

IN-DEPTH ANALYSIS

Requested by the ECON committee



# Subdued Inflation, Targets and Monetary Policy Cooperation

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Monetary Dialogue September 2019



Policy Department for Economic, Scientific and Quality of Life Policies  
Directorate-General for Internal Policies  
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# Subdued Inflation, Targets and Monetary Policy Cooperation

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## **Abstract**

This paper examines the case that there has been a structural change in the determination of inflation in the EU (and elsewhere) that has led to a low real-wages, low inflation, slow productivity growth regime. In fact, there appears to have been no structural change. Instead, there has been a marked convergence between the performance of those variables in national economies. The implication is that there is little scope for greater monetary coordination in the conventional sense, or adjusting the monetary rules (e.g., targets), since this uniformity is the origin of the low inflation problem. Outcomes can be improved with better coordination of monetary policy with non-monetary variables. There are two lines of attack. One is a short term approach using conventional instruments (monetary-fiscal, structural or labour market reforms, improving policymakers' credibility). The other is a long term approach based on improved income distribution, a better distribution of the gains from productivity growth, and stabilisation by means of an external anchor (exchange rate).

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## EXECUTIVE SUMMARY

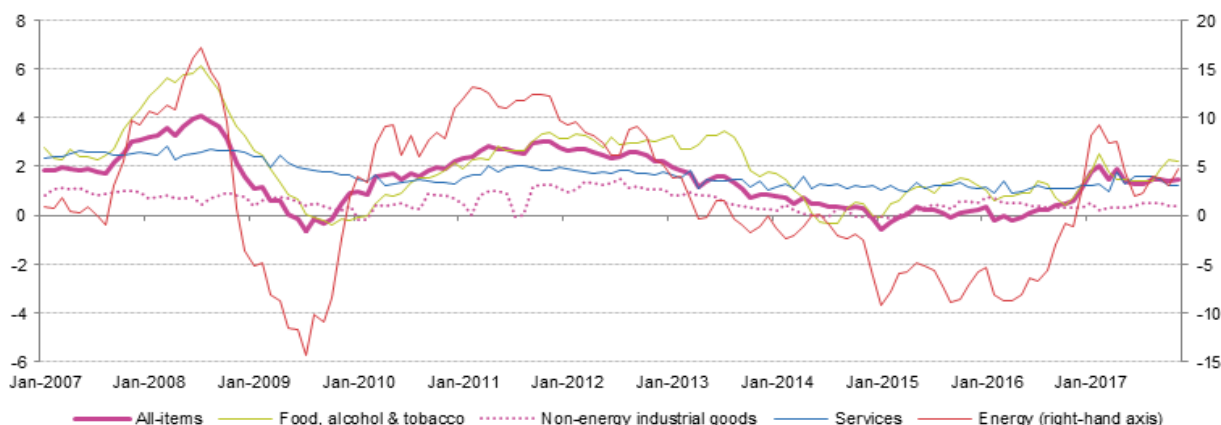
- The question posed in this paper asks us to examine whether the unrelenting persistence in low euro area inflation, and the low real wages and very slow growth in productivity observed during the slow recovery since the great recession, now represents a permanent state of affairs (a “new normal”). If so, what can be done to generate better outcomes? Is a new monetary policy stance from the ECB warranted, based on greater coordination?
- To do this, we test formally if the persistence in the inflation rate is transitory; or whether it constitutes a structural change that might be expected to continue indefinitely at current rates and ultimately settle at or above the ECB’s 2% inflation threshold that could automatically trigger a change in policy.
- In such an exercise, it is important to be sure that any shift in inflation is a) significant statistically, b) likely to be sustained into the medium-term and prove durable thereafter, and c) be evenly distributed so that the low inflation economies are not unfairly penalised by the measures taken to help those who have caused the inflation.
- Evidence and simple statistical tests show that there was a brief acceleration in inflation in 2016 towards 2%, but this flattened out in early 2017 and the proximity to 2% was lost. Inflation since then has been constant at 1.5%. Moreover, core inflation was constant at 0.9% throughout, which demonstrates that inflation itself was mostly generated externally, not structurally by the recovery.
- What accounts for the weak price dynamics? It appears that low growth in real wages has led to substantial increases in (mostly) low skilled employment. That then implies weak investment, slow productivity growth, and consequently, slow output growth and inflation.
- We find that this model fits the data rather closely, down to poor labour productivity and low total factor productivity. This model also implies that advanced economies have been substituting cheaper labour for the excess capital stocks of the past.
- As a result, some of the inefficiencies caused by excessive capital are being worked off, which will help the euro area economies in the long term if this process is allowed to continue. It is also true that the euro area is not alone in this situation; the same process has been unfolding in all the advanced economies (although the euro area is not among the better performers in this regard). This may be cold comfort, but it is some comfort.
- What really matters is coordination with instruments beyond monetary policy. Hence the real risk is that policymakers get stuck in their own bubble and fail to investigate coordination with alternative policies. These alternative policies may include structural and labour market reforms to restore market flexibility, and a more flexible/coordinated use of fiscal policy. The link between employment, wage growth, and competitiveness are also often mentioned as a real possibility but have seldom been implemented seriously. Rebuilding the credibility of the policymakers is another useful support mechanism. But what won’t work is more globalisation or conventional monetary coordination (Carney 2017).
- More interesting perhaps are the non-traditional approaches outlined in Section 6. Changes in the distribution of income and productivity gains may have a big impact in size if history is anything to go by, but be very slow to take effect. One easy and practical solution is to set up a clear and easy to track exchange rate mechanism to encourage productivity improving investments. This appears not to have been considered but could make a difference.

