Is the UK Productivity Slowdown Unprecedented?

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Abstract

We estimate trend UK labour productivity growth using a Hodrick-Prescott filter method. We use the results to compare downturns where the economy fell below its pre-existing trend. We find that the current productivity slowdown has resulted in productivity being 19.7% below the pre-2008 trend path in 2018. This is nearly double the previous worst productivity shortfall ten years after the start of a downturn. On this criterion the slowdown is unprecedented in the last 250 years. We conjecture that this reflects a combination of adverse circumstances, namely, a financial crisis, a weakening impact of ICT and impending Brexit.

Keywords: Brexit; financial crisis; Hodrick-Prescott filter; ICT; productivity slowdown.

JEL Classification: C22; N13; N14; O47.

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1. Introduction

The weakness of UK productivity growth after 2007 has been much discussed. The so-called 'productivity puzzle' is captured by the observation that in 2018 quarter 4, real GDP per hour worked was only 2.0 per cent above the pre-crisis peak seen in 2007 quarter 4 and was 18.3 per cent lower than if pre-crisis trend growth had been sustained (ONS, 2019). Pre-crisis peak labour productivity was not surpassed until 2016 quarter 2.

Not surprisingly, people have looked for a precedent for such a decline in productivity performance. This is interesting per se but if a similar episode can be identified this might provide useful insights into the current malaise. There have been significant productivity slowdowns in the past – for example, at the end of the mid-Victorian boom in the early 1870s, in the Edwardian 'climacteric' at the turn of the 20th century, during the 'great depression' of the early 1930s, and at the end of the European 'Golden Age' of rapid catch-up growth in the early 1970s. At least two of these episodes might be thought to have some relevance for today – the Edwardian era, which is sometimes seen as a hiatus between general purpose technologies, and the 1930s as a period of severe recession.[1]

The obvious prior question is whether these previous slowdowns are comparable in terms of the shortfall in performance relative to previous expectations. In this paper we investigate this issue by looking at the measure given prominence by ONS: namely, to estimate how much the level of labour productivity had fallen below what would have been expected if the previous trend had been sustained for the next 10 years. This analysis is facilitated by the recent publication of a dataset (Thomas and Dimsdale, 2017) which provides estimates of labour productivity over the long run on a GDP per hour worked basis. We estimate trend productivity growth by using the Hodrick-Prescott (1997) filter to analyse these data.

Our main results are as follows. First, we find that during the last 150 years trend labour productivity growth has varied between 0.9 and 3.3 per cent per year. In the context of this long run performance, pre-crisis trend productivity growth was very respectable at around 2.3 per cent per year, higher than at any time except the Golden Age. Second, our estimate of the shortfall between actual labour productivity in 2018 and what would have been expected on the basis of the pre-crisis trend is similar to that of ONS at 19.7 per cent. Third, this shortfall at the 10-year interval far exceeds that of any previous productivity slowdown. The two previous largest negative deviations from previous trend are 10.9 per cent ten years after 1971 and 10 per cent ten years after 1883. Fourth, in the case of both the Edwardian climacteric (1898) and the great depression (1929) the shortfall at the 10-year mark is much smaller at 5.5 and 5.3 per cent respectively. Fifth, labour productivity was lower in the late 18th century when it averaged -0.13 per cent per year between 1760 and 1800 than it has been post 2008 but this did not entail a downward turn from a previous strong trend growth performance.

[1] For example, in an interview with the Daily Telegraph in 2018 Ben Broadbent, Deputy Governor of the Bank of England, compared the current state of the economy with the 'climacteric', the sharp fall in productivity growth during the pause between the age of steam and the age of electricity at the end of the Victorian era which was first highlighted by Phelps-Brown and Handfield-Jones (1952).

We conclude that the present productivity slowdown can indeed be described as unprecedented and this adds to the sense that it is a ‘puzzle’. We conjecture that it may be the outcome of a novel combination of circumstances – a financial crisis plus a hiatus between general purpose technologies plus uncertainty associated with a major change in trading arrangements.[2]

2. Data

Our data are taken from Thomas and Dimsdale (2017). This source is superior to earlier datasets in two ways which matter for our analysis. First, it embodies several important revisions that have recently been made to historical estimates of real GDP. For the period prior to 1855, these are based on the study by Broadberry et al. (2015), which provides annual estimates where previously only benchmark years were available. For the period from 1870 to 1948, in line with modern ONS methods, the ‘balanced estimates’ made by Sefton and Weale (1995) and Solomou and Weale (1991) are used rather than the ‘compromise’ estimate of GDP favoured by Feinstein (1972). Finally, for the period since 1948, current ONS estimates are available which incorporate recent methodological innovations affecting the construction of the GDP deflator and the treatment of R&D expenditure. These changes are conveniently summarized in Bank of England (2011) and their effect is to raise the growth rate of real GDP compared with previous estimates.

