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Is There a Productivity Puzzle in the OECD Economies?[1] Or Why Has Economic Recovery Since the Great Financial Crisis Not Produced Increased Inflation?

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Abstract

This paper investigates whether there has been a structural shift in inflation since a recovery began in the OECD economies. For policy purposes, it is important to be sure that such shifts are significant statistically, are likely to be sustained over the near future and be evenly distributed over the member economies so that no one of them is damaged by anti-inflation measures taken to help others. We approach the problem in two steps: first we examine the circumstantial and informal evidence, and then conduct formal statistical tests for structural changes in euro area inflation in 2015-2016. We find no evidence of a structural change. An even distribution of inflation criterion is the closest to being satisfied, but the other two are far from satisfied in any formal sense. The question remains: why has there been no inflation in the recovery since 2014? To answer that question, we demonstrate how low growth in real wages and self-reinforcing low productivity growth produces slow output growth and low inflation; and how low real wages and productivity in turn lead to low investment. This model fits the data well, down to the lack of labour and total factor productivity, and to the substitution of cheaper labour for excess capital stock. It implies a fall in investment spending (also seen in the data) that extends the period for which the low productivity-low inflation outcomes apply.

Keywords

Productivity Puzzle, Capital-Labour Substitution, Static Real Wages, Productivity Dynamics

[1]This policy contribution is a revised version of the paper prepared for the Committee on Economic and Monetary Affairs of the European Parliament (ECON) as an input for the Monetary Dialogue of 26 February 2018 between ECON and the President of the ECB. Copyright remains with the European Parliament at all times. The original paper is available at http://www.europarl.europa.eu/committees/en/econ/monetary-dialogue.html.

1. Introduction

Inflation in the euro area has not been significant, from a policy perspective, for the past decade—that is, since the financial crisis began to have a real impact at the end of 2008 (Figure 1; all items index). Rather, the main concern was the prospect of too much disinflation after 2011; and then actual deflation through 2015-16.

However, the euro area's gradual recovery starting in 2015 has generated a small recovery in inflation starting in 2016, accelerating from August 2016 to February 2017, then roughly steady to April 2017 before decelerating again to the end of 2017 (Figure 2). But the numbers are small. Inflation, at the peak of the 2016-17 increase, only just touched 2% before drifting back to 1.5% by May 2017 until the end of that year. So, while it is fair to say that economic recovery in the euro area has led to an increase in inflation, that increase has been small, has remained within the ECB's target of 2% or less, and was not sustained. Hence, on a superficial look at the data, it would be hard to argue that there had been a structural change. We test that proposition directly in the next section.

A second point is that a clear correlation exists between the euro area inflation rates in Figure 1 and Figure 2 and the inflation rate in energy prices and (to some extent) food prices. But there is no corresponding correlation between inflation and industrial goods and services prices. This is important because energy is mostly imported, as is food to a significant degree. Hence the principle factors driving inflation are external, rather than internally generated. That puts them beyond the ECB's immediate control; imported inflation, in this case, could be a signal of increasing Euro area competitiveness.

The paper itself is organised as follows. Section 2 identifies the main components and the characteristics of inflation trends in the Euro area over the past decade, and their distribution across national economies. Included here are the movements in core inflation and official forecasts of future inflation to help identify possible structural shifts in an intuitive way. The formal tests for structural shifts/breaks are then conducted in Section 3 to show that the conclusion of "no structural shift" has statistical significance. Section 4 then supplies a formal theory, based on the interaction of real wages and productivity dynamics, to show how this situation would have arisen naturally in the aftermath of a severe recession where the key concerns are to substitute relatively low-cost labour for more expensive capital, and the consequent lack of incentive to invest.

This argument is fully supported by the data, in the OECD area at least. But there is very little previous literature to compare on this topic—although the fear of a productivity puzzle is widespread among commentators and policy specialists. Those commentaries are therefore reported in Section 4, to be contrasted with the very sparse literature that does exist (because it reaches very different conclusions for fairly obvious reasons) supplemented by a couple of case studies that support the explanation advanced here. Section 5 then considers the long-term implications of the productivity dynamics and adds some reinforcing

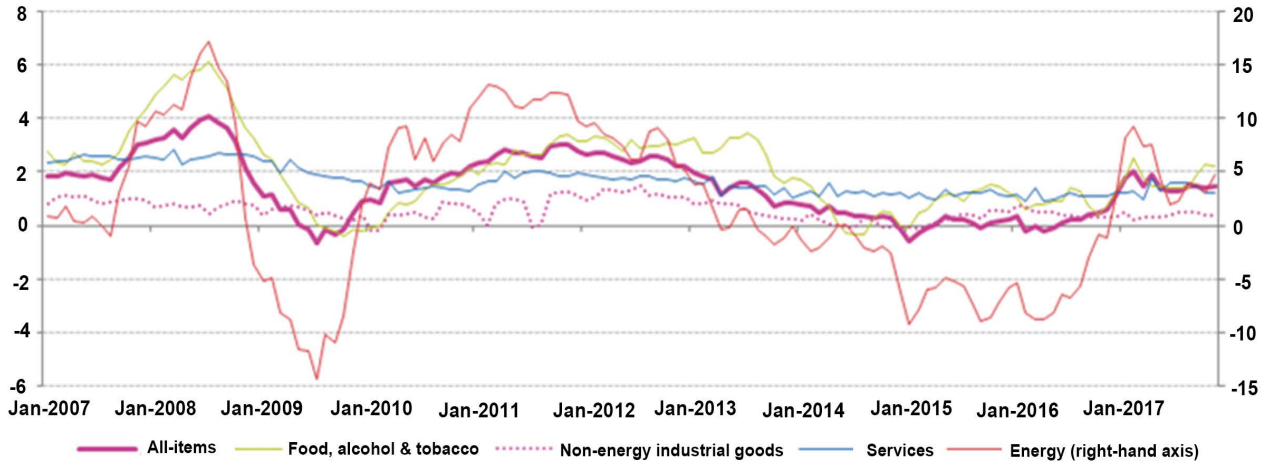

Figure 1. Euro area inflation and its components, a longer perspective (2007-2017). Source: Eurostat [1].