## 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 an impact at the end of 2008 (Figure 1). Rather, the main concern was the prospect of too much disinflation (after 2011) and then actual deflation through 2015-16.

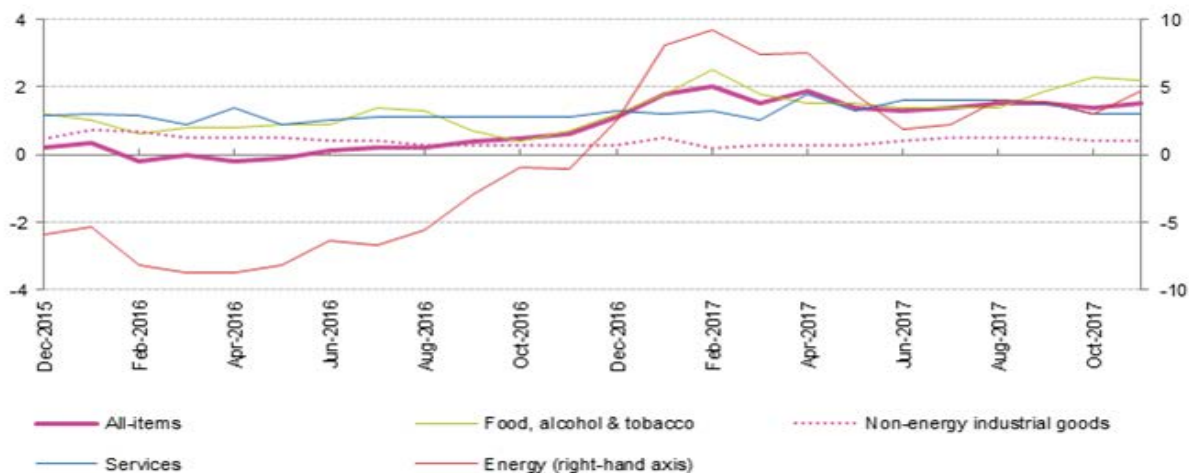
However, the euro area’s gradual recovery starting in 2015 has generated a small recovery in inflation which started in 2016, accelerated in August 2016 to February 2017, then held roughly steady to April 2017 before decelerating again to the end of 2017 (Figure 2). But the numbers are small. Inflation, at the peak of the 2016-17 increase, only just touched the target value of 2% before drifting back to 1.5% in 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, the increase has been small, has remained within the ECB’s target of 2% or less, and was not sustained. Hence, from a cursory look at the data, it would be hard to argue that there had been a passing structural change. However, an underlying change of regime is possible. We test that proposition directly in the next section and appendix to this paper.

Figure 1: Euro area inflation (% pa) and its components (2007-2017)



Source: Eurostat.

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





Source: Eurostat.

The second point is that there is a fairly clear correlation between the euro area inflation rate in Figures 1 and 2, and inflation in energy prices and to some extent food prices. However, there is no corresponding correlation between inflation and industrial goods or services prices. This is relevant 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 could be a signal of increasing competitiveness instead.

## 2. INFLATION TRENDS AND STRUCTURAL CHANGE TESTS

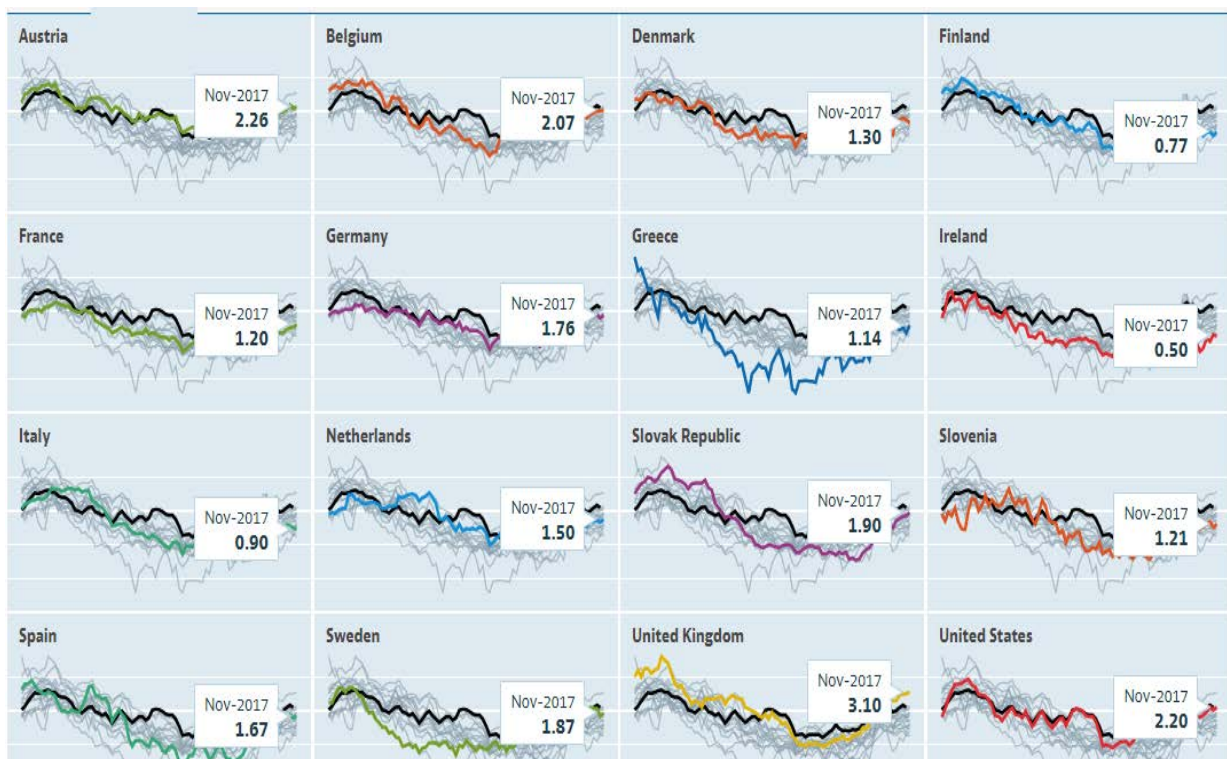
### 2.1. Inflation Trends by Country

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

- i) it still falls short of the 2% Euro-wide target, the mandated ECB target;
- ii) it is unclear if this inflation was caused by the recovery or by external factors such as the recovery in energy prices in 2017, occasional food price spikes, and increased wage bargains in Germany;
- iii) 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)<sup>1</sup>.

