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Productivity and the Great Recession

In his 2003 Presidential Address to the American Economic Association, Robert Lucas stated:

> Macroeconomics was born as a distinct field in the 1940's, as a part of the intellectual response to the Great Depression. The term then referred to the body of knowledge and expertise that we hoped would prevent the recurrence of that economic disaster. My thesis in this lecture is that macroeconomics in this original sense has succeeded: Its central problem of depression prevention has been solved, for all practical purposes, and has in fact been solved for many decades. There remain important gains in welfare from better fiscal policies, but I argue that these are gains from providing people with better incentives to work and to save, not from better fine-tuning of spending flows. Taking U.S. performance over the past 50 years as a benchmark, the potential for welfare gains from better long-run, supply-side policies exceeds *by far* the potential from further improvements in short-run demand management.[1]

Less than five years after he delivered his address, a recession began in the US which morphed into the global financial crisis and into what has come to be called the Great Recession, affecting all Western economies to a greater or lesser extent.

Lucas can be forgiven for not predicting the global financial crisis. And he turned out to be right in predicting that the consequences of the crisis were mitigated in the US by the policy response, which certainly drew on the lessons learned from the Great Depression. In the Great Recession of 2008-2009, US GDP fell by a far smaller percentage than it had in the Great Depression of the 1930s. But he was clearly wrong to state that the institutions of monetary and fiscal policy in place in the US in 2003 would prevent such a crisis arising in the first place. And all the advances in macroeconomics since the 1930s have not prevented other countries, for example in Southern Europe and particularly Greece, from suffering the equivalent of a Great Depression.

Another view expressed in Lucas's address has proved very influential. This is that macroeconomics is mainly about the movements of GDP and productivity around a trend which is determined by other factors lying largely outside of macro – some of them economic in nature, like taxes, and others less immediately so, like technical progress. This is surprising, since there was plenty of evidence that financial crises, particularly banking crises, can damage growth. The most obvious examples are the Latin American debt crisis of the 1980s and the Asian financial crisis of the 1990s.[2] Economists studying these regions have often noted the disastrous effects of "sudden stops", when banks that have made illiquid investments on the basis of short-term funding, often from abroad, have this funding cut off. A "sudden stop" is a good description of what happened to the banks in many Western countries in 2008 and 2009.

As is well known, the growth of labour productivity and total factor productivity (TFP) declined sharply in countries experiencing a marked reduction of GDP in the Great Recession. There is nothing surprising about this. It is a well-known effect of labour hoarding and low capital utilisation, similar to what had been experienced in previous recessions. What is surprising is that low or even zero productivity growth has continued well past the time at which the recession proper, that is the period when GDP was actually falling, came to an end and into the so-called

1 R.E. Lucas Jr.: Macroeconomic priorities, in: American Economic Review, Vol. 93, No. 1, 2003, p. 1.

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2 These have been subsequently studied in C.M. Reinhart, K.S. Rogoff: This Time Is Different: Eight Centuries of Financial Folly, Princeton 2009, Princeton University Press; C.M. Reinhart, K.S. Rogoff: Growth in a Time of Debt, in: American Economic Review, Vol. 100, No. 2, 2010, pp. 573-578; C.M. Reinhart, K.S. Rogoff: From Financial Crash to Debt Crisis, in: American Economic Review, Vol. 101, No. 5, 2011, pp. 1676-1706; and C.M. Reinhart, K.S. Rogoff: Errata: "Growth in a Time of Debt", mimeo, 5 May 2013, available at http://www.carmenreinhart.com/user_uploads/data/36_data.pdf. See also e.g. N. Oulton, M. Sebastiá-Barriel: Effects of Financial Crises on Productivity, Capital and Employment, in: Review of Income and Wealth, Vol. 63, February 2017, pp. S90-S112.

