ARTICLE

POTENTIAL OUTPUT, ECONOMIC SLACK AND THE LINK TO NOMINAL DEVELOPMENTS SINCE THE START OF THE CRISIS

Potential output estimates are highly uncertain, but according to most estimates from international institutions, potential growth in the euro area has fallen since the onset of the financial crisis in 2008 largely due to smaller contributions from capital and labour. The most recent estimates suggest that potential growth may be stabilising in the euro area and that it is already picking up in the United States.

In the United States, the greater flexibility of labour markets and the economy more generally is supporting potential growth. As regards the euro area, although it is too early to see the effects of the structural reforms implemented since the start of the crisis, further are needed to support potential growth, especially in view of the negative impact population ageing is expected to have on potential growth in the near future.

The link between activity and inflation has become more tenuous in recent years, whether judged by means of gaps derived from potential output or by means of alternative measures of economic slack. The structural rigidities remaining in the euro area are among the factors behind this phenomenon, although the firm anchoring of inflationary expectations may also explain the behaviour of prices and wages during the crisis.

1 INTRODUCTION

Potential output is an important variable, as it measures the level and rate of activity that may be achieved in the economy in the medium to long term. This is in contrast to actual output, which simply measures the current level and rate of activity and can be above or below potential for some time, although not in the long run.

Potential output growth is subject to fluctuations over the business cycle because some of its components are affected by cyclical developments. These fluctuations, however, tend to be much less pronounced than the fluctuations in actual output growth. This was the case also during the recent financial crisis, although to what extent is uncertain, perhaps more so than in previous downturns owing to the severity of the slowdown in activity and the size of the imbalances that had accumulated prior to it.

In the longer term, potential output growth in the euro area is likely to remain below the growth rates recorded before the crisis on account of demographic factors. It is unclear, though, to what extent the crisis-related decline in potential output will be temporary or more long-lasting. This will depend, among other things, on the effects of the structural reforms undertaken in recent years in supporting higher rates of productivity growth and flexibility in the medium and long term.

This article therefore discusses output developments during the crisis, examining the factors behind the developments and what may be done to support future potential output developments. The article also examines the link between alternative measures of slack and the nominal side, and investigates the extent to which the measures of slack help in explaining the relatively muted reaction of prices and wages since the onset of the crisis.

Section 2 reviews the concept of potential output and the estimates for euro area and US potential output since the onset of the crisis in 2008, including the contributions from capital, labour and total factor productivity (TFP). It includes an analysis of developments in TFP growth in the euro area and compares them with those in the United States. Section 3 discusses measures of slack,

including the gap derived from potential and actual output – the output gap – and examines the link between those measures of slack and nominal developments since the onset of the crisis. Section 4 concludes.

2 EURO AREA POTENTIAL OUTPUT DEVELOPMENTS SINCE THE START OF THE CRISIS

2.1 THE CONCEPT OF POTENTIAL OUTPUT

The concept of potential output is not precisely defined.[1] In broad terms, potential output may be taken as an indication of the level or rate of activity that could be achieved in the economy in the medium to long term. Indeed, it is often thought of as the level or rate of activity that can be sustained by means of the available factors of production without creating pressure on prices and the rate of inflation.

Although this broad definition may be widely accepted, the experience during the crisis, particularly the large build-up of (ex post unsustainable) imbalances in a stable inflationary environment, has led to suggestions that associating potential output with non-inflationary output may be too restrictive and that it may be necessary to incorporate information about the financial cycle to make measures of potential output and the corresponding output gaps more telling.[2]

In an accounting sense, potential output is determined by the trend components of the factors of production – capital and labour – and TFP, where the latter captures the overall efficiency of the use of the factors of production.

The trend component of TFP is driven by technological change, as well as by the economic framework conditions, and is a key element supporting potential output in the long run. Trend capital is the existing capital stock augmented with capital accumulation, which is the net effect of additions to the capital stock, i.e. capital formation (or investment), and deductions from it due to depreciation and scrapping. Trend labour also depends on endowments and their evolution, i.e. population dynamics (demographics), including migration, and how such dynamics translate into labour supply through the share of population of working age and the rates of labour participation and structural unemployment.

How the trend components and potential output evolve over time is determined both by the structural features of the economy and by the institutional and economic framework conditions in which the economy operates. Key aspects of the latter are the legal and regulatory environment and the design of the tax system, as well as structural features such as financial, labour and product market regulation.

It is important to note that changes to both the framework conditions and the structural features of the economy tend to occur only gradually. The impact of such changes on potential output therefore

1 For an earlier discussion of the concept of potential output, see the article entitled "Potential output growth and output gaps: concept, uses and estimates", *Monthly Bulletin*, ECB, October 2000. See also the article entitled "Trends in Potential Output", *Monthly Bulletin*, ECB, January 2011.

2 See Borio, C., Disyatat, P. and Juselius, M., "Rethinking potential output: Embedding information about the financial cycle", *BIS Working Paper*, No 404, 2013. The authors argue that incorporating information on real interest rates and real credit and residential property price growth, for example, as a way to take into account explicitly the financial cycle (e.g. in the pre-crisis upswing, ample finance at favourable conditions), would imply potential output developments that are more muted pre-crisis and display less of a fall during the crisis, explicitly reflecting the unsustainable nature of the pre-crisis financial cycle.

tends to take some time to unfold. This implies that the developments in potential output seen since the onset of the financial crisis can, to a large extent, be attributed to the imbalances that had accumulated prior to the crisis. Moreover, it means that potential output in the post-crisis period is also going to depend on the policy response to the crisis.

Potential output in the post-crisis period may be lifted by structural reforms raising the quantity and quality of capital and labour, or raising productivity across sectors, as well as the restructuring of the economy by shifting resources towards more productive sectors. In the absence of such reforms and restructuring, potential output growth may be held back for some time to come.

Although inflation is ultimately a monetary phenomenon, the concept of potential output also provides an indicator for assessing pressures on prices and inflation, via the output gap – generally defined as the percentage deviation of the level of actual activity from the level of potential output. The output gap is a measure of the over or underutilisation of resources in the economy (i.e. overheating or slack), and an indicator of the state of the business cycle, that contains information for likely developments on the nominal side.

