.161	0.156	0.750
Female employed	−1.263	0.000	4.125
Males employed	−2.451	0.000	0.115
Value of animals	1.623	0.000	0.195
Own land	−0.144	0.046	0.865
Business assets	0.059	0.556	1.077
Saving for emergency	−1.123	0.108	0.344
Loan	0.550	0.107	0.625
Constant	0.678	0.245	2.215

Source Authors' calculation

The level of education improves people's income-increasing skills, which are very important for income generation. The conclusion drawn from the raw data is that no poor person in the study area has a graduate level education. Education is an essential factor that causes high incomes to break out of the vicious circle of poverty.

School education is considered the best strategy for developing human capital skills to alleviate social poverty. The conclusion is that trained, skilled, and educated people are more likely to use intimidation resources at the optimal level to earn higher income for their families. Based on the given data, it can be concluded that as the family size increases, the chances to fall into poverty also increases, so the family size is positively correlated with poverty, and the opportunities for deprivation also increase.

4.2 Comparison of Poverty Reduction Programs

This paper uses the conditional method of the logit regression conditional forward method to evaluate and measure the performance and efficiency of poverty reduction agencies. The model includes variables with automatic procedures and identifies effective variables that help reduce poverty. It can also be observed that the model may not show a variable, so it is concluded that no variable will affect the determinants of poverty reduction.

Table 3 is formed by combining the logit model of forwarding conditions with the main data. The data shows that the occupations in the family and men and women's employment are negatively correlated and have statistically significance. The larger the family size, the greater the likelihood of poverty. The smaller the family size, the smaller the chance of poverty (Wang et al. 2018). The Zakat institution in Punjab provides funds to various institutions for higher education and skills development training, which enhances the capability of earning. The Vocational Training Institute (VTI) is an institution that provides free training for the poor with the help of Zakat institutions.

Since 2008, the Benazir Income Support Program (BISP) has provided funds and financial assistance to poor and disadvantaged women in the country. Table 4 shows no variables in the model that can be used to estimate and measure the performance of BISP. BISP only provides 1,000 rupees a month financial assistance

Table 3 Performance estimation of Zakat institutions

Dependent variables	B	Sig	Exp (B)
Occupation	−1.511	0.052	0.214
Size of family	1.567	0.000	5.290
Females employed	−2.570	0.000	0.121
Males employed	−2.007	0.000	0.155
Constant	0.676	0.546	1.969

Source Authors' calculation

Table 4 Performance estimation for Benazir income support program

Dependent variables	B	Sig	Exp(B)
Constant	5.601	0.000	97.87

Source Authors' calculation

Table 5 Logit model for the Pakistan Bait-ul-Maal

Dependent variables	B	Sig	Exp(B)
Working male member	−20.688	0.887	.0000
Constant	21.601	0.876	15428

Source Authors' calculation

to poor and disadvantaged women in society. The amount of such financial assistance is negligible, and it is impossible to participate in contributions due to any factors that cause poverty.

The Pakistan Bait-ul-Maal (PBM)provides training to poor families to carry out income-generating activities to fight against poverty in the country. Table 5 shows that by applying the logit condition forward method to raw data for beneficiaries of the PBM, only working male members shows a negative correlation with poverty significantly.

From Table 6 it can be concluded that education level, family size, and land area are essential determinants for poverty reduction. The goal of microfinance institutions is to prove the loan to large families and educated people. Although the employment status is negatively correlated with poverty in this result insignificantly, it is estimated that education level and land are negatively correlated with poverty. It is also concluded that there is a positive correlation between family size and poverty. Many poverty reduction programs are working and providing funds for livestock, entrepreneurship, and agricultural purposes, which do not contribute effectively. The conclusion is that the funds for poverty alleviation programs should be carefully planned so that the poor must use these funds for the productive purposes of livestock, entrepreneurship and agricultural enterprise to generate higher income (Liu et al. 2015).

Table 6 Performance estimation for microfinance institutions

Dependent variables	B	Sig	Exp(B)
Schooling level	−1.908	0.000	0.147
Total member of house	5.133	0.000	161.395
Males employed	−23.008	1.001	0.132
Own land	−1.477	0.001	0.213
Constant	−3.301	0.052	0.029

Source Authors' calculation

5 Conclusion and Policy Implications

The logit model's empirical results based on cluster samples show that the total number of households is a determinant that is significantly positively correlated with the probability of poverty in the sample area. An empirical evaluation was also carried out from sample data, showing that education level, age, male and female employment, and livestock are statiscally significant and negatively correlated with the possibility of poverty. It is evident from the empirical results that developing human capital is the necessary tool to reduce the poverty level in rural Pakistan as no household is found below the poverty line that has graduation level education. Education is the fundamental factor of human capital development, and it has a significant negative correlation with the possibility of poverty. Therefore, education is an essential and vital factor in managing poverty reduction in rural Pakistan. Besides, education provides more formal employment opportunities for men and women, increasing family income levels, and reducing poverty levels.

Experience from the present study shows that in terms of education, age, female employees and male employees are statistically significant and negatively correlated with poverty. Education for both males and females provides them with more employment opportunities and higher income opportunities to reduce poverty. Therefore, education increases human capital and brings more employment opportunities, which is negatively related to the possibility of poverty. Due to human capital's importance, many institutions are carrying out free education and training to eradicate poverty in Pakistan. Interestingly, microfinance has no statistic importance in this model. This may be due to the inefficient use of the insufficient amount of loans, so monitoring and feedback are essential to achieve microfinance's expected results. Therefore, it is necessary to conduct further research to understand why microfinance cannot promote the household's income activities in Pakistan. According to government arrangements, many institutions and non-governmental organizations are working to reduce poverty through microfinance management. Therefore, it is crucial to study carefully to evaluate the reasons that are not advantageous to poverty reduction.

When the forwarding condition method of logit regression is used to improve the effectiveness of the organization, experience proves that the Zakat organization effectively contributes to poverty reduction. The institution provides training to low-income families to explore permanent jobs, which is negatively related to poverty. Other institutions have allocated large budgets to manage and fund poverty reduction efforts, but they have performed poorly in continuing to reduce poverty. As a result, human capital is more effective than financial tools used to manage poverty reduction.

Microfinance institutions provide monetary loans to the poor, and Zakat institutions improve human capital by providing free training to the poor. Loans are insignificant for poverty reduction in this study, while the employment status of working women and working men in the family are significantly negatively correlated with the likelihood of poverty. It can be seen from the above findings that compared with other institutions in Pakistan, Zakat's performance in financing and management of poverty reduction in Pakistan is much better.

Therefore, it is necessary (1) to provide some form of help and support to the poor to increase their welfare; (2) to screen and organize them so that the emphasis of providing assistance packages can be focused on improving efficiency; (3) to assist the coordination and cooperation between the various institutions involved in the poverty reduction plan to properly plan and achieve the expected goals. Therefore, their roles must be clearly defined to avoid overlapping responsibilities. An effective poverty reduction strategy requires basic national institutions as a necessary prerequisite for fighting poverty in society in a sustainable manner. Institutions that fight against poverty must simultaneously address their socio-economic, institutional, and political factors. Since economic growth is significant for poverty reduction, it cannot change the root cause of poverty unless these institutional factors are addressed. Because poor people's political power and earning power are low, making more comprehensive policies is complex and wide-ranging.

These institutions should adopt different strategies and function in different ways according to poor and fragile societies' needs. Therefore, institutions need to perform their duties and obligations in order to maintain the goals of the poverty reduction plan in the long term. They must ensure that they can achieve the poverty reduction plan's goals, and they must be able to implement their management and funding goals. The institution must also be responsible for monitoring beneficiaries to benefit from the purpose of the plan fully. The strategy should be formulated as needed and implemented correctly by the mediator; the results will then be satisfactory. The strategy should be based on the following approaches.

5.1 Identify and Screen the Poor

Identification and screening of productive and unproductive poor are essential steps in this approach. All poor people have different abilities and capabilities to overcome poverty on a sustainable basis. It is imperative to improve human capital for education and training. Therefore, keep in mind the goals of different projects for the poor. If mediators take this step seriously, they can identify and screen out candidates suitable for the right plan. Then, they can quickly achieve good results in poverty reduction management and financing plans without resources.

5.2 Provide Services to Selected Candidates

Productive and unproductive poor need to be identified as a first step. Different programs must target the mutually exclusive separate segments of productive and unproductive poor. Therefore, after selecting excellent candidates for a particular program, service delivery must be effectively planned and implemented to achieve meaningful results.

5.3 Program Monitoring and Feedback

The policy implementation institution avoided this step, which is the main obstacle to achieving concrete results in poverty reduction management. Monitoring the execution phase of the program is very important to achieve the specific target results. The purpose of the services provided must be carefully monitored, and feedback on the plan must be measured.

5.4 Beneficiary Graduate

The ultimate goal and purpose of managing and funding all poverty reduction programs and projects are to make the beneficiaries self-sufficient and self-dependent on a sustainable basis. Therefore, the beneficiaries must be supervised and provided temporary support until they get rid of poverty and take care of themselves and their family's interests and social welfare. Providing training and education does not mean that the poor are productive and can find work. Ensuring work and employment depends on their social and cultural attitudes towards work. The beneficiaries must be prepared to assume income responsibilities, accept new and progressive ideas, and learn new production techniques. They must be supervised and motivated for employment, and their income must be increased to manage family poverty reduction.

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Part III
Enhancing Energy Security and Energy Efficiency for Poverty Reduction and Inclusive Growth

Chapter 9
Energy Security, Economic Growth, and Poverty Reduction: Empirical Evidence from Selected ASEAN Member States

Thatchanon Anancharoenkij and Warattaya Chinnakum

Abstract This study analyzes energy security and economic growth's relationship with poverty reduction in selected ASEAN member states. To measure energy security, we consider five factors: availability, applicability, acceptability, affordability, and develop-ability. In this analysis, we run panel cointegration by FMOLS with panel data on eight ASEAN member countries from 1990 to 2016. The empirical results show that all energy security variables, except the renewable energy consumption and CO_2 emissions, have positive effects on economic growth. In addition, the results of this study show a positive relationship between poverty reduction and economic growth. Based on these results, policy makers should emphasise to find primary energy sources and focus on available of energy management on both supply and demand side and should research alternative energy sources and provide a diversified combination of energy sources to reduce reliance on primary energy sources in order to support applicability and acceptability. They should also try to modify the energy structure by focusing on the impact and contribution of the accessibility of the poor population whose access to new alternative energy sources can support economic growth for poverty reduction.

Keywords Energy security · Economic growth · Poverty reduction

JEL Codes C330 · I30 · O130 · O40 · Q430

1 Introduction

Energy has an essential role in economic growth. Energy is considered a production input, besides labor and capital; hence, for production and economic output, accessing affordable energy is needed. Energy consumption is required for poverty reduction and a tool for sustaining and enhancing economic growth, particularly in developing nations (Legros et al. 2009; Abdur and Khorshed 2010; Boardman and Kimani 2014). Energy security is essential for business development, job creation,

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employment, manufacturing, and international competitiveness for income generation, which leads to poverty reduction. So, economic growth, which is essential for poverty reduction, is impossible without energy security (World Bank 2013). Therefore, energy security, meaning access to affordable energy, is the pre-condition for economic growth, leading to poverty reduction. Besides, energy security is crucial to ensure economic development, which leads to sustainable growth and development (Karekezi et al. 2012).

Due to increasing economic and population growth, energy demand in the ASEAN countries is continuously increasing. However, energy supply is limited. This may lead to insufficient energy supply for poverty reduction in the future. In addition, affordable, reliable, and sustainable energy supply causes problems for energy security, which can affect the economic growth needed to reduce poverty (Young 2005). These problems pose a great challenge for ASEAN members and their inclusive economic growth. At the 34th ASEAN Ministers on Energy Meeting (AMEM) in Myanmar on 21 September 2016, member states made a deal to cooperate to attain energy security and sustainability for the progressive energy sector (ASEAN Center for Energy 2018). Therefore, energy security is a crucial step for ASEAN member countries to achieve economic growth, which is essential for reducing poverty.

In this study, we aimed to assess the energy security status of ASEAN countries. Consequently, it was found that many regions have a problem with inadequate energy resources and thus have energy insecurity, which is a barrier to economic growth and poverty reduction. Some countries are leading fossil energy exporters, while other countries need to import fossil energy. Having domestic energy markets within one region can enhance regional energy security. However, this is no guarantee that the available energy resources for ASEAN countries are sufficient for their future economic activities. In economic terms, the increasing energy demand and energy resource insufficiency is an issue not only for less developed countries but also for developing and developed countries, which need to take it seriously if they want to achieve economic growth and poverty reduction. In an environmental context, the high level of carbon emissions and global warming have already become one of the world's most significant concerns and is a major global issue. Some countries, however, have more modern, clean energy systems to eliminate or reduce the high levels of CO_2 emissions and have greater access to energy sources to conduct economic activity for economic growth and poverty reduction, based on their energy policies or objectives (Kanchanaa and Unesakia 2014).

Energy security is an issue that needs to be analyzed and measured. Initially, studies on energy security focused on the quantity and price of primary energy sources, such as oil (Colglazier and Deese 1983; Yergin 1988). Then, energy security measurement expanded to include other factors as well. According to the Asia Pacific Energy Research Centre (APERC 2007), the definition of energy security is the availability of energy resources in a sustainable context that support economic activity. According to this definition, many factors affect the security of energy supply, such as the availability of energy sources (physical), the accessibility of energy sources (geopolitical), the affordability of energy, and the acceptability (environmental) of energy. The meaning of availability is the supply of available primary energy and the

ability to discover primary energy sources, a physical factor for economic activity. The affordability context is the appropriate domestic price and market price conditions, and available energies in the market, including both domestic energy and imported energy. The acceptability dimension includes the social and environmental aspects of the new sources of energy, which affect energy production and utilization in the economy (Le and Nguyen 2019). Applicability is the ability of a region to access and increase its reserves of indigenous energy. Malik et al. (2020) stated that there are dimensions known as the '4As of energy security' (Cherp and Jewell 2013). Measuring the 4As of energy security was proposed by APREC (2007), and it became a standard measurement tool for energy security. Also, a recent study by Fang et al. (2018), defines energy security in the context of development capabilities (develop-ability), which is the energy system with a particular focus on low carbon energy. Hence, the development of capability refers to the 'sustainability of environmentally friendly energy use', which is considered to be the most critical indicator in the context of energy sustainability capability (Fang et al. 2018).

The shares of the population living below the national poverty lines in ASEAN indicate that all experienced a decline in poverty incidence between 2005 and 2017 (ASEAN Secretariat 2019). Moreover, the poverty rate in the ASEAN region show a declining trend. According to the World Bank's poverty measure of US$ 1.25 or US$ 2 purchasing power parity (PPP) (Sumarto and Moselle 2015). Besides, there has been continuously increasing economic growth, by an average of 5.3% annually, since 2000, far above the global average of 3.8% (ASEAN Secretariat 2018). This increasing economic growth in the regional economic system relates to the energy sources that will support the economic growth. Simultaneously, energy demand has also been increasing continuously, as shown in the Fig. 1.

