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THE PRODUCTIVITY PUZZLE¹

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“[T]echnology remains the dominant engine of growth...if we suppose that all...countries had access to roughly the same pool of technological innovations, then it appears that the ones that invested fastest were best able to take advantage of the available knowledge...it could be the case that some countries are better able to exploit the common pool of technological progress than others, for reasons that have nothing to do with the rate of capital formation; but in exactly those technologically progressive countries investment is most profitable, so naturally the rate of investment is higher. Or else rapid technical progress and high investment could both be the result of some third factor, like the presence of conditions that encourage entrepreneurial activity. High investment and fast technical progress will then go together.”

R. M. Solow, “Growth Theory and After”, *Nobel Prize Lecture*, 1987.

Introduction

Economic growth matters. The material improvement in living standards as measured by the increase in the production of goods and services has been an artefact of the modern world. Britain has been characterised as the first industrial nation (Mathias, 1969) and accordingly with a sustained period of economic growth, it reached a peak in 1900 of 9.4% of world output (Maddison 2010). This fraction has declined with the increasing growth of emerging parts of the world but also because Britain’s relative performance has tended to deteriorate. At present the UK is at some 2.8% of world GDP and seems likely to fall to 1% or less over the next 20 to 30 years. That observation does not necessarily imply that living standards, as measured broadly by per capita income, will fall but more that many other nations may see their living standards rise materially faster. This process has been emphasised by the phenomenon that has come to be known as the productivity puzzle: that growth in measured productivity has fallen far behind previous trends and this has opened up a large gap between anticipated and actual income per head (see Figure 1).²

We might characterise ‘normal times’ as involving the steady expansion of the economy’s supply capacity with small jolts or shocks to demand, from changes in confidence, sentiment or from overseas markets, that lead to small fluctuations around that expansion path: these small fluctuation are called business cycles. The growth in capacity can most easily be thought about as the sum of the growth in inputs, typically capital and labour, and how they combine to produce a given level of output, total factor productivity: a set of words that act to describe technological progress. The growth in total factor productivity is thus simply the growth rate in the index of outputs to the index of inputs in production. Providing short run fluctuations in demand, which take the economy temporarily away from this level of supply capacity, do ebb away then we can concentrate on accounting for economic growth in terms of these factors alone.

The problem following the financial crisis of 2007-8 is not so much that we cannot account for growth in output in this manner, as we are approach the tenth anniversary, but more that the growth in output seems concentrated in the increase of inputs rather than productivity. It is as though the economy rather than working

¹This overview lecture should be treated as a short introduction to many others' research. © Jagjit S. Chadha 2017.

² This briefing draws heavily on the work of Nick Oulton (2016) and I am grateful to him for advice.



smarter has simply been working harder. Figure 2 normalises output, jobs and hours worked to 100 for 2008Q1. And we can see that after the recession, which reached a trough in 2009, each of output, jobs and hours were some 7-8% above their previous 2008 peak by the end of 2016. The productivity question arises because each of output per job and output per hour were by the end of the 2016 broadly speaking exactly where they were in 2008. The productivity of labour employed as measured by quantity (what economists call the extensive margin) or by hours (the intensive margin).

Long run trends in output

Table 1 examines the long run patterns of growth that put recent patterns into context. Over the very long run since around 1760 growth has averaged at slightly under 2%. We can account for growth by two inputs, labour and capital, and a single measure of overall (total factor) productivity. The idea is that firms in the economy combine inputs in a mix between labour and capital and create a given level of output using available level of technological progress. Over the long run, increasing labour inputs have contributed just under 20% of the overall increase in output, capital 37% and productivity 44%. If we examine the mid-twentieth century onwards, the average growth rate creeps up to around 2.5% but the overall contribution of labour inputs falls to well under 5% with capital explaining around 40% and overall productivity just under 60%.

Indeed, this picture becomes clearer if we account for the overall growth in income per worker, which is a measure of labour productivity. And we can see to what extent it is explained by the increased deployment of capital, which is called capital deepening, or the growth in overall productivity. Over the long run, we note labour productivity, in terms of a simple production function, seems to be explained by around 40:60 in favour of the growth in overall productivity.³ In attempting to understand the recent productivity puzzle we shall need to understand both the lack of capital formation and the cessation in overall productivity growth.

Figures 3 and 4, which we reproduce from the first election briefing, show both the year to variance in measures of total factor productivity, labour productivity and real wages that suggests short run demand conditions may play an important role in understanding year to year fluctuations. But the long run trends indicate deterioration in measures of productivity in the UK. Total factor productivity has crept down in three steps from the immediate post-war period to be hovering just above zero at present. Labour productivity follows a similar path and together these suggest a narrowing of the ratio between outputs and inputs. Real wages growth ought to follow labour productivity relatively closely but labour market institutions and the tightness or otherwise in the labour market may lead to some temporary deviations. And so we observe growth rates in real wages of around 4% from approximately 1960 to the late 1980s. But as with the fall in labour productivity growth, average real wage growth has started to fall this century. And Figure 5 drives this deterioration home by showing that real average weekly earnings are some 7% below their pre-crisis peak in February 2008.

