Can Intangible Investment Explain the UK Productivity Puzzle? A Response and Comment

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July 2013

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Abstract

This note responds to the recent critique by Goodridge, Haskel and Wallis (GHW) of our 2012 study of Britain's productivity puzzle. We show that a correct reworking of the latest official data on changes in labour composition overturns GHW's main criticism. We also question the strength of the empirical evidence offered by GHW in support of their alterative explanations of the productivity puzzle.

Keywords: Intangible investment; labour hoarding; productivity.

JEL Classifications: O47; E22; E24

Introduction

In the May 2013 edition of the *National Institute Economic Review*, Peter Goodridge, Jonathan Haskel and Gavin Wallis (GHW) argue that the explanations of the UK productivity puzzle put forward by Martin and Rowthorn in our 2012 study (MR) are inconsistent with the timing and pattern of upskilling of the employed workforce seen after 2007.

In this reply,[1] we argue that GHW miscalculate aggregate changes in labour composition and use industry definitions that understate the differences in skill intensity of MR's high and low productivity sectors. A methodologically correct reworking of GHW's calculations using revised official data overturns their key criticism. Other findings noted by GHW are, we argue, entirely consistent with our thesis. We conclude that more compelling evidence will be required before weight can be placed on GHW's alternative explanations of the productivity puzzle.

Our explanation of the productivity puzzle and GHW's critique

Synopsis

In MR, as in Martin (2011), the UK's post-2007 productivity shortfall is interpreted as primarily the result of a persistent effective demand failure, albeit one likely over time to depress the economy's productive capacity as, for example, investment and embodied technical progress fall short. We argued, without claim to originality, that the demand shortfall manifested itself in the form of lower productivity rather than much higher unemployment, as in previous major UK recessions, thanks to the pre-crisis strength of companies' cash flow and profitability and workers' willingness after 2007 to accept lower real wages.[2]

In our detailed analysis, we recalled the textbook distinction between, on the one hand, *overhead* labour, retained until a firm fails, and, on the other hand, *variable* labour, whose retention during recession depends on the wage rate, firing and hiring costs and the expected duration of weak activity. We stressed the role of overhead labour in explaining the pro-cyclicality of both productivity and employment and the impact of lower wages and interest rates in raising firms' rates of survival. We also emphasised the role of low wages in encouraging the substitution of labour for capital and the relative expansion of less innovative firms. These low-wage mechanisms, it was argued, would promote jobs but depress productivity, including underlying total factor productivity, even to the point where it could fall during recovery.

[1] Jonathan Haskel invited our comment on an earlier published version of the GHW paper but other commitments and the unavailability of official data prevented our swifter reply.

[2] We interpreted real wage submissiveness as partly a reaction to the same balance sheet shocks that drove the increase in planned household saving, an argument that counters the "reverse-causation" proposition that low real wages were solely the result of low productivity.

Believing the productivity puzzle to be primarily a macroeconomic phenomenon and also distrustful of the official sectoral data, we sought better understanding by dividing the economy's activity that was not dominated by government services into two large sectors, comprising relatively high and relatively low labour productivity industries. We noted that the course of productivity and jobs in the two aggregate sectors was consistent with our story, which predicted the possibility of hoarding of skilled variable labour that was used more intensively on average in the high-productivity sector.[3] We also argued that the growing abundance of cheaper labour had stimulated employment disproportionately in the low-productivity sector.

GHW's central criticism

This synopsis of our views serves to correct the description offered by GHW[4] whose central criticism rests on their analysis of the impact of compositional changes – in, for example, educational attainment, age and gender - on the productive effectiveness of the labour force. To this end, GHW compare changes in hours worked with comparable movements in indices of quality-adjusted labour input (QALI) published by the Office for National Statistics.[5] The difference between the growth rates of QALI and of hours worked is a measure of growth in labour composition.

GHW argue that, on our logic, the high-productivity sector should enjoy a "relatively large rise in labour composition", implying relative upskilling of the employed workforce, both in the downturn and in the subsequent recovery. But, GHW state:

> "The data from Acheson and Franklin (2012) do not support this version of the Martin/Rowthorn view. In the initial recession, growth in labour composition was 1.6 per cent per annum and 2.5 per cent per annum in the high and low productivity sectors and in the recovery 1.9 per cent and 2.0 per cent. Thus, in the recession, the low productivity sectors retained relatively more skilled than the high productivity and in the recovery have hired relatively more skilled workers than the high productivity sectors. …"
>
> (GHW, R52).

