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Monetary Policy

Lower potential growth in the euro area after the crisis

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Lower potential growth in the euro area after the crisis

The global financial crisis in 2008 and subsequent euro area sovereign debt crisis have had a substantial adverse impact on economic growth. In Norway their direct effect took the form of reduced demand for Norwegian exports. We use a growth accounting framework to determine the factors that drove growth ahead of and during the crisis and ascertain the growth potential in the coming years. We find that for the period 2013–2020, potential growth is approximately half of what it was before the crisis.

The euro area as a whole is the world's second largest economy and Norway's largest trading partner. The economic crisis has adversely impacted Norway directly through trade, and indirectly through financial market turbulence and effects on household and business confidence.

Activity in the euro area is now picking up, but growth is expected to remain unusually sluggish for several years ahead. Thus, the Norwegian economy cannot expect a significant boost from European demand for Norwegian exports. Low growth will make it difficult for many countries to reduce their debt-to-GDP ratio. In a situation with little fiscal policy leeway, there is a greater likelihood of a very poor economic outcome.

We have used a growth accounting framework to assess the potential growth in the euro area in the period 2013–2020 and find that it is approximately half of its pre-crisis level. Of course, growth projections such as these are only as reliable as the underlying assumptions, but there are several good reasons to expect lower potential growth. An ageing population is one factor. In addition, there is reason to expect that the persistent reverberations of the financial crisis will weigh on investment growth ahead. The reform programmes in euro area countries have set ambitious targets for employment growth, but rising structural unemployment in the wake of the financial crisis may make these targets difficult to reach.

Conceptual framework

Roughly speaking, total output in a country depends on the supply and utilisation of fixed capital and labour, and how efficiently these two factors are utilised. Growth accounting can be used to determine how much of the changes in output are due to variations in the utilisation of these three factors.

Total output (Y) can be expressed as a function of capital (K), labour (T) and productivity (A). Thus, output at time t is

$$(1) \quad Y_t = A_t K_t^{1-\alpha} T_t^\alpha$$

where α refers to the output elasticity of labour. It indicates how much output increases when the utilisation of labour increases by 1 percent. It can be shown that if these factors are rewarded according to their marginal product, the labour and capital shares of output are α and $(1-\alpha)$, respectively.

With the exception of productivity, it is possible to find measures for all the factor inputs in the production function (1). Y is GDP at constant prices, K is the stock of capital at constant prices, T is total hours worked and α is the labour share of income as a percentage of GDP. The stock of capital is the value of all buildings, machinery and inventory in a given year. Total hours worked is the number of hours worked by all persons employed. Productivity is measured as the “Solow residual”, a catch-all that includes efficiency and other non-observable factors. A is usually referred to as “total factor productivity” (TFP).

Growth and contributions to growth in euro area countries in the pre-crisis period

In the following, we use the growth accounting framework to determine the factor contributions to growth in euro area countries ahead of the financial and sovereign debt crisis. Here, the euro area refers to the 12 member states as at 2001¹. The pre-crisis period is 1996–2007, where 1996 is the first year for which a complete data set is

¹ Germany, France, Italy, Spain, Netherlands, Belgium, Austria, Greece, Finland, Portugal, Ireland and Luxembourg.

available and 2007 is the last year before the financial crisis. Appendix 1 provides a technical review of the growth accounting exercise conducted in this commentary.

GDP growth

For the euro area as a whole, average GDP growth in the period 1996–2007 was substantially lower than in the rest of the OECD, but is in line with the decade preceding (Chart 1).

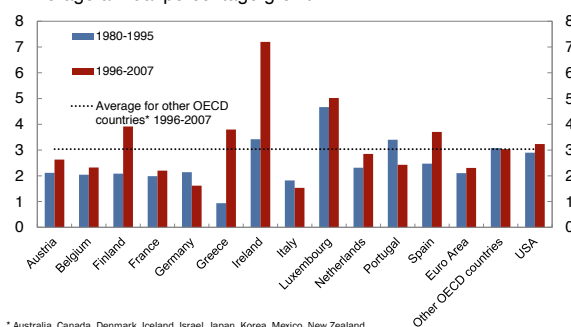
There was considerable variation among countries. In the vast majority of euro area countries, average growth rates rose compared with the previous decade, and in some of them growth also outpaced other OECD countries.

Growth was generally strongest in the peripheral countries. In Spain, Greece and Ireland, average GDP growth in the period 1996–2007 was higher than both the historical rate and the average of the other OECD countries. However, in Italy and Portugal, the growth rate fell relative to both the previous period and the benchmark group of countries.

In most of the core countries, GDP growth in the period 1996–2007 was lower than in the rest of the OECD. Nevertheless, with the exception of Germany, the pace of growth in these countries rose compared with the preceding period.

Chart 1. GDP

Average annual percentage growth



* Australia, Canada, Denmark, Iceland, Israel, Japan, Korea, Mexico, New Zealand, Norway, Sweden, Switzerland, Turkey, United Kingdom, and the United States

Source: OECD

Pre-crisis period: 1996–2007

As we have constructed our growth accounting exercise, the contribution of labour productivity is given by the sum of the contributions of capital intensity and total factor productivity (TFP). For the euro area as a whole, the largest single contribution to growth (0.9 percentage points) was made by TFP (Table 1). That the contribution from TFP is among the most important components is not an unusual finding². Increased capital intensity made a contribution to growth of 0.5 percentage points. Thus, increased labour productivity explains 1.3 percentage points of the average GDP growth of 2.3 percent.