While the output gap is a particularly useful measure of slack, it is also particularly uncertain, as potential output – and hence the output gap – can only be estimated and not measured. Alternative measures of slack, such as capacity utilisation, are therefore also useful for judging the degree of slack in an economy and may indicate pressures on inflation.

2.2 THE EVOLUTION OF FACTORS OF PRODUCTION AND TOTAL FACTOR PRODUCTIVITY SINCE THE BEGINNING OF THE CRISIS

According to recent estimates by the European Commission, which give a broadly similar picture to estimates from other institutions, euro area potential output growth declined to 0.9% on average in the period 2008-12, compared with 2.2% on average in 2000-07 – a drop of 1.3 percentage points. Chart 1 shows that, for the same periods, euro area actual output growth dropped to -0.2% from 2.2%, a fall of 2.4 percentage points and much greater than that for the estimates of potential growth. This is broadly comparable with the case of the United States (see Chart 2), where for the same periods the fall amounted to 1.4 percentage points in the average estimates of potential output growth (from 2.5% to 1.1%) and to 2.0 percentage points in average actual output growth (from 2.6% to 0.6%).

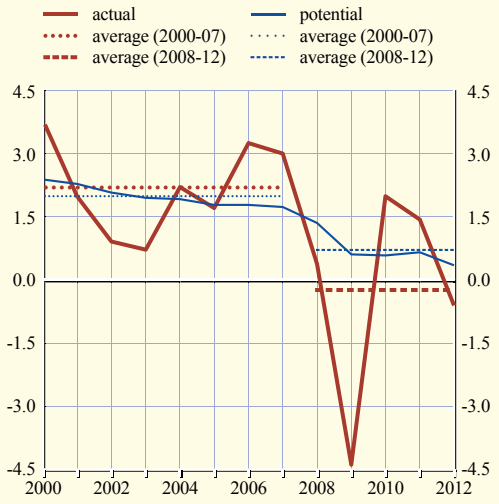
As can be seen from Chart 3, the slowdown in the estimates of euro area potential output growth was mainly due to the estimated non-TFP contributions (labour, notably persons, and capital). The estimated TFP contribution, by contrast, dropped only marginally during the crisis, having already declined in the pre-crisis period, consistent with the experience in previous financial crises.[3] Chart 3 also shows that the estimated contribution from labour (persons) fell noticeably at the onset of the crisis in 2008, recovering subsequently, while the estimated contribution from labour (hours per person) was negative throughout the entire period. As a result, the estimate of the overall contribution from labour turned negative in 2008. The estimated contribution from capital remained positive during the crisis, although it shows a sizeable decline in 2009 with little recovery since.

Chart 4 shows that in the United States the TFP contribution also slowed only marginally during the crisis, having started to decline long before it. However, while estimated potential output growth

3 See *World Economic Outlook*, IMF, October 2009.

Chart 1 Potential and actual output – euro area

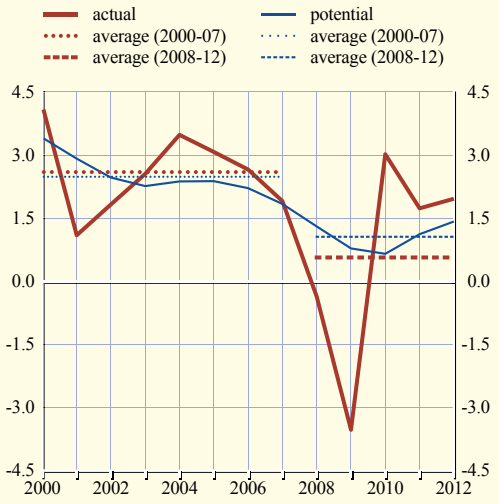
(percentages per annum)



Sources: European Commission (CIRCABC) and ECB calculations.

Chart 2 Potential and actual output – United States

(percentages per annum)

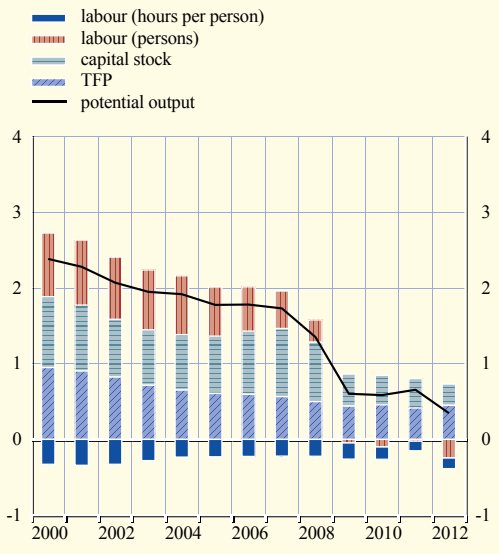


Sources: European Commission (CIRCABC) and ECB calculations.

in the euro area remained weak in 2011-12 (possibly driven by the sovereign debt crisis and its consequences, such as a deterioration in confidence and an increase in uncertainty), it has started to recover in the United States (possibly due to the more flexible nature of the US economy). This is discussed in more detail in Box 1.

Chart 3 Potential output and its components – euro area

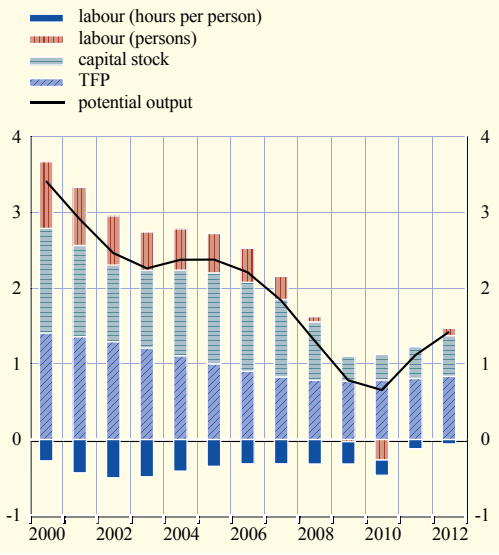
(annual percentage changes; contributions in percentage points)



Source: European Commission (CIRCABC).