We reject GHW's criticism on several grounds. First, their calculation of the compositional effect in the high and low productivity sectors is methodologically wrong. Second, they do

[3] At its simplest, ignoring discounting, a profit-maximising firm would hoard one worker costing f to fire and h to hire and paid a wage of w a year were the expected number of years R in recession to imply: $R < (f+h)/w$. The conventional hoarding story assumes the ratio of $f+h$ to w is greater for skilled than unskilled variable labour, notwithstanding the skilled wage premium. This presumption receives some support from the limited available evidence (see, for example, Manning (2010), section 2.1.2). A suitably long recession would lead to zero variable labour hoarding, confining under-utilisation to overhead labour in surviving firms. We argued that variable labour shedding probably accelerated after the events of September 2008. See MR (2012), 34-36, 38-39.

[4] GHW (2013), R51 interpret us incorrectly to say that the low-productivity sector *alone* shed overhead labour in the downturn, whereas both sectors would have done so as firms failed, and describe the recovery in low-productivity sector jobs solely as a reaction to previous job cutting without regard to our emphasis on the role played by low wages.

[5] Educational attainment is "the primary driver of the index" (Acheson (2011)). The age and gender characteristics are proxies for human capital acquired through work experience.

not follow our sectoral definitions, thereby understating the true difference between high and low productivity sectors. Third, properly calculated compositional effects revealed by revised ONS data overturn GHW's conclusions.

To calculate the composition effects in the two aggregate sectors, GHW take a simple average of the growth rates of labour composition in the individual industrial sectors for which official QALI data exist. This method of calculation overstates the impact of large compositional gains in comparatively small sectors such as "agriculture & mining" and "arts & recreation", which GHW assign to their low productivity sector. The same procedure also overstates the economy-wide growth in composition.[6]

The correct method of calculation, not open to GHW with the then available ONS dataset, deducts growth in hours worked in each of the aggregate sectors from a comparable weighted sum of growth in hours worked, where the weights are labour compensation shares of the various labour types. We are indebted to Franklin and Mistry (2013) for release of the underlying QALI data to enable proper recalculation.

A second objection is that GHW do not use MR's definitions of high and low productivity sectors. Our division of the economy into the two aggregate sectors was based *solely* on individual industries' level of value added per worker relative to the average. We found considerable heterogeneity within each aggregate sector, but also interesting broad features: the high-productivity sector tended to be relatively more capital intensive, skilled-labour intensive and innovative.[7]

GHW do not follow our approach.[8] GHW's high-productivity sector comprises: manufacturing, construction, transport, information & communication, financial services; their low-productivity sector comprises: "agriculture & mining" (includes utilities), "distribution" (includes accommodation and food services), professional & administrative services, "public services" (includes private education and health services), and "arts & recreation" (includes other personal services).

GHW's definitions differ from MR's in two key respects:

- GHW include government-dominated services in their low-productivity sector, whereas we expressly exclude them from the analysis.[9] Government services productivity data are unreliable and our theoretical story relates to private sector firms taking commercial decisions to retain, fire and hire workers.

[6] Using simple averages, economy composition growth would be put in the recession and recovery phases as defined by GHW at about 2.1% and 1.9% respectively. The correct figures according to Acheson and Franklin (2012) are 1.7% and 1.5%.

[7] MR (2012), Appendix C.

[8] In their Table 2, but not in their text, GHW qualify their classification as "best we can match to the Martin/Rowthorn classification" but omit explicitly to note the substantial differences. GHW's description of our high and low productivity sectors (GHW (2013), R51) is inaccurate although they refer to the relevant table in MR (2012), which gives the correct details.

[9] We also exclude real estate activities since the official productivity data are highly misleading.