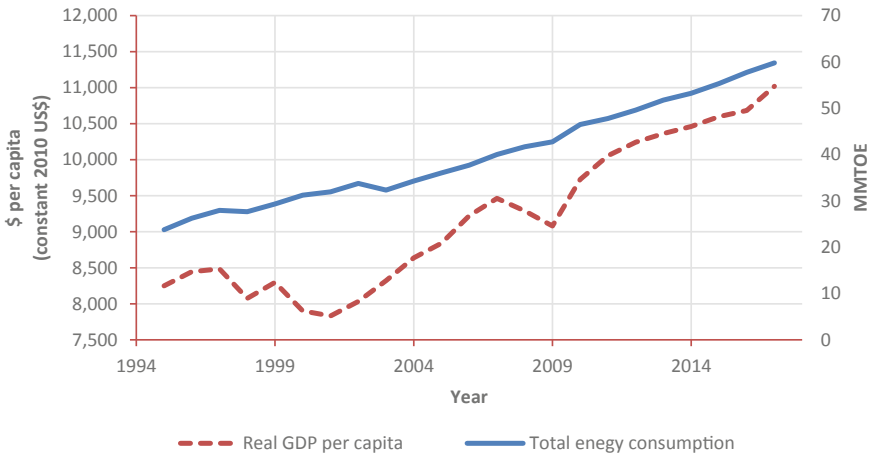

Fig. 1 Total energy consumption and real gross domestic product per capita in ASEAN region from 1995 to 2017 (*Source* World Bank 2019)

This increase in economic growth in the regional economy involved energy sources that supported the economic changes. It is expected that energy consumption will continue to increase in the future, which affects energy security in the ASEAN region. Other factors can enhance energy insecurity concerns, such as pollution and external politics, which are used as a tool in trade negotiations. World market oil price fluctuations also affects energy exporters and importers and has a negative impact on energy access energy for citizens when conducting economic activity that could lead to economic growth and poverty reduction (Kocaslan 2014).

This study aimed to investigate the relationship between energy security, economic growth and poverty reduction in selected ASEAN member states, namely Thailand, Indonesia, Singapore, Malaysia, the Philippines, Brunei, Vietnam, and Cambodia, from 1990 to 2016. The research was conducted by measuring energy security in all five dimensions, including the availability of available energy sources (availability), ability to pay (affordability), ability to deal with environmental issues associated with the impact of energy utilization in the economy (acceptability), ability to access and increase reserves of local energy (applicability), and ability to develop an energy system (develop-ability), taking into account the poverty variable. The results of this study propose policy regarding the role of energy security in reducing poverty for inclusive and sustainable economic growth in ASEAN nations.

2 Review of Literature

There are many relevant research studies on the impact of energy security on economic variables. We divide the relevant studies into the three following categories:

2.1 Definition of Energy Security

There is a lot of related literature that focuses on measuring energy security. There are many relevant studies focused on the security of primary energy resources, such as oil and gas. Due to the changes in the global energy structure, the meaning of energy security has expanded so as not to be limited to oil and gas supply. Bielecki (2002) defined energy security as the ability to ensure sufficient and reliable energy sources at a reasonable price. Later, Simpson (2007) measured energy security in environmental and social dimensions. Turton and Barreto (2006) were concerned with energy security from geopolitical development and climate change perspectives. Vivoda (2010) studied the environmental and social contexts in measures of energy security. Muñoz et al. (2015) measured energy security from a multidimensional perspective, comprising economic, social, political, environmental, and geopolitical dimensions. Then, there were many studies that developed the energy security definition in other perspectives, such as national, regional, international, economic, political, geopolitical, institutional, and legal, such as the studies of Le and Nguyen

(2019) and Taghizadeh-Hesary et al. (2019a). The Asia Pacific Energy Research Centre (APREC) (2007) proposed the contemporary definition of energy security as the availability of energy resources in a sustainable context that support economic activity; this definition led to the 4-As theory of energy security, consisting of availability, accessibility, affordability, and acceptability. This contemporary energy security framework was developed by Yao and Chang, (2014). Narula (2014) proposed a definition of sustainable energy security (SES) as the ability to 'manage the energy in an affordable, equitable, efficient, and environmentally-benign manner'. Kruyt et al. (2009) used the 4 As theory as an indicator to study energy-supply security in the long term. Narula and Reddy (2016) separated energy systems into supply, conversion, distribution, and demand subsystems in order to evaluate energy security in India using SES indicators: availability, affordability, efficiency, and acceptability, with quantitative metrics. Narula and Reddy (2015) proposed the CSES index framework for evaluating energy security from a sustainability perspective. Tongsopit et al. (2016) examined energy security of ASEAN nations under the 4 As framework, consisting of availability, applicability, affordability, and acceptability, by using a quantitative approach. The empirical results showed little progress in energy security from 2005 to 2010

2.2 Energy Consumption and Economic Growth

There are many relevant research studies on the impact of energy security on economic variables. Based on these studies, many studies show a unidirectional relationship from economic growth to energy consumption, such as Alam et al. (2012), who studied Bangladesh data from 1972 to 2006, and Akinlo (2008) for 11 sub-Saharan African countries.

Besides, many of the results of the studies show a unidirectional relationship from energy consumption to economic growth, such as Chaudhry et al. (2012) and Kakar and Khilji (2011), who studied Pakistan for the period 1972–2012 and 1980–2009. These empirical results also show that energy is one of the main factors of economic growth.

Many studies also revealed bidirectional causality between energy consumption and economic growth, such as that of Ghali and El-Sakka (2004) and Farhani and Ben Rejeb (2012), who studied 95 countries from 1971 to 2008. Saidi and Hammami (2016) studied 58 countries. Additionally, Jakovac (2013) studied Croatia in 1952–2010.

In addition, some studies found no causality between energy security that measures energy consumption and economic growth, such as that of Altinay and Karagol (2004), who studied Turkey from 1950 to 2000. Wolde-Rufael (2005) examines 19 developing countries.

2.3 *Measuring Energy Security and the Energy Security Nexus*

There are few relevant research studies for measuring energy security in different countries and also energy security nexus studies. Malik et al. (2020) studied energy security in Pakistan using the 4As framework (availability, applicability, acceptability, and affordability) over the period 2011–2017. Balitskiy et al. (2014) studied the energy security status on 26 EU countries, by considering natural gas consumption as an energy security proxy. Taghizadeh-Hesary et al. (2016) examined developed countries (US and Japan) and an emerging economy (People's Republic of China) by using the impact of oil price stability as a proxy for energy security on macroeconomic variables. Mahmood and Ayaz (2018) studied Pakistan over the period 1980–2012 by using the gap between demand and supply. Le and Nguyen (2019) investigated 74 countries over the period 1990–2016 using an expanded 4As (availability, applicability, acceptability, affordability, and develop-ability). Besides, there are many studies on the impact of energy security on another issue. For example, Taghizadeh-Hesary et al. (2019b) revealed that energy supply impacts the price of food and other commodities.

The review of the literature shows that there is no study that has assessed the impact of energy security on poverty reduction. Hence from this aspect this study has novelty.

3 Methodology

In investigating the impact of energy security on economic growth as the main objective of this study, we first show a simple production function as in Eq. (1):

$$GDP = f(Labor, Capital, Energy) \tag{1}$$

Many studies used the production function applied to the relevant energy research, such as Shahbaz et al. (2018) and Mahmood and Ayaz (2018). According to Pokrovski (2002), the fundamental role of energy is as an essential factor of production that enhances economic growth and development. The studies by Rivera-Batiz and Romer (1991) and by Shahbaz et al. (2013) reveal that trade will improve domestic productivity through innovation and technology development to support economic growth. The ASEAN region is one of the main oil or natural gas exporters. Additionally, political stability issues or international politics may affect oil or natural gas exports as they are used as a political bargaining condition. Many studies found that political factors affect the relationship between energy security and economic growth, such as Taghizadeh-Hesary et al. (2016). Inflation is another factor that affects the final price of energy, therefore affecting energy consumption and energy security, as shown by

Taghizadeh-Hesary et al. (2019a). In this study, we use household and final consumption expenditure of non-profit institutions serving households (NPISHs) measured in terms of basic consumption needs as poverty variable. This variable definition follows the World Bank (1990): 'the inability to attain a minimum standard of living'. Therefore, we extended with the neoclassical production function as follows:

$$GDP = f\left(Labor, Capital, Trade, Pol, Inflation, POV, ES^{j}\right) \quad (2)$$

where GDP is real domestic output, $Labor$ is labor input, $Capital$ is capital input, $Trade$ is trade openness, Pol is political stability, $Inflation$ is the inflation rate, POV is the poverty variable and ES^{j} is the energy security variable when j = 1, 2, 3, …, 8.

We developed the model to show the relationship between economic growth, energy security measures, poverty and related variables. This empirical model can be expressed as follows:

$$\begin{aligned}\Delta\ln(GDP_{it}) = {} & \alpha_i + \beta_1\Delta\ln\left(Labor_{it}\right) + \beta_2\Delta\ln\left(Capital_{it}\right) \\ & + \beta_3\Delta\ln(Trade_{it}) + \beta_4 Pol_{it} + \beta_5\Delta(inflation_{it}) \\ & + \beta_6\Delta\ln(POV_{it}) + \beta_j\Delta\left(\ln ES_{it}^{j}\right) + \varepsilon_{it}\end{aligned} \quad (3)$$

Where $\ln(GDP_{it})$ is the natural log of real GDP, $\ln\left(Labor_{it}\right)$ is the natural log of labor input, $\ln\left(Capital_{it}\right)$ is the natural log of capital input, $\ln(Trade_{it})$ is trade openness, Pol_{it} is political stability, $Inflation_{it}$ is the inflation rate, $\ln(POV_{it})$ is the natural log of poverty variable, $\ln ES_{it}^{j}$ is the natural log of energy security variable (except ES_{it}^{8}) when j = 1,2,3,…,8,ε_{it} is the disturbance term that assumes $N(i.i.d)$,α_i is a constant term,$\beta_1, \beta_2, \ldots, \beta_j$ are the parameter which shows the relationship between GDP and related variable in model, and Δ denotes the first difference of the variable. The variables' definitions, calculations, and data sources are shown in Table 1.

This study uses the energy security definition as per the sustainability context according to the major goals for advancing the energy sector and economy by the creation of the ASEAN Economic Community (ASEAN) in 2015, which was developed by Yao and Chang (2014). The essential 4 As framework measuring energy security includes availability, applicability, acceptability, affordability, and develop-ability as developed by Narula and Reddy (2015).

In this study, we investigate the linkage between energy security, economic growth, and poverty reduction. This study contains nine measures to capture five dimensions of energy security: availability, applicability, acceptability, affordability, and develop-ability. *Availability* indicates the existence and sufficient primary energy or other fossil fuel sources to meet the region's needs. More primary energy sources and reserves are reflected by a higher availability dimension. In this chapter, ASEAN performance on the availability dimension is measured through the following indicators: ES^{1} is the ratio of primary energy production to primary energy consumption.

This indicator is the ratio of energy supply to energy demand with the higher value indicating a primary energy supply (energy sources) that can adequately meet the primary energy demand, implying a higher level of energy security. *Affordability* is a dimension that indicates the ability of all sectors of the economy to access energy resources and equitable access to energy at a reasonable price for all income groups (Tongsopit et al. 2016). A lower affordability level implies lower accessibility to energy for the people. This also implies the inability to meet the energy needs of the people (Malik et al. 2020). This dimension is measured through the following indicators: ES^2 is the ratio of primary energy production (kg of oil) per capita. This indicator implies the ratio of energy supply to the population. The higher this ratio, the greater access people have to sources of energy. This indicator is a positive indicator of energy security. We use the annualized standard deviation of Crude Oil–West Texas Intermediate (WTI) Spot Cushing daily price: ES^8 also measured the affordability dimension. Higher oil price volatility affects firms and consumers, which are more unpredictable and increases uncertainties in consumption as well as investment. This indicator is a negative indicator of energy security. *Acceptability* is a dimension reflecting energy sources or energy systems from an environmental and societal context, measuring the impact of energy on the environment and society (Tongsopit et al. 2016). This dimension is measured through the following indicators: ES^3 is non-fossil energy consumption, representing the energy structure's impact on the environment and society. The progress of non-fossil energy improves the sources of energy capacity, safety, and sustainability of the energy system (Fang et al. 2018). This implies that greater non-fossil energy represents lower reliance on fossil energy consumption and thus higher energy security. ES^5 is renewable energy consumption, reflecting the acceptance of renewable energy in an environmental and social context, which is a positive indicator of energy security in the acceptability dimension. The ES^7 is CO_2 emissions, representing acceptability, and is a negative indicator of energy security. *Applicability* is a dimension that indicates the ability to use new technologies to increase energy efficiency or reduce energy waste as well as increase energy conservation. This dimension is measured through the following indicators: ES^4 is the energy intensity level of primary energy, representing the amount of energy consumed for every GDP unit. A lower energy intensity represents increased efficiency and energy conservation and increases energy security (Malik et al. 2020). *Develop-ability* is a dimension that indicates the ability to develop an energy system that is low-carbon, clean, and optimized for energy sustainability (Fang et al. 2018). This dimension is measured through the following indicators: ES^6 is the primary energy consumption per capita. A rise in primary energy consumption per capita leads to an increased risk of energy insecurity, making it a negative indicator of energy security (Fang et al. 2018).

In this study, we used panel data for eight ASEAN member states (Thailand, Indonesia, Singapore, Malaysia, Philippines, Brunei, Vietnam, and Cambodia) from 1990 to 2016. Myanmar and Laos were excluded due to a lack of available data. The data used in this study came from the World Bank database, Energy Information Administration (EIA), World Governance Indicators (WGI), and the BP Statistical Review of World Energy (2020). This data was normalized on a range (1–10). The

formula for the transformation of original data was based on Han and Kamber (2011) and Malik et al. (2020) and is as follows.

$$\frac{X' - 1}{10 - 1} = \frac{X - \text{Min } A}{\text{Max } A - \text{Min } A} \tag{4}$$

$$X' = 1 + \left[\frac{X - \text{Min } A}{\text{Max } A - \text{Min } A} \times (10 - 1) \right] \tag{5}$$

where

X': Transformed Indicator
X: Untransformed Indicator
A: Untransformed data range of X
Min A: Minimum value in A
Max A: Maximum value in A

But, some indicators are inversely related, and a higher value corresponds with lower energy security. In these cases, the maximum and minimum values of the raw score are considered as the minimum and maximum, respectively, indicated by a scale value equal to 1 and 10, respectively. The equation in this case becomes:

$$X' = 1 + \left[\frac{X - \text{Max } A}{\text{Min } A - \text{Max } A} \times (10 - 1) \right] \tag{6}$$

Transforming the data allows us to compare each indicator. However, the scale measures only the relative value score. Interpretation of these indicators should be considered in conjunction with an assessment of the untransformed values (Malik et al. 2020).