Chart 4 Potential output and its components – United States

(annual percentage changes; contributions in percentage points)



Source: European Commission (CIRCABC).

Box 1

EURO AREA PRODUCTIVITY GROWTH: A COMPARISON WITH THE UNITED STATES

This box compares the recent productivity performance in the euro area with that in the United States on the basis of the latest observations from the European Commission's AMECO database. In contrast to the TFP estimates reported elsewhere in this article (where productivity contributions to potential output are estimated on the basis of assumptions of fully-utilised inputs at optimal capital-labour ratios), the numbers reported in this box are derived from observed ("revealed") changes in output and input usage.[1] This focus on actual productivity developments thus provides a useful cross-check, in that a strong divergence between actual and potential estimates may be an indication of uncertainty surrounding estimates of trend TFP growth.

Chart A illustrates aggregate ("headline") labour productivity developments for the euro area and the United States from 2000. The chart shows that euro area labour productivity growth (per person employed) was already lacklustre compared with that in the United States before the onset of the crisis and that it virtually stagnated (averaging 0.1% per year) after 2008. By contrast, while US productivity growth also slowed considerably between the two periods, it nevertheless averaged around 1.0% per year after 2008.

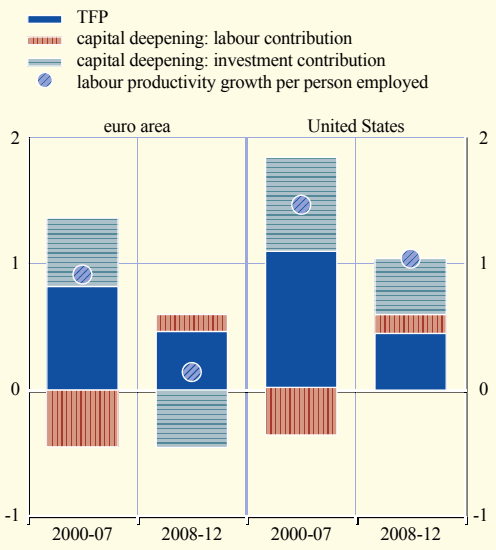
From a growth-accounting perspective, labour productivity growth can be broken down into growth attributable to changes in "capital deepening" (i.e. an increase in the capital-labour ratio, combined with changes in capital and labour utilisation) and that attributable to growth in "total factor productivity" (TFP). Capital deepening can be further subdivided to isolate the respective contributions of changes in the rate of investment and changes in employment levels to changes in capital labour ratios. Having accounted for changes in the factor inputs, TFP is then interpreted as representing the underlying growth in economic efficiency not attributable to changes in the factors of labour or capital, i.e. those elements of technological change, resource allocation, managerial "know-how", economies of scale and scope, etc., which underlie the long-run trend of aggregate productivity growth.

Chart A shows that, despite virtually halving on both sides of the Atlantic since the onset of the crisis, capital deepening remained positive, as strong declines in rates of net investment were slightly offset by strong job-shedding in both economies, while TFP dynamics followed very different paths. In marked contrast to the mostly positive TFP growth observed in the United States after the onset of the crisis, euro area TFP was negative. As a result, favourable developments from factor inputs were more than offset by revealed TFP developments, leaving headline euro area productivity growth broadly stagnant. The more downbeat picture of TFP developments from this perspective (relative to the contribution of trend TFP examined in the main text) can be largely attributed to differences between trend and observed TFP developments over the course of the crisis and also underlines the large uncertainty surrounding trend TFP estimates at this juncture.

1 This box also reports productivity developments per person employed (rather than per hour worked, as used elsewhere in this article). The data reported in the AMECO database refer to estimates, harmonised on the basis of the standard European (ESA) methodology, which typically report aggregate productivity dynamics in terms of "whole economy" developments. Data for the United States may therefore differ from US "headline" estimates, which often refer instead to the "non-farm economy" or the "non-farm business sector" (i.e. excluding the public sector).

Chart A Labour productivity growth breakdown – euro area and United States

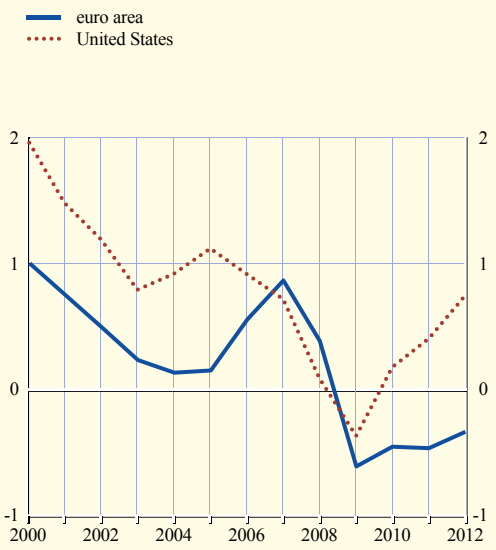
(average annual percentage changes; contributions in percentage points)



Sources: European Commission (AMECO) and ECB calculations.
Notes: The sum of the shaded portions of the bars denotes the contribution to aggregate labour productivity growth of changes in capital deepening, broken down into the contributions arising from changes in capital spending (net investment in capital per person employed multiplied by the capital share in total factor costs) and changes in labour composition (growth in labour multiplied by labour share in total factor costs). The solid portion of the bars represents the estimated contribution from growth in total factor productivity.

Chart B Observed TFP growth 2000-12 – euro area and United States

(percentage changes; annual data)



Sources: European Commission (AMECO) and ECB calculations.