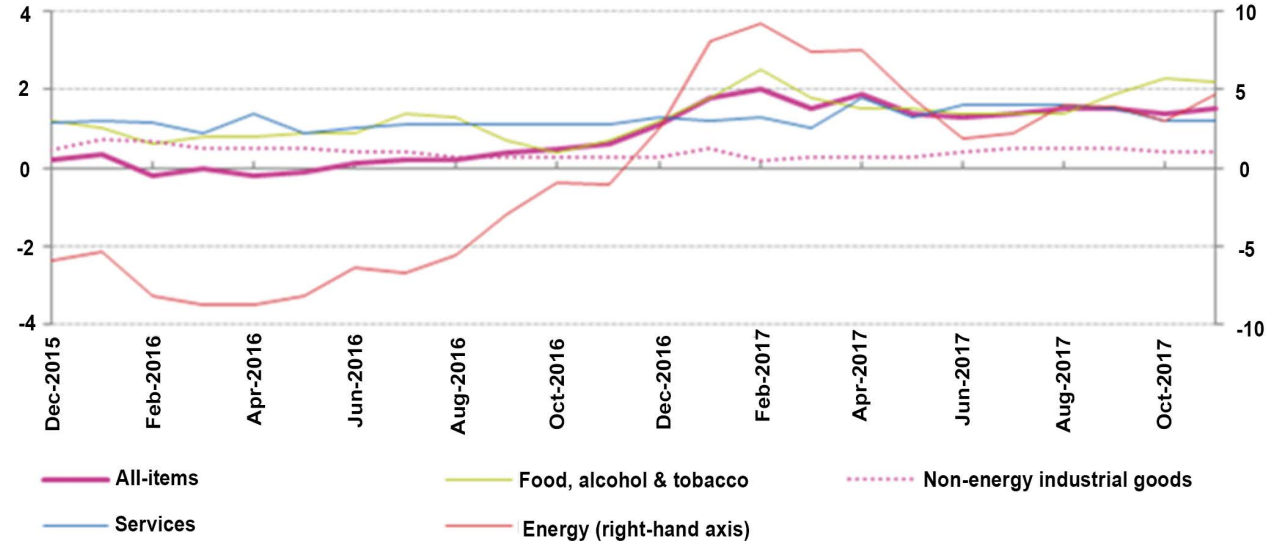

Figure 2. Euro area inflation and its main components (% pa), December 2015-November 2017. Source: Eurostat [2].

factors from a related literature which are likely extend the impact of our theoretical argument. Finally, Section 6 concludes with some policy implications, and crucially two important topics for further research that flow naturally from this research: the impact of automation and emerging skill shortages.

2. Inflation TRENDS and Structural Change Tests

2.1. Inflation Trends by Country

Inflation had reached 1.5% by the end of 2017. However, three points about that increase:

1) it still falls short of the 2% Euro-wide target, the mandated ECB target;

2) it is unclear if this inflation was caused by the recovery. More likely it was caused by external factors such as the recovery in energy prices in 2017, occasional food price spikes and the level of wage bargains in Germany;

3) the inflation increases were distributed unevenly: 0.8% in the average Euro economy in 2016; but 1.7% in Germany, 1.5% in France, 1.0% in Italy, 0.9% in Spain, 0.2% in Greece, 0.1% in Ireland.[2]

Inflation rates since then have tended to converge. Euro area inflation touched 2.0% in February 2017, but then fell back to 1.5% in April (remaining there for the rest of that year) and is forecast by the ECB to remain in the 1.4% - 1.8% range until 2022. Likewise, inflation in Germany briefly reached 2.2% in February 2017 (**Figure 3**); but fell back to 1.5% in March and 1.8% in November. In Italy, it fell to 0.9% in March and stayed there; in Spain from 3% to 1.7%; and in France it fell to 1.2% from 1.5%.

2.2. Core Inflation and Inflation Forecasts

We now examine recent developments and forecasts for core inflation in the euro area (**Figure 4**). Core inflation itself has moved very little in the past two years, apart from a small uptick from 0.9% to 1.2% in 2017. This has now been fully reversed and is evidently not expected to reappear. Nor do Eurostat's current forecasts give any reason to suppose that the existing core inflation rate, 0.9%, is likely to change in the near future. The initial part of the uptick in early 2017 is probably due to food price increases (see lower left panel, **Figure 4**); but the second part would have to be an internal matter, such as a period of increased wage settlements in Germany, since energy prices are stripped out of the core inflation measure. As a result, the forecasts of actual inflation (top right) show that inflation is not expected to increase either. In addition, despite the uptick, the month-on-month figures show no *trend* tendency (or forecast tendency) to increase. Again, there is no evidence for a structural change here.

3. Direct Tests for Structural Change

To perform more formal direct tests for a structural change in euro area inflation outcomes, we conduct a series of regressions on monthly euro area data starting from January 2011 to December 2017 inclusive. The regressions are specified as follows:

$$\dot{P}_t = \alpha_0 + \sum_1^m \alpha_j \dot{P}_{t-j} + \beta t + \gamma D_t + \delta\left(\dot{P}_{t-1} \cdot D_t\right) + \varepsilon_t$$

where m = 4, t = time trend, $D_t = 1$ if $t \geq$ January 2015 $(0$ otherwise$)$ is a dummy variable to detect a level change in trend inflation, and $\left(\dot{P}_t \cdot D_t\right)$ is the corresponding dummy to detect a slope change (an acceleration) in the inflation process, at any time since the start of 2015. Not all variables are included in each regression since we aim to pick out only the most significant. The results are displayed in **Table 1**, with t-ratios to allow tests of statistical significance to be conducted for each factor in the inflation process—and specifically for the structural change variables.

[2]These figures are for December 2016 (Datastream).

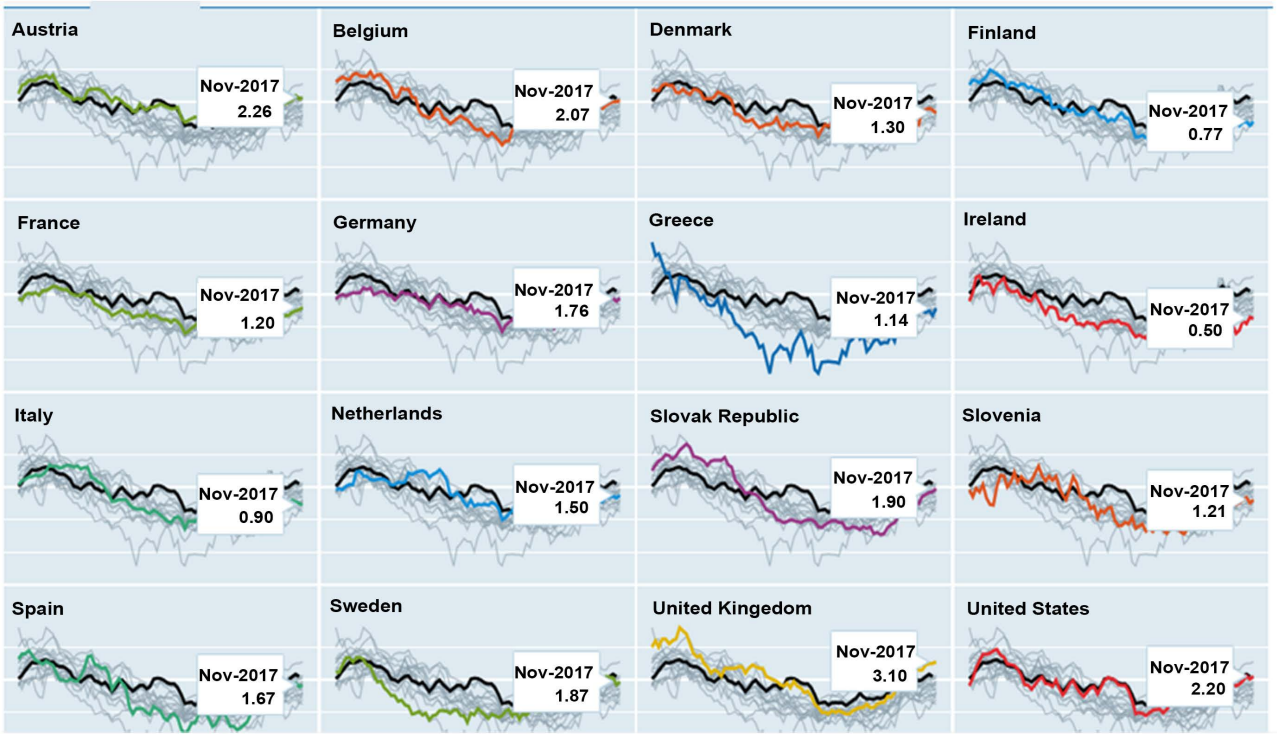

Figure 3. Inflation rates by country in the Euro Area 2007-17. Source: OECD.