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%.

Figure 3: Inflation rates by country in the euro area 2007-2017



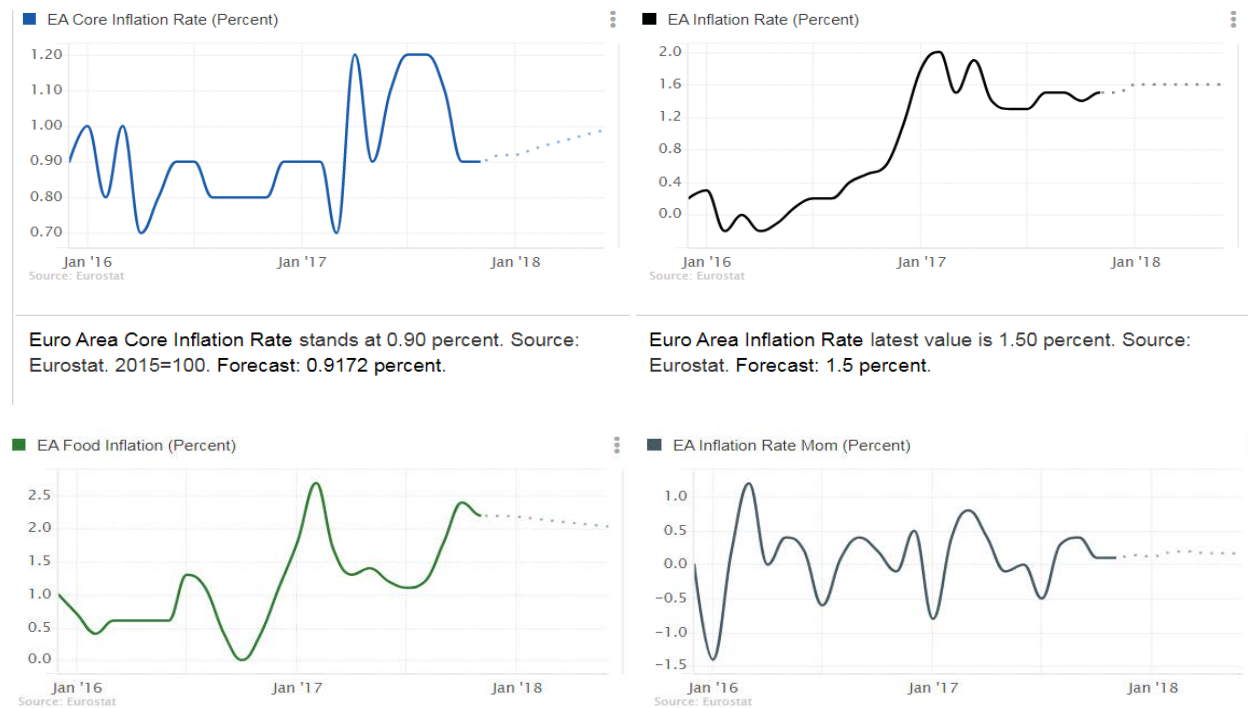
Source: OECD.

<sup>1</sup> These figures are for December 2016 (Datastream).

## 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 four 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 (lower left panel, Figure 4); but the second part would have been 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.

Figure 4: Core inflation and forecasts in the euro area



### 3. WHY HAS THE RECOVERY NOT PRODUCED A MATCHING STRUCTURAL CHANGE IN INFLATION?

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

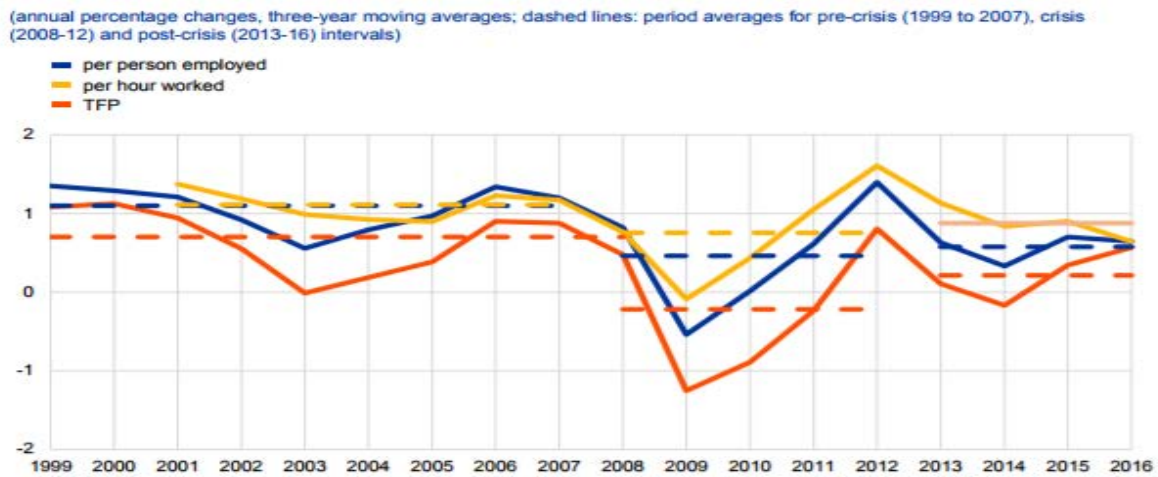
To be fair, this has been a feature of many if not most of the advanced economies, not just the euro area. Nevertheless, the essential message is the same in the euro area as elsewhere. With wage settlements subdued or static as you would expect under the high unemployment in the recession itself, and with limited prospects of rapid growth in the near future, short term low wage contracts would seem to be 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, as in previous years in many euro area economies, an inexorable rise in unit labour costs has led to an overinvestment in (at that point, relatively cheap) capital at the expense of labour.