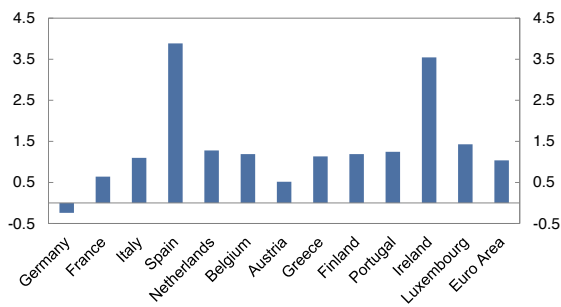
2 For the euro area, see e.g. Musso and Westermann 2005: "Assessing potential output growth in the euro area: a growth accounting perspective" ECB, *Occasional Paper* No. 22.

Table 1. Growth accounting 1996 – 2007
Average percentage growth with contributions in percentage points

	Total	Distribution			Labour productivity		Labor force utilization			Demographics		
		Growth	Labour productivity	Labour force utilization	Demographics	Capital intensity	Total factor productivity	Hours worked per person	Employment rate	Participation rate	Age structure	
Germany	1,6	1,8	0,0	-0,3	0,6	1,2	-0,6	0,0	0,7	-0,3	0,1	Germany
France	2,2	1,6	0,0	0,6	0,6	1,0	-0,6	0,4	0,2	0,0	0,6	France
Italy	1,5	0,4	0,9	0,2	0,3	0,2	-0,2	0,5	0,7	-0,2	0,3	Italy
Spain	3,7	-0,2	2,1	1,7	0,1	-0,3	-0,4	1,1	1,4	0,5	1,2	Spain
Netherlands	2,8	1,6	0,9	0,4	0,3	1,3	-0,4	0,3	0,9	-0,1	0,5	Netherlands
Belgium	2,3	1,1	0,8	0,4	0,3	0,9	0,0	0,2	0,6	0,0	0,4	Belgium
Austria	2,6	2,1	0,2	0,3	0,7	1,4	-0,2	0,0	0,4	0,0	0,3	Austria
Greece	3,9	2,7	0,5	0,6	0,6	2,2	-0,3	0,0	0,8	0,2	0,4	Greece
Finland	3,9	2,7	0,7	0,5	0,1	2,6	-0,3	0,8	0,2	0,0	0,5	Finland
Portugal	2,4	1,2	0,4	0,9	0,8	0,4	0,0	-0,1	0,5	0,3	0,5	Portugal
Ireland	7,2	3,7	0,7	2,8	0,7	3,0	-0,9	0,7	1,0	1,1	1,8	Ireland
Luxembourg	5,0	3,6	0,3	1,1	1,3	2,3	-0,6	-0,1	1,0	-0,1	1,2	Luxembourg
Euro Area	2,3	1,3	0,6	0,4	0,5	0,9	-0,4	0,3	0,7	-0,1	0,5	Euro Area

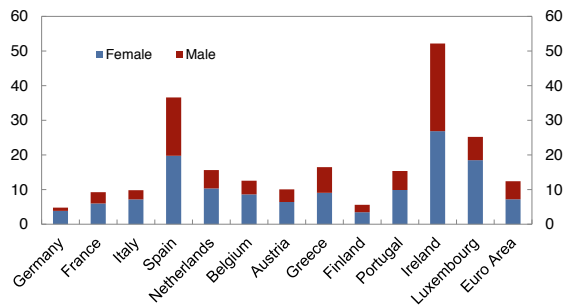
Source: Norges Bank

Chart 2. Total hours worked
Annual average percentage growth, 1996 – 2007



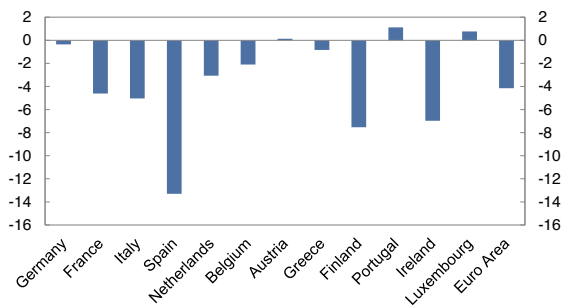
Source: European Commission

Chart 3. Labour force
Percentage change between 1996 and 2007



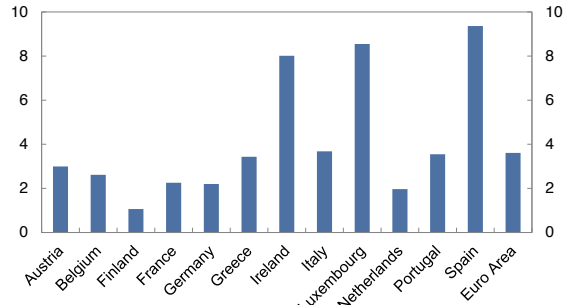
Sources: Eurostat and European Commission