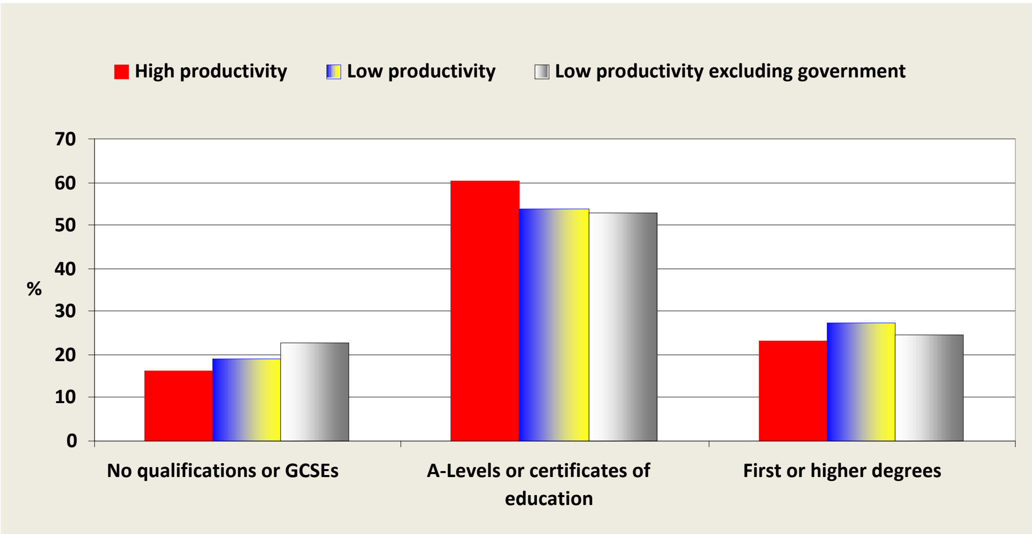
- The high level of aggregation of the QALI dataset means that our high-low productivity distinction cannot be replicated, even with government-dominated services excluded.[10] Two QALI conflated industries are notably problematic: both are treated by GHW as low productivity but include some individual activities which are high productivity, and so classed by MR.

In more detail, the QALI dataset conflates:

- Mining (including North Sea oil extraction) and utilities, both relatively well-paid industries, intensive in their employment of graduates and included within our high-productivity sector, with generally low-paid agricultural activities, which employ a disproportionately large number of the less educationally qualified, and are assigned to our low-productivity sector.[11]

- Highly-paid “knowledge” services, such as legal, architectural and market research services, accounting for a little under half hours worked in the conflated sector and classed by us as high productivity, with the similarly large sector largely comprising lower-paid, basic business services, such as office cleaning and call centres, and classed by us as low productivity.

Chart 1: Workers’ labour income share by educational attainment, %, 2007



Sources and notes: Franklin and Mistry (2013), authors’ calculations. The high and low productivity sectors are as defined by GHW (2013). “Low productivity excluding government” excludes government-dominated services: public administration, defence, education and health and social work services (some privately provided). Educational qualifications are the highest obtained in each group.

[10] According to the ONS, the industry aggregation is “hard-wired” into the QALI calculations at the lowest level judged to be reliable using Labour Force Survey data.

[11] Statements regarding educational attainment are based on the EU KLEMS dataset which uses a three-way breakdown of educational attainment: “university graduates”, “intermediate” and “no formal qualifications”. See O’ Mahony and Timmer (2009).

The result of their classification, as Chart 1 shows, is that GHW's high-productivity sector's workforce appears to be only mildly more skill-intensive, judged by educational attainment, than GHW's low-productivity sector's workforce. The deduction of government-dominated services helps sharpen the comparison, yet even with this adjustment the classification cannot capture the full disparity in skill-intensity between the high and low productivity sectors envisaged by MR.

Table 1: Changes in labour composition

Logarithmic per cent changes in index levels between dates shown	1Q 2008 to 2Q 2009	2Q 2009 to 4Q 2010	4Q 2010 to 4Q 2012
Not seasonally adjusted data			
High productivity	1.7	2.2	2.4
Low productivity (excluding government)	1.3	1.8	1.6
Seasonally adjusted data			
High productivity	1.7	2.1	2.2
Low productivity (excluding government)	1.4	1.7	1.7
Average of sectors (seasonally adjusted)			
High productivity	1.6	1.6	1.7
Low productivity	1.6	1.7	1.8
GHW (2013) original results*			
High productivity	1.6	1.9	n.a.
Low productivity	2.5	2.0	n.a.

Sources and notes: Franklin and Mistry (2013), GHW (2013), authors' calculations. n.a.- not available. High and low productivity sectors are those defined by GHW (2013) but, where indicated, with the exclusion from their low-productivity sector of government-dominated services. The high and low productivity sector definitions are not the same as those in MR (2012). The growth in labour composition is defined as the difference between the logarithmic per cent changes in QALI and in hours worked. Except where indicated, the growth in QALI is defined as the labour-income-weighted logarithmic change in hours, derived using the standard Törnqvist formula and the Franklin and Mistry (2013) data. We checked that our method replicates the ONS QALI data for the economy and industrial sectors. We are indebted to Priya Mistry for her advice on the detailed ONS methodology; she is not implicated by our results. We seasonally adjust the labour composition indices (the quotient of the QALI and hours indices) using the X-12 ARIMA method, additionally constrained to replicate the calendar year index averages of the unadjusted data. Standard tests to detect seasonality are passed in all sectors save transport. * GHW (2013), Table 2, figures which are simple averages of Acheson and Franklin (2012)'s calculations of the per cent changes in the QALI industrial sectors' composition over each of the periods shown (GHW's Table 2 denotes one column as a 3Q2009 to 4Q2010 period).