However, there is a catch. Once this process has set in a reinforcing mechanism 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 then remain attractive to employ extra (cheap) labour rather than invest in new capital. But if that 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 anaemic 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 mechanism in the first place further into the future and ensures that it continues.

There is no “productivity puzzle” here as some have claimed. Instead, we see the inevitable consequences of correcting 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 because of the self-reinforcing mechanism identified above. That is then the explanation of the absence of a 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 above, the absence of a structural change is likely to continue for a long while.

How does the data look? Does it support this explanation of the lack of a structural change in higher inflation rates in the euro area? Figures 5 and 6 show that indeed it does. Figure 5 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, will amount to quite a reduction overall.

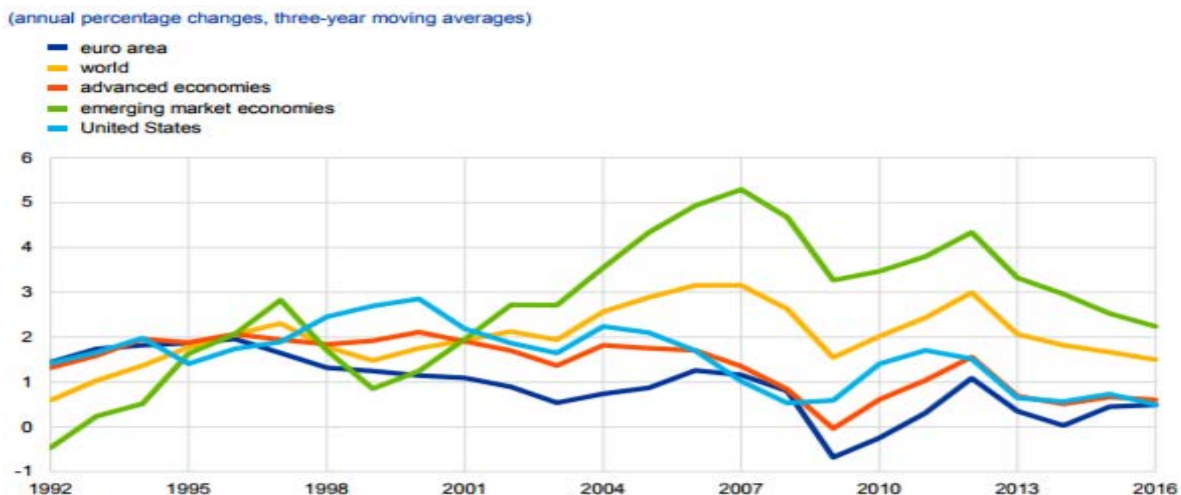
Figure 5: Euro area productivity growth



Sources: Eurostat, the European Commission's AMECO database and ECB staff calculations.  
 Note: TFP is computed from estimates of output per person employed (taken from the European Commission's AMECO database, which includes an estimate for 2016 on the basis of the European Commission's Winter Forecast 2016).

Figure 6 then reinforces this evidence for labour productivity. But bear in mind that 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 perhaps, but clearly below the world average, and significantly below that in the emerging market economies.

Figure 6: Labour productivity growth in the euro area, vs. the world and regions



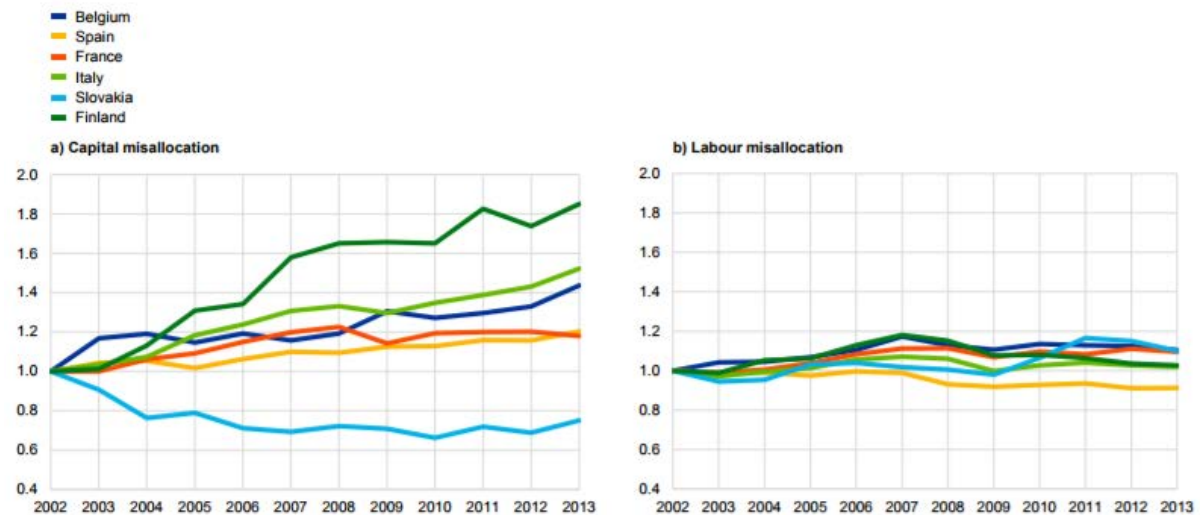
Sources: The Conference Board and ECB staff calculations.  
 Note: Labour productivity is defined as output per person employed.