Chart 4. Unemployment rate
Percentage change between 1996 og 2007



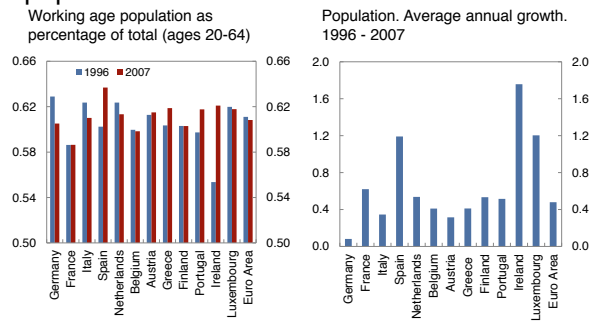
Source: European Commission

Chart 5. Net immigration 1995-2005
As percentage of 1995 population



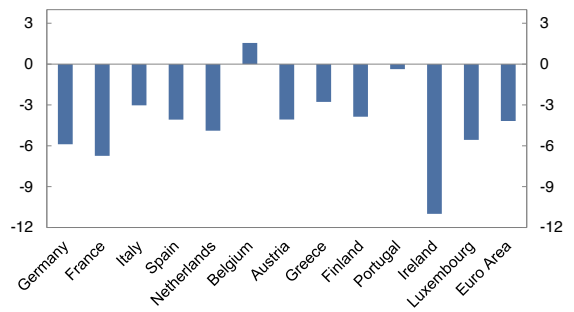
Source: The World Bank

Chart 6. Population growth and working age population



Source: European Commission

Chart 7. Hours worked per person employed
Percentage change 1996 – 2007



Source: European Commission

The remainder of the growth is due to better utilisation of available labour (0.6 percentage points) and demographic developments (0.4 percentage points). Solid overall population growth pushed up the working age population (aged 20–64), despite a slight decline in labour force participation.

The largest positive contribution to labour utilisation came from an increase in the participation rate, followed by a lower unemployment rate. Hours worked per employee fell in almost all euro area countries, making a negative contribution to growth.

Labour input

Total labour input depends on the number of persons employed and hours worked per person employed. For the euro area as a whole, total hours worked rose by an average of 1 percent per year in the period 1996–2007. In the vast majority of these countries, growth in hours worked was close to this average (Table 1 and Chart 2). Two countries - Spain and Ireland - stand out with considerably higher growth in hours worked, while Germany, France and Austria end up at the opposite end of the scale. In the following, we consider explanations for developments in the five outlier countries.

Developments in Spain and Ireland were fairly similar. Higher growth in hours worked reflected high labour force growth and a falling unemployment rate (Charts 3 and 4). Important reasons for the strong labour force growth were (i) large net inward migration (Chart 5)³, (ii) an increase in the working age population (Chart 6), and (iii) strong growth in female labour force participation.

Solid labour force growth in Ireland was counteracted by a substantial fall in hours worked per person (Chart 7), primarily owing to a decline in hours worked by full-time workers. In Spain, there was also a fall in hours worked per person, but more in line with developments in the euro area as a whole.

Of the major countries, Germany and France experienced the weakest developments in total hours worked. In the case of France, this partly reflects a relatively sharp drop in hours worked per person and in part to stagnation in labour force participation. This was counteracted to some extent by solid population growth.

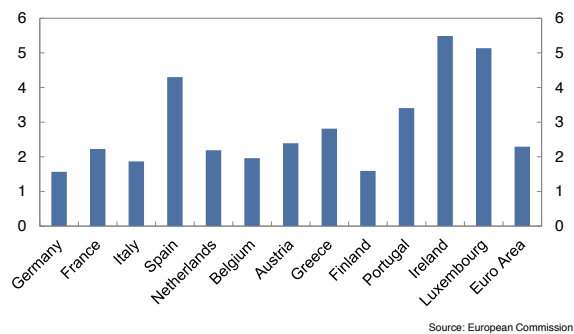
Germany was the only country to experience a decline in total hours worked. Demographic developments were the most important reason. Unlike the other euro area countries, there was scarcely any population growth in Germany between 1996 and 2007. The participation rate fell more in Germany than in any other euro area country. In addition, the unemployment rate was approximately the same in 2007 as in 1996. In Austria, relatively weak developments in all components contributed to the low growth in total hours worked, although no single cause is especially prominent.

The “Lisbon Strategy for Economic Reform”, adopted in 2000, was aimed at boosting euro area productivity growth and labour utilisation. Although the data we examine are not sufficient for assessing the success of reforms under the Lisbon strategy, we can nevertheless venture some tentative observations. The reforms appear to have had a positive effect on participation and unemployment, but scant impact on hours worked and labour productivity. Participation rates for women and men have risen considerably in a number of euro area countries, with improvements after 2000 more pronounced. Furthermore, the unemployment rate has fallen despite growth in the labour force. However, since the euro area was in an economic upturn in the pre-crisis years, we should be cautious about drawing conclusions regarding the positive impact of the Lisbon reforms. It is equally plausible to

3 Owing to characteristics and availability of data, we must focus on this period rather than 1996–2007

Chart 8. Capital stock

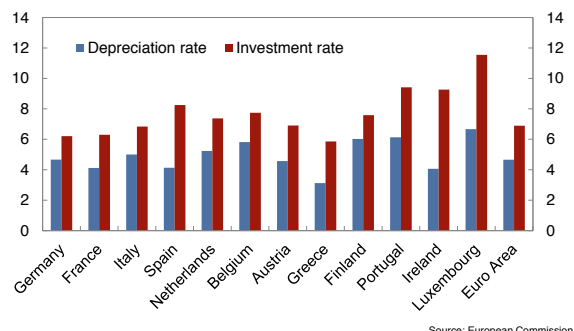
Average annual percentage growth, 1996 – 2007



Source: European Commission

Chart 9. Investment and depreciation rate

Average 1996 – 2007



Source: European Commission

imagine that improved utilisation of labour reflects cyclical conditions.