The Franklin and Mistry (2013) release makes it possible to revisit GHW's conclusions with the advantage of a detailed quarterly QALI dataset, albeit one that is not seasonally adjusted and that comes with the same conflation of some high and low productivity activities. The top half of Table 1 shows our reworking of GHW's calculations, but with the low-productivity sector defined to exclude government-dominated services, and with proper weighting of detailed hours growth to derive the growth in the aggregated sectors' QALI and labour composition.

The key result, with or without allowance for seasonality, is that estimated growth in labour composition is higher in the high-productivity sector for the periods originally studied by GHW and subsequently. This pattern is the reverse of GHW's original findings, even though the distinction between high and low productivity sectors is not as sharp as the one used by MR.

There are several explanations for the reversal:

- Exclusion of government services - including them would raise growth in labour composition in the low productivity sector above that in the high-productivity sector in the initial recession period but not subsequently (government activities play no role in our theory of labour hoarding).

- Proper weighting - as the table shows, GHW's procedure of taking a simple average of individual industries' labour composition growth removes the estimated excess composition growth of the high-productivity sector.

- Revisions – labour composition growth during the initial recession period has been revised down notably in "agriculture & mining" and "arts & recreation", two smaller industries within GHW's low-productivity sector.

Although GHW's main criticism of MR is overturned by these results, the developments in labour composition are not without interest. We can note the strong rise in composition, which has grown at a pace since 2007 that exceeds the pre-crisis trend, especially in, but not confined to, the high-productivity sector.

Could this accelerated upskilling be explained by the complementarity of skilled labour with rising intangible investment or by other supply-side mechanisms? As noted in MR and Martin (2011), many productivity pessimists predicted the opposite outcome: a loss of skills due to less learning-by-doing. We would argue that the continued upskilling of the labour force is consistent with the presence of ongoing technical progress to which may have been added the impact, under conditions of deficient demand, of fierce job competition and the displacement of the less skilled by the better educated: "bumping down". Established theory and some suggestive facts support this interpretation of the QALI compositional data.[12]

Labour hoarding in general

GHW use the QALI estimates, which at the time extended to 2010, to make the following more general observation:

> "If low-skilled labour had been hoarded, we would expect the contribution of labour composition either to grow less fast or even to decline. But growth in the contribution of labour composition in 2009 and 2010 has been extremely strong, suggesting the opposite has occurred, that is, that firms have hoarded high-skilled labour at the expense of low-skilled. This is borne out in the analysis contained in Acheson (2011) and Acheson and Franklin (2012). Note that this is also consistent with the data for R&D investment in figure 1, and other categories of intangible investment, all consistent with

[12] On theory, see, for example, Gautier (2002); Khalifa (2012). On facts, see, for example, ONS (2012a), Felstead et al. (2013).

> the idea that it is the higher skilled 'knowledge workers' that have been kept on by firms." [13]

GHW present these facts about labour composition as if they constitute evidence *against* our analysis as well as in support of their alternative explanation based on the assumed complementarity of supposedly rising intangible investment and skilled labour. We therefore feel obliged to stress that the shedding of less skilled labour and the greater retention of the high skilled over the recession is wholly consistent with the simplest conventional variable labour hoarding story, as well as being part of a general uptrend in the educational attainment of the workforce.

Our analysis was not focussed on the simplest conventional hoarding story, however: it cannot explain the unusual features of the post-2007 recession. Central to our theme was the role of lower real wages, encouraging labour hoarding throughout the economy and the expansion of jobs ahead of output in some low-productivity sectors. Recent work by the Institute for Fiscal Studies supports our arguments.[14] However, GHW hardly mention the role of wages in their depiction of our analysis.