In addition, there is also evidence of a misallocation of inputs into production in the lead up to and into the great recession, sufficient to cause an undoing of the inefficiencies of a distorted balance of inputs when the great recession triggered changes in relative input costs. Unfortunately we do not have a complete data set to support that contention beyond doubt. But Figure 7 shows increasing

over-allocations of capital in a number of economies, if not a majority of them, over the years up to 2013 according to the calculations made by ECB (2017). This was most marked in Finland, Italy and Belgium; but they are still significant (a 20% increase over 10 years) in France and Spain.

Figure 7: Capital and labour misallocations in euro area economies, 2002-2013

(weighted averages of dispersion in the marginal revenue product across firms within a given sector; 2002 = 100)



Source: ECB staff calculations based on the 5th vintage of CompNet data.

These observations set a starting point for, and are entirely consistent with, our hypothesis of a “job-rich” recovery with low real wages, low productivity growth, slow output growth, and no structural change in inflation. Labour misallocations, by contrast, appear to have been small over the same period (rising slightly in 2007, falling in 2012-13). But they show nothing on the same scale as the corresponding capital misallocations. This then completes the story.

Notice that the precepts and implications of this model of the recovery are directly opposite of those assumed in the Basu et al. (2006) model of the short-run 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 and productivity changes to the choice of factor inputs and output; and from the choice of factor inputs and relative prices to productivity outcomes. The Basu et al. model lacks this second interaction channel and hence typically gives biased results. Second, Basu et al. do not allow for recessions or recoveries, and that leads 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 – which leads to a “shift premium” (a premium on real wages) on wages to balance rises in demand for labour against a quasi-fixed supply. The key link here is between the shift premium in wages and hours worked, reflecting both effort and capital utilisation. The upshot is rising real wages but little employment increase in a recovery – precisely the opposite to what we have seen in the Euro-zone (and this paper), where labour supply has evidently been very responsive.

## 4. CONVENTIONAL RESPONSES TO THE LOW REAL WAGES, LOW INFLATION DILEMMA

The key lesson from the discussion so far is that there is a crucial difference between policies intended to improve a single economy's performance in conditions of low inflation and low productivity growth (policies elsewhere assumed to remain unchanged), and policies intended to help a group of economies in a currency union or common economic block. That is, between policies for an individual economy and those for the collective. Relying on globalisation or a productivity gain available within a currency union is not going to work because the gains from the initial action will be undone by parallel gains/responses in partner economies. There may be scope to help an individual economy; but coordination on policies of this kind in a union is a contradiction in terms since that is what has caused the problem in the first place (Carney's 2017 advocacy for them notwithstanding).

i) There have been many calls for economies to open up their markets to foreign trade and capital to boost *relative* competitiveness on an individual basis, starting with the Washington Consensus and Reagan-Thatcher era reforms, to more recent cases. But there have been few advocating the same on a world, OECD or Euro-wide basis. Nevertheless, coordination of a different kind is still needed. Monetary-fiscal policy coordination is the obvious candidate; if only because introducing fiscal policy adds extra policy space to be used and because, having lost the use of domestic monetary policies, most economies will face greater demands to deliver more through their fiscal policies (Demertzis et al. 2004).

ii) Daley (2019) argues that firms and labour have lost price and wage-setting power to globalisation and automation. That has weakened the link between employment and wage growth (hence inflation) at the cost of competitiveness and productivity. To rebuild that link, we need coordination between monetary policy and structural and labour market reforms.

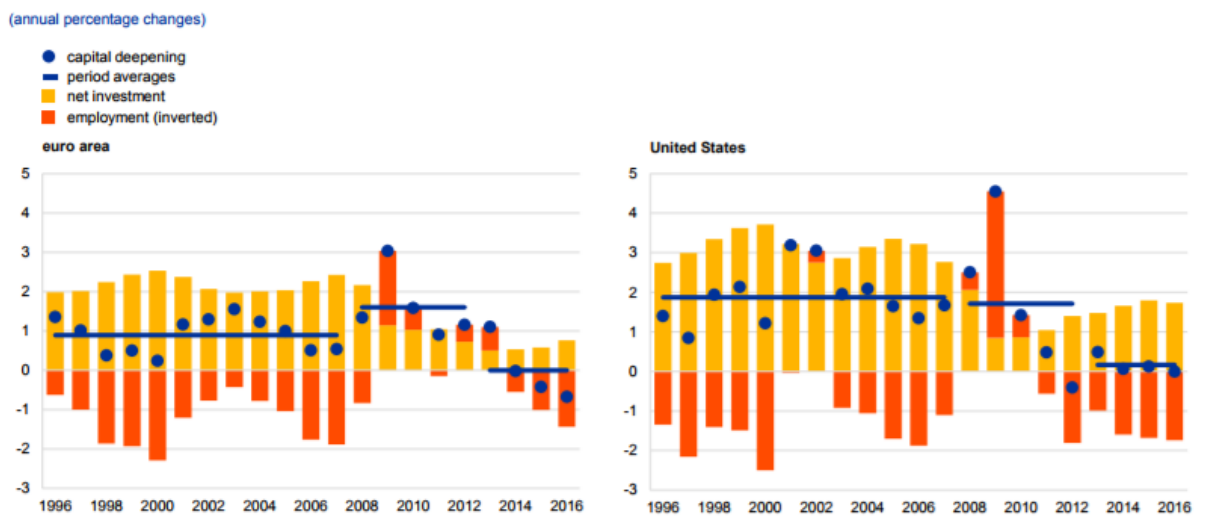
iii) Lane (2019) questions the ability of central banks to maintain the credibility of monetary policy when inflation is falling below target. Once again, coordination is needed, but this time coordination with some other anchor of monetary policy so that the policymakers can demonstrate the credibility of their policies independently of the apparently counter-intuitive inflation and low wage outcomes. It all comes down to the credibility of the policymakers themselves, as opposed to the policies as such (Drazen and Masson, 1994).