4 Empirical Results

Table 2 (Appendix) shows statistical descriptions for the eight sample ASEAN member states from 1990 to 2016. As seen in the table, the real GDP per capita has an average of $11,662.651. The results also reveal the main energy security variable has an average value that is greater than half. Significantly, the eighth energy security indicator, which measures the affordability aspect, has the highest security value at 6.11. In contrast, the third energy security indicator, which measures the acceptability aspect, has the lowest value at 3.9024. The POV which the measured by households and non-profit institutions serving households final consumption expenditure per capita (constant 2010 US$) has an average of $3809.24 per capita, or $10.44 per day which is more than the minimum income or expenditure of $1.90/person/day from the 2011 purchasing power parity (PPP) line, which is the World Bank's current definition of extreme poverty (Ferreira and Sánchez-Páramo 2017).

The correlation matrix is reported in Table 3. Table 4 shows the cross-section dependence test. This study began by analyzing the cross-sectional dependence test. Because trade openness involves various economies. We need to test for cross-sectional dependence. The null hypothesis H_0 for this test is that there is no cross-section dependence and the alternative hypothesis H_1 for this test is that there is cross-section dependence (Sun et al. 2020).

Table 5 shows the panel unit root tests for the stationary of the variables or series, based on Levin, Lin and Chu t, Breitung *t*-stat, Im-Pesaran-Shin, ADF—Fisher Chi-square and PP—Fisher Chi-square unit root. The results show that all variables are stationary at 1% in the first difference (except for some test statistics of energy security indicators that are stationary at 5%).

Next, we need to run a panel cointegration test. The results of the Kao panel cointegration test are presented in Table 6. The Kao tests, based on Augmented Dickey-Fuller (ADF) statistics, were conducted with no deterministic trend. The results reject the null hypothesis of no cointegration. The results show a statistically significant cointegration of economic growth, labor, capital, trade, inflation, political stability, poverty, and each energy security variable. In other words, these variables move together in the long run.

Base on this result, we run a panel cointegration model by using fully modified OLS (FMOLS), as shown in Table 7. Table 7 presents the empirical results for long run panel cointegration by fully modified OLS (FMOLS) for energy security on economic growth in ASEAN countries in the period 1990–2016. The estimation results show that capital formation, trade openness, and poverty reduction significantly positively influence economic growth. This result follows the economic theory. Capital formation is the main factor in the production of an economy. Thus, increases in gross capital formation support manufacturing, and have positive effects on economic growth. The results also show that the trade openness of ASEAN countries has a significantly positive effect on economic growth. Trade openness tends to improve innovation and transfer of technology, improve productivity, and provide higher income and more opportunities to people (World Bank 2018). Besides, there are some results that show that inflation has a negative effect on economic growth. Moderate inflation is an incentive for investors to increase their investment to keep up the value of money. However, severe inflation can lead to economic instability due to a severe drop in the purchasing power of money, which negatively affects economic activity and harms economic growth. It will have a negative impact on economic growth.

Furthermore, the results for poverty reduction, which is measured by household consumption expenditure, show that it has a significantly positive effect on economic growth for the most part. However, the main interest of this study is also the impact of energy security on economic growth and poverty reduction. Based on this result, all energy security have a significantly positive affect on economic growth, except renewable energy consumption and CO_2 emissions, which have a not significantly negative affect on economic growth.

In Table 5, the empirical results show that energy security (1), measured from the aspect of availability, has a significantly positive effect on economic growth. A 1%

increase in energy security (1) increases GDP per capita by 0.0084%, which reflects a higher ability of the source of energy to meet one unit of energy consumption, reflecting higher energy security. Then, energy security (2) (primary energy production/population), measured from the aspect of availability, has a significantly positive effect on economic growth. A 1% increase in energy supply per capita increases GDP per capita by 0.0240%, reflecting a higher ability of the source of energy per capita or energy supply capacity and more resources for production reflecting higher energy security from an availability perspective. This will lead to support for economic growth. Energy security (3) (non-fossil energy consumption), measured from the aspect of acceptability, has a significantly positive effect on economic growth. A 1% increase of non-fossil energy consumption increases GDP per capita by 0.0334%, which implies a higher non-fossil energy consumption or non-fossil energy utilization in the economy, reflecting acceptability aspects that will lead to economic growth. Next, energy security (4) (energy intensity level of primary energy) measured from the aspect of applicability has a significantly positive effect on economic growth. A 1% increase of energy intensity level of primary energy per one unit of GDP increases GDP per capita by 0.0520%. This implies a higher energy intensity lead to contribute on economic growth. This reflects the structure of ASEAN industry, emphasizing energy-intensive industries such as food, paper, basic chemicals, iron and steel, and nonferrous metals manufacturing (ASEAN Center for Energy 2015). Next, energy security (6) (primary energy consumption/population) measured from the aspect of develop-ability has a significantly positive effect on economic growth. A 1% increase of primary energy consumption per capita increases GDP per capita by 0.0177%, which implies a higher energy consumption per capita. This reflects lower energy security from a develop-ability perspective that will lead to economic growth. It can be inferred that greater primary energy demand is considered harmful to existing primary energy sources. Next, energy security (8) (oil price volatility) measured from the aspect of affordability has a significantly positive effect on economic growth. A 1% increase of oil price volatility increases GDP per capita by 0.0016%, which implies a higher oil price volatility, which is reflected in lower energy security from an affordability perspective that will lead to economic growth.

5 Conclusion and Policy Implications

This study presents empirical research on energy security and economic growth. For this study, we used panel data analysis applied to eight ASEAN countries during the period 1990–2016. The theoretical framework of this study is based on an extended version of the production function. Eight measurements of energy security were used to capture five dimensions of energy security, namely availability, acceptability, applicability, affordability, and develop-ability.

The empirical results show that the availability dimension of energy security (1) (primary energy production to primary energy consumption) has a significantly positive effect on economic growth. This reflects that the availability of primary

energy resources must satisfy energy consumption to conduct economic activity at a reasonable price. This process leads to job creation and employment, which supports economic growth and poverty reduction. So, policy makers should search for new primary energy resources. They should also manage the existing primary energy resources to meet energy consumption adequately, emphasizing energy security as an essential factor in conducting economic activity for economic growth and poverty reduction.

In addition, the empirical results show the acceptability dimension of energy security (3) (non-fossil energy consumption) has a significantly positive effect on economic growth. From this result, it can be seen that non-fossil energy is alternative energy that allow for increased accessibility of diverse energy resources, which increases energy security from an acceptability perspective. Utilized as the factor in conducting economic activity, this leads to support for economic growth and poverty reduction via accessibility of diverse energy resources. Policy makers should subsidize research and development of non-fossil resources to lower the cost. This helps people have more accessibility to diverse energy resources, which creates jobs and increases employment for economic growth and poverty reduction. These types of energy also help to decrease reliance on primary energy sources to support energy security for economic growth and poverty reduction. Furthermore, they support the use of non-fossil energy in both the household and industrial sectors. However, subsidies for the poor are important to increase access to non-fossil energy resources to conduct economic activity for poverty reduction.

The results also show that the develop-ability dimension of energy security (6) (primary energy consumption/population) has a significantly positive effect on economic growth. This reflects greater primary energy consumption, implying higher primary energy demand per capita to conduct economic activity, leading to an increase in economic growth, allowing people access to more income, leading to reduced poverty. This can imply that lower energy security from a develop-ability perspective will support economic growth and poverty reduction. Policy makers should consider primary energy and alternative energy resources to meet adequate energy consumption for economic growth and poverty reduction

The results also show that the applicability dimension of energy security (4) (energy intensity level of primary energy) has a significantly positive effect on economic growth. This implies a high level of energy consumption per unit of GDP, reflecting the use of more factors of production that harm energy security from an applicability perspective. This could be a reflection of the structure of ASEAN industry, manufacturing-based economies, emphasizing energy-intensive industries such as food, paper, basic chemicals, iron and steel, and nonferrous metals manufacturing (ASEAN Center for Energy 2015). For the propose of economic growth and poverty reduction, policy makers could search new primary energy resources and alternative energy resources to meet energy demand, which is an essential factor in manufacturing that affects economic growth and poverty reduction

The empirical results of this study show that the affordability dimension of energy security (2) (primary energy production/population) reflects the energy supply per capita for use of factors of production for economic activity. This indicates a higher

affordability aspect of energy security. The affordability dimension of energy security (8) (annualized standard deviation of Crude Oil–WTI Spot) has a positive effect on economic growth. The fluctuation of crude oil prices is one uncertainty in economic activity, and it may negatively affect poverty reduction indirectly. Policy makers should manage energy resources to meet per capita use by following the above discussion on availability aspects. They should also plan greater access to energy sources at reasonable prices that can be utilized for economic activity for poverty reduction.

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Appendix

Table 1 Variable descriptions

Type of variable	Notation	Variable	Description	Sources
Dependent variable	GDP	Real GDP per capita	Constant 2010 US$	WDI*
Independent variable: energy security	ES^1	Availability	Primary energy production/primary energy consumption	EIA**
	ES^2	Affordability	Primary energy production/population (Kg/person)	EIA and WDI
	ES^3	Acceptability	Non-fossil energy consumption (%)	WDI
	ES^4	Applicability	Energy intensity level of primary energy (MJ/$2011 PPP GDP)	WDI
	ES^5	Acceptability	Renewable energy consumption (% of total final energy consumption)	EIA and WDI
	ES^6	Develop-ability	Primary energy consumption/population (Kg/person)	WDI
	ES^7	Acceptability	CO_2 emissions (kg per 2011 PPP $ of GDP)	WDI
	ES^8	Affordability	The annualized standard deviation of Crude Oil–WTI Spot price	bp Statistical Review of World Energy June 2020
Independent variable: other variable	Capital	Capital	$	WDI
	Labor	Labor	person	WDI
	Trade	Trade	Trade as percentage of GDP per capita	WDI
	Inflation	Inflation	Inflation, GDP deflator (annual %)	WDI
	Pol	Political stability	Political stability and absence of violence/terrorism, in level (−2.5 to 2.5)	WGI***

(continued)

Table 1 (continued)

Type of variable	Notation	Variable	Description	Sources
	POV	Poverty reduction	Households and NPISHs Final consumption expenditure per capita (constant 2010 US$)****	WDI

Note All the variables are taken logarithms except for inflation and ES[8]
*World Development Indicators (World Bank 2020a)
**Energy Information Administration (Energy Information Administration 2020)
***World Governance Indicators (World Bank 2020b)
****Non-profit institutions serving households
Source Authors

Table 2 Statistical descriptions data for the eight sample countries in the ASEAN region 1990–2016

Variable	Observations	Mean[a]	Std dev	Minimum	Maximum
Real GDP per capita	213	11,662.65	15,413.69	321.28	55,042.73
Capital	213	3140.56	4457.85	−4311.63	19,462.43
Labor	216	29,235,816	32,226,778	110,138	125,957,742
Trade	213	2,056,437	4,325,229	7740.30	20,909,425
Inflation rate	212	6.32	10.38	−22.09	75.27
Pol	144	−0.08	0.98	−2.09	1.50
POV	209	3809.24	4682.76	297.83	19,371.19
Energy security 1	216	5.04	3.01	1	10
Energy security 2	216	4.97	3.11	1	10
Energy security 3	184	3.90	2.79	1	10
Energy security 4	208	5.74	2.84	1	10
Energy security 5	216	5.90	2.73	1	10
Energy security 6	213	5.46	2.75	1	10
Energy security 7	203	4.25	2.92	1	10
Energy security 8	216	6.11	2.50	1	10

Note All energy security variables are normalized into value 1–10
[a]The average of only the eight selected countries in the ASEAN region 1990–2016
Source Authors' calculation

Table 3 Correlation matrix

	GDP	Capital	Labor	Trade	Inflation	Pol	POV	ES^1	ES^2	ES^3	ES^4	ES^5	ES^6	ES^7	ES^8
GDP	1														
Capital	0.9472	1													
Labor	−0.4885	−0.5111	1												
Trade	0.8692	0.8537	−0.3908	1											
Inflation	−0.2336	−0.2919	0.3806	−0.2269	1										
Pol	0.7306	0.7399	−0.5776	0.594	−0.2286	1									
POV	0.89	0.8493	−0.4103	0.9549	−0.2536	0.6181	1								
ES^1	−0.1589	−0.1076	0.1857	−0.0469	0.024	−0.1411	−0.1235	1							
ES^2	−0.0795	−0.0724	0.1747	−0.0668	0.0083	−0.0144	−0.0844	0.6655	1						
ES^3	−0.1682	−0.1402	−0.04	0.0355	0.057	−0.2065	−0.1033	0.0358	−0.3527	1					
ES^4	0.1185	0.1332	−0.0819	0.2033	−0.0959	0.2507	0.1108	0.2641	0.0963	0.1027	1				
ES^5	−0.2966	−0.2873	−0.1211	−0.3511	0.124	−0.1188	−0.3648	−0.0146	−0.4973	0.4491	0.1417	1			
ES^6	0.3189	0.2475	−0.3759	0.3392	−0.1809	0.0973	0.3413	0.2086	0.0419	0.1281	0.4972	0.0793	1		
ES^7	0.1954	0.179	−0.2644	0.423	−0.0551	0.0972	0.371	−0.1104	−0.4727	0.7749	0.1044	0.3228	0.3039	1	
ES^8	0.1051	0.1392	0.0084	0.0903	−0.2015	0.0741	0.0655	0.1316	0.2584	−0.1646	0.1591	−0.3518	0.1313	−0.1717	1

Source Authors

Table 4 Results of cross-sectional dependency test

Model	Breusch Pagan	Pesaran scaled LM	Pesaran CD
(1)	67.44***	5.27***	3.09***
(2)	74.90***	6.27***	2.48**
(3)	81.26***	7.11***	0.59
(4)	73.92***	6.13***	3.48***
(5)	73.45***	6.07***	3.42***
(6)	65.56***	5.02***	3.30***
(7)	94.79***	8.92***	1.46
(8)	68.97***	5.48***	3.07***

Series GDP; Capital; Labor; Inflation; Trade; Political stability; Poverty proxies; Each energy security proxies
Note ***, ** the rejection of null hypothesis of no cointegration is statistically significant at 1 and 5% levels, respectively
Source Authors

Table 5 Results of Levin, Lin snf Chu, Breitung, Im-Pesaran-Shin, ADF-Fisher, and PP Fisher panel unit root test