"recovery" period. An extreme example is the UK, which has had effectively zero growth of labour productivity in the ten years since 2007 – this despite a falling unemployment rate (which currently stands at 4.4%) and an increase in the labour force and hours worked, which are now some nine per cent higher than at the previous peak.

Nonetheless, the accepted view now seems to be that ongoing low productivity growth has little or nothing to do with the recession. It is instead explained by a decline in the growth rate of TFP, which predated the crisis. This decline is partly exogenous, due to the fading effects of the ICT revolution, but is also partly endogenous, due to weaknesses in the competitive process, which again predate the recession.[3] This has been compounded in some countries by a failure to adopt the type of structural reforms long advocated by the OECD.

The authors cited above have offered convincing explanations for why we ought to expect TFP growth to be lower in the future than it was in the glory days of the ICT revolution in the US. And there does seem to be evidence that the competitive process has been weakening; for example, laggard firms seem to have increasing difficulty catching up to the leading ones.[4] But this is not the whole story. I argue instead that the Great Recession did significant damage to productivity growth through a number of channels. Consequently, raising the growth rate of GDP would also raise the growth rate of labour productivity and of TFP. That there has been no spontaneous recovery in productivity growth to pre-recession rates thus far, particularly in Europe, is due to the nature of the recession, which I argue is due to constrained demand for each country's exports.[5]

3 A. Bergaud, G. Cette, R. Lecat: Productivity Trends from 1890 to 2012 in Advanced Countries, Banque de France Working Paper No. 475, 2014; J.G. Fernald: Productivity and potential output before, during and after the Great Recession, in: J.A. Parker, M. Woodford: NBER Macroeconomics Annual 2014, Vol. 29, Chicago 2014, University of Chicago Press, pp. 1-51; G. Cette, J.G. Fernald, B. Mojon: The pre-Great Recession slowdown in productivity, in: European Economic Review, Vol. 88, 2016, pp. 3-20.
4 See e.g. G. Cette, S. Corde, R. Lecat: Firm-level productivity dispersion and convergence, in: Economics Letters, Vol. 166, May 2018, pp. 76-78.
5 This view is more fully set out in N. Oulton: The UK (and Western) productivity puzzle: does Arthur Lewis hold the key?, Centre for Macroeconomics, Discussion Paper No. CFM-DP-2018-09, 2018. There I set out what I call the neo-Lewis model, which finds inspiration in W.A. Lewis: Economic development with unlimited supplies of labour, in: The Manchester School, Vol. 22, No. 2, 1954, pp. 139-191. This model behaves like the Solow model in good times, but in bad times the growth of GDP is constrained by the growth of demand for exports.

The slowdown in growth since the Great Recession

Table 1 documents the slowdown in the growth of output and productivity since 2007 in 23 Western countries, based primarily on data from EU KLEMS.[6] EU KLEMS is preferable to other data sources on grounds of methodological consistency, but it only provides data on TFP growth for 14 of the 23 countries. On average across these 23 countries, GDP growth has slowed down by 2.66 percentage points per annum (pppa), hours worked by 1.18 pppa, and labour productivity (GDP per hour) by 1.30 pppa. In the 14 countries for which TFP growth can be calculated, it slowed down by 0.88 pppa, while the growth of capital intensity slowed by 0.40 pppa. Certainly for these 14 countries, and probably for the others as well, the slowdown in TFP accounts for the bulk of the slowdown in labour productivity, in a growth accounting sense.

The labour productivity experiences of different countries are quite diverse. Though labour productivity growth fell on average, there were five exceptions: Denmark, Ireland, Greece, Italy and Spain. In the case of Greece, Ireland and Spain, this improvement in productivity was accompanied by a massive decline in labour input, in both employment and hours. For Italy, the improvement was tiny, and in any case, Italian labour productivity growth was roughly zero before the crisis. Meanwhile, Australia is an exception in the other direction. It experienced a very small decline in labour productivity growth alongside a below-average decline in GDP growth.