Focusing on TFP dynamics since the height of the crisis, Chart B suggests signs of a re-emergence of the TFP gap seen in advance of the crisis between the euro area and the United States. Although both economies suffered sharp TFP contractions at the depth of the global recession, since then US TFP appears to have rebounded significantly, while euro area TFP growth remains subdued.[2]

Policy implications of the recent slowdown in euro area TFP growth

Several possible factors are likely to explain the continued weakness of euro area TFP performance. Low levels of capacity utilisation, resulting from weak or contracting economic activity, have tended to persist rather longer – and to a greater extent – in many euro area economies than in the United States and have undoubtedly affected the efficiency of capital and labour usage, thus depressing TFP growth. As economic growth returns, measured TFP growth is thus likely to rebound somewhat in the euro area (and to perhaps slow somewhat in the United States, reflecting higher current levels of capacity utilisation).

While both economies are likely to have experienced considerable destruction of firm and sector-specific human capital in permanently downsized sectors and enterprises, typically stronger labour

2 While TFP estimates vary considerably (according to the model and data source used), estimates of US rates of TFP growth continue to outstrip those typically observed in the euro area.

and product market regulation in many euro area countries is likely to have slowed both firm-level adjustments and broader sectoral reallocations to a greater extent than in the United States, effectively delaying the rebound in TFP and weakening potential rates of TFP growth. Ongoing financial market frictions – constraining working capital, affecting firms' investment decisions and ultimately limiting innovative activity (by curtailing R&D, reducing investment in innovative technologies or limiting funds available to new – and potentially innovative – firms) – are also likely, against the backdrop of sovereign debt concerns in some economies, to have been stronger in the euro area than in the United States, leading to a postponement of investment and restructuring.

Since the crisis, actual TFP growth for the euro area has remained weak, possibly an indication that there are downside risks to current estimates of trend TFP growth in the medium term. Efforts to support a rebound in euro area TFP growth will require measures to enhance the knowledge-based economy and foster innovation, so as to strengthen competitiveness. These objectives would be supported by further wide-reaching structural reforms – to product, labour and financial markets – in order to encourage investment and innovation, accelerate sectoral and firm-level restructuring and enable adequate incentives for human capital investment.

2.3 THE FACTORS DRIVING CONTRIBUTIONS TO POTENTIAL OUTPUT DURING THE CRISIS: STRUCTURAL AND CYCLICAL

This section explores some of the explanatory factors behind the evolution of the different components of potential output, distinguishing between those that are structural and those that are cyclical. Examples of structural factors are reforms to labour and product markets, changes in tax and pension systems, population developments, inter alia migration, and regulatory changes impacting on financial markets. These factors tend to affect the trend components of labour and TFP, as well as capital formation, and may therefore have a permanent effect on potential output levels and their growth rates.

Looking at the impact of structural reforms, both model-based and empirical evidence suggests that product and labour market reforms, as well as fiscal consolidation, may benefit potential output in the medium to long term. For example, as regards product markets, the deregulation of services, if it reduces mark-ups and increases competition, leads to higher investment, longer hours worked and greater growth of TFP in the longer run. Higher TFP growth is achieved through improved incentives for innovation and the adoption of technology (especially in countries that rely on adopting technology rather than being technological leaders), eliminating industrial inefficiencies and promoting more efficient firms under competitive pressure.[4] Reforms lowering entry costs appear to be particularly desirable, as they lead to lower unemployment.

The evidence suggests that labour market reforms – such as less stringent employment protection legislation – lead to higher employment and investment. The reform of unemployment benefit and retirement systems, as well as activation policies, have been shown empirically to increase steady-state employment levels, albeit in a slow and gradual way. Labour market reforms are also beneficial for TFP growth, although some dimensions of labour market flexibility (a large share of temporary contracts) may have a negative impact on firms' propensity to undertake long-term, human-capital intensive R&D projects. Fiscal consolidation, while decreasing hours worked in the

4 See Gomes, S., Jacquinot, P., Mohr, M. and Pisani, M., "Structural reforms and macroeconomic performance in the euro area countries: a model-based assessment", *Working Paper Series*, No 1323, ECB, Frankfurt am Main, April 2011.

short run, especially in the case of expenditure-based consolidation, benefits potential output in the long run through longer hours worked and investment.

In the euro area, progress with the implementation of structural reforms has been achieved (including prior to the crisis) in relation to labour markets and pensions, raising participation rates of the elderly and female workers, thereby supporting the trend labour contribution. While this effect is likely to be permanent, it is difficult to observe it in the aggregate participation rates for the euro area, which are also influenced by cyclical factors, implying lower participation rates for other groups of workers. However, rigidities still remain in labour markets and further reforms – including changes to tax systems, e.g. by lowering taxes on labour – are necessary to remove them.

In addition to the structural factors, potential output has also been affected by cyclical factors during the recent financial crisis. For example, investment rates have contracted substantially. One reason is that, during the crisis, a large amount of underutilised capacity emerged due to the prevailing lower output levels (accelerator effect) and adjustments took place in sectors that experienced excessive growth prior to the crisis (e.g. construction). As additions to the capital stock, in the form of newer technology generations, tend to have a higher technology content than the existing capital, it also means that the technology intensity of the total capital stock has increased at a lower rate than prior to the crisis.

The crisis has also lowered investment rates through its impact on financing conditions (terms and availability of credit, a financial accelerator effect) and uncertainty (heightened during the crisis, making it more difficult to assess investment projects). Moreover, the high indebtedness of non-financial corporations and the remaining need for balance sheet adjustment may restrict credit demand, resulting in lower investment rates and accumulation of capital for a considerable period.

While investment rates would be expected to recover as the euro area emerges from the crisis, the crisis has led to a permanent shift in the structure of the capital stock towards sectors and firms with different technology intensity. For instance, the decline in the share of construction, which has low TFP content, may lead to an increase in aggregate TFP growth (see below).