Variable		Levin, Lin and Chu	Breitung	Im-Pesaran-Shin	ADF Fisher	PP Fisher
Real GDP per capita	At Level	1.54	1.11	−0.53	22.83	38.56 ***
	At First Diff.	−1.66**	−5.80***	−5.53***	58.27***	161.98***
Capital	At Level	−0.44	0.19	−0.62	17.91	15.01
	At First Diff.	−6.85***	−7.24***	−8.68***	90.56***	106.05***
Labor	At Level	0.66	−3.66***	2.45	11.89	5.55
	At First Diff.	−2.91***	−2.54***	−5.31***	56.24***	45.85***
Trade	At Level	2.08	1.06	−1.16	20.92	10.53
	At First Diff	−8.20***	−9.91***	−7.62***	75.90***	75.56***
Inflation rate	At Level	−14.87***	−4.42***	−12.78***	182.07***	153.70***
	At First Diff	−7.90***	−4.88***	−12.50***	142.12***	1872.48***
Pol	At Level	−3.58***	−1.26	−2.67***	33.26***	47.58***
	At First Diff.	−8.51***	−2.85***	−6.03***	60.31***	94.10***
POV	At Level	−0.25	−2.12**	−0.83	22.32	9.24
	At First Diff.	−6.13***	−7.26***	−5.98***	61.15***	57.63***
Energy security 1	At Level	1.93	3.19	1.01	17.84	8.56
	At First Diff.	−5.81***	−3.01***	−6.92***	72.27***	73.05***

(continued)

Table 5 (continued)

Variable		Levin, Lin and Chu	Breitung	Im-Pesaran-Shin	ADF Fisher	PP Fisher
Energy security 2	At Level	−0.07	3.00	1.34	19.40	18.71
	At First Diff.	−4.31***	−0.93	−4.96***	60.00***	352.55***
Energy security 3	At Level	−2.79***	3.20	0.83	16.44	31.63**
	At First Diff.	−4.46***	−0.19	−3.42***	65.92***	254.53***
Energy security 4	At Level	−2.58***	0.03	−3.27***	37.59***	116.10***
	At First Diff.	−8.34***	−4.14***	−8.24***	85.89***	117.66***
Energy security 5	At Level	11.13	–	8.83	1.94	2.57
	At First Diff.	0.94	–	−2.74***	76.59***	67.76***
Energy security 6	At Level	−2.23***	−0.37	−1.17	26.85***	22.03
	At First Diff.	−4.09***	−1.92**	−6.78***	75.64***	405.03***
Energy security 7	At Level	−3.11***	1.87	−3.57***	54.70***	148.28***
	At First Diff.	−8.87***	−1.96**	−8.18***	88.36***	241.63***
Energy security 8	At Level	−3.50***	−2.04**	−5.92***	58.88***	58.43***
	At First Diff.	−15.39***	−14.42***	−13.28***	136.82***	141.43***

In Levin, Lin and Chu, Breitung test: Null: Unit root (assumes common unit root process). In Im-Pesaran-Shin, ADF, PP test: Ho: Unit root (assumes individual unit root process) is stationary. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively

Source Authors

Table 6 Results of the Kao panel cointegration test

Model	ADF *t*-statistics	*p*-value
1	−3.02***	0.00
2	−4.00***	0.00
3	−2.43***	0.00
4	−2.32**	0.01
5	−1.74**	0.04
6	−3.25***	0.00
7	−1.73**	0.04
8	−2.21**	0.01

Series GDP; Capital; Labor; Inflation; Trade; Political stability; Poverty proxies; Each energy security proxies
Note ***, ** the rejection of null hypothesis of no cointegration is statistically significant at 1 and 5% levels, respectively
Source Authors

Table 7 The results of panel FMOLS cointegration estimate between energy security, poverty reduction and economic growth

Independent variable	Dependent variable: real GDP per capita							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital	0.0375*** (0.0107)	0.0318*** (0.0010)	0.0313 (0.0206)	0.0459*** (0.0153)	0.0318** (0.0122)	0.0375*** (0.0115)	0.0421*** (0.0159)	0.0302** (0.0136)
Labor	−0.2221 (0.1919)	−0.3143** (0.1507)	0.0863 (0.3144)	−0.2323 (0.1877)	−0.1579 (0.2149)	0.1880 (0.1696)	−0.4134* (0.2355)	−0.0757 (0.1626)
Trade	0.1012*** (0.0123)	0.0948*** (0.0114)	0.1466*** (0.0364)	0.0838*** (0.0190)	0.1000*** (0.0148)	0.0966*** (0.0144)	0.0744** (0.0299)	0.0764*** (0.0208)
Inflation	−0.0005* (0.0003)	−0.0005 (0.0003)	−0.0014*** (0.0005)	−0.0011*** (0.0004)	−0.0007 (0.0004)	−0.0006* (0.0004)	−0.0014 (0.0009)	−0.0004 (0.0006)
Political stability	−0.0120 (0.0083)	−0.0099 (0.0082)	−0.0084*** (0.0070)	−0.0247*** (0.0088)	−0.0156 (0.0096)	−0.0211** (0.0089)	−0.0261** (0.0123)	−0.0137 (0.0087)
Poverty reduction	0.3836*** (0.0588)	0.3855*** (0.0505)	0.3606* (0.2124)	0.3966*** (0.0729)	0.05246*** (0.0596)	0.2894*** (0.0641)	0.5338*** (0.1397)	0.5112*** (0.0594)
Energy security 1	0.0084* (0.0045)							
Energy security 2	–	0.0240*** (0.0090)						
Energy security 3	–		0.0334*** (0.0089)					
Energy security 4	–			0.0520*** (0.0112)				
Energy security 5	–				−0.0049 (0.0058)			

(continued)

Table 7 (continued)

Independent variable	Dependent variable: real GDP per capita							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Energy security 6	–					0.0177** (0.0083)		
Energy security 7	–						−0.0028 (0.0221)	
Energy security 8	–							0.0016*** (0.0005)

Note *, **, and *** denote statistical significance at 10, 5, and 1% levels, respectively. Standard errors a represented in ()
Source Authors

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Chapter 10
Poverty Reduction and Energy Transition in the Commonwealth of Independent States (CIS)

Ehsan Rasoulinezhad and Farhad Taghizadeh-Hesary

Abstract This chapter seeks to find the relationship between poverty and energy transition in the Commonwealth of Independent States (CIS) region using the data from 1992 to 2018. The study is based a panel data of 12 member states of the CIS: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. The main findings revealed a positive relationship between poverty, income inequality, and energy transition at in-country and panel group levels. Besides, it is found that the relationship of poverty with energy transition is weaker for oil producers such as Russia, Kazakhstan, and Azerbaijan. At the same time, the magnitude of this relationship is more extensive for smaller economies in the CIS region, such as Belarus and Georgia. The causality analysis proved the bi-directional relationship between energy transition, poverty, and income inequality in the CIS region. These results confirm that using expensive energy, especially in smaller economies, will slow economic growth and elevate the poverty ratio. Hence, accessing cheap and clean energy is crucial for alleviating poverty and reaching sustainable and inclusive growth.

Keywords Poverty reduction · Energy transition · The Commonwealth of Independent States (CIS) region · Inclusive growth · Sustainable development

JEL codes Q41 · K32 · O11

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1 Introduction

Over the last decades, the challenges of poverty and its relationship with other macroeconomic variables have been considered by many researchers. Numerous studies have tried to find out the causal relationship between poverty and several variables such as GDP growth (see Adams Jr 2004; Mulok et al. 2012; Anam et al. 2015; Iniquez-Montiel and Kurosaki 2018; Breunig and Majeed 2020), economic development (see Mehanna 2004; Amin et al. 2020), employment (see Mahendra Dev 2017; Zizzamia 2020) and inflation (see Ravallion 2000; Amad Nabi et al. 2020). Poverty is considered a sign of economic development and is recognized as one of the most prioritized issues for governments to control and reduce. According to the 2020 Global Multidimensional Poverty Index (MPI) report (UNDP 2020), 22% of the total population in 107 developing countries live in poverty, which is a potential threat to the population welfare. Chen and Ravallion (2013) expressed that poverty is a central concern of population welfare, economic size, and development.

Another ongoing challenge of our globe is air pollution. Globally, air pollution, mainly CO_2 emissions, is majorly due to fossil fuel combustion. In 2018, power generation (which refers to the generation of electricity and heat), together with transport, accounted for over two thirds of total global emissions and was responsible for almost all global growth since 2010 (IEA 2020). The impact of CO_2 emissions on health, global GDP, and on global warming has been highlighted in several studies, including Hoel and Kverndokk (1996), Zecca and Chiari (2010), Martins et al. (2019), Licheng et al. (2020), Sun et al. (2020), Taghizadeh-Hesary et al. (2020), Taghizadeh-Hesary and Taghizadeh-Hesary (2020). Malerba (2020) expresses that two of the main challenges of our current era are poverty and global warming, which need to be studied more by scholars. In the energy economics literature, there is a common consensus that energy has no apparent effect on poverty reduction. On the one side, fossil fuel consumption in many countries experiencing unprecedented developing processes ensures a larger economic size. It leads to a higher employment rate and poverty reduction. For example, Qu et al. (2020) prove a positive impact of fossil fuel consumption on employment rate and poverty alleviation in China's case. On the other hand, more massive consumption of fossil fuels in countries is considered a major cause of CO_2 emissions and related diseases, increasing health expenditure, meaning more economic pressure on families living in poverty. Many scholars have proved this matter, such as Schmid et al. (2019), who found out the uni-directional linkage running from CO_2 emissions to health costs.

The relationship between energy transition and poverty reduction has been hotly argued over the last years, particularly after the Paris Agreement signed in 2015. It represents the need to increase the global reaction to the threat of global warming and environmental pollutions.

A significant level of poverty characterizes CIS member states (see Ibadoglu [2008] for Azerbaijan; Lukshin [2009] for Russia; Bakhshinyan et al. [2019] for Armenia; Mussurov et al. [2019] for Kazakhstan), extreme dependency on fossil fuels and a high need of energy transition (see Karatayev and Clarke (2014) for

Kazakhstan; Lobova et al. (2019) for CIS member states; Rasoulinezhad et al. (2020) for Russia).

According to the BP statistical review report of 2020, the CIS region, among different regions of the world, has increased CO_2 emissions, especially since 2000, when a vast number of CIS member states such as Russia experienced economic flourishing due to economic structural reforms and FDI attraction. Figure 1 shows that other regions, such as North America, Europe, and the Asia Pacific control the challenge of CO_2 emissions.

Considering the CIS region's mentioned two challenges, the relationship between energy transition and poverty reduction has not been well-documented in the existing literature review. Therefore, this study would try to focus on this literature gap to determine how energy transition and poverty reduction are related in the CIS to represent new insights for the researchers and policy makers in this region.

This chapter is structured as follows: Sect. 2 shows the existing literature gap that the chapter is trying to fill in. Data and methodology are debated in Sect. 3. The empirical results are represented and expressed in Sect. 4, and the last section sums up the chapter with some concluding remarks and policy implications.

2 Literature Review

Earlier studies have not considerably assessed the relationship between energy transition and poverty. Different contributions have concentrated on the relationship between consumption of energy resources (renewables and non-renewables) and poverty or income inequality that matters for poverty in countries. This literature can be divided into two strands: (1) studies focusing on the relationship between energy consumption and poverty, and (2) studies concentrating on poverty in the CIS. These two strands of literature are discussed in turn below.

The first strand contains the studies related to the relationship between renewable and non-renewable energy consumption and poverty. Several scholars have considered the poverty–fossil fuel consumption nexus. Rentschler (2016) argued that the price of fossil fuels directly relates to the poverty increase. Therefore, many countries like Cameroon (2008) and Bolivia (2010) left fossil fuel price reforms in order to reduce the poverty rate in their societies.

This argument for the fossil fuels–poverty relationship has been proved by other scholars like Siddiq et al. (2014) and Bazilian and Onyeji (2012).

Moreover, Dorband et al. (2019) expressed that carbon pricing as a tool to increase fossil fuel prices may harm the level of social welfare and poverty, which is in line with the studies of Drews and Van den Bergh (2016), Baranzini et al. (2017) and Klenert et al. (2018). In another study, McGee and Greiner (2019) investigated the relationship between renewable energy consumption and income inequality for 175 countries. The significant findings depicted that any changes in renewable energy consumption may affect income inequality. Nadimi and Tokimatsu (2018) studied

the impacts of energy use on quality of life and poverty. They found out that renewable energy consumptions for developing nations may reduce air pollution, causing lower health expenditure and poverty reduction. Another highlighted point in energy consumption and poverty reduction is that following Mushtaq et al. (2020), the relationship between these two variables is not similar among different regions.

The second strand of literature includes earlier studies related to poverty in the CIS. Bletsass (2007) argued that poverty alleviation is one of the most critical challenges of the CIS member states' governments. The primary need to find solutions for poverty in this region has been expressed by many economists such as Simai (2006) and Ferre-i-Carbonell and Van Praag (2001). In another study, Ivanov and Suvorov (2006) declared that poverty had become a severe problem for post-Soviet Russia trying to control and reduce income differences through various Russian socio-economic developments. Claypool and Ismayilova (2019) investigated this matter for Azerbaijan and concluded that the government should make a reliable plan to reduce the country's poor. Asadullah and Savoia (2018) argued that good governance and efficient institutions are two essential factors to overcome the challenge of poverty in developing nations in the CIS region. Vidadili et al. (2017) brought energy into the poverty modeling. They expressed that moves toward renewable energy may improve people's life quality in the region, especially economies like Azerbaijan, who depend highly on fossil fuels. Adedoyin et al. (2020) emphasize energy transition and environmental consequences in the CIS from 1992 to 2014. They found out that renewable energy consumption may decrease CO_2 emissions, which is a positive sign for the living environment.

Despite the existing literature showing that poverty and energy transition are two challenges in CIS, we did not find any study related to the linkage between energy transition and poverty reduction in the CIS. Therefore, our chapter has novelty and is trying to fill in this literature gap.