We can now turn to the capital stock and capital formation. We can note a similar secular decline in the growth of investment (Figure 7), which appears to be below the rate of depreciation in the capital stock, which has been estimated to be around 8% by Oulton and Srinivasan (2003). Aggregate investment equations have not performed well recently and have over-predicted investment growth, this is particularly the case given lower real rates that arguably ought to have stimulated investment. Accordingly the real capital stock has not increased since the start of the recovery. And according to European Commission estimates the capital stock to output ratio has also suffered a secular decline. If we used the ONS estimates of the capital stock to output ratio there is not such a decline decade by decade but a similar pattern since the 1970s of a decline in the capital-output ratio.

High Employment and Low Productivity

In many larger advanced economies, labour productivity growth slowed sharply and remained subdued for years after the financial crisis of 2007/08. Arguably nowhere was this more obvious than in the UK. Understanding the sources of weak productivity growth is crucial for formulating appropriate policy responses. As already

³ In a standard neo-classical model, sustained growth in output cannot be explained by one-off increases in the capital stock because these lead only to temporary increases in growth but clearly persistent increases in capital may achieve something similar to growth in overall productivity.



explored, over the long run the UK has suffered from low levels of investment and relatively low increases in total factor productivity. The large recession following the financial crisis has highlighted this problem. And although much of UK employment experience after financial crisis can be understood in terms of labour market flexibility, it has at the same time exacerbated the problems of low investment and productivity. The labour market reforms in the last three decades of the twentieth century created the conditions for a flexible response to the recession. These reforms shifted incentives to employers with reductions in tax and made unemployment (and non-participation) support less generous. There was also an increase in the institutional flexibility of the labour market with some reform of trade union powers and employment protection legislation. Trade union power also diminished because of the decline in both traditional manufacturing industry and of large public sector monopolies.

In effect, we have stumbled on a low wage-low productivity-high employment outcome (equilibrium). This outcome limited the impact on unemployment from the Great Recession and may have played a role in reducing the extent to which households increase their savings ratios. The maintenance of relatively high levels of employment may have helped limit the impact on house prices from the recession and thus limited spill-overs to a vulnerable financial sector. The problem is that this outcome is one that implies low productivity growth.

Explanations

Before turning to examine the various explanations for the puzzle, let us just set out the sectoral balances in the economy, which sum to zero as an identity. Figure 8 shows that in the period since the financial crisis, the public sector has been consistently borrowing from the rest of the economy. Over the same period, the rest of the world through the current account has been lending to the UK. Firms have been small net lenders on average but broadly in balance since 2013. Households who traditionally supply savings to the rest of the economy, did so from the final quarter of 2008 to early 2013 but have been in balance since then. And so neither households are supplying funds nor are firms borrowing. The main action is between government borrowing from the rest of the world.

Measurement & ICT

One distinct possibility for understanding the productivity slowdown is that we are not capturing the output in the digital economy properly and that when we construct measures of real output, our price deflator overestimate inflation by not according an appropriate weight to information and communication technology. Indeed this very point was made forcibly by Robert Solow in 1987:

“what everyone feels to have been a technological revolution, a drastic change in our productive lives, has been accompanied everywhere, including Japan, by a slowing down of productivity growth, not by a step up. You can see the computer age everywhere but in the productivity statistics.”

The enormous change in our lives brought about by the digital revolution may be part of the answer to the measured productivity puzzle and as Oulton (2016) argues the adoption of ICT may help us grow more rapidly in the future but, unless our measurement problems are worse than other similar countries possibly because of our reliance on the service sector, it may not help us understand fully our relative underperformance.

Demand side shifts

The productivity puzzle concerns trying to understand the capacity of the economy to produce goods and services. But to the extent that income may fall quickly in a recession without an equally rapid adjustment in capital and labour inputs, the measured fall in output may look observationally equivalent to a fall in productivity. So the early expectations of the measured fall in productivity was that once that output recovered so would measured productivity. As productivity has continued to underperform it is harder to make the case that it is related to the temporary shift in demand following the financial crisis, which implies that either the temporary shift in demand had permanent effects or the root cause of the shift in demand was more permanent.