## 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, will be reduced. Productivity growth, both that which comes from 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 8. 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 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.

Figure 8: Capital deepening in the euro area and US

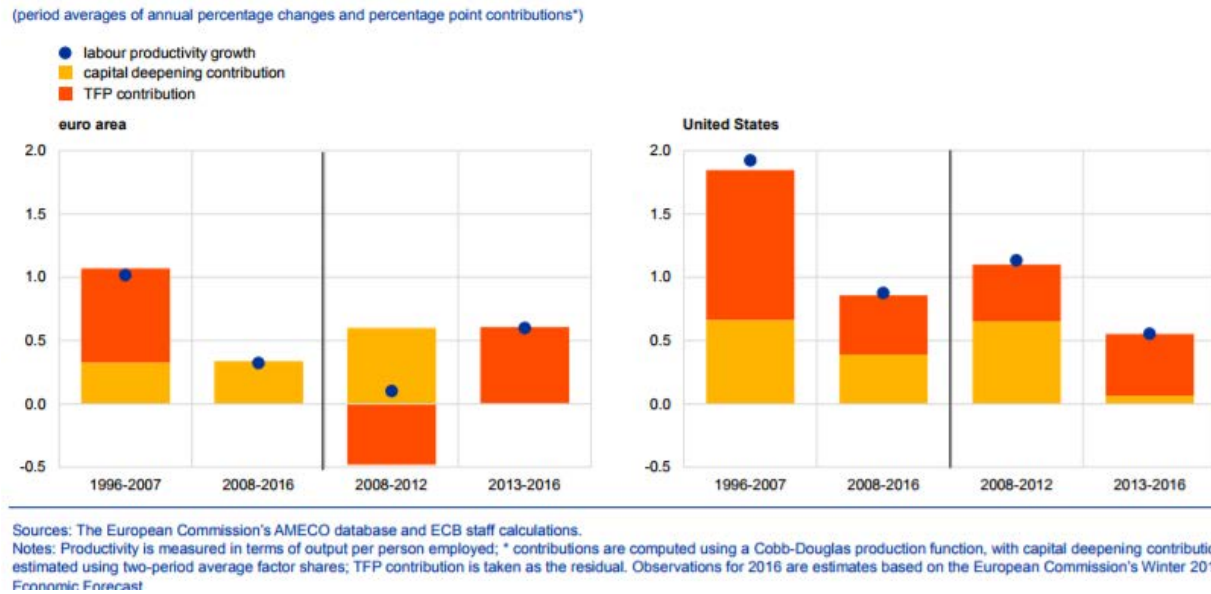


Sources: The European Commission's AMECO database and ECB staff calculations.

Notes: Observations for 2016 are estimates based on the European Commission's Winter 2016 Economic Forecast. Period averages correspond to 1996-2007, 2008-12, and 2013-16, respectively.

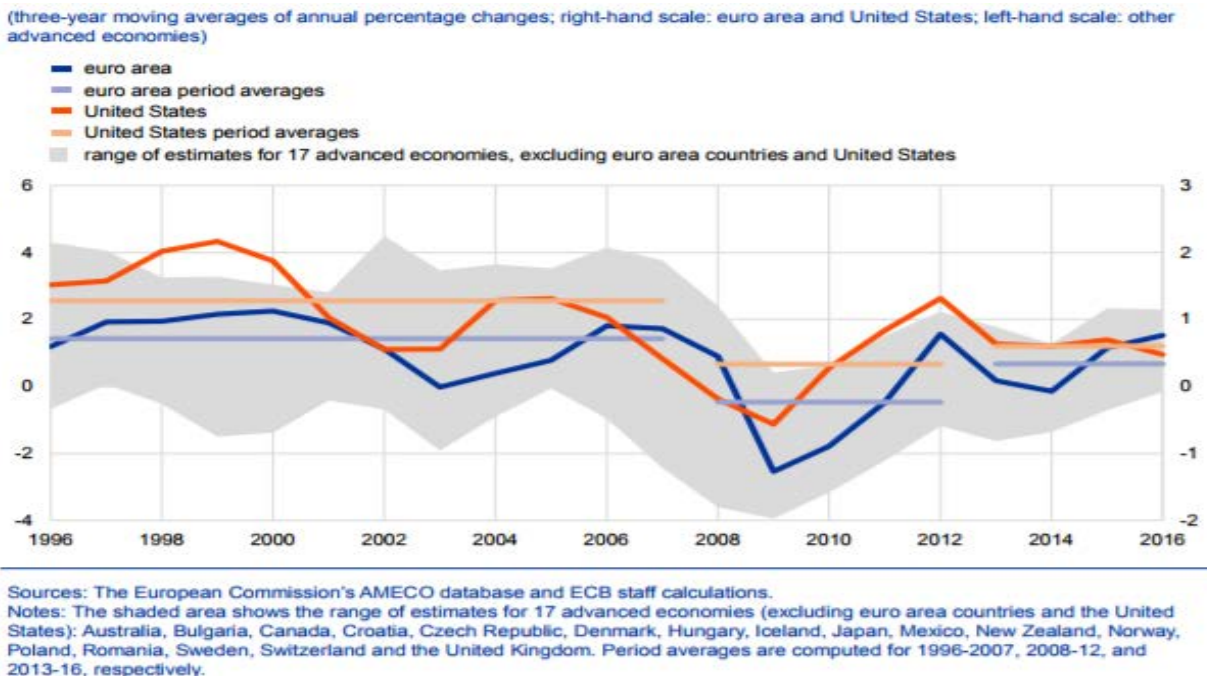


Figure 9: Productivity growth and its decomposition in the euro area and the US



Thus, 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 9). 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 are small in the US. In addition, 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 so far 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.