The picture for TFP is even worse. TFP growth has been on average negative from 2007 to 2015, and so the TFP level was lower for most countries in 2015 than it was in 2007. The best performer is the US, but even here the TFP level in 2015 was only about one per cent above the 2007 level.

Elsewhere I have argued that the varying pattern of labour productivity growth post-crisis reflects differences in labour market institutions.[7] In some countries, such as the UK, labour input rose quite rapidly before the crisis and has continued to rise since then. In others, the growth of labour input has been constrained post-crisis by immigration policy (Canada and Australia) or by labour market rigidities which prevent the unskilled in particular from competing effectively in the job market. The latter situation is the case in much of continental Europe, which has

6 The latest release of data, from September 2017, is available at www.euklems.net. I exclude very small countries and ones which do not report data for hours worked.
7 See N. Oulton, op. cit.

Table 1
Changes in growth rates, 2007-2015 compared to 2000-2007, in 23 countries
in % per annum

Country	GDP	Employ-ment	Hours	GDP per hour	TFP	Capital intensity
Austria	-1.74	-0.11	-0.50	-1.24	-0.91	-0.57
Australia	-1.21	.	-1.19	-0.02	-0.23	+0.21
Belgium	-1.28	-0.26	-0.30	-0.98	-0.57	-1.34
Bulgaria	-4.17	-2.98	-3.18	-0.99	.	.
Canada	-1.18	.	-1.00	-0.19	+0.10	-0.66
Czech Republic	-3.79	-0.46	0.20	-3.97	-3.87	+0.22
Germany	-0.78	+0.67	0.44	-1.22	-0.95	-1.42
Denmark	-0.94	-1.16	-1.01	+0.07	-0.40	+0.84
Greece	-7.39	-3.72	-4.21	-3.18	.	.
Spain	-3.78	-5.24	-4.85	+1.07	-0.05	+1.47
Finland	-3.81	-1.28	-1.24	-2.57	-2.61	+0.10
France	-1.28	-0.56	-0.54	-0.74	-0.59	-1.02
Ireland	-4.68	-4.27	-5.31	+0.63	.	.
Italy	-2.09	-1.76	-2.17	+0.09	+0.19	+0.20
Nether-lands	-1.39	-0.89	-0.63	-0.76	.	-0.02
Poland	-2.26	+0.04	-0.11	-2.15	.	.
Portugal	-1.87	-1.32	-1.40	-0.48	.	.
Romania	-4.40	+0.92	0.20	-4.59	.	.
Sweden	-1.70	+0.04	0.30	-2.00	-0.59	-1.05
Slovenia	-4.46	-1.38	-0.66	-3.80	.	.
Slovakia	-3.94	-0.53	-0.60	-3.35	.	.
United Kingdom	-1.83	-0.17	0.00	-1.83	-1.30	-1.65
United States	-1.22	-0.68	-0.15	-1.08	-0.54	-1.35
Cross-country average	-2.66	-1.20	-1.18	-1.30	-0.88	-0.40

Notes: Ireland: 2007-2014, not 2007-2015, since Irish GDP in 2015 was distorted by tax manipulation by multinationals. Poland: 2003-2007, not 2000-2007, due to missing values in 2000, 2001 and 2002. For Canada and Australia, figures are for the market sector. For all other countries, figures are for the whole economy.

Sources: Data for Europe and the US are from EU KLEMS: EU KLEMS Growth and Productivity Accounts 2017 Release, available at www.euklems.net. Data for Canada are from Statistics Canada: Multifactor productivity, value-added, capital input and labour input in the aggregate business sector and major sub-sectors, CANSIM Table 383-0021, available at https://www.statcan.gc.ca/eng/start. Data for Australia are from Australian Bureau of Statistics: Estimates of Industry Multifactor Productivity, Table 5260.0.55.002, available at http://www.abs.gov.au/AusStats/ABS@.nsf/MF/5260.0.55.002.

seen a large rise in unemployment and a large fall in employment.