Capital input

Fixed capital is the other measurable factor input. In the period, we note less variation across countries in capital input than in labour input. All countries experienced positive growth in the capital stock (Chart 8). For the euro area as a whole, growth rates averaged 2.3 percent. Again, Ireland and Spain stand out with high growth, while Germany was among the countries with the lowest growth.

Most of the variation in the rate of growth in the capital stock across countries is due to variation in investment rates (Chart 9). Wear and tear in the capital stock also varies across countries, but to a lesser degree.⁴

A thorough explanation of the divergence in investment rates across countries is beyond the scope of this commentary. Of course, one reason for some of this divergence is that countries with the highest growth in labour input must invest more to maintain their capital-to-labour

4 The investment rate is fixed capital investment as a percentage of the capital stock. The depreciation rate is depreciation (wear and tear) as a percentage of the capital stock.

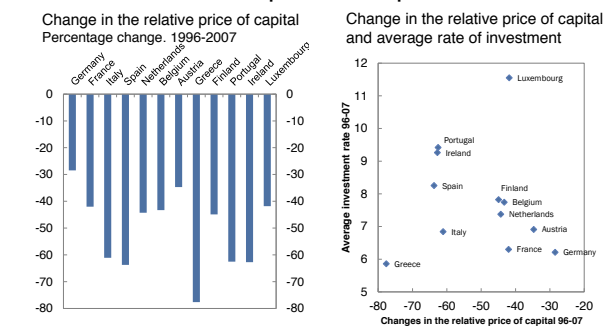
ratio (see Appendix 2). In some countries, investment growth can probably also be explained in part by the need to catch up with technologically more advanced countries.

Another contributing factor is differences in the price of capital relative to labour. When the relative price of capital falls, it will pay to increase output by increasing the capital stock. Developments in the relative price of capital across countries broadly correlate with variations in investment rates (Chart 10). Southern European countries and Ireland experienced the steepest decline in relative borrowing costs between 1996 and 2007 and, except for Greece and Italy, the highest investment rates. A lower price of capital reflected the fact that interest rates in these countries approached the levels of Germany and France in the period prior to the introduction of the euro. At the same time, there was relatively high growth in wage costs in the southern European countries and Ireland. At the other end of the scale, we find the core countries, which experienced a less pronounced decline in the relative price of capital.

Growth and growth accounting: crisis and post-crisis periods

In the first part of this section we examine factors that have weighed on growth after 2007. In the second part of the section, we apply growth accounting to outline possible growth developments in the euro area in the years to 2020.

Chart 10. Relative price of capital¹⁾



1) The price of labour is given by the wage cost per unit produced. For the development in the price of capital, changes in borrowing costs are used as an approximation. When interest rates (given by 10-year government bond yields) fall more than wage costs, the relative price of capital falls.

Sources: OECD, Thomson Reuters, and European Commission

During the crisis: 2008–2012

The global financial crisis that began in 2008 and the subsequent euro area sovereign debt crisis had a destructive impact on investment and employment. At end-2012, the level of fixed capital investment was 20 percent below the level at the beginning of 2008. Over the same period, the unemployment rate had climbed by nearly 5 percentage points.

For the euro area as a whole, real GDP fell by an average of 0.2 percentage point per year since the beginning of the crisis (Table 2). According to our growth accounting framework, declining labour utilisation is the primary

Table 2. Growth accounting 2008 – 2012
Average percentage growth and contribution in percentage units

	Total	Distribution			Labour productivity		Labor force utilization			Demographics		
		Growth	Labour productivity	Labour force utilization	Demographics	Capital intensity	Total factor productivity	Hours worked per person	Employment rate	Participation rate	Age structure	
Germany	0,8	0,0	0,6	0,1	0,0	0,0	-0,4	0,7	0,3	0,2	-0,1	Germany
France	0,1	0,0	-0,2	0,4	0,6	-0,6	-0,1	-0,4	0,3	-0,2	0,5	France
Italy	-1,4	-0,5	-1,3	0,4	0,6	-1,1	-0,7	-1,0	0,4	-0,1	0,5	Italy
Spain	-0,9	1,8	-3,0	0,2	1,7	0,1	0,1	-3,9	0,8	-0,3	0,6	Spain
Netherlands	-0,1	0,0	-0,2	0,1	0,5	-0,5	-0,1	-0,4	0,3	-0,3	0,4	Netherlands
Belgium	0,4	-0,1	-0,3	0,8	0,3	-0,4	-0,1	0,0	-0,1	0,0	0,8	Belgium
Austria	0,6	0,9	-0,8	0,5	0,6	0,3	-1,1	0,0	0,3	0,1	0,3	Austria
Greece	-4,4	-1,0	-3,4	0,1	1,3	-2,3	0,0	-3,7	0,3	-0,3	0,4	Greece
Finland	-0,6	-0,2	-0,5	0,2	0,6	-0,8	-0,3	-0,2	0,0	-0,3	0,5	Finland
Portugal	-1,1	1,4	-2,0	-0,4	1,0	0,3	-0,3	-1,7	0,0	-0,4	0,0	Portugal
Ireland	-1,5	1,6	-3,5	0,5	1,6	-0,1	-0,6	-2,2	-0,7	-0,5	1,1	Ireland
Luxembourg	-0,3	-2,4	-0,2	2,3	0,5	-2,9	-0,7	-0,2	0,8	0,4	2,0	Luxembourg
Euro Area	-0,2	0,4	-0,9	0,3	0,7	-0,3	-0,4	-0,9	0,3	-0,1	0,4	Euro Area