Second, the Thomas and Dimsdale (2017) dataset contains estimates for total hours worked on an annual basis from 1856 onwards. This is an important improvement which permits time-series analysis of labour productivity growth in terms of output per hour worked rather than per worker during the pre-World War I period. Given the considerable changes to hours worked after the mid-19th century this is much preferred and, in particular, it makes a notable difference at the end of the mid-Victorian boom. Prior to 1856 estimates of hours worked are available only for a few benchmark years at wide intervals between which there are substantial differences. Thomas and Dimsdale construct an interpolated series which provides the basis for their real GDP per hour worked series for earlier years. We do analyse the pre-1856 data but note that it has to be treated with caution. Fortunately, for the years after 1870 the estimated trend rate of labour productivity growth is essentially the same whether estimation starts in 1761 or 1856.[3]

3. Computing trends in productivity

The underlying model for obtaining trend productivity growth rates is that of an additive decomposition of the logarithm of labour productivity x_t, which is observed over the years $t = 1,2,\dots,T$, into a trend, μ_t, and a cycle, ψ_t, typically assumed to be independent of each other, i.e.,

$$x_t = \mu_t + \psi_t \qquad E(\mu_t \psi_s) = 0 \text{ for all } t \text{ and } s \tag{1}$$

[2] Uncertainty has adverse effects on investment but also undermines the efficient use of managers’ time which is swallowed up by planning for various contingencies.
[3] Our analysis is based on Table A56 Column O of Thomas and Dimsdale (2017). Ryland Thomas kindly supplied an updated version of this page of the spreadsheet which allowed us to extend the analysis to 2018.

The actual model used here is one in which the trend follows a random walk

$$\mu_t = \mu_{t-1} + \beta_{t-1} + a_t \tag{2}$$

in which the drift, which is the trend growth rate here, also follows a random walk, albeit without drift,

$$\beta_t = \beta_{t-1} + b_t \tag{3}$$

The errors a_t and b_t are assumed to be independent zero mean white noises with variances σ_a^2 and σ_b^2. The cycle ψ_t is also assumed to be white noise with variance σ_ψ^2 and, from the assumption made in (3), will be independent of both a_t and b_t. Equations (1)-(3) are together known as a structural model and their specifications have been chosen to ensure that the trend component could be both smooth and slowly evolving. Furthermore, as we discuss below, it also has the additional benefit of having a ready interpretation as a popularly used trend filter.

The model may be fitted by casting equations (1)-(3) into state space form and estimating the parameters by employing maximum likelihood via the predictive error decomposition of the Kalman filter, with the trend component then being estimated using the Kalman smoother (Mills, 2019, chapter 17 provides an introductory discussion of such models). When the model was fitted to labour productivity, it was found that the variance of the error to the trend equation (2), σ_a^2, was estimated to be both very small and insignificantly different from zero. Setting this variance to zero produces what is known as a 'smooth trend' structural model and is equivalent to obtaining the trend using a Hodrick-Prescott (HP) filter with the smoothing parameter, say λ, set to a very large value (see, for example, Mills, 2019, chapter 8). The trend component of labour productivity was thus computed using the HP filter with $\lambda = 10{,}000$. This setting does indeed produce a satisfactorily smooth, albeit slowly evolving, trend component and readily interpretable trend growth rates, defined as $100\Delta\mu_t$, which gives the growth rate in percentages per annum.[4]

Figure 1 shows the logarithm of labour productivity from 1856 to 2018 with this 'smooth' trend superimposed. It is clear that labour productivity from 2008 has diverged substantially from this extrapolated growth path and this is also seen in Figure 2, where the growth rates (in % per annum) of actual and trend labour productivity are shown. These range from just over 0.9% during the first decade of the 20th century to just above 3.3% during the 1960s. Trend labour productivity growth just