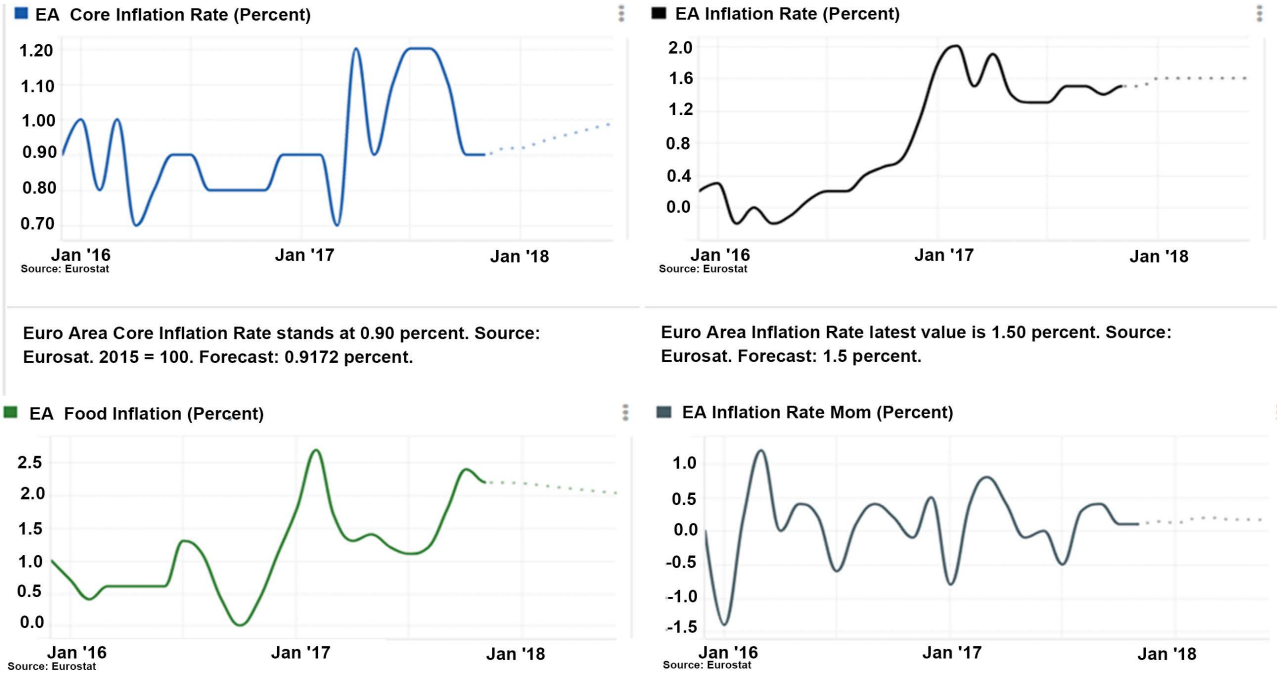

Figure 4. Core inflation and forecasts in the Euro Area.

What does Table 1 tell us? There are three types of regressions to describe the evolution of inflation: a time trend (regression (1)); five autoregressive or lag processes (regressions (2) to (6)); and two direct structural change tests (regressions (7) and (8)):

Table 1. Trends and structural change, euro area inflation, Jan. 2011-Dec. 2017.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
constant	**2.42** (13.23)	**2.49** (13.43)	**2.56** (13.67)	**2.63** (13.90)	**2.71** (14.22)	**0.31** (0.78)	**−0.052** (0.86)	**0.025** (0.63)
time	**−0.275** (7.39)							
$\dot{P}_{t-1}$		**−0.029** (7.68)				**1.03** (8.89)	**0.997** (35.55)	**0.969** (40.30)
$\dot{P}_{t-2}$			**−0.030** (8.00)			**−0.021** (0.125)		
$\dot{P}_{t-3}$				**−0.031** (8.31)		**−0.091** (0.55)		
$\dot{P}_{t-4}$					**−0.037** (8.70)	**0.041** (0.36)		
D_t							**0.101** (0.66)	
$\dot{P}_{t-1} \cdot D_t$								**0.010** (0.22)
Adj·R^2	**0.395**	**0.417**	**0.441**	**0.463**	**0.489**	**0.950**	**0.955**	**0.953**

Source: own calculations, OECD CPI-inflation data, t-ratios in brackets. Dependent variable, current inflation $\dot{P}_t$.

1) Each has a constant term which is the most significant part of the regression for models (1) to (5), but a goodness of fit (Adj· $\mathbf{R}^2$) statistic less than half that of those in regressions (6) to (8). This suggests that the constant (intercept) term is standing proxy for some other significant factor/factors not yet represented in regressions (1) to (5).

2) The time trend in the data is strongly significant, but negative—as can also be seen in the actual data (blue dots) in Figure 5. It is negative until December 2014, and not positive until May 2016 (and then not positive enough to outweigh the negative trend up to 2014). It would therefore be premature to expect to expect a structural change to positive *trend* inflation (as opposed to occasional positive values) after the long negative trend.

3) There is strong (cyclical) serial correlation in the residuals of this regression, evident in the scatter plot of the residuals in Figure 5. As a result, the coefficients in the time-trend regressions are likely to be poorly determined. This calls for alternative specifications. Interestingly though, the scatter plots of the observations and residuals show a tendency to converge after 2014 (without going so far as to coincide) which implies inflation is returning to an underlying pattern of past behaviour rather than a new trend. A structural change therefore seems relatively unlikely.

4) The lag models, (2) to (6), show very similar results, if slightly improving with lag length. The trend effect is still negative but significant. There is not much that is new to be learned from these models, except that nothing is gained if several lags are used together. But note, the proxying role played by the constant term vanishes in that case.