These differences in institutions would not have mattered much if the good times which prevailed before the crisis had continued. But since the crisis, each country has faced constrained demand for its exports, which leads to slower growth of GDP. Why? Because a lower growth rate of exports eventually means a lower growth rate of imports as well. This prevents domestic demand from filling the gap left by the constrained demand for exports. Suppose imports are consumer goods. Then either the intertemporal borrowing constraint will lead to lower imports or, if not, lenders will refuse to extend unlimited credit to finance consumption.[8] This is the case even for countries like the US which run persistent current account deficits. Now if, in this situation of constrained demand, the growth of labour input is held down, the impact on labour productivity can be mitigated, though at the cost of higher unemployment and lower employment. But in countries where this is not possible, labour productivity growth will slow down more sharply.

This mechanism could operate irrespective of what is happening to TFP. But because on the face of it the productivity slowdown is a TFP slowdown, it is necessary to directly consider the factors lying behind the latter.

Why has TFP growth declined?

Recessions and TFP

According to standard growth theory since Solow, in the long run the growth of TFP drives capital accumulation and the growth of labour productivity.[9] In turn, the growth of TFP, though it may be influenced in the short run by many other factors,[10] is ultimately driven by innovation and technical progress. The latter may be affected by economic institutions and incentives but not by monetary and fiscal policy.

On the face of it, it seems highly implausible that a fortuitous and exogenous decline in the rate of innovation could account for slow productivity growth after 2007 in the countries studied here. The issue is not whether we are technology optimists like Brynjolfsson and McAfee

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8   The analysis is similar if imports are of intermediate goods used in production.
9   R.M. Solow: A Contribution to the Theory of Economic Growth, in: Quarterly Journal of Economics, Vol. 70, No. 1, 1956, pp. 65-94.
10 N. Oulton: The mystery of TFP, in: International Productivity Monitor, Vol. 31, 2016, pp. 68-87.

or technology pessimists like Gordon.[11] The collapse in TFP growth that has occurred since 2007 in EU countries and even in the United States seems to dwarf the effects stemming from a lower rate of technological progress.

The alternative explanation is that the recession itself has somehow adversely affected TFP growth. There are in fact at least two channels through which this could have occurred.

First, the amount of innovation taking place in the economy may be temporarily reduced, due to a loss of business confidence.[12] Innovation is implemented through or accompanied by investment in intangibles (e.g. R&D, in-firm training or expenditure of management time on corporate restructuring), or it could take the form of new entrants into an industry bringing new products, new technology or new business methods. All this is (arguably) what lies behind TFP growth as conventionally measured, but not all of these are counted as investments in the current System of National Accounts.

Innovation is a cumulative process, and the supply of workers and entrepreneurs capable of innovating is likely to be inelastic. So unlike with physical capital, a reduction in innovation in one period cannot easily be made up in a subsequent one. In other words, less innovation today means that the future *level* of TFP is permanently lower. For illustration, suppose that prior to a crisis, assumed to last h years, the economy is capable of generating a stream of innovations a, b, c, ... from the current year t onwards. As a result of the crisis, the first innovation a is now delayed to year $t+h$; the subsequent innovations b, c, ... are now also delayed h years to years $t+h+1$, $t+h+2$, ... , and so on. Though all innovations are eventually introduced, the level of TFP will clearly be lower in every post-crisis year than it would have been in the absence of the crisis. And for h years, the growth rate of TFP will be below its pre-recession rate, even if it recovers after this period. A reduction in the TFP level will also lead to a secondary effect, namely a reduction in the desired level of capital, which also reduces labour productivity.

A second channel through which the recession could have negatively impacted TFP growth is via an externality associated with the expansion of output itself. This argument goes back to Hall.[13] Following his work, Bartelsman et al. found support for increasing returns on US data, Caballero and Lyons on European data, and Oulton on UK manufacturing data (124 industries over nine sub-periods within 1954-1986).[14] Hall had invoked a "thick market externality" to explain the phenomenon: an example is the delivery van which travels as many miles on average in good times as in bad times but delivers more packages when times are good. This suggests that the effect operates at business cycle frequencies and is simply due to varying utilisation.