3 Data and Model Specification

Several studies such as Wiseman (2017), Chapman and Itoaka (2018), McGee and Greiner (2019), Vainio et al. (2020), Adedoyin et al. (2020), and Rasoulinezhad et al. (2020), among others, included economic size, official exchange rate, CO_2 emissions, population growth, inflation rate, in their empirical estimations to study the impact of these independent variables on different aspects of energy like energy transition. Their significant findings generally depicted that these independent variables are statistically significant and impact energy aspects. Hence to be consistent with the earlier studies, our econometric model by considering poverty instead of population growth, takes the following equation:

$$ENTR = f(GRO, EXC, CO2, POV, INEQ, INF) \tag{1}$$

Equation (1) expresses that energy transition (ENTR) is a function of economic growth (GRO), official exchange rate (EXC), CO_2 emissions (CO_2), poverty (POV), income inequality (INEQ), and inflation rate (INF). Since our sample is a panel of CIS member states, Eq. (1) can be written as Eq. (2):

$$ENTR_{i,t} = \alpha_0 + \alpha_1 GRO_{i,t} + \alpha_2 EXC_{i,t} + \alpha_3 CO2_{i,t} + \alpha_4 POV_{i,t} + \alpha_5 INEQ_{i,t} + \alpha_6 INF_{i,t} + \varepsilon_{i,t} \quad (2)$$

The data for the Eq. (2) variables are gathered from the BP and the World Bank and covers the post-USSR period (1992–2018). The variables used are energy transition (renewable energy consumption divided by non-renewable energy consumption) in percentage, economic growth (percentage), the official exchange rate (LCU per $), CO_2 emissions (measured in metric tons per capita), poverty (poverty headcount ratio based on World Bank's $1.90 per day poverty rate), income inequality (Gini index) and inflation rate (percentage). This study's specific sample is 12 member states of the Commonwealth of Independent States (CIS): Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

The descriptive statistics of the variables are recorded in Table 1. According to energy transition, the CIS member states have a mean of 0.23% (share of renewable energy consumption to fossil fuel consumption). This variable takes a maximum of 1.83% (Tajikistan in 2003) and a minimum of 0.00% (Turkmenistan in 1992). The mean of these 12 countries' economic growth is 2.7% over 1992–2018; Azerbaijan has the highest growth rate in 2006 (34.4%), and the lowest economic growth (−44.9%) happened in Georgia in 1992. Besides, our sample's average official exchange rate is $254.53, which has a record of 8069.8 in Uzbekistan in 2008 and a minimum record of 0.003 in Belarus in 1994. CO_2 emissions have a mean of 5.19 metric tons per capita over 1992–2018 in the CIS member states.

In contrast, Kazakhstan and Tajikistan have the maximum (15.94 metric tons per capita) and minimum (0.29 metric tons per capita) in 1994 and 2006. Regarding poverty, the CIS member states have an average of 7.04% of the population over 1992–2018, where Uzbekistan recorded the highest poverty (62.10% of the population) in 2003. Moreover, income inequality (GINI coefficient) has an average of 32.8 in the region, whereas it takes a maximum of 48.40 in Russia in 1993 and a minimum of 24 in Ukraine in 2014.

For estimating coefficients, it is necessary to check the preliminary tests. The first one is panel unit root test, which is performed in this chapter using Levin–Lin–Chu (LLC) (Levin and Lin 1993), IPS (Im et al. 1997) and MW (Maddala and Wu 1999) tests. If the panel unit root tests confirm the stationarity of series, we need to test for cointegration among variables. To this end, we conduct Pedroni (1999, 2004) and Larsson et al. (2001) panel cointegration tests. If all the series are cointegrated, the estimations of coefficients can be carried out. In doing so, we apply panel dynamic OLS (DOLS) and fully modified OLS (FMOLS) estimators for cointegrated panels.

Finally, to explore the direction of the relationship between energy transition, poverty, and income inequality, we carry out a panel vector error correction model (VECM).

4 Results and Discussion

The first step before running the estimation is to find out the presence of cross-sections among series. Checking the existence of cross-sections is so crucial because following Pesaran et al. (2008), skipping cross-sectional dependence may lead to estimation bias. In this paper, the adjusted Lagrange Multiplier (LM) statistics proposed by Pesaran et al. (2008) was performed. Its H_0 confirms the absence of cross-sectional dependence.

Table 2 represents the results of Pesaran's cross-sectional dependence test. According to the results, we cannot reject the H_0 (no-cross sectional dependence) of the cross-sectional dependence test.

Based on the achieved results, reported in Table 2, we can apply the first generation of panel unit root tests. Tables 3, 4 and 5 present the findings of the three tests of LLC, IPS, and MW at level and first-level differences. The results prove that the variables become stationary at first-level differences, pointing out that our model's variables are integrated of I(1) in the panel of CIS member states.

After determining the existence of I(1), we can carry out a panel cointegration test to find out the presence of long-run linkage between the series in our model. Table 6 shows Pedroni's panel cointegration test results, which rejects the H_0 (no cointegration) in most statistics. Hence, energy transition, poverty, and other regressors are cointegrated in our sample of CIS member states for the period 1992–2018. We applied the likelihood-based panel cointegration test for robustness checking, which results are presented in Table 7.

According to the results reported in Table 7, $R = 2$ is the most common selected rank in an individual country in the CIS region, proving the cointegrating relationship between variables of our panel of CIS member states.

After conducting preliminary tests, we can perform the econometric estimations which have been done here by employing FMOLS and DOLS estimators. Tables 8 and 9 present the findings of FMOLS and DOLS in the individual country.

Regarding DOLS and FMOLS estimators' results, the coefficients are similar in terms of sign and magnitude. Both estimators found out a negative relationship between economic growth and energy transition. Resource-rich economies' growth, such as Russia, Kazakhstan, and Azerbaijan, dominates CIS economic growth. Hence their higher economic growth comes with higher consumption of fossil fuels, which is not in favor of the energy transition. One of the leading movers of these resource-based economies is their access to cheap domestic fossil fuels.

Carbon emissions positively impact CIS member states' energy transition, meaning that any increase in air pollution may become a reason to boost the consumption of renewable energy resources in these countries. The results revealed a positive and statistically significant coefficient regarding poverty and income

inequality, meaning that any increase in energy transition progress may lead to a higher percentage of poverty and income inequality. The magnitude of this impact is smaller for oil producers such as Russia, Kazakhstan, and Azerbaijan. At the same time, this linkage is weaker for smaller economies in the CIS region, such as Belarus and Georgia. Renewable energy projects are still more expensive when comparing to fossil fuel projects. Especially in the resource-abundant regions such as in the CIS region, fossil fuels are much cheaper than renewable energy. The main reason is that renewable energy technologies are mainly new technologies and expensive (Taghizadeh-Hesary and Yoshino 2020). Another reason is that renewable energy projects have more difficulties accessing finance, as they are considered risky projects. Hence, investors for funding these projects need to borrow from markets at higher interest rates that reduce their competitiveness (Taghizadeh-Hesary and Yoshino 2019). This is why, although most recently, thanks to technological developments, the costs of generating electricity from renewable energy resources reduced, they are still expensive and less competitive. This assertion is confirmed by our findings. Relying on expensive energy resources will slow economic growth and elevate the poverty ratio, especially in smaller economies. Hence accessing cheap and clean energy is one of the factors for alleviating poverty.

Table 10 reports the findings of DOLS and FMOLS at group level of our panel.

Considering the results of FMOLS and DOLS, shown in Table 10, we can express that economic growth negatively impacts the CIS region's energy transition. The high dependency of economic growth in major economies of CIS on fossil fuel energy (see CASE 2008) is the main reason for this finding. In contrast, the other independent variables, such as exchange rate, CO_2 emissions, and inflation rate, have a positive relationship with energy transition, meaning that any depreciation of national currencies of the CIS member states against the US dollar may increase the cost of clean energy projects leading to a reduction of energy transition in this region. Moreover, the increase of the environmental pollution level in this region motivates states to accelerate clean energy projects to control pollution. Regarding the positive coefficient of the inflation rate, we can explain that increase in the price level of commodities may increase the price of technologies and instruments to develop fossil fuel fields in this region, which motivates states to accept the cost of clean energy prices that boosts the process of the energy transition in the CIS region. Besides, poverty has a negative coefficient, meaning that a higher rate of poverty may be considered a major obstacle for economic development that decelerates states' attempts to boost clean energy projects. Furthermore, income inequality negatively impacts the energy transition of the CIS region. Following Bartiaux et al. (2019) and Luciani (2020), we can explain that income inequalities may lead to energy inequalities among people in the CIS region, which is a negative influencing factor on the development of clean energy projects.

Since the evidence of cointegration between series in our model has been confirmed, the short and long-run causality test can be performed. In this paper, we conducted a panel VECM (Vector Error Correction Model) by Pesaran et al. (1999) and its findings are reported in Table 11 as follows.

Regarding energy transition as a dependent variable, the lagged error-correction term's coefficient is negative (−0.13) and statistically significant at 5% level. ECT's negative sign confirms the presence of long-run Granger causality running from economic growth, CO_2 emissions, exchange rate, poverty, income inequality, and inflation to energy transition in the CIS member states. Besides, considering poverty and income inequality as a dependent variable points out the short and long-run causality relationship of the energy transition. Therefore, we can conclude a bi-directional short and long-run relationship between energy transition, poverty, and income inequality. The bi-directional linkages between energy transition-poverty and energy transition-income inequality depicted that any short-run or long-run change in the energy transition is significantly related to poverty and income inequality changes and vice versa. Other scholars such as Bazelian and Yumkella (2015) and Okwanya and Abah (2018) found the importance of energy in poverty reduction. Furthermore, our result is in line with Shakouri and Khoshnevis Yazdi (2017), who provided evidence that clean energy positively impacts on energy growth leading to poverty reduction and a higher level of social inequality.

5 Concluding Remarks and Policy Recommendations

Poverty has been considered one of the main substantial and existing challenges of the CIS economies since the collapse of the former Soviet Union in 1991. Despite different levels of poverty and income inequalities among the CIS member states, the region faces the challenge of widespread poverty and significant inequality. High living expenditures and low wage levels are two golden keys to reasoning the current level of poverty in this region. This challenge can lower energy consumption in this region because of its adverse effect on household and transportation's energy consumption and hitting the supply side due to the lack of demand in the markets. Therefore, it would, directly and indirectly, impact energy transition progress in the region, which is important due to the region's environmental pollution.

This chapter explores the relationship between energy transition and poverty in 12 CIS member states over the 1992–2018 period.

Empirical estimations revealed that all series are integrated at first-level differences. The panel cointegration estimators of DOLS and FMOLS indicated a positive relationship between poverty, income inequality, and energy transition at in-country and panel group levels. The causality analysis proved the bi-directional relationship between energy transition, poverty, and income inequality in the CIS region.

The cost of generating electricity from renewable energy resources compared to fossil fuels in the CIS region in the majority of the cases is still higher. Hence, expensive renewable energy will reduce households' and corporates' affordability to consume energy, increase energy poverty, reduce economic growth, and increase poverty. There are some exceptions, such as Georgia and the Kyrgyz Republic. Due to their geographical location and abundant water resources, they can access cheaper hydropower energy, but these could not be generalized.

A major policy implication based on the empirical results is that to regulate the domestic energy market for achieving a higher share of renewable energy to achieve the goals set in the Paris Agreement and the Climate Actions goal of the sustainable development goals. However, these policies might impact the total electricity costs in the domestic market in the short run. Nevertheless, considering the hidden costs of pollution emitted from fossil fuels on the environment and health, governments should prioritize renewable energy projects.

The primary reasons for developing renewable energy projects in the CIS region are lack of long-term financing, the low rate of return of these projects, various risks, and the lack of market players' capacity (Taghizadeh-Hesary and Yoshino 2020). Practical solutions include: increasing the role of public financial institutions and non-banking financial institutions (pension funds and insurance companies) in long-term green investments, utilizing the spillover tax to increase the rate of return of green projects, developing green credit guarantee schemes to reduce the credit risk, establishing community-based trust funds, and addressing green investment risks via financial and policy derisking. These solutions have been implemented in different regions such as East Asia and South-East Asia but not in Central Asia and the CIS region. Utilizing these tools can enhance the share of renewable energy in this region and tend to energy transition with lower electricity costs, which favors economic growth and poverty reduction.

Another policy recommendation is selecting priorities in policies to overcome poverty and income inequality (following Khan and Heinecker (2018), who confirmed the relationship between inequality and energy use), which impact energy transition. In other words, the CIS member states need to control poverty in order to reach a higher level of energy transition (larger share of clean energy sources in their total energy consumption basket). However, different policies need to be determined by different CIS economies based on their economic size (Taghizadeh-Hesary and Rasoulinezhad 2020) and financial openness.

Furthermore, the CIS member states are developing, and less developed countries need to expand their economic cooperation with developed ones to benefit from more efficient technologies of green energy sources. Moreover, enhancing the pace of energy transition decreases CIS member states' dependency on non-renewable energy resources, creating a new role for the private sectors, small and medium businesses, and start-up companies in the region, accelerating poverty reduction.

Appendix

See Fig. 1 and Tables 1,1,2,3,4,5,6,7,8,9,10, and 11.

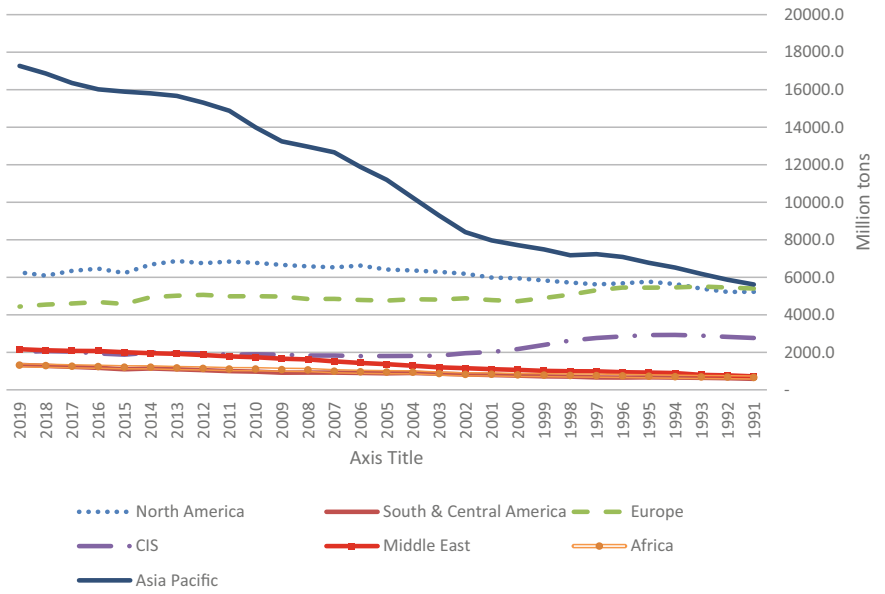

Fig. 1 CO_2 emissions by different regions, 1991–2019 (million tons) *Source* Authors' compilation based on *BP Statistical Review of World Energy* 2020

Table 1 Descriptive statistics of variables

Variables	Unit	Mean	Std. deviation	Maximum	Minimum
Energy transition	%	0.23	0.43	1.83	0.00
Economic growth	%	2.7	8.90	34.4	−44.9
Exchange rate	LCU per US$	254.53	936.52	8069.6	0.0003
CO_2 emissions	Metric tons per capita	5.19	4.16	15.94	0.29
Poverty	% of population	7.04	12.14	62.10	6.39
Income inequality	GINI coefficient	32.8	5.40	48.40	24
Inflation rate	%	106.7	458.84	4734.91	−10.63