[4] The use of a higher value for λ than is often employed in many applications of the HP filter in macroeconomic modelling (for example, setting the smoothing parameter to 100 is common practice when using annual data) may also be justified from the theoretical and simulation analyses of Harvey and Trimbur (2008) and Flaig (2015). Hamilton (2018) has recently criticised the HP filter, arguing against the widespread use of the filter to extract a business cycle component from monthly and quarterly macroeconomic time series. As we have emphasised, our purpose here is to extract a smooth and evolving trend component from annual data. The structural model (1)-(3), with the error variance of the trend component set to zero in accordance with the data, achieves this aim, with the correspondence to the HP filter with a large setting of the smoothing parameter providing a helpful expository device to aid in the interpretation of the trend component model. Hamilton (2018) also proposes an alternative, 'robust', method of estimating the trend component. This is to use the predicted values, $\hat{x}_t(h)$, from the regression of x_t on a constant and the lagged values $x_{t-h}, x_{t-h-1}, x_{t-h-2}, x_{t-h-3}$ to estimate the trend component, so that the trend growth rate is estimated as $100\Delta\hat{x}_t(h)$. For all values of h between 1 and 5 the estimated trend growth rates from this regression follow essentially the same pattern as the observed growth rates

prior to the great recession was 2.3%. Figure 3 shows the cumulative divergence from trend growth in year *t* over the next 10 years. The behaviour of labour productivity since the financial crisis is unprecedented, with the divergence in the decade from 2007 being –20.8% and –19.7% from 2008. As we remark in the introduction, these declines are twice that of the next steepest decline, -10.9% in the decade from 1971, and almost four times the declines seen during the Victorian climacteric and the depression of the 1930s.

This exercise was also carried out for the longer period from 1760 although, as noted above, some caution should be exercised as the pre-1856 data on labour productivity has been interpolated. Thus Figures 4-6 reproduce Figures 1-3 for the extended period. For the post-1870 period the results are essentially the same. For the years prior to 1856 we observe very low productivity growth, both actual and trend, at the outset followed by a gradual rise to a peak in trend growth at 1.7% in the 1860s. Actual productivity growth between 1760 and 1800 averaged -0.13% compared with 0.25% from 2008 to 2018. However, Figure 6 shows that the downturn in recent productivity performance continues to be unprecedented when the period from the mid-18th to mid-19th century is also included in the analysis; since 1760 there is no previous episode where 10 years on productivity was anywhere near 20 percent below what would have been expected from its previous trend growth.

4. Discussion

Our analysis has been carried out using conventional estimates of real GDP as the basis for measuring labour productivity. It has been widely remarked that the rise of the digital economy presents a serious challenge to national accounting and thus to traditional labour productivity measurement. The issue partly concerns some economic activity moving across the boundary between GDP and home production and partly because of new business models in which digital services are not fully charged for directly (Coyle, 2017). Bean (2016) suggests that real GDP growth could have been as much as 0.7% per year larger over the period 2005 to 2014 had the impact of the digital economy been captured fully. Even so, the increase in this digital contribution post 2008 was presumably quite a lot less than 0.7% since it was already in evidence previously.[5] There is widespread agreement among economists who have examined the issue for the United States, where the literature is much richer, that measurement problems account at most for a small proportion of the productivity slowdown Byrne et al., 2016; Syverson, 2017).

If the productivity slowdown is not primarily a statistical artefact and is unprecedented, what might be the explanation for such a dramatic turn of events? It is fair to say that the answer to this question has proved elusive but we can offer a conjecture that a combination of adverse circumstances, itself unprecedented, may be responsible for a large part of the evaporation of productivity growth since 2008. The unfavourable conditions include the ebbing away of the ICT (information and communications technologies) boom, the implications of the financial crisis and, in the recent past, impending Brexit.

ICT is an important general-purpose technology (GPT) which had a substantial impact on UK productivity growth around the turn of the century. Using conventional growth accounting methods,

[5] It is highly likely that the national accounts have been underestimating growth for a long time before the crisis as well as recently but much less plausible that this has suddenly got worse to the extent needed to account for much of the productivity slowdown, see Crafts (2018).

the contribution of ICT capital to labour productivity growth averaged 0.82 percentage points per year during 1996 to 2007 compared with only 0.19 percentage points during 2008 to 2018 (The Conference Board, 2019). Similarly, the contribution of TFP growth in ICT production fell from 0.23 to 0.04 percentage points (EU KLEMS, 2017).[6] Cumulated over the 10 years from 2008, this implies labour productivity in 2018 was about 8.5% lower than if the earlier ICT contribution had been sustained. Although a new GPT may be on the horizon in the form of artificial intelligence, this has yet to have a significant impact on productivity.