5) The two structural change tests, models (7) and (8), are rejected. Both the level change test and slope change (acceleration) tests return weak and strongly

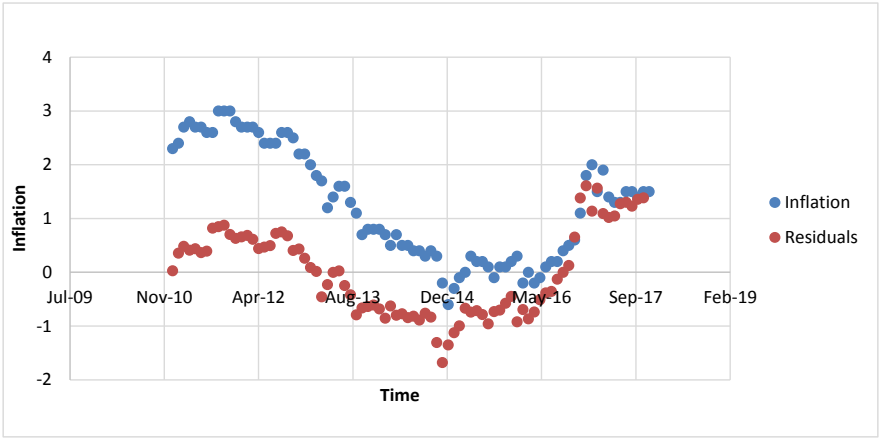

Figure 5. Data points for Table 1.

insignificant results—though the changes would have been positive, had there been any significant evidence for them.

The implication of these tests is therefore that inflation has not been subject to a change in price dynamics, merely to a continuation of past trends (since 2011 at least).

4. Why Has Recovery Not Produced a Structural Change in Inflation?

In contrast to all recoveries over the past six decades, all of which were heavily criticised for being "job-less" and slow to take effect, the most striking features of the recent recovery have been the rapid reductions in unemployment, apparent immutability of real wages and persistently slow growth in output levels. In fact, the current recovery appears to have been the antithesis of those that went before: employment was quickly restored to full employment (pre-crisis) levels; unemployment rates fell to broadly full employment levels very soon after; output started to grow at 1% - 1.5%, but unlike in previous recoveries failed to speed up from there. And real wages failed to increase at all (in fact, at times, they decreased by small amounts in several OECD economies).

To be fair, this has been a feature of many, if not most, of the advanced economies. However, the essential message is the same in the euro area as elsewhere. With wage settlements subdued or static under the high unemployment resulting from the recession itself, and with limited prospects of rapid growth in the near future, short term low wage contracts would be seen as a less risky and more flexible alternative to large capital investment projects so long as output growth remains slow or uncertain. In effect, the choice became to substitute relatively cheap labour (in real terms) for relatively expensive capital—especially when, in previous years in a number of OECD economies, an inexorable rise in unit labour costs had led to an overinvestment in (the then relatively cheap) capital at the expense of labour.

However, there is a catch; once this process has set in, a reinforcing mechan-

ism comes into play. So long as there is little upward pressure on wages (likely to be true at the semi- and unskilled ends of the labour market), it will remain attractive to employ extra labour rather than invest in new capital. But if the extra employment grows at the same rate or nearly the same rate as output (also likely in this context), or possibly faster, labour productivity will be static, or very slow growing, or possibly falling. Slow growth, no growth, or declining growth in productivity makes it very hard to justify any growth in wages: which in turn projects the incentives that created this kind of mechanism in the first place further into the future and ensures that it continues.

There is no "productivity puzzle" here. Instead we see the inevitable consequences of correcting changes to relative input prices in the production process. But what might appear to be a natural correction to the distortions of the past is going to be hard to escape in the future because of the self-reinforcing mechanism identified above. This is the explanation of the absence of structural change to the higher rate of inflation that we might have otherwise expected as the recovery took hold. And given the self-reinforcing mechanism, this absence of a structural change is likely to continue for a while.

How does the data look? Does it support this explanation of the lack of a structural change to higher inflation rates in the euro area? **Figure 6** and **Figure 7** show that it does. **Figure 6** shows both labour and total factor productivity (TFP) growth in the euro area since 1999. Both fell sharply in the great recession in terms of average growth rates. But, despite a noticeable recovery thereafter, their post-recession growth rates are now (on average) still only half to three-quarters of their pre-recession (1999-2007) levels. That, projected over a period of time, is quite a reduction.

Figure 7 reinforces this point at least for labour productivity (but labour productivity is the central issue in this analysis). A secular decline in euro area productivity has clearly been in evidence since 1997, but it has been reinforced since 2006 and into the great recession. In fact, and unfortunately from the point of view of competitiveness, the euro area's productivity growth is the weakest in this diagram—not far behind the US and other advanced economies, but clearly below the world average, and significantly below that in the emerging market economies.

There also evidence of misallocation of inputs into production in the lead up to and into the great recession, sufficient to warrant undoing the inefficiencies of a distorted balance of inputs when the great recession triggered changes in relative input prices. Unfortunately, we do not have complete data to support that contention beyond doubt. But **Figure 8** shows increasing over-allocations of capital in a number of economies, if not a majority, over the years up to 2013 according to calculations made by ECB [3]. This was most marked in Finland, Italy and Belgium; but they are still significant (a 20% increase over 10 years) in France and Spain.

This sets the starting point for, and is entirely consistent with, our hypothesis of a "job-rich" recovery with low real wages, low productivity growth, slow

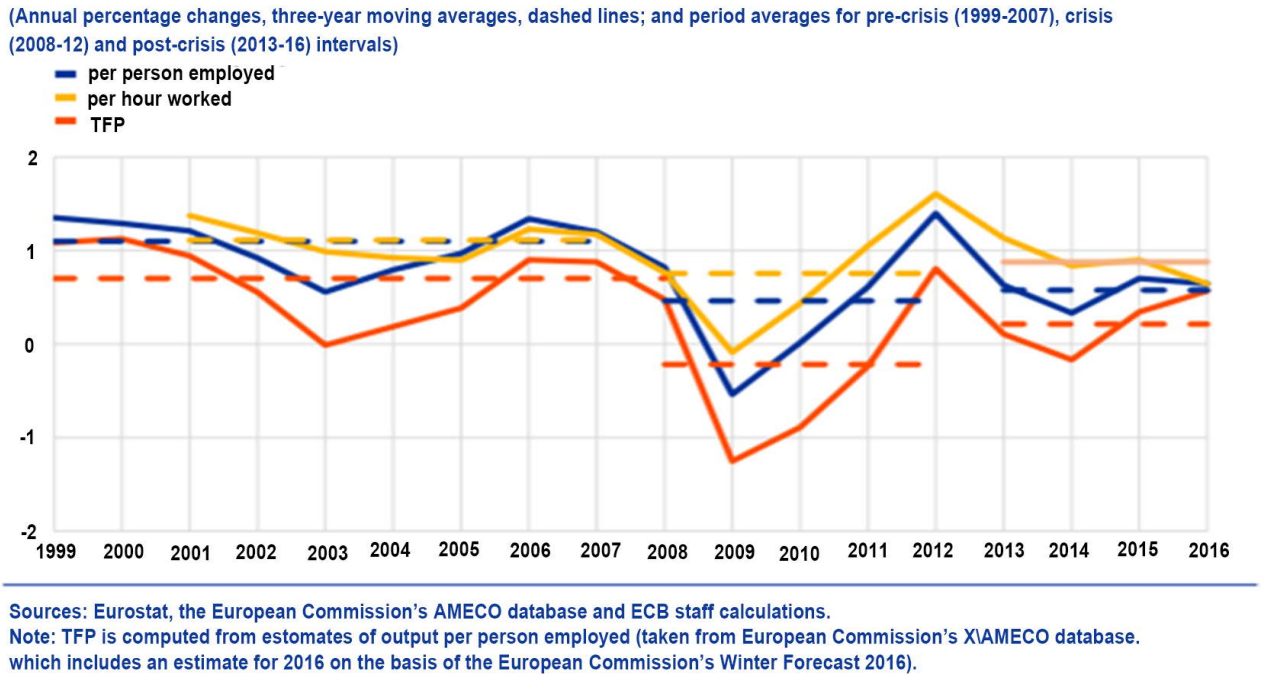

Figure 6. Euro area productivity growth.