Note Std. deviation indicates standard deviation
Source Authors' calculation

Table 2 Results of Pesaran's cross-sectional dependence test

Test	Stat.	*P*-value
Pesaran's test	1.438	0.391

Source Authors' calculation

Table 3 Results of LLC panel unit root tests

Variables	Without trend	Prob.	With trend	Prob.
Energy transition	1.066	0.783	3.366	0.999
D(Energy transition)	−6.792	0.00	−6.800	0.00
Economic growth	1.419	0.804	0.463	0.791
D(Economic growth)	−5.561	0.00	−4.775	0.00
Official exchange rate	1.793	0.492	0.395	0.702
D(official exchange rate)	−7.032	0.00	−4.683	0.00
CO_2 emissions	1.394	0.694	3.512	0.799
D(CO_2 emissions)	−6.830	0.00	−7.482	0.00
Poverty	−0.298	0.350	0.605	0.585
D(Poverty)	−3.693	0.00	−4.611	0.00
Income inequality	−0.480	0.517	0.719	0.490
D(Income inequality)	−4.859	0.00	−4.668	0.00
Inflation rate	1.254	0.743	3.354	0.893
D(Inflation rate)	−7.125	0.00	−6.940	0.00

Note D refers to first-order differences of variables. *indicates significance at the 0.01 level
Source Authors' calculation

Table 4 Results of IPS panel unit root tests

Variables	Without trend	Prob.	With trend	Prob.
Energy transition	1.863	0.783	3.683	0.511
D(Energy transition)	−4.491	0.00	−4569	0.00
Economic growth	4.609	1.00	2.633	0.999
D(Economic growth)	−3.809	0.00	−4.592	0.00
Official exchange rate	0.254	0.788	0.506	0.732
D(official exchange rate)	−4.585	0.00	−5.684	0.00
CO_2 emissions	2.353	0.584	1.855	0.999
D(CO_2 emissions)	−3.594	0.00	−4.666	0.00
Poverty	3.666	0.310	2.544	0.893
D(Poverty)	−4.109	0.00	−4.709	0.00
Income inequality	3.965	1.00	3.740	0.999
D(Income inequality)	−4.315	0.00	−4.603	0.00
Inflation rate	0.269	0.950	−1.188	0.999
D(Inflation rate)	−4.659	0.00	−5.655	0.00

Note D refers to first-order differences of variables. *indicates significance at the 0.01 level
Source Authors' calculation

Table 5 Results of MV (ADF) panel unit root tests

Variables	Without trend	Prob.	With trend	Prob.
Energy transition	14.590	0.996	10.414	0.694
D(Energy transition)	67.391	0.00	64.289	0.00
Economic growth	15.396	0.991	9.583	0.991
D(Economic growth)	60.583	0.00	65.392	0.00
Official exchange rate	26.598	0.999	35.110	0.294
D(official exchange rate)	69.119	0.00	84.440	0.00
CO_2 emissions	13.391	0.996	14.891	0.991
D(CO_2 emissions)	54.130	0.00	78.754	0.00
Poverty	14.449	0.996	10.455	0.683
D(Poverty)	69.593	0.00	63.668	0.00
Income inequality	15.133	0.988	9.943	0.449
D(Income inequality)	60.814	0.00	68.598	0.00
Inflation rate	22.583	1.00	37.485	0.995
D(Inflation rate)	70.808	0.00	90.686	0.00

Note D refers to first-order differences of variables. *indicates significance at the 0.01 level
Source Authors' calculation

Table 6 Results of Pedroni's cointegration test

	Panel v stat	Panel σ stat	Panel ρρ stat	Panel adf-stat	Group σ stat	Group ρρ stat	Group σ stat
Stat.	−0.501	−0.202	−4.199	−2.693	1.173	−2.683	−1.994
Prob.	0.633	0.428	0.00	0.00	0.673	0.00	0.02

Source Authors' calculation

Table 7 Results of Larsson's cointegration test

Country	Likelihood test stat.				
	R = 0	R <=1	R <=2	R <=3	Rank
Armenia	86.493*	55.392*	30.593	15.499	2
Azerbaijan	90.855*	51.384*	22.483	11.330	2
Belarus	78.909*	49.616*	25.492	10.412	2
Georgia	88.488*	52.699*	21.884	8.690	2
Kazakhstan	90.394*	58.599*	27.599	10.799	2
Kyrgyzstan	94.692*	59.568*	21.600	12.922	2
Moldova	100.793*	56.110*	30.592	10.990	2
Russia	104.693*	59.803*	29.694	13.143	2
Tajikistan	86.485*	55.619*	25.396	9.094	2
Turkmenistan	85.922*	51.778*	24.381	13.001	2
Ukraine	73.583*	54.386*	22.688	13.894	2
Uzbekistan	85.492*	41.692*	29.300	9.084	2
Panel	8.449*	3.384*	1.319	0.894	2

Note *means H0 rejection at 0.05 level of significance
Source Authors' calculation

Table 8 Results of DOLS at individual country

Country	–	Regressors					
	–	GRO	EXC	CO_2	POV	INEQ	INF
Armenia	Coefficient	−0.03	0.26	0.03	−0.21	−0.36	0.19
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00
Azerbaijan	Coefficient	−0.16	0.51	0.12	−0.04	−0.39	0.39
	Prob.	0.00	0.00	0.00	0.01	0.04	0.00
Belarus	Coefficient	−0.33	0.19	0.22	−0.27	−0.28	0.22
	Prob.	0.03	0.00	0.00	0.00	0.01	0.00
Georgia	Coefficient	−0.02	0.03	0.04	−0.31	−0.38	0.22
	Prob.	0.00	0.02	0.00	0.04	0.01	0.00
Kazakhstan	Coefficient	−0.42	0.20	0.12	−0.01	−0.09	0.21
	Prob.	0.00	0.01	0.00	0.00	0.00	0.02
Kyrgyzstan	Coefficient	−0.14	0.02	0.11	−0.43	−0.40	0.03
	Prob.	0.03	0.00	0.00	0.00	0.00	0.00
Moldova	Coefficient	−0.00	0.02	0.41	−0.41	−0.26	0.00
	Prob.	0.00	0.03	0.01	0.02	0.00	0.00
Russia	Coefficient	−0.51	0.43	0.24	−0.09	−0.02	0.12
	Prob.	0.04	0.00	0.00	0.00	0.01	0.00
Tajikistan	Coefficient	−0.04	0.12	0.31	−0.21	−0.44	0.00
	Prob.	0.05	0.00	0.00	0.01	0.02	0.00
Turkmenistan	Coefficient	−0.00	0.52	0.42	−0.37	−0.18	0.19
	Prob.	0.00	0.00	0.00	0.00	0.01	0.04
Ukraine	Coefficient	−0.41	0.03	0.19	−0.19	−0.36	0.01
	Prob.	0.00	0.05	0.01	0.01	0.0	0.00
Uzbekistan	Coefficient	−0.17	0.48	0.00	−0.14	−0.29	0.33
	Prob.	0.00	0.03	0.01	0.05	0.00	0.04

Source Authors' calculation

Table 9 Results of FMOLS at individual country

Country	–	Regressors					
	–	GRO	EXC	CO_2	POV	INEQ	INF
Armenia	Coefficient	−0.18	0.38	0.11	−0.43	−0.26	0.21
	Prob.	0.00	0.04	0.00	0.00	0.00	0.00
Azerbaijan	Coefficient	−0.51	0.22	0.01	−0.090.	−0.00	0.49
	Prob.	0.00	0.04	0.01	0.00	0.00	0.00
Belarus	Coefficient	−0.01	0.03	0.14	−0.36	−0.11	0.02
	Prob.	0.00	0.010	0.05	0.01	0.00	0.00
Georgia	Coefficient	−0.00	0.19	0.42	−0.24	−0.16	0.04
	Prob.	0.03	0.040	0.00	0.00	0.01	0.00
Kazakhstan	Coefficient	−0.44	0.029	0.00	−0.04	−0.12	0.00
	Prob.	0.00	0.00	0.00	0.00	0.00	0.03
Kyrgyzstan	Coefficient	−0.14	0.28	0.41	−0.42	−0.21	0.19
	Prob.	0.04	0.00	0.00	0.03	0.00	0.01
Moldova	Coefficient	−0.04	0.10	0.00	−0.29	−0.19	0.16
	Prob.	0.04	0.00	0.00	0.00	0.00	0.01
Russia	Coefficient	−0.64	0.48	0.29	−0.03	−0.11	0.42
	Prob.	0.00	0.01	0.00	0.00	0.00	0.03
Tajikistan	Coefficient	−0.08	0.19	0.05	−0.33	−0.22	0.04
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00
Turkmenistan	Coefficient	−0.00	0.28	0.42	−0.15	−0.11	0.05
	Prob.	0.00	0.03	0.02	0.05	0.00	0.01
Ukraine	Coefficient	−0.01	0.19	0.19	−0.36	−0.17	0.24
	Prob.	0.05	0.02	0.00	0.00	0.01	0.04
Uzbekistan	Coefficient	−0.19	0.31	0.11	−0.20	−0.16	0.05
	Prob.	0.04	0.01	0.00	0.04	0.01	0.00

Source Authors' calculation

Table 10 Results of FMOLS and DOLS at group level

Regressor	FMOLS		DOLS	
	Coefficient	Prob.	Coefficient	Prob.
Economic growth	−0.31	0.00	−0.19	0.00
Exchange rate	0.04	0.01	0.14	0.00
CO_2 emissions	0.19	0.00	0.25	0.00
Poverty	0.28	0.03	0.36	0.00
Income inequality	0.21	0.00	0.16	0.00
Inflation	0.17	0.00	0.28	0.00

Source Authors' calculation

Table 11 Results of VECM causality test

	Short-run causality							Long-run causality
	$\Delta ENTR$	$\Delta EGRO$	ΔCO_2	ΔEXC	ΔPOV	$\Delta INEQ$	ΔINF	ECT_{t-1}
$\Delta ENTR$	–	−2.65 (0.04)	4.83 (0.00)	2.49 (0.01)	4.15 (0.00)	3.76 (0.05)	1.99 (0.00)	−0.13 [3.80]
$\Delta EGRO$	−1.19 (0.04)	–	3.43 (0.00)	1.05 (0.00)	3.58 (0.00)	4.69 (0.04)	3.59 (0.01)	−0.35 [4.11]
ΔCO_2	0.59 (0.01)	0.11 (0.00)	–	0.39 (0.04)	1.11 (0.00)	3.29 (0.02)	4.58 (0.00)	0.19 [3.94]
ΔEXC	0.10 (0.00)	0.30 (0.05)	0.39 (0.00)	–	0.17 (0.00)	4.19 (0.00)	3.77 (0.01)	0.44 [4.29]
ΔPOV	0.13 (0.00)	−0.15 (0.00)	0.01 (0.00)	0.31 (0.04)	–	0.39 (0.00)	0.59 (0.01)	−0.29 [4.66]
$\Delta INEQ$	0.22 (0.04)	−0.59 (0.00)	0.24 (0.00)	0.11 (0.03)	0.55 (0.00)	–	4.52 (0.01)	−0.19 [4.50]
ΔINF	0.19 (0.00)	0.04 (0.00)	2.58 (0.01)	3.11 (0.03)	0.23 (0.05)	4.59 (0.00)	–	−0.32 [5.39]

Source Authors' calculation

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Chapter 11
Improving the Energy and Environmental Efficiency for Energy Poverty Reduction

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Abstract This study aims to measure social welfare and poverty reduction through efficient use of energy and reduction in CO_2 emissions. For this purpose, this study applies mathematical multi-system programming using selected European countries' data between 2014 and 2018. The outcomes of empirical findings show that Norway, Switzerland, and Poland are highly efficient in energy usage. Norway and Switzerland are also among the most energy-efficient countries, which have lessened CO_2 emissions in Europe. These European countries have become energy efficient; thus, they have improved social welfare by improving environmental quality and reducing poverty. According to our findings, there is a significant and positive relationship between social welfare and energy efficiency in Europe. Therefore, European nations have an opportunity to reduce poverty, improving people's lives, provide good health, create more jobs, and preserve the natural environment through energy efficiency. Moreover, this study's outcomes may serve as a beacon house light for reducing poverty and improving the quality of social welfare indicators in developing Asia by following the trajectory of energy efficiency.

Keywords Energy poverty, European countries · Social welfare · Carbon dioxide reduction · Energy efficiency · Developing Asia

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1 Introduction

More than a billion people live without electricity worldwide; most belong to developing economies (Shyu 2014). Therefore, energy poverty seems multifaced, which is increasing systematically. According to Energy Poverty Observatory collected information, energy poverty disturbs nearly 50 million people in EU countries. About 600 million individuals live without energy in Asia and the Pacific, and roughly 4.1 billion consume wood and charcoal for heating and cooking (Thomson and Bouzarovski 2018). It is important to notice that energy poverty is a major factor of income poverty in developing countries and dragging individuals toward the bottom of the welfare ladder. Therefore, developing nations' primary objective is to improve the production of goods by increasing energy efficiency, reducing energy poverty, and recovering welfare loss. There is no specific cut-off point to define the energy poverty line; however, in a general way, energy poverty refers to households not having access to energy services, such as cooking, lighting, home heating, and other electrical appliances (Bouzarovski and Petrova 2015; Middlemiss and Gillard 2015; Gillard et al. 2017).

The developing nations have a strong belief that increasing energy efficiency will result in reducing energy poverty. It means higher affordability and accessibility and more energy consumption at the household and corporate levels. At the household level, it will affect the quality of life. People can have electricity in their houses, children will go to schools with electricity, and people will receive services in public facilities with electricity. At the corporate level, it will increase productivity and output. Energy is considered a production factor; hence higher energy consumption will increase firms' production. Moreover, higher energy efficiency will increase the total factor productivity that will increase production indirectly. These will tend to enhance social welfare, higher economic growth, and reduce poverty. Due to such problems, poverty reduction through solving energy poverty and enhancing energy efficiency has become the leading global objective of enhancing social welfare (Eisenberg et al. 2010).

In energy consumption and environmental dynamics, another factor affecting the quality of life is pollution, especially greenhouse gases (GHG). Globally, GHG emissions were up to 0.148 million metric tons of carbon equivalent in 2017. It shows a 3.6% annual growth rate of GHG emission worldwide (Meng et al. 2019). These gases are the sources of energy-related emissions, causing about 80% of welfare loss (Meng et al. 2019). The current global energy consumption pattern mainly relies on fossil fuels amounting to two-thirds of CO_2 emissions. Thus, reducing GHG emissions has become the main objective to improve social welfare. The Kyoto Protocol and the Paris Agreement on climate change require nations to reduce CO2 emissions; however, globally, fossil fuels are still the economies' primary movers. Their share is larger in the developing world.