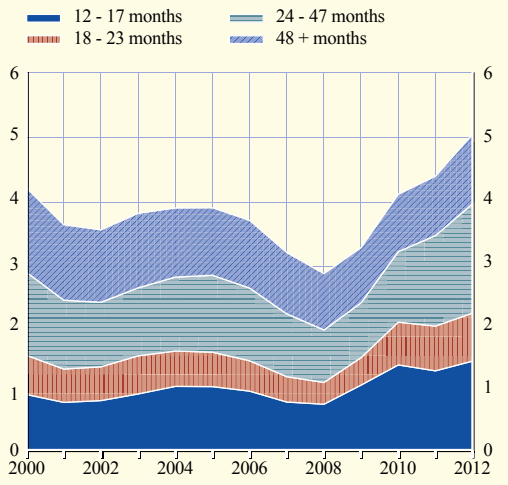
Other cyclical effects may be observed on labour input. One major factor in this respect is the migration triggered by the crisis. Immigration from the new EU Member States to some of the euro area countries increased, as did intra-euro area migration, but in parallel, immigration from outside the EU to some euro area countries fell significantly. Overall, net immigration to the euro area decreased during the crisis.

As regards participation rates, the cyclical effects are twofold. There has been a "discouraged worker" effect, as evidenced by the increasing number of those who are available to work but no longer searching for a job.[5] That effect in the euro area appears to have affected younger workers disproportionately, resulting in large increases in youth unemployment and non-participation. However, to some extent, this has been offset by an "added worker" effect, as efforts are made by previously inactive members to preserve household incomes. Overall, however, euro area participation rates have actually continued to rise throughout the crisis, but as a result of the above-mentioned structural factors, notably pension reforms and the better integration of female workers.

5 See the box entitled "Three indicators to complement the standard definition of employment and unemployment", *Monthly Bulletin*, ECB, June 2013.

Chart 5 Euro area long-term unemployment rate – duration of unemployment

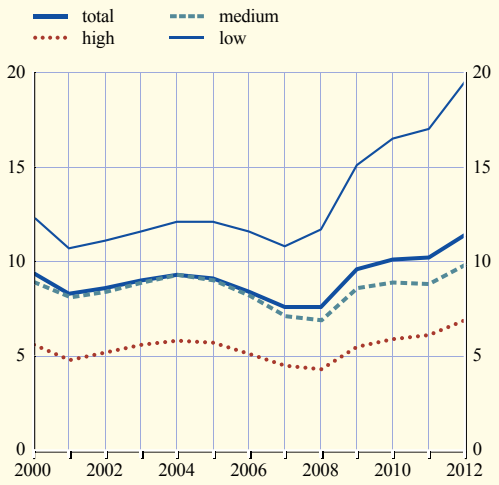
(percentage of labour force; annual data)



Source: Eurostat.

Chart 6 Euro area unemployment rate – skill level of unemployment

(percentage of labour force of corresponding skill level; annual data)



Source: Eurostat.

The crisis has also led to a rise in structural unemployment levels, through increases in long-term unemployment, and has increased the mismatch of labour.[6] Chart 5 shows that long-term unemployment in the euro area has been rising. The longer the unemployed are out of work, the more their skills and human capital are eroded, the less favourably they will be viewed by potential employers and the more discouraged they may become to search for a new job, thereby reducing the downward pressure on wages exerted by higher unemployment. Skill mismatch has also increased in the euro area. As shown in Chart 6, the unemployment rate among low-skilled workers has increased far more than among higher-skilled workers, indicating a strong fall in demand for the less skilled and consistent with a rise in skill mismatch.

The increase in long-term unemployment and mismatches may be partly explained by the fact that, following the restructuring of many euro area economies as a result of the crisis – in particular, a sharp decline in employment in the construction sector – it may be difficult for workers who have been laid off in a shrinking sector to find jobs in other, expanding sectors. Consequently, structural unemployment may remain high until the labour market accommodates the new structure of the economy.

Economic policy has a key role in preventing crisis-triggered increases in unemployment from becoming permanent, for example by reducing labour market rigidities, by making wages more flexible and by reducing excessive employment protection, as well as by promoting active labour market programmes and more effectively tailoring the education system to the evolving human capital needs of the economy.

6 See Bonthuis, B., Jarvis, V. and Vanhala, J., "What's going on behind the euro area Beveridge curve(s)?", *Working Paper Series*, No 1586, ECB, Frankfurt am Main, September 2013.

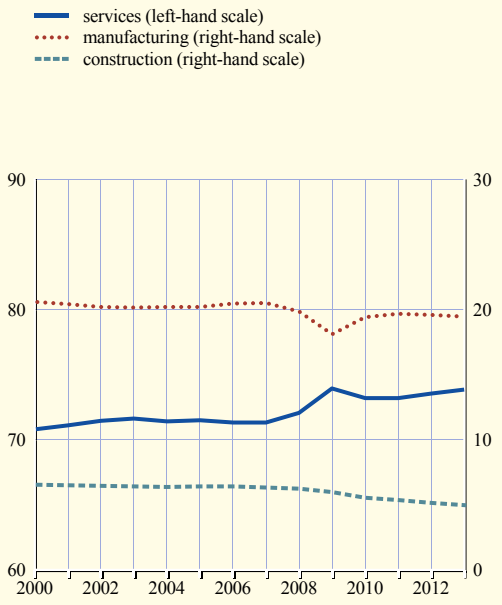
In terms of TFP, there is an impact from the changes in economic structure brought about by the crisis, particularly the shift towards sectors with different productivity.[7] As shown in Chart 7, the share of construction and manufacturing in value added in the euro area has decreased since 2008, while the share of services has increased, to some extent as a response also to a possible pre-crisis misallocation across sectors.

Available research suggests that differences in TFP growth across sectors might be substantial, with the highest TFP growth typically found in manufacturing, particularly of communication and transportation equipment, followed by TFP growth in services, with the lowest TFP growth in construction. Available sectoral data for the euro area tend to be in line with this finding.

Overall, the decline in the share of construction in value added since 2008 suggests that aggregate TFP growth in the euro area is likely to increase following the crisis. The small decline in the share of manufacturing may have had a negative impact on TFP, but the impact of the higher share of services is difficult to estimate, given the heterogeneity across service sectors with respect to TFP intensity. Hence, the change in TFP in services and in the total economy depends on the shares of the sub-sectors. Looking at the development of these shares (see Chart 8), it can be concluded that, since 2009, a reallocation within the services sector has taken place marginally towards higher TFP sectors, most notably a higher share of information and telecommunication and financial intermediation services.