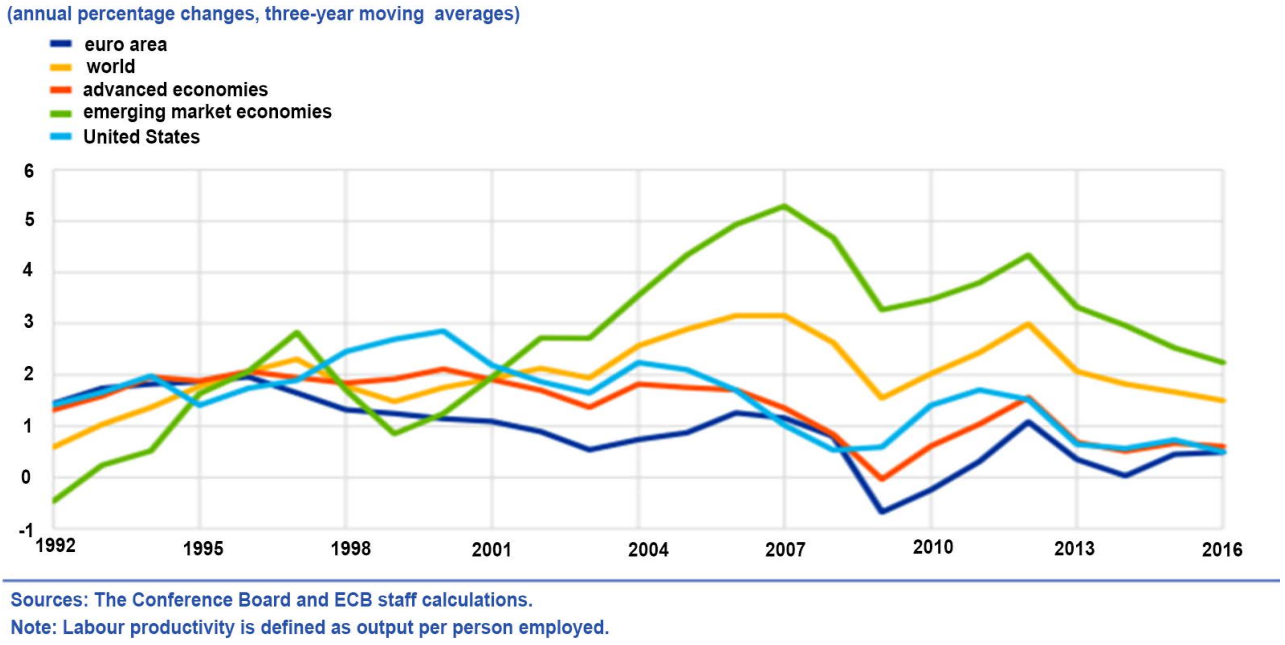

Figure 7. Labour productivity growth in the Euro Area, vs. the World and Regions.

output growth and no structural change in inflation. Labour misallocations, by contrast, appear to have been small over the same period and on average (rising slightly in 2007, falling in 2012-13), but show nothing on the same scale as the corresponding capital misallocations—which completes the story.

Notice that the precepts and implications of this model of the recovery are the direct opposite of those assumed in Basu *et al.*'s [4] model of the short run

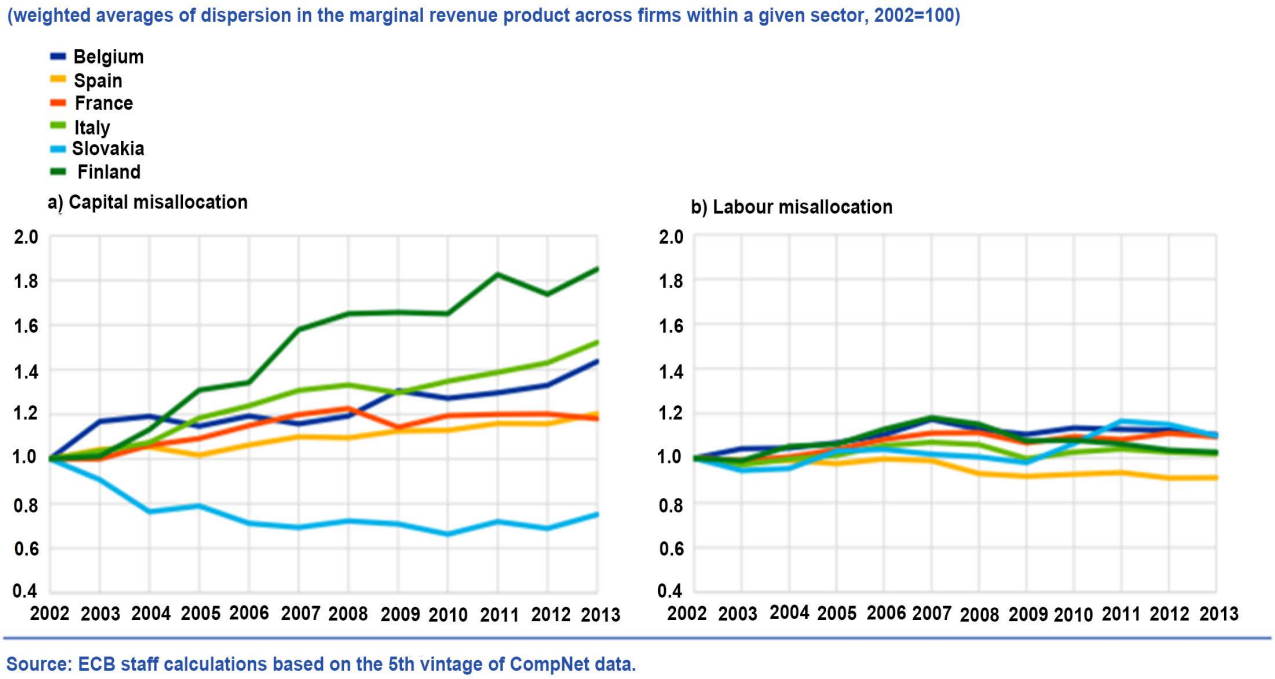

Figure 8. Capital and labour misallocations in Euro Area Economies, 2002-13.

impact of technological change on output and factors of production. First because, once productivity is endogenized (if only partially) as here, causality can flow both ways: from technology/productivity changes to the choice of factor inputs and output; and from the choice of inputs and relative prices to the productivity outcomes. The Basu *et al.* model lacks this second interaction channel and may give biased results. Second, Basu *et al.* do not allow for recessions or recoveries which lead to assumptions that are inconsistent with the circumstances of this paper. Capital and labour inputs are considered to be fixed, with serious adjustment costs. Whereas utilisation of capital might vary with output to an extent, an effectively fixed labour supply means hours worked and labour effort have to vary a lot more—which leads to a "shift premium" on wages (a premium on real wages) to balance rises in demand for labour against a quasi-fixed supply. The key link is then between the shift premium in wages and hours worked reflecting both effort and capital utilisation. The upshot is rising real wages and very little employment increase in a recovery—exactly opposite to what we have seen in the Eurozone and elsewhere in the OECD, where labour supply has evidently been very responsive.