But this is not the only possibility. Oulton found that the externalities seem to apply peak-to-peak as well as over the course of the business cycle, which is not consistent with the thick market story.[15] Another type of externality is a learning effect: knowledge of new techniques and methods diffuses faster through the economy as the rate of overall expansion increases. This type of effect would be expected to operate peak-to-peak.

Did the TFP slowdown precede the Great Recession?

The earlier release of the EU KLEMS dataset (the March 2011 update of the November 2009 release) provides good quality and methodologically consistent data for 18 countries over varying time periods, ending in 2007. Figure 1 plots the results. Each panel shows the actual path of TFP growth (light green line), the Hodrick-Prescott trend (dark green line) and the mean over the sample period for each country (dashed line). With the exceptions of Australia and Ireland, there is little evidence of decline. In 2007 most countries were at or above their own mean level.

Because of its economic importance, let us consider the US in more detail. Figure 1 does indeed show a decline in the HP trend starting around 2003, though in 2007 it was still above the mean TFP growth level. The same cannot be said for the annual TFP growth level, which dipped below the mean in 2007. Here we can benefit from the more sophisticated analysis of Crafts and Mills.[16] They

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11 See E. Brynjolffson, A. McAfee: The Second Machine Age, New York 2014, Norton; and R.J. Gordon: The Rise and Fall of American Growth, Princeton 2016, Princeton University Press.

12 N. Oulton, M. Sebastiá-Barriel, op. cit.

13 R.E. Hall: The Relation between Price and Marginal Cost in U.S. Industry, in: Journal of Political Economy, Vol. 96, No. 5, 1988, pp. 921-947.

14 See J. Bartelsman, R.J. Caballero, R.K. Lyons: Customer- and supplier-driven externalities, in: American Economic Review, Vol. 84, No. 4, 1994, pp. 1075-1084; R.J. Caballero, R.K. Lyons: Internal versus external economies in European industry, in: European Economic Review, Vol. 34, No. 4, 1990, pp. 805-826; and N. Oulton: Increasing Returns and Externalities in UK Manufacturing: Myth or Reality?, in: Journal of Industrial Economics, Vol. 44, No. 1, 1996, pp. 99-113.

15 N. Oulton: Increasing Returns... , op. cit.

16 N. Crafts, T.C. Mills: Predicting Medium-Term TFP Growth in the United States: Econometrics vs. 'Techno-Optimism', in: National Institute Economic Review, Vol. 242, No. 1, 2017, pp. R60-R67.