Intangibles and the productivity puzzle: some questions

A substantial part of our 2012 study was devoted to a critique of pessimistic supply-side explanations of the productivity puzzle. It was argued that the pessimists lacked a credible narrative. The reasons they offered – loss of productive capital in various forms, loss of high-productivity activities, risk-averse banks and so on – cannot plausibly explain why Britain's economic potential should have been damaged suddenly, severely and irreversibly after 2007. The timing is implausible, the identifiable damage small, and its permanence questionable – although, we concluded, the more demand management policies are predicated on pessimistic supply-side beliefs, the greater the risk that serious capacity damage will occur.

GHW's analysis offers an interesting additional explanation of apparent empirical significance. Of the 16 per cent productivity shortfall in 2012, GHW attribute around 5 percentage points to the combined impact of a 1.6% understatement of output, arising from the omission of many intangibles from the official national accounts record, and a 0.75 percentage point fall in annual total factor productivity growth, arising from a deceleration in investments that produce favourable TFP spillovers.

GHW present their empirical findings forcefully without much, if any, qualification. We argue below for greater circumspection: before GHW's explanations can be regarded as robust, much more convincing evidence will be required.

[13] GHW (2013), R51-R52.

[14] Blundell et al. (2013).

Output mismeasurement

GHW's assessment of output growth mismeasurement is founded on the theoretical and empirical framework, notably developed by Corrado, Hulten and Sichel (2005), which extends traditional growth accounting methods to accommodate the input and output of intangibles. The revised framework reclassifies and capitalises as intangible investment various categories of business spending that are recorded as intermediate consumption in the national accounts. The ONS currently capitalises only a limited range of intangibles (computer software and various copyrights) thereby possibly understating output growth. GHW neatly formulate the extent of any measurement bias in terms of omitted intangibles' output share and the extent that their growth exceeds growth in measured output.

We do not question GHW's general methodology but the robustness of their 2012 estimate. Lacking full data beyond 2009, GHW assume a constant output share for those types of intangible investment that are not already capitalised by the ONS. GHW also assume that real intangible investment grew after 2009 at the same rate as investment in R&D, itself assumed to have grown in 2012 at a rate unchanged from 2011.[15] Having fallen in the downturn, the volume of R&D spending stabilised in 2010 and grew in 2011 by 6%.[16]

GHW's projection method raises two specific concerns. First, the growth of intangible spending is predicated on a small part of the total. According to the estimates in GHW's pioneering work on an innovation index, business R&D in 2009 accounted for just 15% of total intangible investment excluding the ONS capitalised spending categories.[17] Major items of spending amongst the remaining 85% were design (16%), branding (13%), organisational capital and training (each 27%). Inspection of the published history suggests there exists a positive but incomplete correlation between past annual real growth in R&D and non-R&D intangible spending.

The second specific concern arises from the results of an ONS innovation survey, which indicated sharp falls in some intangible investment spending. Notwithstanding the survey's acknowledged small sample weaknesses, the preliminary results provoked the concern of the innovation-promoting organisation "Nesta" whose headline ran: "Nesta report shows £24bn collapse in innovation investment and a more deep-rooted crisis".[18] Taken at face value, the survey results suggest little change in real spending on design between 2009 and 2010, but a substantial decline in spending on brand and organisational capital to levels

[15] GHW (2013), R53

[16] ONS (2012b). This figure for business R&D includes some computer-related R&D that GHW (2012a) subtract to avoid the double counting of R&D and software spending.

[17] GHW (2012a)'s Table 2 shows, in 2009, intangible investment: £124.2 billion; business R&D: £14 billion; software: £22.6 billion; copyrights (mineral exploration and artistic originals): £5.6 billion.

[18] Nesta (National endowment for science, technology and the arts) webpage headline of 16th July 2012. See, also, Westlake (2012). Field and Franklin (2012) describe the ONS survey, which, like GHW (2012a), is part of the Nesta Innovation Index programme. Unlike purchased software, the survey does not properly track R&D spending. The composition of the remaining intangible spending differs greatly from that estimated by GHW (2012a).

below those implied by GHW's projection method, only partly offset by a rise in spending on training.[19]

Whatever the merits of this survey, the conclusion drawn is that much better and more up-to-date information will be required before a reliable judgement can be made about the importance of any output measurement bias after 2009.

Slower total factor productivity growth

There are two parts to GHW's analysis of TFP deceleration. The first comprises an adjustment for utilisation to purge movements in TFP of the impact of the business cycle. The second is a calculation of the lagged spillover effects arising from R&D spending, well-established as a source of favourable externalities, and from tangible investment in telecommunications equipment, which may have favourable networking and informational productivity spillovers, including better "academic collaboration".