Banking crises can be expected to have an adverse impact on productive capacity such that the level of potential output is permanently reduced compared with a business-as-usual counterfactual. Thinking in terms of a production function or growth accounting, there may be direct adverse effects on capital inputs as investment is interrupted, on human capital if skills are lost or restructuring makes them redundant, on labour inputs through increases in equilibrium unemployment, and on TFP if R&D is cut back or innovative firms cannot get finance. The impact of the UK financial crisis on potential output has variously been estimated to be between 3.8 and 7.5 per cent (Crafts, 2019).[7] In addition, productivity growth in the financial sector itself has been markedly reduced with the implication that its contribution to overall labour productivity growth fell by 0.6 per cent per year pre- and-post-crisis (Riley et al., 2018). Thus, the financial crisis may have reduced the level of labour productivity relative to the counterfactual of staying on the pre-2008 trend by 10 per cent or more.[8]

Brexit is the third unusual shock to have materialised. Here the relevant aspect is, of course, the short run impact since mid-2016 working through channels such as its effect on investment through uncertainty, the diversion of top-management time towards Brexit planning and a relative shrinking of highly-productive exporters compared with less productive domestically orientated firms. Using evidence from a large survey of UK firms, Bloom et al. (2019) estimate that impending Brexit has reduced productivity by between 2 and 5 percent. An alternative estimate of the Brexit effect is provided by Born et al. (2019a) using a synthetic control group methodology which creates a 'doppelganger' economy which is not subjected to the Brexit shock.[9] The result is that GDP (and presumably labour productivity) was about 2 per cent lower in 2018 than it would have been without the vote for Brexit.

Obviously, this discussion does not provide a precise accounting for the productivity puzzle. It does, however, highlight a marked contrast with previous episodes when downturns from an earlier trend productivity growth were observed which some might expect to have been similar but which were, in fact, relatively mild. In neither the Great Depression nor the Edwardian climacteric were the three ingredients of a rapidly ebbing GPT, a banking crisis and prolonged uncertainty over trading arrangements all present. Indeed, there is no previous experience in British economic history where these three phenomena have occurred in such a short space of time.

[6] This comparison is between 1996 to 2007 and 2008 to 2015.

[7] In the short to medium term financial disruption may also give rise to significant resource misallocation and thus productivity losses. Gerth and Otsu (2018) find that this had a big impact on efficiency in the UK through 2014 but it is not known if this effect persisted through 2018. Resource misallocation is generally substantial in Europe though less severe in the UK than most other countries (Gorodnichenko et al. (2018).

[8] Reduced productivity growth in financial services no doubt partly reflected a lower ICT capital contribution so is not entirely additional to the ICT impact already discussed.

[9] The technicalities of the approach are explained in Born et al. (2019b).

As we noted earlier, the 10-year difference after 1929 was 5.3% (Figure 3). The 'great depression' years look quite different from post-2008 in that there was no UK banking crisis and the impacts of GPTs of the time (electricity and the internal combustion engine) were gathering pace rather than weakening.[10] The move from fixed exchange rate and free trade to cheap money, dirty floating and the general tariff on manufactures was completed in less than a year, after which recovery soon followed (Crafts, 2013).

In the case of the Edwardian climacteric, the 10-year difference after 1898 was 5.5% (Figure 3). The steam age was coming to an end and electricity had yet to make a significant impact on productivity (Ristuccia and Solomou, 2014). Growth accounting suggests, however, that the impact of steam power on productivity growth extended over a long period of time but never reaching the intensity of the peak associated with ICT (Crafts, 2004), with the implication that its waning weighed less heavily at the start of the 20th century than that of ICT in the early 21st century. There was no banking crisis during the Edwardian climacteric. There was, however, a lengthy and bitter controversy over moving away from free trade, with Joseph Chamberlain as the leading advocate of tariff reform, which culminated in a landslide victory for the (pro-free-trade) Liberal Party in the General Election of 1906.