Case study* 1: *The UK. To underpin this role of poor productivity argument, consider the UK economy since 2007. This extends our model of productivity to other OECD economies beyond the major players, the US and Eurozone.

It has been widely reported that, by 2014, UK labour productivity had not recovered its pre-crisis level[3]. In fact it hasn't grown at all since 2011, despite a recovery in GDP growth of 1% - 2%. The worst period appears to have been be-

[3]See BBC News [5] and the Economist [6].

tween 2007 to 2010 when productivity actually shrank; then a slight recovery in 2009-11 and zero growth till 2017. Various reasons have been offered for this poor performance, chief among them that workers have moved from more productive firms as investment spending was reduced, to less productive firms where less risky cheap labour can be substituted for expensive capital. Added to that, weak training, poor education and poor infrastructure makes the lack of investment, in high tech industries and those dependent on skills, particularly damaging [5]. Weak investment not only reduces productive capacity; in the long run it has reduced real wages, tax revenues and spending power by 20% since 2008 according to the Economist [6]. This is the opposite to what is needed to increase productivity, as is shown in case study 2 below. Instead it prolongs austerity. But it does confirm to the model of productivity dynamics presented in this section and Section 5. It is possible that rising wages driven by the skills shortage and increasing credit provision by the banks as the burden of non-performing loans and "zombie firms" appear to recede, will lead to gradual improvements. Case study 2 highlights the same problem. But until then, weak productivity growth interacting with or driven by low real wages and low investment spending will remain a fundamental problem—and possibly a larger one numerically than Brexit.

5. Longer Term Implications of Slow Productivity Growth, Low Inflation Recovery

Investment in a low wage world: Now we come to the undeclared "elephant in the room": investment. If low real wages have been induced by the fear that firms will otherwise invest in automation, or might otherwise "export" jobs to a cheaper location or country, then capital investment will necessarily be restricted—in particular productivity enhancing investment, including that which demands a greater use of skilled labour. Productivity growth, both that which comes from a greater use of capital (capital deepening) and that from new skills, techniques, rationalisation or more efficient organisation (TFP: total factor productivity), will be lower and future productive capacity (not to mention competitiveness) will be lost.

The implications of a low inflation, low real wages world for investment spending were already implicit in the relative adjustment of inputs discussion in Section 4: the shift to low real wage growth, whether triggered by the fear of automation, globalisation, or a fear that the financial crisis would persist, would naturally lead firms to switch to employing cheaper labour over more expensive capital. This effect is corroborated by the data in **Figure 9**. Comparing the euro area and the US, net investment has been lower in the euro area for several years; certainly since 2000, but most obviously since the recovery started (after 2012). Moreover, capital deepening, which remained positive (just) in the US, is clearly negative in the euro area starting in 2014. More generally, employment has expanded (read downwards on the inverted scale) by more than capital deepening

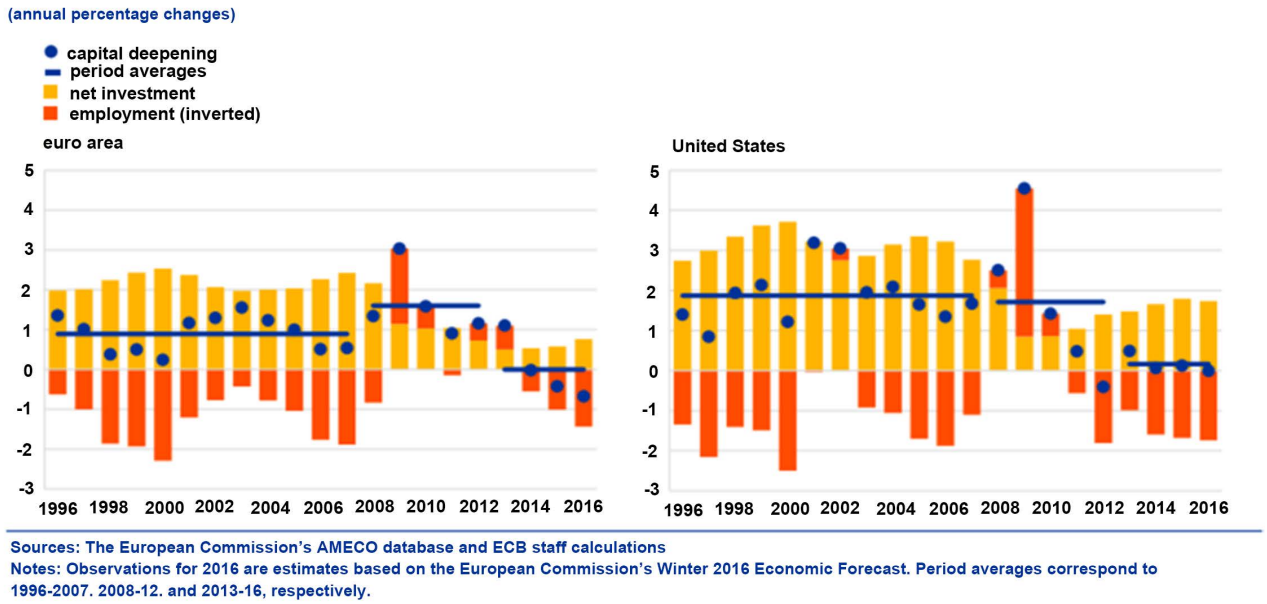

Figure 9. Capital deepening in the euro area and United States.

in both places—even to the extent of having outpaced the losses in capital deepening in the euro area. This confirms that there have been increasing substitutions of labour for capital, more so in the euro area than in the US.

Hence, this section is now arguing that there is an additional mechanism in which losses in investment spending will have further reduced productivity growth, and hence future output capacity and growth. This too can be seen in the data (see **Figure 10**). The same losses of capital deepening contributions to productivity growth are present; indeed, they vanish altogether in Europe in the recovery period (2013-16) and remain small in the US.