Source: Norges Bank

reason for the shrinking output. Falling labour utilisation pulled down growth by 0.9 percentage point. Most of this was due to a rising unemployment rate. Hours worked per person employed also made a negative contribution, since hours worked continued to decline at the same pace as prior to the crisis. Labour force participation, however, made a positive contribution, despite more difficult labour market conditions.

Falling labour utilisation was counteracted by positive contributions to growth from demographic developments (0.3 percentage point) and labour productivity (0.4 percentage point). The demographic composition was unchanged from the pre-crisis period, with growth in the overall population and a decline in the percentage of the working age population. The contribution to growth from demographics was somewhat lower than in the period prior to the crisis, since population growth remained slightly lower.

Underlying the improvement in labour productivity is increased capital intensity, which was counteracted in part by a negative contribution from TFP. Rising capital intensity is due partly to a decline in total hours worked, but primarily to a continued increase in the capital stock throughout the crisis. Thus, despite these reductions, the level of investment was more than sufficient for replacing obsolete capital in the euro area as a whole. In some countries, the capital stock fell in some years in the period.

Post-crisis growth potential: 2013 – 2020

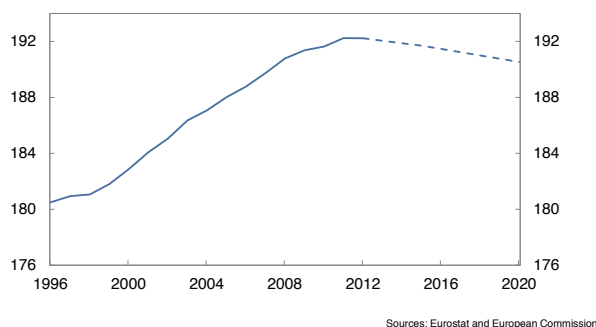
In the following, we use the growth accounting framework to assess the outlook for potential growth in the euro area in the period 2013–2020. The projections are the result of inverting the growth accounting procedure: rather than starting with the actual GDP growth rate and decomposing it into contributions from factor inputs, we begin with forecasts for these inputs and determine what they imply for potential growth.

We have drawn up projections of potential growth for all 12 countries. Growth potential for the euro area as a whole is given by the sum of the factor inputs in these 12 countries. While we have primarily examined a baseline scenario, we have also considered what would be necessary to bring about weaker or stronger developments in growth potential.

As a part of crisis resolution work and ongoing reform efforts in the EU, a number of EMU countries have embarked on structural reforms⁵. The Lisbon Strategy

⁵ See eg. http://ec.europa.eu/europe2020/pdf/2014/csrimpl2014_swd_en.pdf

Chart 11a. Working age individuals in euro area. Millions



was relaunched in 2010 as the “Europe 2020 Strategy” with the aim of boosting innovation, improving competitiveness and raising labour utilisation. Time will tell if the reforms under this strategy succeed. We make no direct assessment of any contribution to growth from these reforms. The projections of growth potential outline possible outcomes of given developments in a factor input. As it appears below, the assumptions underlying factor inputs are only loosely tied to reform efforts.

Developments in factor inputs

Underlying the projections is an assumption that potential growth ahead will be lower than in the pre-crisis period. An ageing population is one factor. In addition, there is reason to believe that the persistent reverberations of the financial crisis will hold down investment growth ahead. At the same time, rising structural unemployment in the wake of the financial crisis may make it difficult to increase employment.

For demographic developments, we have used Eurostat’s population projections. For the period 2013–2020, Eurostat assumes that the population of euro area countries overall will rise by approximately $\frac{1}{4}$ percent a year. Underlying this is an assumption that net immigration will rise from 0.2 percent of the total population in 2010 to 0.3 percent in 2020.