Several studies attempted to relate energy efficiency, CO_2 emissions, and environmental efficiency topics individually or combined. For example, Kanoglu et al. (2011), Mahlberg and Luptacik (2014), Sueyoshi et al. (2017), Sun et al. (2020a)

focused on energy efficiency without taking CO_2 emissions into account. However, Shemer et al. (2001), Rochelle (2009) and Zhang et al. (2020) analyzed how gain in energy efficiency can reduce CO2 emissions. In comparison, Peters et al. (2007) relied on energy efficiency and environmental efficiency, and Sun et al. (2020b) estimated environmental efficiency and convergence. All the above studies use non-parametric methods to test energy efficiency and CO_2 emissions. Economic efficiency deals with the potential of industries to turn energy inputs into production outputs and unfavorable outputs. As a result, fossil fuel energy consumption emits CO_2 and other gases, including NOx and $PM_{2.5}$, which are harmful to health and cause several cancers and respiratory diseases (Taghizadeh-Hesary and Taghizadeh-Hesary 2020; Taghizadeh-Hesary et al. 2020; Rasoulinezhad et al. 2020). Here, it is impossible to measure the country's real social welfare performance without considering these outputs. Therefore, it is essential to find the above-mentioned undesirable type of outputs. We are discussing here two methods to assess the undesirable outputs. According to Cook et al. (2014), the traditional data envelopment analysis (DEA) applied for the undesirable outputs use as input during data translation.

Further, the second method is called the environmental DEA technology, which assumes a feeble unwanted output in environmental DEA technology. Sueyoshi et al. (2017) suggested the non-radical DEA method for environmental performance based on multidimensional measurements and the non-radial Malmquist matrix to measure EU countries' environmental output differences. Zhou et al. (2010) measured carbon emission efficiency of top CO_2 emitter economies. Mohsin et al. 2020) studied the ecological benefits of renewable energy in various EU countries to establish a multi-criterion decision analysis to apply energy and economics.

Thus, previous literature considered CO_2 and energy consumption to measure countries', regions', and cities' energy and environmental efficiency. There is rear work found related to increasing social welfare and reducing poverty through energy, which plays a significant role in any country's economic policy and poverty reduction plans. Therefore, this study has novelty and considers these aspects based on the social model proposed by Zhou et al. (2006). For the objective mentioned above, we used a dataset of the selected European countries from 2014 to 2018. In 2017, European economies reduced GHG emissions by about 19% compared to emission levels in 1990. Therefore, it is expected that Europe is on track to meet the 2030 targets on climate change. On the other hand, developing Asian economies' emissions are still increasing, and they need to learn from other regions' successful experience. Therefore, this study's major contribution is to propose a policy design for developing Asian economies and learn from EU nations' experience.

This chapter is structured as follows: Sect. 2 provides the background of the study. Section 3 is on the methods and materials. Section 4 depicts results and discussions and, finally, the conclusion of the study and policy implications are provided in Sect. 5.

2 Background

Many people in developing countries and particular residents in advanced countries are defined as being in energy poverty, whose well-being is compromised by deficient energy intake, dangerous substances, and unnecessary fuel collection for necessities. It is inversely associated with access to advanced renewable energy sources, while enhancing access is only one factor in energy poverty reduction. Energy poverty is distinguished from fuel poverty, which emphasizes affordability. According to the World Economic Forum's energy poverty action initiative, energy access is crucial for improving the quality of life and is essential for economic progress. Energy deprivation is also prevalent in the poorest countries. Due to very diverse views about energy poverty across the developing nations, energy researchers have used different metrics to quantify energy deprivation. Furthermore, different methods are used to identify vulnerable groups in different peripheries. A lack of consensus about the concept and various understandings about the issue are the potential pitfalls to accurately resolve energy insecurity and energy poverty (Le et al. 2019). In the European region, Europe's building stock up-gradation is a crucial factor in alleviating energy insecurity (Rademaekers et al. 2016; Thomson et al. 2017).

EU countries consume 23.14% of world energy and generate a 36% share of world carbon emission (Menegaki and Tugcu 2017). Despite that, the EU is on track to meet the targets for reducing GHG emissions by 2030.

In contrast, it is expected that energy poverty and GHG emissions may further surge in Asian regions, and energy insecurity is an inevitable challenge for Asian developing economies in the future (Yoshino et al. 2020). Despite that, unlike with income poverty, there is no precise definition of energy poverty, but there is a need to understand this emerging issue to avoid energy starvation in the future.

The increasing trend in the energy burden has been observed in Europe since 2000. It is noticeable that absolute poverty declined sharply after 2004–2005, while poverty in relative terms such as relative poverty compared to other regions has decreased moderately. However, the upward trend in energy poverty seems to be one of Europe's emerging issues (Bouzarovski 2014).

The level of energy poverty is based on four criteria, such as arrears on utility bills, inadequately insulated houses, disproportionately high housing expenditure, and inadequate heat to keep the house warm. Based on these categories of energy poverty, most European countries fail to provide useful energy sources to their inhabitants. For example, Bulgaria and Portugal fail to provide adequate energy sources to their citizens to warm their homes. Moreover, European countries, mainly Italy and Germany, mostly depend on energy imports to meet their energy demands. The good thing is that all countries are trying to increase renewable energy use—Germany and the UK are leading the trend. Not only in the European region, but Germany also ranked third in the world among those that had installed wind power capacity at 59 gigawatts (GW) by 2018. Similarly, the UK generates 40% of total electricity by utilizing renewable resources such as wind, biomass, and solar.

It is expected that energy demand will rise by more than double in European countries by 2030 due to rapid industrialization and economic development (IEA 2017a). The world's major industrial democratic economies spend at least $100 billion/year to sustain oil, gas, and coal consumption, despite swearing to end carbon-based energy subsidies by 2025. France, Canada, Italy, UK, and Germany in 2016 committed to eradicating fossil fuels from their national energy mix by 2025. However, it is a stark reality that Britain's Overseas Development Institute (ODI) spent no less than $100 billion per year to carry on using domestic and imported fossil fuels in 2015 and 2016. European nations are planning to eliminate subsidies on fossil fuels to avoid welfare losses. It is expected that this step will help toward a swift transition from nonrenewable to renewable energy sources and prove helpful to protect the environment (Shi et al. 2020). Indirectly, environmental preservation steps will improve the quality of life and help alleviate poverty and improve social welfare. Thus, the usage of renewable energy sources will not only strengthen energy security in the region. It will also help combat acute climate change—hurricanes, snowstorms, wildfire, cold waves, tornadoes, and droughts (Sweeney 2009; Nejat et al. 2015; IEA 2017b). Asian economies also need to promote renewable energy resources in their energy baskets to increase energy security and also reduce GHG emissions (He et al. 2020; Malik et al. 2020; Nepal et al. 2020).

3 Methods and Materials

The Charnes, Cooper, and Rhodes (CCR) model is the initial version of the DEA model, referred to as the traditional model developed by Charnes in 1978, using constant return to scale (CRS) techniques. The DEA model can be inputs and methods oriented towards outputs. The DEA has used the most common approach to multicriteria data envelopment analysis (MCDEA). This approach used the country with a low-efficiency score as the base criteria to seek relative efficiency. For the measurement of relative efficiency, several decision-making units (DMUs) in the network utilized input to generate multiple outputs. We optimize the sum of the weighted ratio of all outputs and inputs for relative efficiency determination. In this study, we apply the input-oriented CCR-DEA approach formulation as below:

$$Maximize\theta = \sum_{r=1}^{n} u_r y_{rj} \tag{1}$$

$$Subject to \sum_{r=1}^{n} u_r y_{rj} - \sum_{s=1}^{m} v_s x_{sj} \leq 0$$

$$\sum_{s=1}^{m} v_s x_{sj} = 1$$

$$(jandi = 1, 2, \ldots, n)u_r \geq 0, v_s \geq 0$$

Where y_{rj} and x_{sj} are the values of output j and input i, respectively, for DMU. u_r and v_s are the decision variables describing the multipliers (weights) given to output j and inputs i. In (1), DMU0 is useful if slacks are minimum and only if $v_s x_{sj} = 1$, which means that the $u_r y_{rj}$-related inequality constraint is active j.

The second requirement in (1) is the second limit in rule (2), which contains the variance term. Besides, it proposed the use of two additives. The MCDEA's first additional target minimizes the cumulative variance within the range of measured DMUs (that is, Min-Max θ_0, $\lambda = 1$, n), and is deemed to be minimax. The new MCDEA's second objective minimizes the total anomalies (that is, ubiquitous Min) and is called minimal. The linearized MCDEA model outline in (2).

$$\theta^* = Minimize\theta_0 \tag{2}$$

$$Subjectto\theta x_0 = \sum_{j=1, j\neq 0}^{n} \lambda_j x_j + s^- \tag{3}$$

$$y_0 = \sum_{j=1, j\neq 0}^{n} \lambda_j y_j - s^+ \tag{4}$$

$$\lambda \geq 0, s^- \geq 0, s^+ \geq 0$$

Furthermore, only the DMU0 variation is restricted to the interval [0, 1]. Deviations may be more significant than harmony for the other DMUs (that is, y_j, quit). In MCDEA, if the value referring to the answer that minimizes the second objective function in (2) is null, the x_j is significant at the minimum or maximum level. Similarly, x_j is minimally effective if it is nil, and only if it does value refer to the answer that minimizes the third objective function in (2). Therefore, the DMU must necessarily be competent in the traditional sector to be minimally or maximally efficient (Zhou et al. 2006; Kemmler and Spreng 2007; Yao and Chang 2014).

Our data set consists of two parts. The first is the standard input-output taken from the World Bank's open knowledge repository. In contrast, the second part is related to energy poverty, which is taken from Thomson et al. (2019), Karpinska and Śmiech (2020) and Sareen et al. (2020). Here, the authors stated that the heating system's replacement could reclassify it as a low-cost investment in the other two subcategories, increasing the residence (such as windows) and increasing the cost, such as the use of a cogeneration system. They collected information from the families that had heating facility in all rooms or in a specific room. Most situations occur when individual rooms are not used, or the bedroom is combined with the living room, so opening the door at night is sufficient to promote heat circulation.

Nevertheless, very few people believe that warmth is essential. Even if they may have to pay high energy costs, they will adjust the heating method according to what

they think is comfortable—a crucial indicator of the quality of living conditions and energy-deficient families (Dolata 2017). In contrast, the only relevant value is income, which is heating time. Besides, the ability to withstand energy costs strongly depends on the heating time and indoor comfort conditions. In other words, as the results explain, as income increased, heating time increased, and living conditions improved. There are still some limitations to overcome energy poverty indicators and their relevance.

Moreover, the data provided by Eurostat (2019) show that in the EU, on average, 7.8% of families cannot maintain adequate heating in their houses, 7% of the population defaults on bills and 13.3% of households report leaking roofs. The walls are damp, or the windows are rotten. There are huge differences throughout the EU concerning energy poverty, even within the group of low-income families. Appropriate coverage of policy intercessions and target-setting processes can meet household energy needs (Yang et al. 2020). However, financial assistance within social policy has a small impact on competition and affects the most disadvantaged energy consumers, such as low-income, single parents, unemployed, and retired people. Therefore, our analysis supports the previous statement that there are no universal social assistance programs and subsidies within the EU to alleviate low-income households' energy poverty. Therefore, it is essential to understand the real causes of energy poverty in EU member states. It will help to suggest suitable policy measures to deal with energy scarcity in each member state.

4 Results and Discussions

Table 1 presents the average annual amount of input/output data, during the period 2014–2018. Here, energy usage (MTOE), population (million), GDP (billion USD), and CO_2 (MT) have been utilized for the selected European countries. It can be observed that Germany (330.80) was the leading economy in terms of primary energy consumption, while Hungary (25.44) holds the lowest position in the region.

4.1 Energy Efficiency Score of European Nations

Table 2 shows the energy efficiency score based on DEA analysis and rank of individual countries for every year.

The energy efficiency score varies from 0 to 1, with 1 indicating the highest energy efficiency level. Results based on DEA analysis show the fluctuations in energy efficiency from year to year and country to country. For example, the UK attained an energy score of 1.00 and achieved the first rank in 2014 but lost an energy efficiency of 0.186 scores and ranked in the tenth position in 2015. It can be observed that, except Norway, Poland, and Switzerland, all the European countries

Table 1 Inputs and outputs indicators of European countries

Countries	Total energy usage	Population	GDP	CO_2
Belgium	60.08	11.25	508.40	118.36
Finland	27.70	5.469	253.10	46.56
Greece	27.04	10.86	245.40	75.12
Netherlands	84.82	16.91	874.10	207.60
Austria	34.60	8.603	416.50	61.70
France	277.00	68.44	2790.00	417.24
Germany	330.80	86.65	4019.9	766.87
Hungary	25.44	9.854	146.40	45.86
Italy	163.82	60.6	2078.11	379.92
Sweden	56.92	9.755	547.40	58.9
Switzerland	29.22	8.233	637.20	39.12
Turkey	139.36	77.65	1083.01	353.34
United Kingdom	199.72	64.87	2697.10	439.48
Norway	47.58	5.16	466.10	35.78
Poland	99.82	38.00	556.10	301.84
Portugal	26.46	10.40	238.70	52.20
pain	138.96	46.52	1523.13	285.44

Source Open knowledge repository, World Bank, 2019

have failed to maintain or improve energy efficiency levels during the entire period under consideration.

According to Fig. 1, in the European region Norway, Poland, and Switzerland are among the most constant energy efficiency countries. Most European countries are still struggling to achieve or maintain high energy efficiency levels and minimize welfare losses. Although measured at the macro level, this energy efficiency score has a strong implication at the micro-level to strengthen energy security and improve marginalized individuals' life standards. According to the latest definitions of fuel poverty followed in the UK, families with insufficient fuel demand usually bear higher energy costs than the national average. In other words, the loss in energy efficiency in EU member nations depicts welfare losses at the domestic level.

Meanwhile, energy poverty also has a direct impact on the welfare status of individuals. According to a study by Gökgöz and Güvercin (2018), to alleviate fuel poverty in Europe, there is a need to spend more than 10% of families' income on fuel consumption to maintain an acceptable temperature in cold or hot weathers. Similarly, families who are consuming less than 10% of their income are classified as energy-poor. According to the energy poverty criterion, individuals living below the threshold level cannot spend a quality life due to lack of indoor heating requirements. Therefore, it can be observed that the improvement in energy efficiency and alleviation of energy poverty are both inevitable to improve the welfare level at the micro and macro levels.