In addition, we can see that the labour productivity contributions in Europe drop through the recession itself while the TFP contributions turn negative. This is not observed in the US, but the contrast provides the clearest evidence yet of cheap, low productivity labour inputs being substituted for TFP-inducing capital inputs in Europe during the crisis—an effect extended by slow productivity growth from both labour and TFP sources, but nothing from extra capital, in the post-crisis recovery. Similar, but rather more positive results for capital investment, appear in the recovery period in the US.

To complete the picture, **Figure 11** shows the development of euro area TFP (to go with euro area labour productivity in **Figure 6** and **Figure 7**) over time, compared to other advanced economies. Slow TFP growth in Europe is certainly not a new phenomenon and has not been eliminated in the post-crisis recovery although the margin by which Europe lags the US may have reduced a little. Europe seems to lag a number of other economies in this regard too.

Case study* 2: *Scotland. As an example of the power of this argument surrounding slow productivity growth and the lack of investment, consider Scotland as a constituent component of the UK economy with a common currency but rather limited fiscal autonomy.

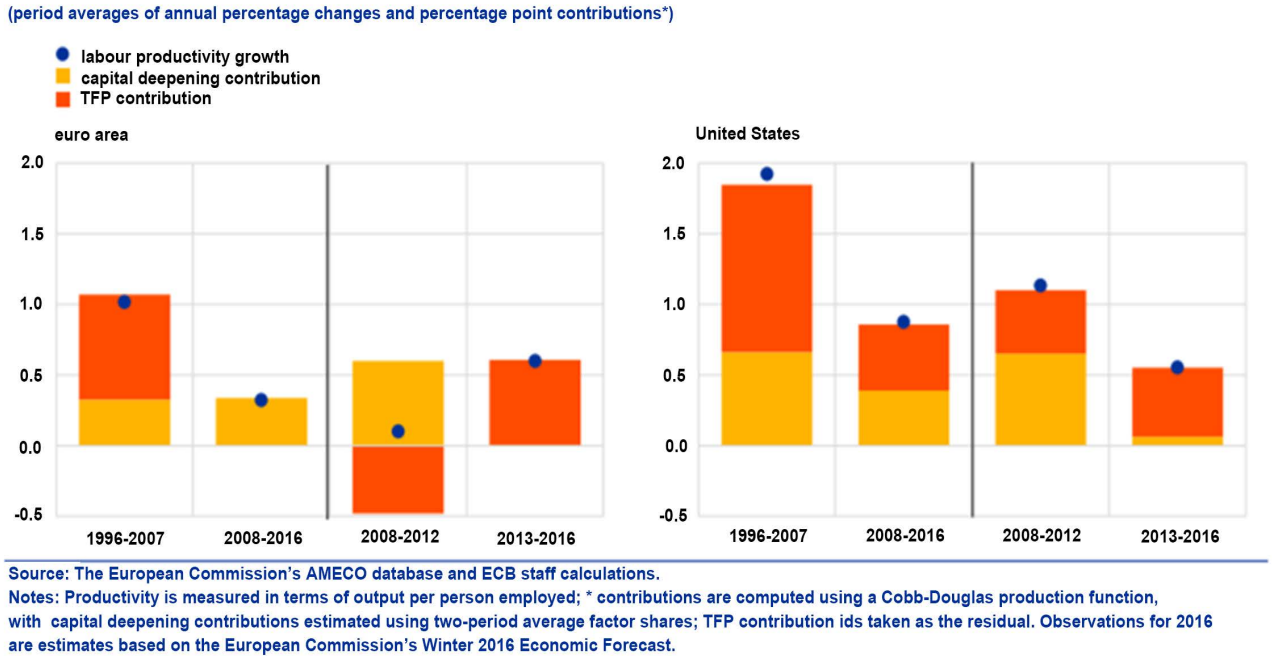

Figure 10. Productivity Growth; its Decomposition in the euro area and the US.

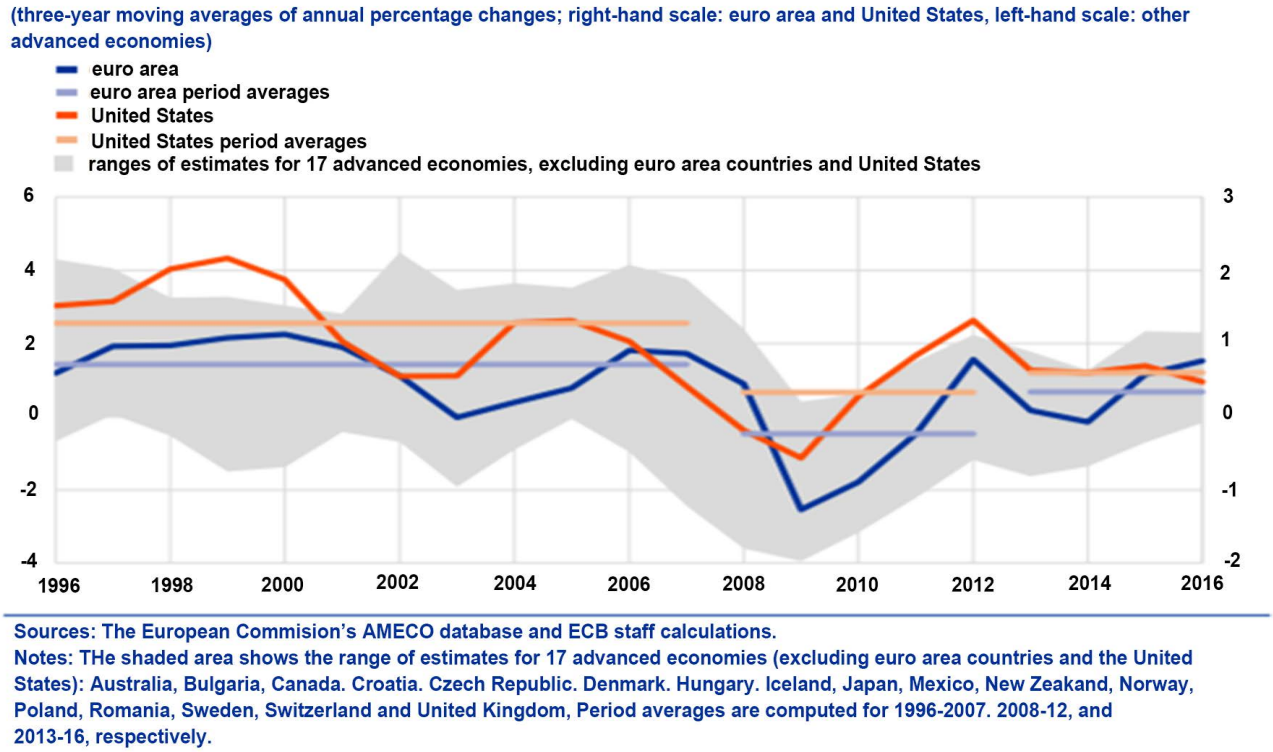

Figure 11. Total factor productivity growth in the advanced economies.