Reallocation of labour to low productivity sectors

Existing NIESR work (see Riley et al, 2014) has examined the dynamics of productivity that lie behind this



stagnation. Ongoing work breaks down the UK's productivity performance by industry, and by the sources of productivity growth. One striking feature is the widespread weakness in total factor productivity within firms, pointing to the importance of a common factor in explaining productivity weakness. Further evidence is consistent with an adverse credit supply shock causing inefficiencies in resource allocation across firms. Indeed, during the immediate recession years 2008/09, this shift was most apparent in sectors with many small and bank dependent businesses. This observation raises important questions about the financing of the UK economy. Other important issues are the roles of skills, innovation and structural reforms (see Aznar et al, 2015).

Financial Sector Distortions and other Sectors

One possibility is that one or two sectors, namely, the financial sector may have contributed to an exaggerated performance prior to the financial crisis and have subsequently performed less well. From Table 2 we can examine this possibility using new estimates of sectoral productivity from the ONS the contribution from each of production, manufacturing and services to the whole economy. In the decade or so prior to the financial crisis, quarterly productivity growth of 0.5% per quarter was reasonably evenly split across the three areas. But we can see after the financial crisis that only manufacturing productivity recovered, albeit not back to its earlier more elevated levels. In the seven measured service sectors, which account for most of overall output, there has on average been a fall of 0.6% since the start of the financial crisis. The largest fall has been in the financial sector, where average growth in productivity has gone from 1.1% to -0.2%. Using the ONS experimental measures in Table 3 of multi-factor productivity, we can account for the sectoral contribution to gross value added (GVA). Overall growth in GVA has fallen from 1.4% to -0.9% on average with again the financial sector having the largest swing by moving from 2.4% to -2.8%.

One hypothesis to examine is whether sectors, such as financial services, that performed strongest prior to 2007/8 then performed weakest subsequently. If this were the case, it would offer some support of the hypothesis that the boom laid the seeds of the productivity puzzle and we would expect to find a negative relationship between the two pre and post periods. But what we find is that each individual sector has a lower contribution to GVA on average and that previous levels of GVA are a good guide to current levels, which implies a common rather than sector specific shock of some 2% in Figure 8.

Table 4 suggests the point in a slightly different manner by examining labour productivity. We look at the output per worker employed in each of the ONS Blue Book sectors and compare the 2007 observation for relative labour productivity with the most recent observation from 2015. We find that very little evidence of shifting across industries, which implies again that there has been a common shock across industries of lower labour productivity.

Boom-Bust

A related idea is that the period prior to the financial crisis was a boom in which certain sectors acted to stoke up activity. But Oulton (2016) shows that when we look at the real economy in terms of inflation (as measured by the GDP deflator), exports, unemployment or the employment rate there was little sign of a boom in the economy. It seems to have been more the case that the boom was in asset prices, particularly in house prices, but these were somewhat insulated, at least in the short run, from the real economy.

Physical capital inputs

One possible explanation for the lower levels of labour productivity is that there has been a reduction in capital employed per employee. Investment fell rapidly after the start of the recession and climbed slowly in the recovery phase and investment to GDP remains below its pre-crisis peak (Figure 9 and Figure 10). The share of new investment used for capital replacement has fallen, which means investment is not primarily re-directed to counteracting depreciation (Figure 11). And accordingly the capital to output ratio has not expanded rapidly and probably fallen (Figure 12). If we examine the capital output ratio under chain-linked prices, which allow for some changes in the type of capital employed, rather than using constant prices which assumes a single type of capital good, then there seems to have been little capital deepening since the start of the recovery. The primary driver of the increase in the capital stock seems to be construction (Figure 13 and 14). But overall since 2012, there has been a reduction in capital stock per employee (Figure 15).



Human capital

The ONS (Blunden and Franklin, 2016) report that labour quality improved initially during the economic downturn, “as the impact of job losses and reduced hours fell disproportionately on younger and less well-qualified workers. However, labour quality has shown essentially no further improvement since the middle of 2012, with all of the increase in QALI since then accounted for by rising hours worked.”

Labour Hoarding

Firms may have responded to labour market flexibility by holding onto labour rather than paying redundancy or as because they are treated as part of the running fixed costs of a business. Lower real wages for current employees may have encouraged firms to increase employment demand, in part at the expense of hiring new more expensive labour from the available pool of recently laid off workers. Given that labour hoarding implies that the capital-labour mix is falling, the question then is whether the actual level of capital employed is falling or whether capacity utilisation is falling, or both.

Banks and Zombie Firms

Since the start of the financial crisis, banks have undergone a process of repairing their balance sheets and also building up capital and liquidity buffers. There has also been a low level of insolvencies given the depth of the recession. The argument has been made that the forbearance shown by banks towards existing firms and the lack of availability of finance to new firms has acted to reduce the introduction of new technologies into the overall production function. Recent research by Arrowsmith et al (2013) found that forbearance might account for some of the shortfall in productivity but they only measure the impact on SME's and therefore the whole economy impact may be considerably larger.