Even so, the number of persons of and below working age is expected to decline, since all of the population growth will take place in the over-65 age group (Chart 11a). There will thus be fewer potential workers. The result is that demographic developments will make a negative contribution to growth of 0.1 percentage point (Table 3). Compared with the pre-crisis period (Table 1), demographic developments pull down potential growth by 0.5 percentage point in the period 2013–2020 and

Table 3. Growth accounting 2013 – 2020

Average percentage growth and contribution in percentage units

	Total	Distribution			Labour productivity		Labor force utilization			Demographics		
		Growth	Labour productivity	Labour force utilization	Demographics	Capital intensity	Total factor productivity	Hours worked per person	Employment rate	Participation rate	Age structure	
Germany	0.6	1.2	0.0	-0.6	0.7	0.4	0.0	0.0	0.1	-0.3	-0.3	Germany
France	1.3	0.7	0.6	-0.1	0.5	0.3	0.0	-0.2	0.8	-0.5	0.5	France
Italy	0.6	-0.3	0.7	0.2	0.0	-0.3	0.0	0.1	0.6	-0.2	0.4	Italy
Spain	1.5	-0.4	1.8	0.1	-0.1	-0.3	0.0	0.4	1.4	-0.4	0.5	Spain
Netherlands	0.9	0.8	0.3	-0.1	0.4	0.4	0.0	-0.1	0.4	-0.5	0.4	Netherlands
Belgium	1.4	0.5	0.7	0.2	0.3	0.2	0.0	0.0	0.7	-0.4	0.6	Belgium
Austria	1.3	1.1	0.1	0.1	0.5	0.6	0.0	0.0	0.1	-0.1	0.2	Austria
Greece	1.9	0.1	1.9	-0.1	-0.3	0.4	0.0	1.6	0.3	-0.3	0.3	Greece
Finland	1.3	1.3	0.4	-0.4	0.5	0.8	0.0	-0.1	0.5	-0.8	0.4	Finland
Portugal	1.0	-0.1	1.0	0.2	-0.3	0.2	0.0	-0.1	1.0	0.0	0.2	Portugal
Ireland	1.6	1.2	0.6	-0.2	0.2	1.0	0.0	0.8	-0.1	-0.8	0.6	Ireland
Luxembourg	2.1	1.0	0.2	1.0	0.6	0.4	0.0	-0.2	0.3	-0.1	1.1	Luxembourg
Euro Area	1.0	0.4	0.70	-0.11	0.3	0.1	0.1	0.0	0.6	-0.4	0.3	Euro Area

Source: Norges Bank

contribute to substantially lower potential growth in the euro area ahead.⁶

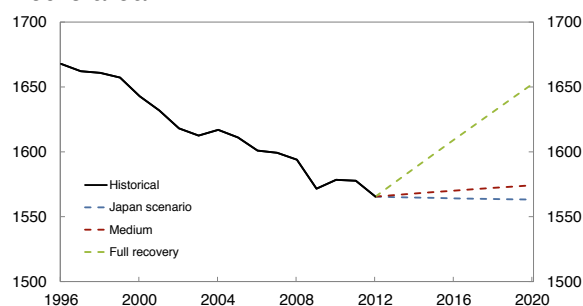
Labour utilisation projections are based on two factors: the total employment rate and hours worked per person employed. Here, total employment rate means the percentage of the working age population in employment.⁷ Working age population is defined as persons aged 20 to 64. The “Europe 2020” strategy sets a target for the total employment rate for each member state in 2020. For the euro area as a whole, the employment rate target is approximately 75 percent, up from 68 percent in 2012. The comparable employment rate in Norway in 2012 was 80 percent.

An individual country’s employment target will depend on growth prospects and expected effects of ongoing and planned structural reforms. Hence, linking our assumptions to employment targets provides a simple way to assess the growth effects of reform efforts.

A relatively high unemployment rate and low participation rate in a number of euro area countries provides scope

for improvements through structural reforms. At the same time, experience shows that it takes time to get the long-term unemployed back in the labour force and to change participation rates. Thus, the process of raising the equilibrium rate of employment is expected to take time. In the baseline scenario we have therefore assumed that the employment targets are overambitious and that they will not be reached until 2025. This implies a total employment rate of around 72 percent in 2020 (Chart 11b), which will make a contribution to potential growth of 0.6 percentage point in the period 2013–2020, 0.4 percentage point lower than in the pre-crisis period.

Chart 11c: Hours worked per employee in the euro area



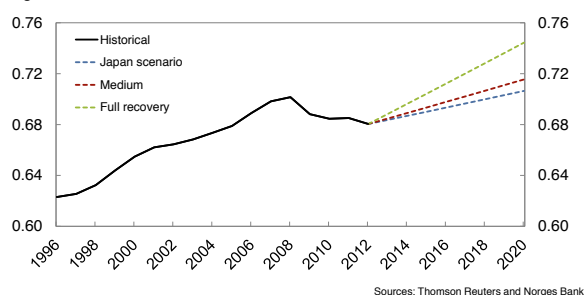
Sources: European Commission and Norges Bank

⁶ One objection to this projection method is that the upper limit for working age is held constant at age 64, even though in a number of countries, reforms include raising the retirement age. All else being equal, a higher retirement age will contribute to higher overall employment, and thus, to potential growth. That said, it is not our goal, as we have stated, to analyse the effects of individual reforms in a particular country. Hence, any effects on total employment can be covered by other factors that help to determine labour utilisation. The impact on potential growth will be the same.

⁷ The contribution to growth from the employment rate is equal to the sum of the contributions to growth from the unemployment and participation rates (see Appendix 1).