5. Conclusions

Our main conclusion is that the answer to the question posed at the outset is 'yes' – the current UK productivity slowdown is unprecedented. We base this finding on the criterion of how far the level of productivity is below the path implied by the continuation of earlier trend productivity growth, a measure of performance highlighted by ONS in recent times. We focus on the level reached ten years after a slowdown began. We estimate the shortfall in 2018 to have been 19.7 per cent. This compares with 10.9 per cent ten years after 1971 and 10 per cent ten years after 1883, these being the next worst episodes in the 250 years.

We do not have a fully satisfactory explanation for the productivity slowdown. Nevertheless, we think it is important to recognise that it has occurred in the context of a novel combination of adverse circumstances. These are the coincidence of a banking crisis, the waning impact of a general-purpose technology (ICT) and uncertainty about international trading relations (Brexit). It is plausible that together they have comprised a major shock to productivity outcomes.

[10] Other countries, notably including Germany and the United States, had major banking crises which contributed to much more severe downturns than in the UK. For a list of countries which did have banking crises, see Crafts and Fearon (2013, Table 6).

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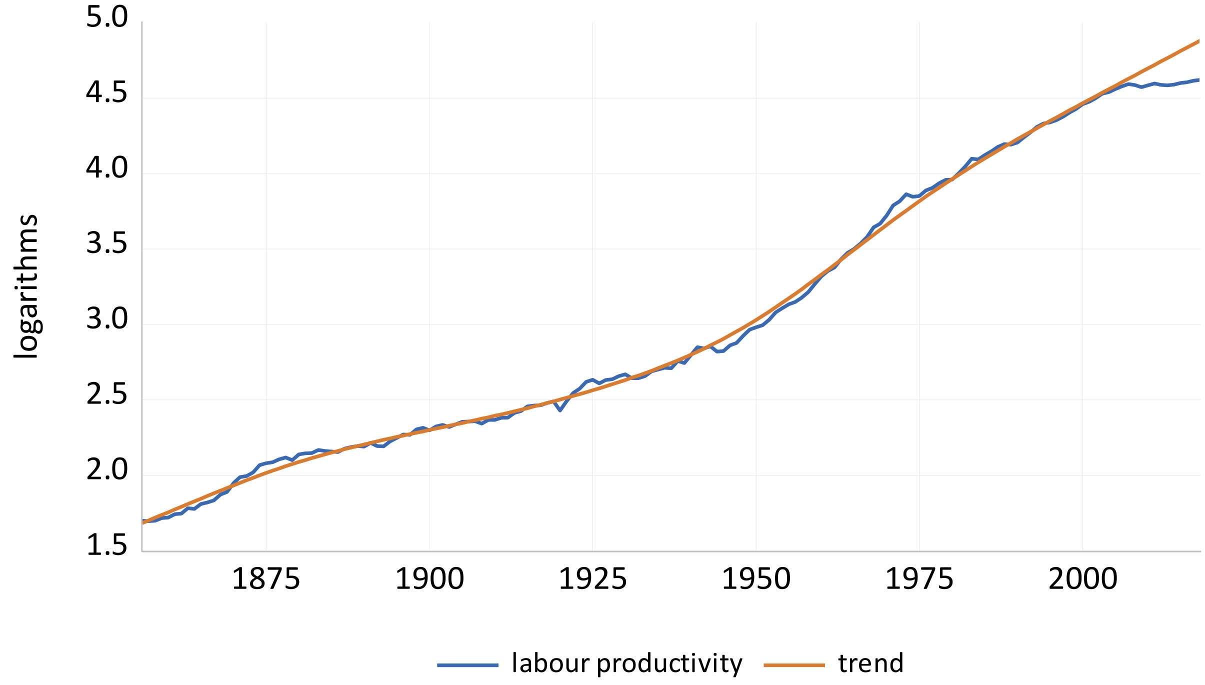


Figure 1 Logarithms of labour productivity, 1856 – 2008, with trend superimposed.