Solutions

Fiscal Policy

The financial crisis heralded a sharp increase in public debt and current public expenditure rose to 44% of GDP in 2010. Public investment peaked recently at 3.3% in 2009 and has subsequently fallen to 2.6% of GDP by 2016. Fiscal policy has been constrained by commitments to current expenditure and this has limited the room for manoeuvre under successive fiscal rules for greater levels of investment. If fiscal policy were to switch towards more carefully assessed public investment to include infrastructure (see Election Briefing No. 3 by Kara and Carreras) it would make a great deal of sense.

R&D

In the long run productivity's main drivers are technological progress and innovation, which are both fostered by investment in research and development (Figures 16 and 17). Over the past 30 years the share of R&D expenditures to GDP has been falling in the UK, reaching 1.7% of GDP in 2016. This is relatively low compared to other G7 countries, with Japan spending 3.5% of its income on R&D and the US and Germany dedicating approximately 2.8% of their income to R&D. The IMF has suggested that the current level of R&D expenditure in developed economies is suboptimal and that long term growth prospects could be significantly increased if public policies focusing on enhancing R&D expenditures were to be introduced (IMF Chapter 2, 2016). According to the IMF the level of R&D expenditure in the economy is socially inefficient due to significant market failures. The uncertainty and high risk linked to R&D investment constrain firms in accessing credit and firms do not consider the positive externalities that are generated by such investments when making decisions. If we look at sources of R&D investments (Figure 18), we see that more than 45% of R&D projects are funded by business enterprises while 33% comes from the public sector. The data also shows a positive relationship between public R&D and private R&D which suggests a complementarity between the two. Government's intervention does not only consist in reducing market frictions; public finance supports investment projects along the whole innovation process. It has been argued that because R&D projects are highly uncertain, have long lead times and are collective and cumulative, there is a need for a variety of finance in which the public sector plays a crucial role.



Lessons from Political Economy

Economic growth tends to occur hand in hand with structural change and a radical transformation of a country's political economy. The type of production and the form of consumption tends to change. Countries move along a ladder from agriculture, to manufacturing to services and this movement is accompanied by urbanisation and an increased reliance on organised finance. These changes produce winners and losers and this leads to changes in income inequality.

Under the changes we observe in a post-industrial society, the very notions of social links and the arrangement of single families in single houses will continue to evolve. One aspect of the deep freeze in the economy is the lack of structural transformation that over time may even develop into one of the causes of stagnation. Traditionally we split income as rewards to the factors of production. So that rent goes to landowners, wages to workers and profits to the owners of capital. But clearly the accumulation of income will depend to a large degree on the incentives for each type of individual who may now have varying elements of claims on each form of production. The incentives or reward structures, as the experience from the financial crisis reminded us, play a key role in determining investment in both physical and human forms. And it is the responsibility of policymakers and institutions to understand and improve these reward structures.

Policies and institutions seem to me to play the most fundamental role in providing a gateway to modern forms of economic growth. Policies can alter the set of returns from investment and technological projects: consider the case of the commitment technology that is required for long term investment plans. We also ask policymakers to lay down physical and virtual infrastructure, the latter implies contracts. Contract enforcement and the maintenance of law and order are key aspects of production. Policy also plays a role in organising firms', by which I also mean market structures. The organisation of firms and banks can combine to ensure that creative destruction enables new, more efficient firms replace tired, older firms. These policies must be flexible because one repeated sin is the failure to reform and ultimately block the adoption of new methods of production.

Understanding economic growth requires us to study the institutional and policy choices made by society. The political economy of growth involves considering the individuals and groups who have won and those who have lost. If potential winners do not have power to influence policy and only recent losers or previous winners do, reform and growth may be blocked. But worse still if winners are disconnected from the rest of society, we might end up asking what it is that holds us together.

Concluding Remarks

The UK economy faces a number of critical problems. The mix of capital to labour is too low to allow sufficiently high growth in real wages. This outcome, whilst limiting the impact of the recession on unemployment, has limited the growth in income per head in the recovery. Whilst increasing investment, public and private, is a key part of the answer it must be investment that that firms actually would choose as part of their production set. Whilst we do not have a history of overinvestment in the UK, it would be possible for investment to increase and not increase productivity because it was essentially not the type that was required. The banking system in a period of retrenchment and reform may be limiting firms' access to finance or creating real or imaginary constraints on credit availability. The public sector may be able to increase public investment and R&D but there will be some difficult choices to be made given the costs of healthcare with an ageing population. Ultimately economic growth is a question for the quality of institutions and for public policy to provide incentives for those creating economic growth.



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