Figure 10: Total factor productivity growth in the advanced economies



To complete the picture, Figure 10 shows the development of euro area TFP (to go with euro area labour productivity in Figures 5 and 6) 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 too.

## 6. NONTRADITIONAL METHODS AND FURTHER ATTEMPTS AT POLICY COORDINATION

- a) **The distribution of income matters:** If the conditions that create an excess supply of labour, or higher returns to expensive capital relative to cheap labour, exist, then firms will continue to invest in cheap labour and low real wages and capital's share in national income will rise. Moreover, this will continue as long as economic growth is faster than the gains from productivity growth. The coordination needed here is either: i) a set of policies designed to reduce imbalances in the distribution of incomes received (nationally or Euro-wide); and/or ii) a set of policies designed to boost productivity growth (of any kind) in the national economies; or iii) an agreed programme of retraining to deflect the skills shortage that underpins low real wages. The former would help take the underlying problem away; the latter two provide an antidote to the current situation. Unfortunately, there is little evidence that the EU economies have much interest in coordinating such policies.
- b) **The distribution of the gains from productivity growth matter:** In a model of fiscal sustainability, Hughes Hallett et al. (2017) find that interactions between income inequality and the distribution of gains from productivity growth affect output growth and the level of public debt. Specifically, increases in the share of the gains from productivity growth that go to the private sector leads to: i) lower levels of optimal (output maximising) sustainable public debt; ii) but to higher rates of output growth – other things equal.

These improvements 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 *inequitable* those incomes distributed are to start with; and b) it becomes even more *ineffective*, the greater the share of productivity gains already going to the private sector. So the *distribution* of productivity gains matters. But there are natural limits to how much this can be used to induce income or inflation changes in a desirable way.

- c) **Sticky prices imply sticky wages that can trap a low real wage-low productivity regime in place:** Much has been made of sticky prices in markets for consumption goods. Sticky prices would prevent, or at least slow down, those markets from clearing within any given timeframe and hence would play a key role in explaining inflation dynamics and the rate of inflation at any point. Recently, Aparicio and Rigabon (2019) have made a detailed empirical analysis of price movements to demonstrate that is exactly what happens. That converts a theoretical possibility (due to Calvo in the 1970s) into a generally applicable proposition. But they go further; wages are notoriously sticky, especially downwards, and what applies to prices typically applies to wages (albeit with different timings and motivation). Hence falling inflation is likely to make wages stickier. And if there is to be coordination to prevent wages being trapped in a low wage regime, it will have to be cross-country wage coordination – an unlikely event in practice.
- d) **The importance of retaining a transparent, predictable external exchange rate regime:** Harris (2002) outlines a mechanism in which the form of exchange rate regime between economies affects investment spending and 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 currency depreciation, firms would feel little pressure to upgrade their plant, rationalise 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 consequent productivity growth will be lower than they might have been. Conversely, a cost disadvantage caused by a currency appreciation, or a 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 the consequent slowdown in productivity growth in the same period (Figure 5).

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 and 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. They will tend to be slower to arrive and last longer. In the current circumstances, there would be a tendency for the euro area economies to diverge rather than converge (as we have seen); and, if the austerity economies are in a majority, for productivity growth to slow down (a second-round effect to that in paragraph 3).

Thus, when competitiveness falls below average (costs rise), firms will seek to upgrade and productivity will grow. But when competitiveness rises (domestic costs fall, and real wages are low) there is less pressure to innovate and productivity growth will be slower. The key point is that the Euro-zone has no fixed or predictable exchange rate regime, the rate being left to fluctuate through benign neglect. Firms will have little idea when they will need to introduce productivity improvements, and when that will be less important. In that case, a coherent strategy to defeat the low wage-low inflation syndrome will be very difficult to organise, and the necessary investments are unlikely to materialise. It would help the Euro-zone economies a great deal if the ECB could devise an explicit external exchange rate regime to coordinate productivity improvements around.

## 7. CONCLUSIONS

The bottom line here is that there appears to have been no structural change in euro area inflation in its recovery over the past three years. Nor has there been a change in the underlying conditions that would suggest that such a change in inflation is likely to take place in the near future. However, this is not to say that inflation has been the same everywhere.<sup>2</sup>

That said one conclusion stands out in this paper's analysis, and in the discussions at the 2019 Jackson Hole meetings (Economist, "*Meeting of Minds*" August 31<sup>st</sup> p.59, 2019), which is that almost all the solutions discussed here remain in the area of conventional monetary policy<sup>3</sup>; they do not consider structural reform in the economy or coordination with instruments outside the monetary arena.

The real risk, therefore, is policymakers get stuck in their own bubble and fail to investigate non-traditional alternative policies properly. These alternatives may include structural and labour market reform to restore market flexibility, and the link between employment, wage growth, and competitiveness are very feasible but have seldom been implemented seriously. Rebuilding the credibility of the policymakers is also a useful support mechanism. But what won't work is more globalisation or conventional monetary coordination (Carney 2017).