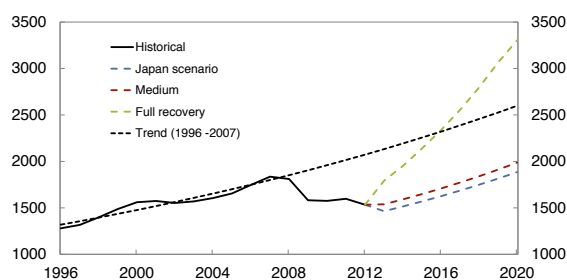
Chart 11b. Total employment rate in the euro area

Percentage share of employed population between 24 and 64 years of age



Sources: Thomson Reuters and Norges Bank

Chart 11d. Gross fixed capital investment at fixed prices



Sources: European Commission og Norges Bank

In the baseline scenario, there is a further assumption that hours worked per person employed in each country will remain unchanged at the 2012 level. Under this assumption, hours worked per person employed will rise gradually for the euro area as a whole, since countries with high hours worked per person employed are also expected to experience the highest employment growth (Chart 11c). Historically, this would entail a substantial improvement. Hours worked per persons employed in the euro area have fallen steadily over the past 20 years, from just under 1700 hours in 1995 to just under 1600 hours in 2012. Weakly rising hours worked will result in a positive contribution to growth of 0.1 percentage point, compared with a negative contribution of 0.4 percentage point prior to the crisis. Hence, the overall contribution to growth from labour utilisation will be 0.1 percentage point higher than in the period 1996–2007.

On the other hand, we expect a decline in the contribution to growth from labour productivity. In particular, a weaker contribution from the capital stock is expected ahead. The financial crisis and subsequent downturn in the euro area may be viewed as a structural shock to the capital stock. Firstly, a level shock from tighter funding conditions and higher bankruptcy rates during the acute phase of the crisis contributed to a steep decline in investment and resulted in a premature disposal of fixed capital. Secondly, a persistent negative contribution, in which continued strained funding conditions keep the number of business start-ups and the level of investment lower than it would have been otherwise.

In line with experience from previous financial crises, we have assumed that the level of fixed capital investment in the first seven years after the financial crisis (i.e. 2010–2016) will remain approximately 25 percent below the pre-crisis trend (Chart 11d)⁸. We furthermore assume a convergence

in investment rates across countries. Especially in the case of Spain and Ireland, it is clear that substantial pre-crisis property investment created unsustainably high investment rates. In a number of member states, there is reason to believe that a higher relative price of capital will shift factor input use towards labour. Conversely, it is clear that countries such as Germany must increase its investment rate in order to maintain potential growth.

In the baseline scenario, we assume that investment rates in each country will rise gradually in the period ahead and approach the historical median for the euro area as a whole in 2025. The median value was taken from the period 1996–2007. The depreciation rate is also set so that it approaches its historical median for the euro area as a whole in 2025.⁹

The investment and depreciation rate assumptions imply average fixed capital investment growth of approximately 3.5 percent per year in the period 2013–2020. This growth rate is somewhat higher than in the pre-crisis period, but the level of investment will remain below its pre-crisis trend.

Given such developments, capital intensity will make a contribution to potential growth of 0.4 percentage point in the period 2013–2020, 0.1 percentage point lower than in the pre-crisis period. Lower growth in total hours worked in isolation will pull up the contribution to growth from capital intensity, but this will be counteracted by the lower level of net fixed capital investment (Chart 11e).

⁸ See eg. IMF *World Economic Outlook*, October 2009

⁹ Relying on historical averages rather than assuming a rising trend may be a little overoptimistic. Data for the euro area going back to 1991 and for the US back to 1960 show a steadily rising depreciation rate. This may reflect technological progress (replacement of outmoded production equipment) and the fact that new production equipment has a longer remaining service life. For example, computer equipment is often assumed to have a service life of 10 years, compared with 20 years for other equipment and 50 years for non-residential buildings (Musso and Westermann 2005). Even so, we have no clear idea about what a rising trend, if any, in the depreciation rate would look like, and must be content with pointing out the upside risk.

The contribution to growth from total factor productivity in each country has been set at half its 1996–2012 value.¹⁰ We include the crisis years because there is reason to believe that the contribution from TFP was overstated in countries with very high growth ahead of the crisis. When the contribution from TFP is computed as a residual, it will capture all factors not reflected in structural conditions, including bubble tendencies in the economy. If this is correct, countries with very high contributions from TFP prior to the crisis will also have very low contributions after the crisis. The average will then provide a more accurate estimate of TFP. Under these assumptions, TFP makes a positive contribution to potential growth in the euro area of 0.2 percentage point. This is 0.7 percentage point lower than in the pre-crisis period, but 0.4 percentage point higher than during the crisis.

Overall, we assume a positive contribution to growth from labour productivity of 0.6 percentage point in the period 2013–2020. This is 0.8 percentage point lower than in the pre-crisis period and explains most of the decline in potential growth.