Figure 1
TFP growth in the market sector in 18 countries up till 2007
in % per annum
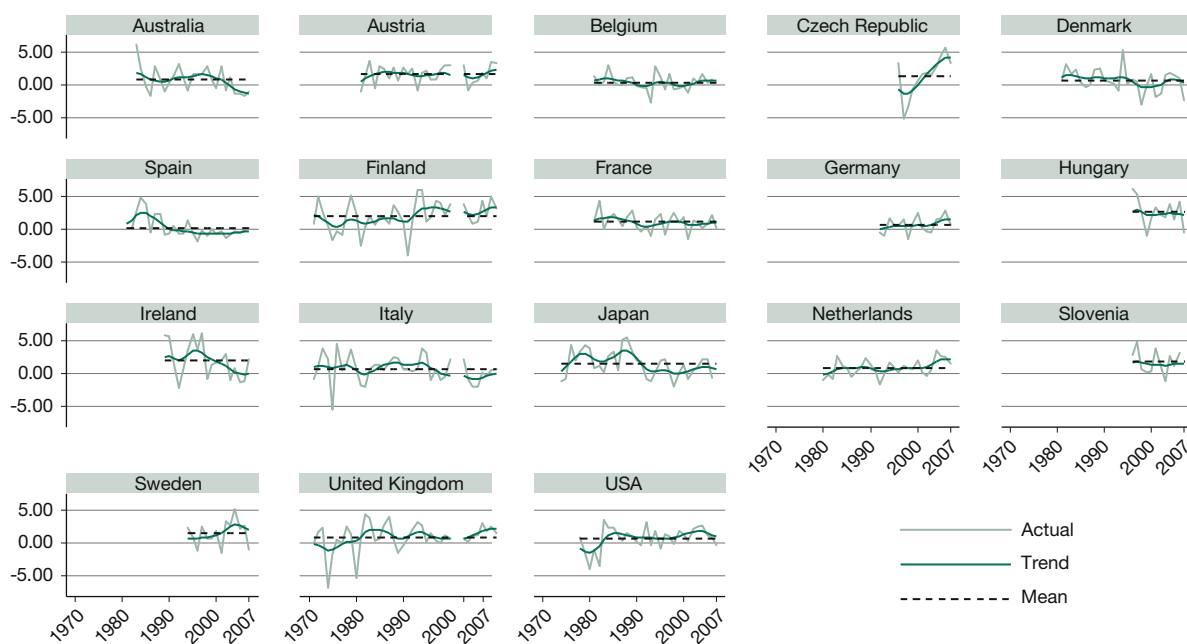
Note: Trend growth rate is that of HP-smoothed TFP level. Dashed lines denote country means of actual TFP growth rate.

Sources: N. Oulton: The mystery of TFP, in: International Productivity Monitor, Vol. 31, 2016, pp. 68-87, derived using EU KLEMS (the March 2011 update of the November 2009 release).

apply a time series model to Fernald's quarterly series for TFP growth in the business sector.[17] TFP growth is modelled as a random walk (the trend) plus a zero-mean, auto-correlated "noise" process. Crafts and Mills find, using Fernald's series for the whole period 1947-2015, that the trend has been slowing continuously since 1967, from around 1.5% pa to around 1.0% pa in 2016. The actual TFP measurement according to Fernald's data over 2007-2015 was 0.56% pa (0.63% pa adjusted for utilisation). In other words, the outturn was substantially lower than the trend, as estimated by Crafts and Mills. Another way to look at it is to note that the Crafts-Mills trend growth rate in 2016 was about 0.1% pa lower than in 2000, so the slowdown in trend growth was quite modest in relation to what actually occurred.[18]

We lack a comparable analysis for the other countries, but it seems likely that even less of their slowdown can be attributed to a decline in trend growth preceding the crisis. The US slowdown was less pronounced than average, while most of the other countries in Table 1 could still benefit from catching up to the US TFP level. Hence, it is implausible to attribute the declining TFP growth in these countries to an exogenous decline in innovation.

Exogenous or recession-induced decline: A test of the two hypotheses

It is difficult to test these ideas using the latest release of the EU KLEMS dataset since there are only 14 countries for which TFP growth rates are available. So I use instead the latest release of the Penn World Table database.[19] After eliminating countries with populations of less than 2 million and those with no data on hours worked, there

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17 J.G. Fernald: A Quarterly, Utilization-Adjusted Series on Total Factor Productivity, Federal Reserve Bank of San Francisco Working Paper No. 2012-19, updated 2014.

18 Ibid. From the spreadsheet accompanying Fernald's paper, dated 1 February 2018, it can be calculated that comparing 2007-2015 with 2000-2007, unadjusted TFP growth slowed down by 0.63 pppa; adjusted for utilisation, the slowdown was 0.57 pppa. This is very similar to the slowdown of 0.54 pppa in Table 1, which is for the whole economy.

19 As described in R.C. Feenstra, R. Inklaar, M.P. Timmer: The Next Generation of the Penn World Table, in: American Economic Review, Vol. 105, No. 10, 2015, pp. 3150-3182. Version 9.0 is the most recent version and is freely available at https://www.rug.nl/ggdc/productivity/pwt.