More interesting perhaps are the non-traditional approaches outlined in Section 6. Changes in the distribution of income and productivity gains may have a big impact in size if history is anything to go by, but be very slow to take effect. One easy and practical thing to help on this score is set up a clear and easy to track exchange rate mechanism with a view to encouraging productivity-improving investments. This appears not to have been considered, but could make a difference.

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<sup>2</sup> 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. The degree of internal convergence has been significant, therefore.

<sup>3</sup> By this, I mean concerns that risk premia generated by current monetary policy interfere with the adjustment process, add to the price of debt, and encourage capital flight from outside, raising the cost of stabilizing the smaller or emerging markets.

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## ANNEX: SOME SIMPLE 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:

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

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  $(\dot{P}_t \cdot D_t)$  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 only aim to pick out the most significant. The results are set out in Table 1, with t-ratios to allow tests of statistical significance for each factor in the inflation process and specifically for the structural change variables.

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)):

- i) 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.  $R^2$ ) 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).
- ii) The time trend in the data is strongly significant, but negative – as can also be seen in the actual data (blue dots) in Figure 11. It is negative until December 2014, and not positive until May 2016 (and not positive enough to outweigh the negative trend up to 2014). It would, therefore, be premature to expect a structural change to positive *trend* inflation (as opposed to occasional positive values) after this long negative trend.
- iii) There is strong (cyclical) serial correlation in the residuals of this regression, evident in the scatter plot of the residuals in Figure 11. So the coefficients in time trend regression are likely to be poorly determined, which calls for alternative specifications. Interestingly though, the scatter plots of the observations and residuals show a tendency to converge after 2014 (without coinciding), which implies inflation is returning to some previous underlying pattern of behaviour rather than a new trend. A structural change seems relatively unlikely therefore.
- iv) The lag models (2) to (6) show very similar results, which improve slightly 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 (although the proxy role played by the constant term vanishes in that case).
- v) The two structural change tests, models (7) and (8), are rejected. Both the level change test and slope change (acceleration) tests return strongly insignificant results – though the changes would have been positive, had there been any significant evidence for them.

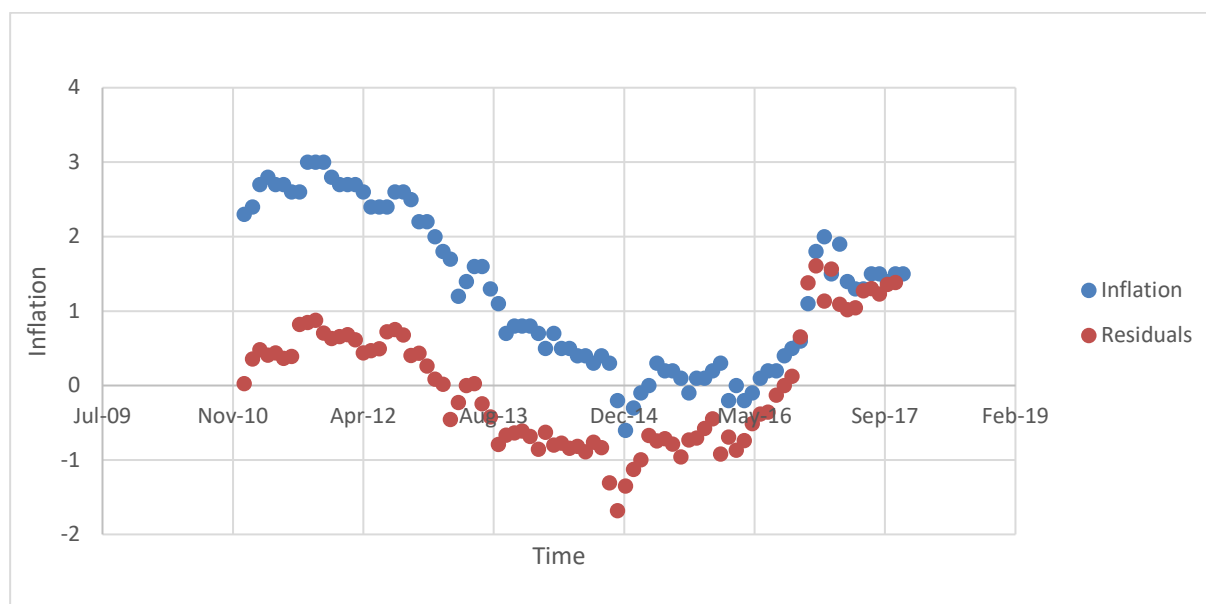
The implication of these tests is therefore that inflation cannot be said to have been subject to a structural change in price dynamics, merely a gradual return to a continuation of past trends (since 2011 at least).

Table 1: Trends and Structural Change, Euro Area Inflation, Jan. 2011-Dec. 2017

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

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

Figure 11: Data points for Table 1







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This paper examines the case that there has been a structural change in the determination of inflation in the EU (and elsewhere) that has led to a low real-wages, low inflation, slow productivity growth regime. In fact, there appears to have been no structural change. Instead, there has been a marked convergence between the performance of those variables in national economies. The implication is that there is little scope for greater monetary coordination in the conventional sense, or adjusting the monetary rules (e.g., targets), since this uniformity is the origin of the low inflation problem. Outcomes can be improved with better coordination of monetary policy with non-monetary variables. There are two lines of attack. One is a short term approach using conventional instruments (monetary-fiscal, structural or labour market reforms, improving policymakers' credibility). The other is a long term approach based on improved income distribution, a better distribution of the gains from productivity growth, and stabilisation by means of an external anchor (exchange rate).

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