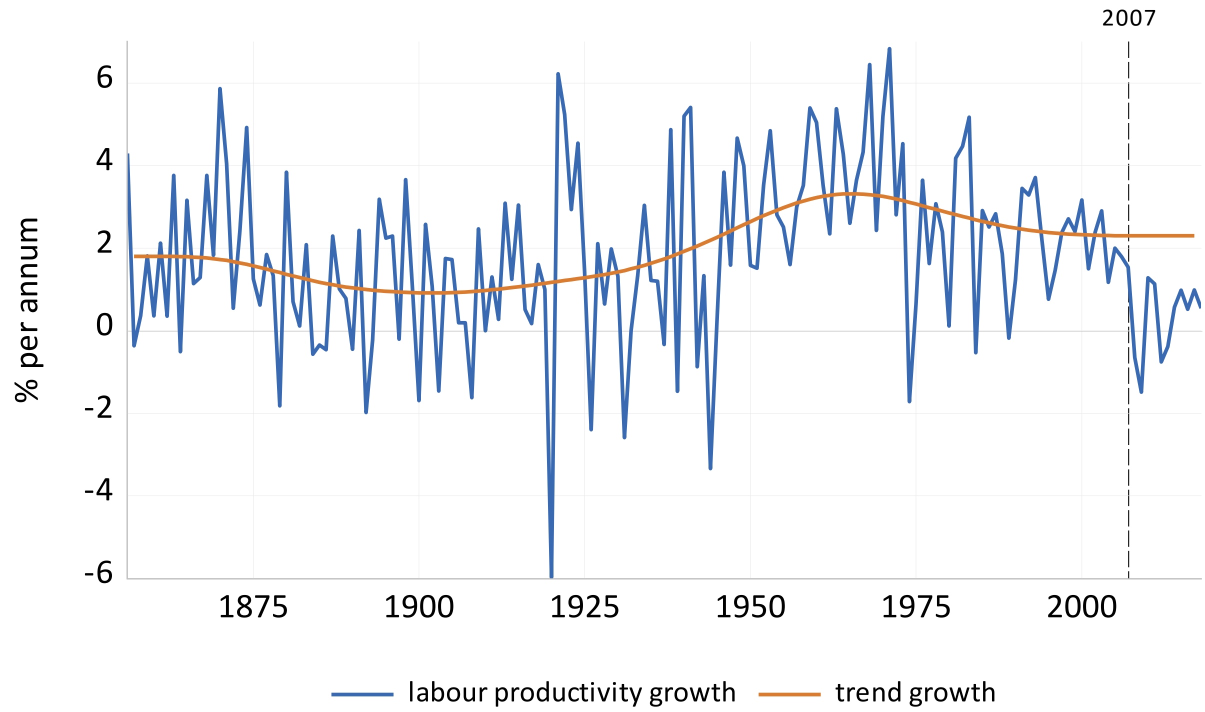


Figure 2 Labour productivity growth, 1857 – 2018, with trend growth superimposed.

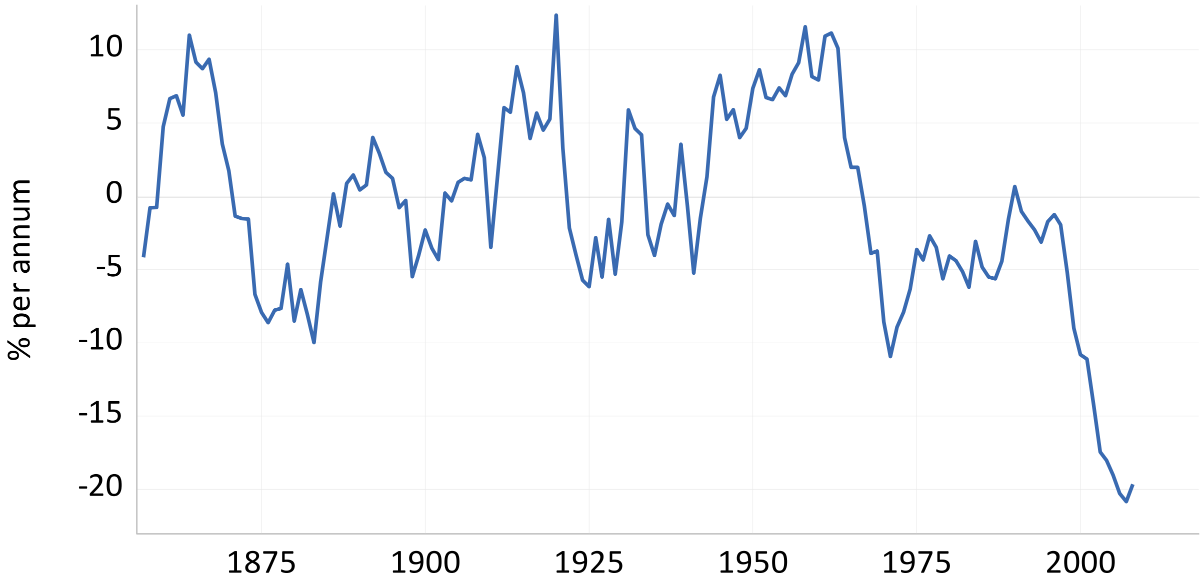


Figure 3 Cumulative 10-year ahead difference from trend growth, 1857 – 2008.