Scotland has labour productivity which is 3% lower than the UK.[4] Yet wages are roughly 6% lower. This implies that unit labour costs are 3% lower in Scot-

[4]These figures are taken from those available to the Scottish government over the past decade: see Council of Economic Advisors [8], Hughes Hallett [9].

land. However, unit production costs are not lower since otherwise the Scottish economy would have grown faster. Scotland has in fact grown by ½% - 1% points slower each year for many years. Hence total factor productivity (meaning productivity of the other factors of production, or in the way in which they are combined) must have been significantly lower in Scotland. Scots work harder than their counterparts, but to less effect because cheaper labour has been substituted for capital and productivity increases. This suggests we need a two-pronged approach: a general drive to increase total factor productivity with improved technology, capital deepening, better work practices; *and* policies to shift the industry mix towards the high productivity activities and those with specialised services, skills, or economies of scale. In short, we need investment to exploit Scotland's comparative advantages; not less investment as has been the case.

To illustrate the latter point, Scotland ranks highly on R&D and innovation in the public sector—principally in higher education—but does less well in business and industry. In fact, business R&D spending runs at half the UK rate. And most is done by US, Scottish and EU owned firms: very little by UK based firms. This is a clear "branch office" problem. In figures, 53% is done by US firms, 25% by Scottish owned firms, 16% by EU firms and 3% by UK owned firms. At the same time, 8% of firms by value added in Scotland are US owned, 31% are non-UK and 61% are UK owned. Taken together, this means that UK based firms undertake just $1/20^{th}$ of the R&D or innovation spending, per unit value added, of non-UK firms. The simplest strategy, then, is to find ways to bring high productivity activities to the local economy by investing in productivity growth underpinned by encouraging foreign trade and ownership in order to make the UK markets and firms more contestable.

Two other factors which may play a role:

1) Harris [7] outlines a mechanism in which the form of exchange rate regime between economies affects investment spending and the productivity dynamics in those economies, and hence the capacity or likelihood that there will be a structural change in inflation rates. Ultimately this mechanism will not change any of the conclusions reached so far, but it may affect the size or strength of their impact. And it provides insight into what is needed for structural changes in inflation to appear.

The exchange rate mechanism operates as follows: faced with a cost advantage created by a currency depreciation, firms would feel little pressure to upgrade their plant, rationalise their production, cut costs, increase efficiency, or improve work practices. In addition, there is less pressure to exit poorly performing markets or enter new ones. Investment and the consequent productivity growth will be lower than they might have been. Conversely, a cost disadvantage caused by a currency appreciation or real appreciation through rising domestic costs, will have the opposite effect. The depreciation of the euro in 2015/16 may therefore have been the origin of the slight increase in inflation in late 2016/early 2017

(Figure 2) and consequent slowdown in productivity growth in the same period (Figure 6).

But within the euro area, there are no currency depreciations/appreciations, only changes in relative costs leading to real exchange rate changes. The pressures to upgrade, invest in new work practices, in productivity enhancements, to cut costs, exit or enter new markets—or lack of such pressures in the case of falling relative costs under the structural reform policies associated with austerity programmes—still exist therefore. But they may be less obvious or immediate; and they will be slower to arrive and may last much longer. The result, in the current circumstances, would be a tendency for the euro area economies to diverge rather than converge; and, if the austerity economies are in the majority, for productivity growth to slow down (a second-round effect to that in the previous paragraph).

Thus, when competitiveness falls below average (costs rise), firms will seek to upgrade and productivity will grow. But when competitiveness rises (domestic costs fall, especially if real wages are low and are likely to remain so) there is less pressure to innovate and productivity growth will be slow. Hence, to get structural change in inflation, you need structural changes in cost inflation of one sort or another; otherwise inflation will remain low and productivity low. This conclusion adds to those in previous sections of this paper.

2) In an analysis of long term fiscal sustainability, Hughes Hallett *et al.* [10] find that inter-actions between income inequality and the distribution of gains from productivity growth affect output growth and the level of public debt in the economy. Specifically, increases in the share of the gains from productivity growth that go to the private sector will lead to:

1) a lower level of optimal (output maximising) sustainable debt in the public sector;

2) but, also, to higher rates of output growth—other things equal.

These desirable improvements in performance will ultimately have an effect on an economy's inflation performance. But they are tempered by the fact that: a) increasing the share of productivity gains going to the private sector becomes less effective as a means to generate income growth, the more inequitably those incomes are distributed to start with; and b) it becomes even more ineffective, the greater is the share of productivity gains already going to the private sector. So, the *distribution* of productivity gains matters a great deal. But there are natural limits to how much those gains can be used to induce income or inflation changes in a desirable way.

6. Conclusions

The bottom line here is that there appears to have been no structural change in euro area inflation in its recovery over past three years. Nor has there been a change in the underlying conditions that would suggest that such a change in inflation has, is likely to, or should take place in current circumstances.

So, it is not possible to argue that a material (significant) improvement has taken place in the ECB's inflation objective which is:

1) sustained over the medium term;

2) likely to be durable;

3) internally generated (self-sustainable) in the sense that it would remain if monetary or other policies were to become less accommodating;

4) that affects all euro area members rather than a few.[5]

The evidence for that change is simply not in the data (Section 3); and there are too many extenuating circumstances in Section 2 to suggest that evidence for those properties, desirable as they may be, is unlikely to emerge anytime soon.

A deeper analysis of the price dynamics underlying this continued low inflation environment, despite a recovery in production, showed the key factors to be persistent low real wages and low productivity growth (Sections 4 and 5). Not only does that analysis explain the lack of structural change in inflation; it implies we should expect low inflation to continue into the near future. The key driver appears to be low productivity growth, leading to low investment spending driven by changes in relative prices for capital/labour inputs and by capital misallocations in the past, and then to lower investment spending again because expectations for growth and future rates of return are reduced.

It would be hard to conclude that inflation had changed structurally until the various forces that underpin low real wages and/or low productivity are resolved or removed. However, the approach taken here is rather general. It is entirely possible that real wage rises will begin to spillover from the skilled labour market (where there may well be excess demand) to the labour market more generally (where, evidently, there is not). That would halt this process and bring us back to a structural break in inflation, higher productivity and faster output growth. Similarly, a secular increase in productivity or increased competition in the markets for tradeables could do the same. By contrast, austerity policies, sharper financial regulation, and the threat that rising wages might make firms switch to investing in automation (causing real wages to fall again), will do the opposite. The impact of structural reform, on the other hand, is unclear: it represses prices but enhances efficiency, investment and productivity. These are all interesting and important extensions to the current research but require a more detailed investigation than can be achieved within the confines of this paper.

Interestingly, as an aside, the argument in this paper illustrates the differences between the current recovery and those following the great depression in the 1930s. In the latter case, more attention was paid to reflation and the output side of the recovery. The result was a faster recovery, rising wages and productivity without obvious inflation. Other stabilising measures like financial regulation, and any fiscal restraints, were then fitted in afterwards.

[5]This last criterion will likely be the first to be satisfied: **Figure 3** shows that national inflation rates varied by factors of 2 to 4.5 in late 2017, with Austria and Belgium on one side vs. Italy and Ireland on the other. But national inflation rates had varied by factors of 17 or more just 18 months earlier.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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