Chart 7 Share of main sectors in total value added

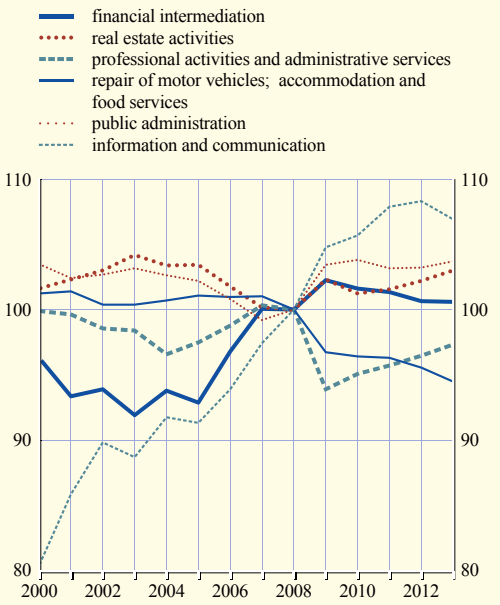
(percentage of total value added; annual data)



Source: Eurostat.

Chart 8 Value added individual service sectors relative to total service sector value added

(2008=100; annual data)



Source: Eurostat.

7 Although the focus here is on TFP, sectoral shifts during the crisis may also affect the capital contribution to potential output if different sectors have significantly different investment rates.

In summary, temporarily lower investment rates, population growth and higher structural unemployment seem to be the key factors (through the contributions from capital and labour components) behind the fall in euro area potential output growth observed since the start of the financial crisis in 2008. While these factors are likely to be temporary, they may become permanent unless structural reforms are implemented to prevent them from becoming entrenched and affecting potential output growth in the medium to long term as well. In parallel, trends due to population ageing imply lower potential growth over the longer term, even if the effects of this may be partly offset by those of higher net immigration and changes in the participation rates due to pension reforms.

3 THE LINK BETWEEN SLACK AND NOMINAL DEVELOPMENTS

3.1 ALTERNATIVE MEASURES OF SLACK IN THE ECONOMY

Assessing potential output is important to policy-makers because appropriately judging and assessing the degree of utilisation of resources in the economy (such as capital and labour) provides an indication as to whether developments in the real economy are consistent with the maintenance of price stability.

In principle, the overutilisation of capacities implies the risks of an overheating economy and upward pressure on inflation (i.e. costs tend to rise when firms use capital and labour very intensively in production). By contrast, a high degree of slack means that there is excess supply due to weak demand and therefore most likely downward pressure on inflation.

This section illustrates the relationship, since the onset of the crisis in 2008, between measures of economic slack (gap measures derived from potential, such as the output gap, as well as alternative measures, such as unemployment and capacity utilisation) and nominal developments (i.e. wage and price inflation).

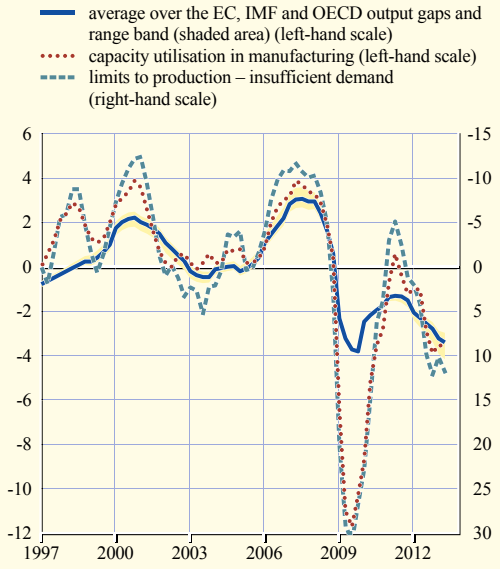
In the empirical analysis below, a number of indicators of economic slack are examined, notably the output gap, the unemployment gap, capacity utilisation and survey-based measures of the extent to which labour and insufficient demand are limiting production. However, different indicators do not necessarily provide a uniform view of the economic situation. Furthermore, estimates of potential output and the output gap are often subject to revision, a circumstance which may change (also ex post) the view of the amount of slack in the economy.[8]

Charts 9 and 10 show how some common measures of slack in the euro area have evolved since 1997. While the output gap (see Chart 9) can be regarded as an indicator of the degree of usage of the overall economy's production capacities, reflecting short-term variations in demand, the unemployment gap (see Chart 10) measures the amount of slack in the labour market. As potential output and structural unemployment are unobserved, the output gap and unemployment gap are similarly unobserved and have to be estimated. On the other hand, survey indicators that are observable can also be used to gain insight into the degree of slack in the economy and can be compared with the output gap and unemployment gap as a consistency check.[9] One feature of

8 See, for example, the box entitled "Recent evidence on the uncertainty surrounding real-time estimates of the euro area output gap", *Monthly Bulletin*, ECB, November 2011.
9 See, for example, the box entitled "A cross-check of output gap estimates for the euro area with other cyclical indicators", *Monthly Bulletin*, ECB, June 2011.

Chart 9 Measures of economic slack in the euro area economy

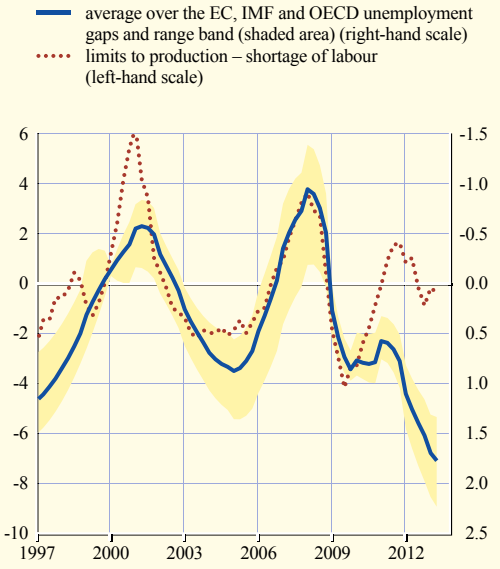
(as a percentage of GDP; percentage point deviation from sample average)



Sources: European Commission, IMF, OECD and ECB calculations.
Notes: The survey-based series have been demeaned with the average over the sample shown (first quarter 1997 to second quarter 2013). The output gap estimates (underlying the range and the dotted line) have been interpolated to obtain quarterly values.