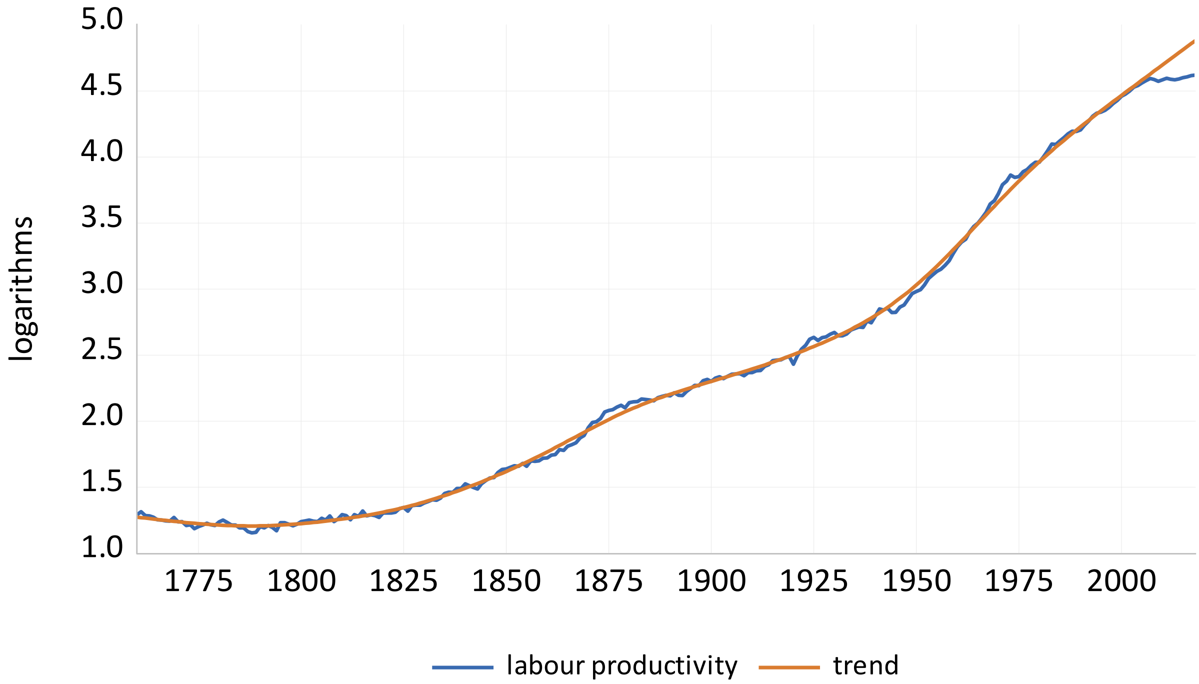


Figure 4 Logarithms of labour productivity, 1760 – 2008, with trend superimposed.