Table 2 Energy efficiency score of European countries, 2014–2018

Years	2014		2015		2016		2017		2018	
DMU	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank
Germany	0.926	8	0.824	9	0.816	9	0.719	10	0.861	9
Belgium	0.838	12	0.751	13	0.753	12	0.731	12	0.742	12
Finland	0.763	12	0.743	12	0.663	18	0.669	15	0.68	15
UK	1.000	1	0.814	10	0.793	10	0.781	10	1.000	1
Norway	1.000	1	1.000	1	1.000	1	1.000	1	1.000	1
Poland	1.000	1	1.000	1	1.000	1	1.000	1	1.000	1
Switzerland	1.000	1	1.000	1	1.000	1	1.000	1	1.000	1
Greece	0.69	16	0.695	16	0.677	15	0.663	16	0.673	18
Netherlands	0.87	8	0.873	8	0.887	7	0.89	7	0.89	7
Austria	0.765	11	0.754	11	0.759	11	0.745	11	0.749	11
France	0.734	20	0.423	21	0.619	20	0.625	20	0.627	20
Hungary	0.476	26	0.473	26	0.48	26	0.485	26	0.494	26
Italy	0.735	14	0.73	14	0.731	13	0.725	13	0.42	17
Sweden	0.646	17	0.635	19	0.628	19	0.687	18	0.633	19
Turkey	0.545	24	0.575	22	0.553	24	0.559	24	0.579	23
Portugal	0.557	23	0.552	24	0.583	22	0.563	22	0.602	22
Spain	0.636	18	0.641	18	0.659	16	0.657	18	0.676	16

Source Based on the Authors' calculation

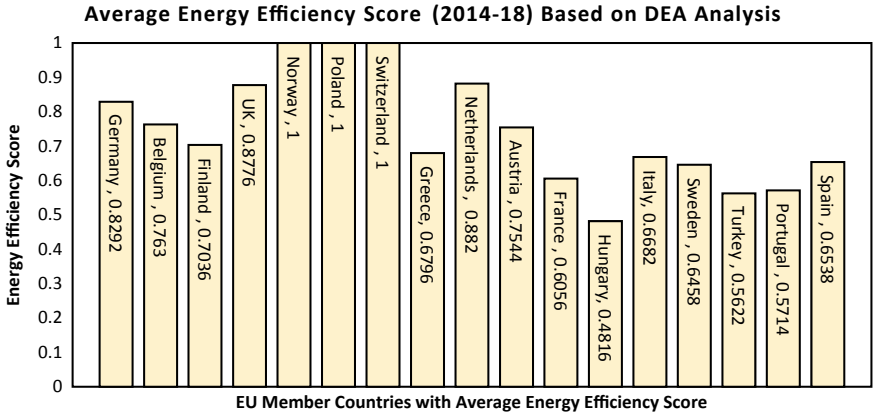

Fig. 1 Average energy efficiency score (2014–2018) in the European. *Source* Open knowledge repository, World Bank, 2019

4.2 Environmental Conservation and Poverty Alleviation in European Nations

Table 3 presents the overall efficiency score to control CO_2 emissions or achieve environmental conservation in all European countries from 2014 to 2018. Again, there have been seen considerable fluctuations in CO_2 emissions during this period. Among all European economies, Switzerland and Norway are the most efficient to protect the environment by controlling CO_2 emissions for five consecutive years, from 2014 to 2018. Thus, the economies with high efficiency to control CO_2 emissions have followed the trajectory of energy efficiency. Such efficiency gain has carried individuals above the energy poverty line and increased social welfare by improving the grassroots level's quality of life. According to the relative ranking, the UK's efficiency to preserve the environment by controlling CO_2 emissions has improved significantly.

According to Fig. 2, every country is struggling to gain efficiency to control CO_2 emissions levels. At the same time, Norway and Switzerland both have a maximum score to control emissions and conserve the natural environment. Thus, the low-efficiency score to control CO_2 emissions is an indicator of climate changes in the future and highlights the extra pressure on the population in the form of high health cost (Taghizadeh-Hesary and Taghizadeh-Hesary 2020). Significantly, the low and low-middle income families struggle greatly to maintain health expenditure due to environmental or climatical changes.

From a legislative point of view, the 'energy poor' are equivalent to the 'vulnerable consumers' in the standard Europe directive on the internal market for electricity and natural gas in Europe. Four member states have set national standards for determining 'vulnerable' families. In the UK, the energy poverty strategy roughly defines vulnerable consumers as elderly families, families with disabilities or chronic illnesses,

Table 3 The efficiency score to control CO_2 emissions in European countries, from 2014 to 2018

Date	2014		2015		2016		2017		2018	
DMU	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank
Germany	0.146	21	0.148	20	0.148	19	0.148	21	0.149	20
Belgium	0.158	19	0.154	19	0.148	19	0.151	19	0.148	21
Finland	0.164	16	0.173	15	0.185	13	0.177	16	0.181	15
Greece	0.168	15	0.167	16	0.172	17	0.176	16	0.172	17
Austria	0.181	13	0.199	13	0.183	14	0.186	13	0.182	14
Netherlands	0.128	24	0.129	24	0.128	24	0.127	24	0.116	24
France	0.245	4	0.265	3	0.262	3	0.257	3	0.252	3
Hungary	0.251	3	0.254	4	0.246	4	0.244	6	0.238	5
Italy	0.188	11	0.195	11	0.19	12	0.19	12	0.189	10
Sweden	0.397	2	0.422	2	0.537	2	0.4	2	0.481	2
Switzerland	1.00	1	1.00	1	1.00	1	1.00	1	1.00	1
Turkey	0.227	7	0.213	8	0.22	7	0.217	7	0.208	8
UK	0.258	6	0.250	5	0.256	6	0.200	8	0.298	3
Norway	1.000	1	1.000	1	1.000	1	1.000	1	1.000	1
Poland	0.181	13	0.182	14	0.18	15	0.178	15	0.176	16
Portugal	0.229	6	0.23	7	0.212	9	0.216	8	0.199	9
Spain	0.201	10	0.201	10	0.191	10	0.194	10	0.185	13

Source Based on the Authors' calculation

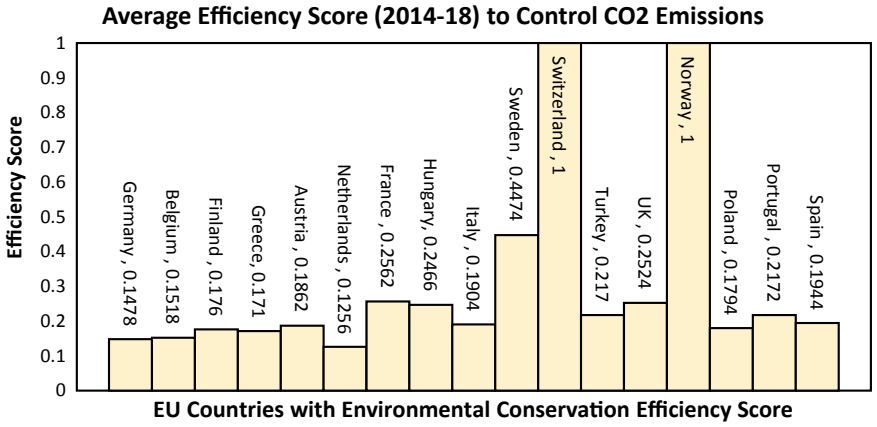

Fig. 2 Average efficiency score to control CO_2 emissions in European countries

and families with young children (the leading population group). However, more common are families on social benefits that are considered eligible for this energy plan.

In Spain, according to the leading indicators, many social electricity bill recipients who are determined to be eligible are not in energy poverty, and vice versa. The same is true in Portugal, which suggests that additional indicators are needed for better evaluation, such as energy efficiency.

Table 4 shows an efficiency base comparison to control CO_2 emissions in European countries in 2018—the efficiency to control CO_2 calculated through Eq. (4). Here, Norway is the only country with a maximum efficiency score to control CO_2 emissions in the region. The efforts to control emissions indirectly produce a welfare gain by improving individuals' life quality through employing environmental conservation. It can be observed that all other European economies have relatively low-efficiency scores to control emissions effectively in the region. Likewise, Sweden ranked at the second position by acquiring an efficiency score of 0.441, substantially less than Norway. So, it can be argued that the average efficiency score of the European regions is relatively low, and joint efforts are needed to improve the efficiency level for environmental conservation at the regional level.

Table 5 presents the efficiency score of European states by analyzing the emission intensity score. Here emission intensity measures CO_2 released in metric tons (Mt) per megajoule of energy production. The efficiency score is based on a reduction in CO_2 emission intensity measured through DEA analysis. It can be observed that the efficiency score varies from 0.5428 to 0.0619. Here, Poland has the highest while Switzerland has a minimum score in CO_2 emission intensity among all European economies.

Table 4 Efficiency score to control CO_2 emission and ranking of European countries in 2018

DMU	Efficiency	Ranking
Norway	1.000	1
Sweden	0.441	2
France	0.256	3
Hungary	0.255	4
Switzerland	0.241	6
Turkey	0.212	7
Portugal	0.200	8
Spain	0.196	9
Italy	0.19	11
Austria	0.189	12
Poland	0.181	13
Finland	0.172	14
United Kingdom	0.173	15
Greece	0.170	16
Belgium	0.154	17
Germany	0.144	18
Netherlands	0.126	19

Source Based on the Authors' calculation

Table 5 European country ranking based on the intensity of CO_2 emission

DMU	Mt/US$	Ranking
Poland	0.5428	1
Turkey	0.3266	3
Greece	0.3065	4
Hungary	0.3054	5
Netherlands	0.2374	6
Belgium	0.2324	7
Portugal	0.2323	8
Germany	0.2022	9
Spain	0.1999	11
Finland	0.1855	12
Italy	0.1644	13
United Kingdom	0.163	14
Austria	0.1482	15
France	0.1140	16
Sweden	0.0889	17
Norway	0.0768	18
Switzerland	0.0619	19

Source Based on the Authors' calculation

4.3 Impact of Energy Poverty in Education and Health Perspectives

It is common to conclude that energy-poor households are the lower-income households living in rural or off-grid areas without electricity. Individuals without electricity belong to vulnerable groups living with numerous socio-economic challenges compared to non-energy-poor households. Energy poverty is also the primary component that drags individuals below the income poverty line by restricting their livelihood activities. Due to cold weather in most parts of Europe during fall and winter, lack of indoor heating is a primary indicator of the severity of energy poverty or energy insecurity in European households. For instance, in European economies, existing heating systems are insufficient and cannot meet the indoor temperature requirements due to the vast gap in energy demand and energy supply. Moreover, the number of individuals who have access to energy live in buildings with low energy efficiency increases energy consumption.

Meanwhile, such individuals, despite access to energy, are still struggling to sustain energy payments. So, it seems that high energy costs write off the welfare gain due to access to energy. Therefore, there is a need to highlight areas where energy can play an important role and improve society's welfare.

Energy plays a crucial role in the provision of education and health services. In the health sector, sterilizers, microscopes, x-ray machines, ventilators, and incubators, for example, cannot work without energy. Similarly, energy plays a vital role in delivering education. It helps to operate laptops, audio-visual equipment, laboratory practices, photocopying, and lamps to study at night. Thus, advancing the quality of services in both the education and health sectors is almost impossible without energy provision. Therefore, better health and education are essential ingredients to promote physically healthy and disciplined societies (Hanif 2018). Contrarily, it seems challenging to promote education and health facilities in the absence of an energy supply. In other words, energy poverty has severe consequences for providing quality education and health services and seriously hinders the welfare level at the micro and macro levels.

The impact of energy poverty on the provision of education and health services is quite direct; there is also a need to understand many indirect channels. Under the shadow of energy poverty, it appears difficult to get a high per acre yield, such as cultivating and irrigating large land areas. Similarly, access to clean drinking water may induce food insecurity and water-led health diseases. Energy poverty may also compel households to use cheap energy sources, increasing indoor air pollution and increasing household-level health risks. Energy poverty influences individuals' health status and hinders healthcare provision in remote or rural areas more. For example, health professionals or paramedical staff usually do not prefer to live in those areas where they have no access to electricity or modern fuels to meet their domestic energy requirement.

As far as the education sector is concerned, energy provision ensures the delivery of different education services, particularly in primary, secondary, and vocational

education. Energy poverty has a multifold impact on education services. It can, for example, affect the physical structures where education is provided. It can distress the abilities of teaching staff and badly affect education at home. More adversely, schools operating in the regions under the influence of energy poverty usually have poor sanitation, no lighting facilities, and operate under security hazards. Due to these issues, parents in those areas usually least prefer to send children to school.

Finally, there is a need to understand energy, health, and education linkages with society's welfare levels. Furthermore, the influence of energy poverty on one sector may also influence another sector and cause loss of welfare in society and vice versa. Thus, due to intra-sectoral linkages of energy poverty, there is a need to develop coordination between energy security and other sectors like health and education. A sound codification mechanism will promote the welfare level by ensuring energy security and providing quality health and education services at the local level.

5 Conclusion and Policy Implications

This study contributes to the literature by theorizing and explaining the connection between social welfare and reducing energy poverty by improving energy efficiency. This study suggests frameworks for calculating output in energy consumption, reducing CO_2 pollution, increasing social welfare, and reducing energy poverty for European countries from 2014 to 2018. Models were established to measure efficiency in energy use and output in CO_2 emissions, respectively. Empirical findings from European countries for the 2014–2018 period are summarized as follows. For energy efficiency, Norway, Poland, and Switzerland are identified as consistent, efficient countries. At the same time, Hungary, Turkey, Portugal, France, and Spain are relatively the lowest-ranked five countries from 2014 to 2018. As for the efficiency of controlling CO_2 emissions, only Norway and Switzerland have been recognized as efficient countries for the five successive years from 2014 to 2018. The remaining countries are struggling to enhance the control of CO_2 emissions. Throughout the five years, the rating statistics for very few European states remained relatively stable. However, suppose we look at each country's ratings. In that case, it is noted that 14 of the 20 European countries surveyed had output levels below 0.55, revealing highly significant variations in CO_2 emission performance among European countries.

In comparison, the bulk of the European countries surveyed achieved higher energy efficiency ratings than CO_2 emission levels, Peru and the Philippines being the only two examples where energy efficiency gain can be observed along with the moderate increase in carbon emission. Brunei, Hong Kong, and Singapore are the three benchmarking economies listed as energy-efficient and CO_2-efficient. Moreover, energy poverty can be talked about through energy efficiency. Simultaneously, welfare aspects can also be constrained by energy efficiency and understanding the linkages between the energy, health, and education sectors. There is a need to benefit from European nations' experience to formulate targeted policies for developing Asian countries. Based on empirical findings and theoretical linkages, the following

steps may help policy makers and practitioners develop a policy framework. The following points are crucial to improve energy efficiency and energy security in social sector development and improve the welfare level and alleviate energy poverty at the regional level. There is a need to develop a robust institutional framework to strengthen good governance and capacity building in the energy sector to ensure energy security. In other words, to minimize energy poverty's role in providing advanced health and education facilities, strong government institutions and a sound governance system are prerequisites. In Asia, females' active participation is also unavoidable; they can ensure efficient energy use at the domestic level. Usually, in developing Asian countries, females spend more time indoors and perform cooking at home. So, their involvement will help reduce indoor air pollution; it will also improve households' health status. There is a need to improve sectoral planning to alleviate energy poverty, particularly in energy provision activities. Energy poverty cannot be reduced with grid-based electrification; there is a need to promote alternative energy sources like wind and solar energy. There is a clear framework required to elaborate which energy types to be prioritized and how they will improve energy provision at the grassroots level.

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