Chart 10 Measures of economic slack in the euro area labour market

(percentage point deviation from NAIRU; percentage point deviation from sample average)



Sources: European Commission, IMF, OECD and ECB calculations.
Notes: see Chart 9.

survey indicators is that they are normally not revised, while the degree of uncertainty and revisions surrounding real-time estimates of output and unemployment gaps is typically high. There are some caveats, however: survey data normally only cover a fraction of the economy; the numerical value belonging to equilibrium, where potential and actual output are equal, is not known; and there is some uncertainty related to the reliability of survey responses.

Although there are significant co-movements between the various measures of slack, the picture is not entirely clear. For example, the exact timing of the peaks and troughs often differs across series. While the gaps (output and unemployment) have been indicating uninterrupted excess supply – slack in the economy – since 2009, the surveys show a slightly different picture. The EC survey on factors limiting production suggests little or no spare capacity in 2011, while for the EC survey on the shortage of labour the most recent data suggest a return to its long-term average level. This is in contrast to the unemployment gap which, at the end of the sample, indicates the highest degree of slack since 1997. These divergences (and the range of estimates across the various institutions) underpin the high degree of uncertainty economic policy-makers face when judging the extent of slack in the economy.

3.2 SLACK AND NOMINAL DEVELOPMENTS

Economic theory suggests an inverse relationship between the degree of slack and inflation developments. This relationship is often described in terms of the Phillips curve. Although

economic slack is widely held to be an important determinant of inflation dynamics, this link is by no means clear, and judging the relative usefulness of different measures of slack for predicting wage and price inflation is not straightforward, as illustrated in Box 2.

In the euro area, historical experience suggests that a relatively large movement is required in the degree of slack to affect inflation in a significant way. Such a weak relationship can be explained by a number of factors. First, the greater credibility of monetary policy associated with lower and well-anchored inflation expectations may be reflected in a flattening of the estimated Phillips curve relationship over the years. Second, the response of wages and prices to slack in the euro area economy may have been affected by downward nominal wage and price rigidities, preventing a more marked response of prices and wages to the deterioration in economic conditions.[10]

The most recent developments, characterised by a marked increase in the degree of slack and a rather stable aggregate wage and price inflation, may, however, also be associated with changes in the composition of employment, as workers with low wages – such as young workers, immigrants and part-time and construction workers – have been those hardest hit in terms of labour shedding and lay-offs. The resulting higher share in employment of higher-skilled/higher-paid workers has had an upward impact on the evolution of aggregate wages.[11] Moreover, increases in indirect taxes and administered prices due to ongoing fiscal consolidation in several euro area countries, as well as higher profit margins in sheltered sectors, have put upward pressure on euro area inflation. The presence of strong inertia in wages and prices due, for example, to structural features affecting wage and price dynamics (such as wage indexation schemes in some countries) or costly, or imperfect, information gathering may also play a significant role in explaining the limited nominal adjustments following the crisis.

On the basis of a technical analysis of the link between economic slack – as measured by the unemployment gap – and wage and price inflation developments in a Phillips-curve framework, the coefficient for the unemployment gap seems to have declined since the start of the crisis to a very low level (see Chart 11).[12] Moreover, there is still a relatively high degree of inflation persistence (measured by the autoregressive coefficient) in the euro area, while nominal wages (partly due to their downward rigidity, in combination with low nominal wage growth during the crisis) have become more persistent, although not as persistent as inflation (see Chart 12). Thus, the rigidities of the euro area economies seem to remain high. Although the high persistence of inflation may also reflect well-anchored price expectations due, for example, to a greater credibility of monetary policy, rigid wage and price behaviour is an important factor in explaining the muted nominal developments which impede competitiveness. In this respect, in order to support a faster rebalancing and restructuring of some euro area countries, the implementation of structural reforms is essential and should focus on measures to remove rigidities and to enhance flexibility.

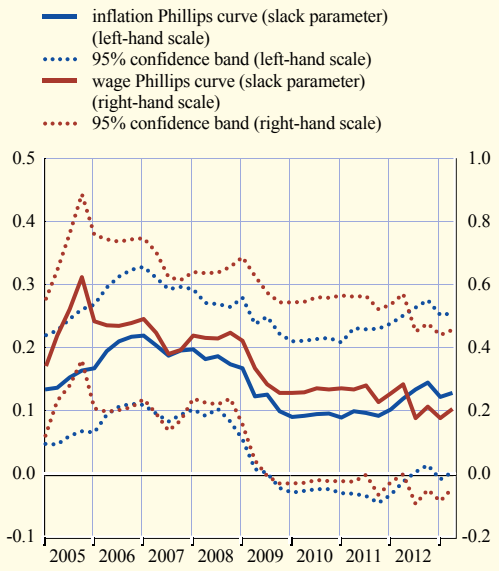
10 For more details, see Section 2.4 of "Euro area labour markets and the crisis", *Occasional Paper Series,* No 138, ECB, Frankfurt am Main, October 2012.

11 For more details on the composition effects and its role in explaining the limited wage adjustment in the aftermath of the crisis, see Box 6 in "Euro area labour markets and the crisis", *Occasional Paper Series,* No 138, ECB, Frankfurt am Main, October 2012.

12 Rolling regression estimates from a simple linear Phillips-curve specification, linking nominal development to the unemployment gap, are used to illustrate the extent to which the historical relationship has changed. For a similar analysis, see the article entitled "The development of prices and costs during the 2008-09 recession", *Monthly Bulletin*, ECB, April 2012.