Table 2
Change in TFP growth and change in capital intensity growth in 52 countries

	Change in TFP growth	Change in K/L growth
	-1	-2
Change in GDP growth	0.527***	—
	(0.0803)	
Change in TFP growth	—	0.283
		(0.194)
Constant	-0.281	1.105***
	(0.168)	(0.363)
N	52	52
R-squared	0.514	0.058

N o t e: Changes are measured as annual average growth over 2007-2014 minus annual average growth over 2000-2007. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

S o u r c e: Penn World Table, version 9.0, and own calculations. I use the PWT's "national accounts" variables: *rgdpna*, *rkna* and *rtfpna* for indices of real GDP, real capital stock and TFP respectively.

remain 52 countries for which TFP is available. Two drawbacks of the Penn World Table should be noted. First, the capital variable is the aggregate capital stock, not the superior capital services measure. Second, the terminal year is 2014, not 2015.

The externality hypothesis suggests that, for cross-country comparisons, the bigger the slowdown in GDP, the bigger the slowdown in TFP. Table 2 shows the results of running this test. The coefficient on GDP is highly significant ($t = 6.6$). Taken literally, this says that a slowdown of one percentage point in GDP causes a slowdown of 0.53 percentage points in TFP. The correlation between the two variables is 0.72.

But how do we know that causality runs from GDP to TFP and not the other way round, as conventional growth theory would suggest? Column 2 of Table 2 is a test of the Solow model's predictions about the effect of a slowdown in TFP growth, which the model takes to be exogenous. That model predicts that a slowdown in TFP growth will cause a slowdown in the growth rate of capital intensity. But the coefficient on the latter, 0.28, is much smaller than the model predicts: with a capital share of about one-third, the coefficient should be about 1.5. It is also insignificant, and the correlation between the two variables is only 0.24. I thus conclude that the externality hypothesis finds support in the data.

Concluding remarks

The productivity puzzle – continued low rates of growth of both labour productivity and of TFP, ten years after the end of the previous boom – is largely explained by the recession itself. Labour productivity growth has varied quite a lot across countries, but I argue that this largely reflects varying labour market institutions.[20] In countries with flexible labour markets, wages adjusted and employment was maintained. In other words, labour productivity took the hit when the growth of GDP was constrained by deficient demand for each country's exports. The fall in TFP growth since 2007 is far too large to be explained by an exogenous decline in the rate of innovation and technical progress. Instead, it is more likely to reflect the damage done by the recession itself. A process of increasing returns – now working in the malign, reverse direction – has reduced TFP growth. I find that countries which suffered the biggest reduction in GDP growth after 2007 also suffered the biggest reduction in TFP growth.

Even if we tend to side with the technology pessimists, there is clearly scope for substantially raising productivity, particularly in Europe. But if the underlying problem is constrained demand for each country's exports, then it is not one which any single country can solve on its own. "Ending austerity" in any one country (except perhaps the very largest) will not do the trick, since it would just lead to a balance of payments problem and increased debt. If the analysis here is accepted, then one theoretical possibility is a coordinated fiscal and/or monetary expansion across the Western world, combined perhaps with incentives to raise investment. To state it in these terms merely emphasises how implausible such a policy sounds. But it is possible that a single large country – or a bloc of smaller ones – could adopt such policies in an uncoordinated way, which might have something of the desired effect.

Alternatively, we could just wait for the world economy to recover of its own accord. At the time of writing, there is much optimism among international organisations and commentators about growth prospects in Western countries. If these forecasts turn out to be right, then the problem may solve itself. But these hopes may turn out to be misplaced or exaggerated, as have earlier ones. In that case, the need for new policies to address the productivity puzzle, beyond the usual call for "structural reforms", will remain on the table.

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20 This argument draws on N. O u l t o n : The UK…, op. cit.