GHW's utilisation adjustment has very little impact on the raw figures: the adjusted and actual growth rates of TFP are very similar over the period they examine from 2001.[20] If true, the large estimated falls in TFP in 2008 and 2009 would have their origins not in the slump in demand but rather in sudden and material technological regress, evidence for which (as detailed in MR) is notable by absence. An alternative explanation is that the utilisation adjustment is highly misleading.

GHW deploy the methodology of Basu et al. (2006) who use detrended variations in average hours worked per worker as a proxy for changes in utilisation of labour and capital. But, as GHW note, their estimate of the relevant coefficient that links growth in TFP and average hours is much lower than implied by the Basu et al. estimates for the US economy. GHW appear to be uncomfortable with their low estimate and examine how a larger US-style coefficient would give a larger cyclical effect.

GHW's coefficient is also much lower than the still higher coefficients estimated for many UK industries by Groth et al. (2006).[21] Roughly combined using 2009 value added weights, their figures imply an overall coefficient of about 1.8, compared with GHW's coefficient of 0.4. If so, of the 3.6% fall in UK TFP in 2009, 2.8 percentage points would be attributable to the cycle downturn, as against GHW's implausibly low estimate of 0.6 percentage points. More generally, we would question the use of average hours worked to capture underutilisation: in a depressed economy, extra hours of intensive effort may be expended in an unrewarding search for sales.[22]

[19] To derive the 2009 to 2010 changes, the survey 2008 to 2010 per cent changes were applied to the 2008 levels of relevant (non-R&D) intangible spending categories detailed in GHW (2012a), Table 2.

[20] GHW (2013), R52-53, Figure 4.

[21] Mining and Oil: 2.6; Manufacturing: 1.6; Utilities: 0.3; Construction, Distribution, Hotels and Restaurants: 1.8; Transport and Communications: 2.0; Other Market Services: 1.8.

[22] Hughes and Saleheen (2012) are not alone in citing the example of estate agents who "may be working intensively even though the volume of business has declined, because it has become harder to match buyers and sellers in a thin market."

The second, more important, part to GHW's TFP analysis causally relates part of the post-2007 TFP deceleration to the early-2000s deceleration in R&D and telecommunication capital services. The 0.75 per cent fall in annual TFP growth attributed by GHW to the earlier intangible investment deceleration accounts for most of their empirical explanation of the productivity puzzle.

The main question raised here is GHW's assessment of the time lags, and their resort to phase averages. Is it plausible to attribute the fall in TFP growth after 2007 to an investment deceleration that occurred years before? That innovative investment may give rise to favourable spillovers with a delay is not a controversial point, but the time lags involved are complex and not easily pinned down. Thanks to adjustment costs, TFP may be initially depressed by bursts of innovative investment rather than raised. TFP growth in the US and UK, for example, appears to have been positively affected by lagged investment in information and communications technology, as would befit a general purpose technology, but negatively affected by concurrent ICT investment.[23]

Consistent with their detailed investigations, GHW suggest a time lag of two years before spillovers from increased intangible investment show up in the form of higher TFP.[24] But with a two-year time lag, the impact of the deceleration in the capital services they emphasise would have shown up in lower TFP growth in the mid-2000s, not after 2007. GHW do not explain that their use of phase averaging effectively imposes a materially longer time lag, for which they present no justification.[25] In the US, there is a body of thought that TFP growth did indeed decelerate before 2007, as spillovers of the ICT revolution waned. Deeper research will be required to ascertain whether the same applies in the UK.

GHW end by emphasising that growth in productive potential is not a given, and may be influenced by, amongst other things, "Keynesian demand expansion". On this, we are in agreement. In our view, the economy needs a blend of strongly supportive demand management policy, better balanced between its fiscal and monetary arms, and supply-side incentives that promote profitable investment with embodied technology. Without effective policy measures, there is a clear and present danger that Britain will remain entrapped in a low-wage, low-productivity immiserising state.[26]

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[23] Basu et al. (2004); Groth (2008).

[24] GHW (2013), R54. In pooled regressions, GHW (2012b) relate a smoothed measure of TFP growth to various types of intangible capital growth. Smoothed TFP growth is formed as a weighted average of contemporaneous and one-year and two-year ahead TFP growth with respective weights: 0.25, 0.5 and 0.25.

[25] Based on GHW's Figure 8, it can be inferred that a time lag of approximately five years would be required to produce the intangibles-related changes in TFP growth shown in their Table 3.

[26] Martin (2010) forewarned of the danger of a slow-growth trap.

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