Chart 11 Rolling estimates of the slack parameter from wage and price Phillips curves

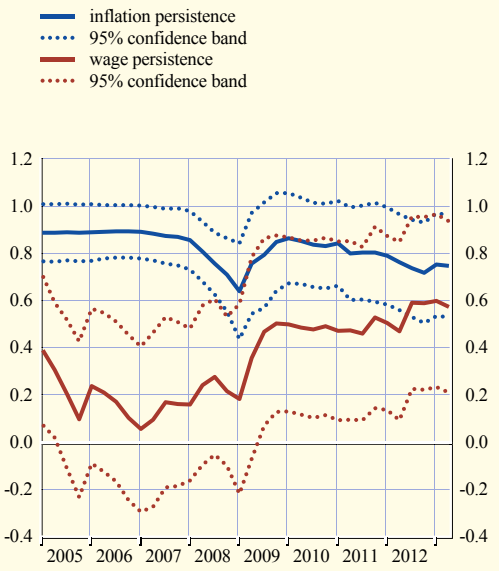
(Q1 2005 - Q2 2013)



Source: ECB calculations.
Notes: The slack parameter is the estimated coefficient on the slack measure in a simplified Phillips curve relationship, estimated from rolling regressions, using a 32-quarter window. The unemployment gap by the European Commission is utilised as the slack measure in the regressions. The estimations are based on quarterly data covering the period from the first quarter of 1997 to the second quarter of 2013. Inflation refers to the HICP excluding food and energy.

Chart 12 Rolling estimates of the persistence parameter from wage and price Phillips curves

(Q1 2005 - Q2 2013)



Source: ECB calculations.
Notes: The persistence parameter is the coefficient on a lagged inflation term in a simplified Phillips curve relationship. For further details, see the notes to Chart 11.

Box 2

EVALUATING DIFFERENT MEASURES OF SLACK AS PREDICTORS FOR MOVEMENTS IN WAGES AND PRICES

The traditional Phillips curve is the most widely used empirical framework for assessing the link between economic activity and nominal developments. According to the Phillips curve, economic slack in the economy should be a determinant of future wage and price inflation. As is well known, judging the extent of slack is complicated, and a variety of different indicators of slack is frequently used.

This box assesses the usefulness, during the crisis, of different measures of slack for predicting wage and price inflation and whether some measures perform better than others at the current juncture. It does so by means of forecasts from bivariate (autoregressive distributed) models based on simple linear Phillips-curve specifications. These specifications rely on information from the slack indicator, as well as past developments of wage and price inflation.[1] To assess the

1 The models use the annual growth rate of compensation per employee and HICP inflation excluding food and energy as the dependent variables, and the regressors include lagged values of the corresponding dependent variable and the economic slack information.

Evaluation of different measures of slack as predictors for wage and price inflation

Measures of slack	Wage inflation (compensation per employee growth)				Price inflation (growth of HICP excluding food and energy)			
	Q1 2008 - Q2 2013							
	t+1	t+2	t+3	t+4	t+1	t+2	t+3	t+4
Output gap	0.91	0.87	0.82	0.80	0.98	0.98	1.00	1.02
Factor limiting production, demand	0.94	0.95	0.95	0.94	0.92	0.92	0.95	0.99
Capacity utilisation, manufacturing	0.99	1.04	1.07	1.10	1.03	1.11	1.20	1.30
Unemployment gap	1.00	0.88	0.80	0.79	1.02	1.04	1.03	1.03
Factor limiting production, labour	0.96	0.91	0.88	0.86	0.97	0.97	0.99	1.01

Source: ECB calculations.
Notes: Table entries are relative root mean square errors that signal the performance of each bivariate model relative to the performance of a simple autoregressive time-series model over different horizons. A value below 1 means that the model with the corresponding indicator outperforms the autoregressive model used as a benchmark, and vice versa. The output gap and the unemployment gap are estimates published by the European Commission. The estimation sample extends from the first quarter of 1997 to the second quarter of 2013.

performance of each slack indicator these forecasts are compared with an autoregressive forecast (i.e. a model excluding the indicator) for one to four quarters ahead, in a pseudo real-time out-of-sample forecast exercise, i.e. using, from the most recent vintage of data, the data points that would have been available when making the forecast.

The results from this evaluation seem to suggest that, of the various measures of economic slack assessed, few offer notable improvements (compared with the forecasts excluding the indicator) over the short term due largely to the sluggish nature of wage and price adjustment to cyclical dynamics (see table). Generally, slack measures tend to be better at predicting wage inflation than price inflation for the crisis period, particularly at longer time horizons. For predictions of compensation per employee, gap measures (output and unemployment gaps) seem to produce more accurate forecasts than survey indicators (particularly in the case of capacity utilisation). However, these results have to be interpreted with caution. For example, gap measures are typically estimated on the basis of how well they explain wage and price inflation (a Phillips-curve equation as part of the identification), which could affect the results on account of endogeneity problems. In addition, as for all empirical work, data revisions and/or a different model specification may lead to different results.

4 CONCLUDING REMARKS

This article has reviewed developments in potential output and its contributions, the factors accounting for those developments, and the link to nominal developments since the onset of the financial crisis in 2008.

It indicates that the negative impact on potential output has been concentrated on the capital and labour components, accounted for by lower investment rates, demographics and higher structural unemployment. While these factors are likely to be temporary, they may become permanent unless structural reforms are implemented to prevent them from becoming entrenched and affecting potential output growth also in the medium to long term. The outlook for euro area potential growth therefore crucially hinges on further substantial progress being made in terms of structural reforms designed to achieve higher rates of potential output growth in the medium and longer term. In order to boost significantly the rate of sustainable growth in the euro area, the positive impact of such reforms also has to considerably outweigh the negative impact of population ageing on future potential growth.

The article also indicates that the link between the degree of slack and inflation has become more tenuous in recent years, whether assessed by means of output or unemployment gaps or by alternative measures of economic slack. This may partly be due to a better anchoring of inflationary expectations. However, the structural rigidities remaining in the euro area appear to play a role. Those structural rigidities may be an indication that the effects of past structural reforms in the euro area have yet to be felt. Structural reforms across the euro area countries have not been far-reaching and ambitious enough to support potential output growth and more reform efforts need to be undertaken to boost potential output growth in the medium and longer term.