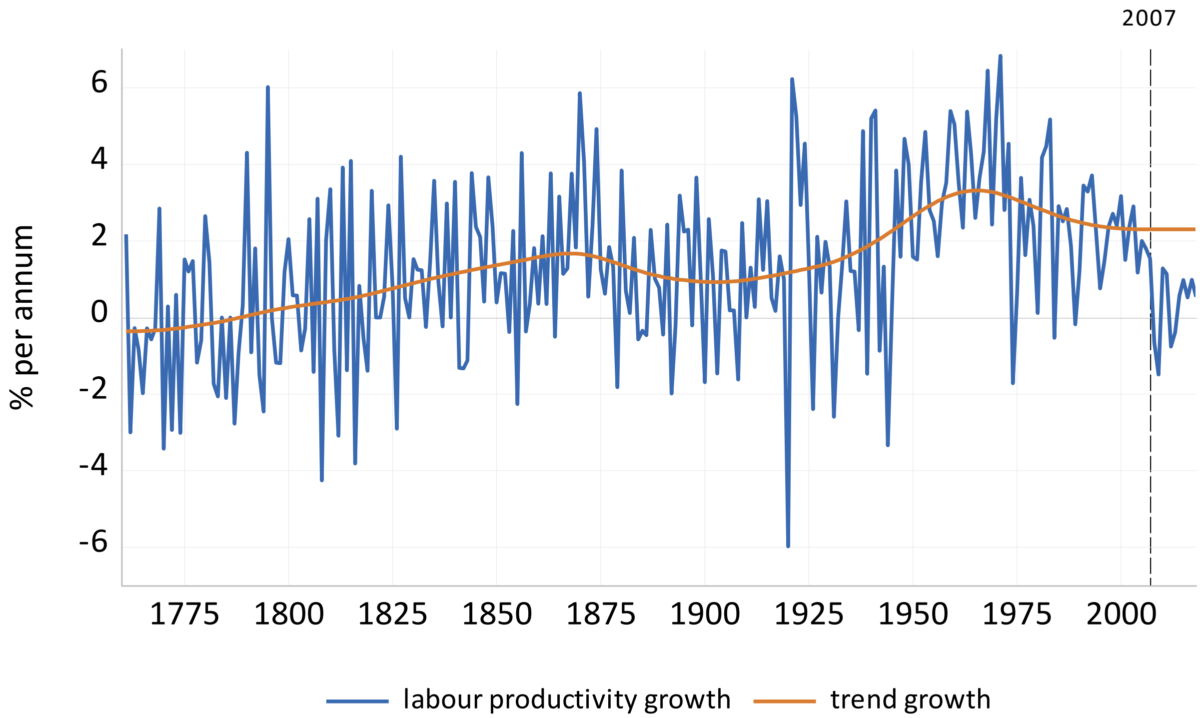
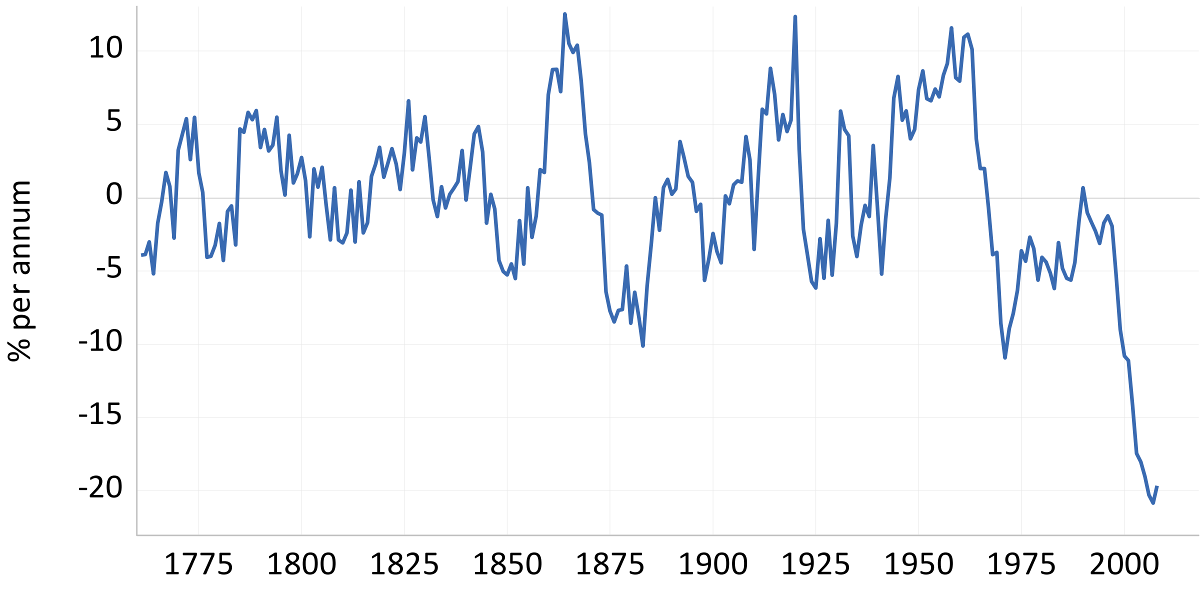


Figure 5 Labour productivity growth, 1761 – 2018, with trend growth superimposed.



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