Growth potential

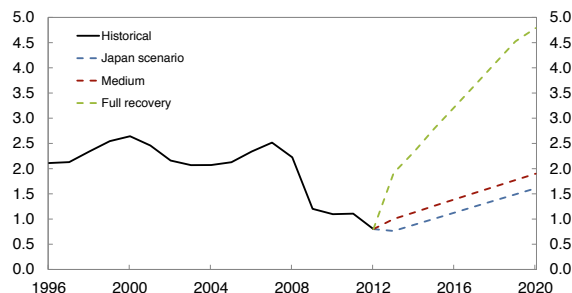
Under the assumptions outlined above, potential euro area GDP growth will be 1 percent over the period 2013–2020, approximately 1 percentage point lower than prior to the crisis. If we assume gradually rising growth potential, this means that growth will rise from 0.6 percent in 2012 to 1.3 percent in 2020. This is broadly in agreement with others' projections (Chart 12). Developments in line with our projection will mean that potential GDP in 2020 will be substantially below the level implied by the pre-crisis trend (Chart 13).

Potential growth is expected to fall sharply in all 12 countries we examine (Chart 13 and Table 3). Compared with the pre-crisis pace of growth, TFP per definition made a negative contribution in all countries. Demographic developments make a negative contribution in all countries, with the largest in Spain and Ireland. The assumption of unchanged hours worked per person employed provides a boost to growth in most countries. Despite a rise in the total employment rate to a historically high level, employment will make a negative contribution in most countries. The reason is that the average annual change in the employment rate is lower than in the pre-crisis period. Capital intensity makes fairly small contributions to growth across the board. Exceptions are countries that experienced very high pre-crisis investment rates.

¹⁰ For countries with a negative contribution (Spain and Italy), this means that the negative contribution will be 1.5 times larger.

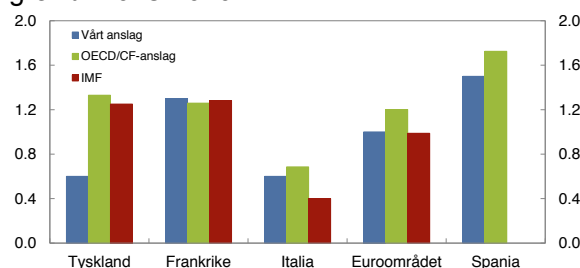
Chart 11e. Capital stock

Annual percentage growth



Sources: European Commission og Norges Bank

Chart 12. Estimates of average potential growth 2013-2020^{1,2)}

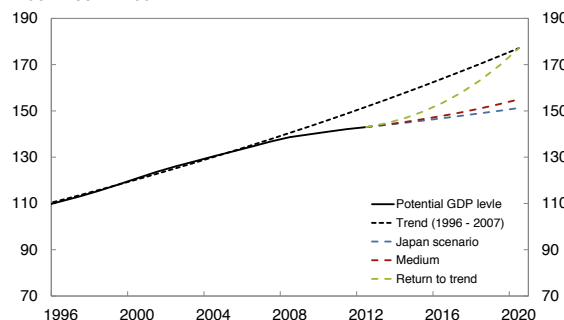


¹⁾ IMF only has estimates for potential growth up to 2018. For 2019 and 2020 we have assumed growth rates in line with Consensus Forecasts long term projections. The IMF does not have estimates for potential growth in Spain.
²⁾ The OECD / Consensus Forecast projections are constructed by assuming that the potential growth for 2012 is equal to OECD estimates, and then approaches Consensus Forecasts' long-term growth expectations.

Sources: IMF, OECD, Consensus Economics and Norges Bank

Chart 13. Potential GDP level

Index. 1991 = 100



Sources: OECD and Norges Bank

For three of the four largest countries, our projections of potential growth are in line with others' forecasts. For Germany, our projection is substantially lower than other forecasts. Demographics make a clearly negative contribution to potential growth in Germany, owing to a shrinking and ageing population. Nor do we see any particular potential for employment growth in Germany, as the total employment rate is already high. For the investment rate, we have assumed a considerable increase over the pre-crisis period, with annual growth in fixed capital investment of 3.1 percent in 2013–2020, compared with 1.2 percent in 1996–2007. Even if we double the contribution

from TFP and set it equal to the 1996–2012 average, our projection remains below those of others.

Alternative scenarios

In addition to the baseline scenario, we have considered what would be necessary to bring about higher or lower growth. In the high-growth alternative, we have assumed that the level of potential GDP for the euro area overall will rise so sharply that it reaches the pre-crisis trend by 2020. In the low-growth alternative, we envisage a sluggish recovery in which euro area growth overall is just as weak as what Japan experienced around the turn of the millennium.

The reason for the comparison with Japan is that of all OECD countries, it is there we find the weakest growth period in the past thirty years. After Japan's crisis at the end of the 1990s, potential growth fell to 0.7 percent at the beginning of the 2000s. For the euro area, a Japan scenario is often referred to as the weakest conceivable growth performance.

ASSUMPTIONS IN THE ALTERNATIVE SCENARIOS

Demographic developments are unchanged from the baseline scenario in both the low-growth and high-growth alternatives. In the high-growth alternative, we assume that the employment target in "Europe 2020" will already

be reached by 2020. Furthermore, we assume that the fall in hours worked after the introduction of the euro is not sustainable, and that hours worked per person employed will need to return to the 2000 level by 2020. The contribution from TFP is set equal to the 1996–2012 average. The depreciation rate is unchanged from the baseline scenario. Finally, the investment rate for each country is set so that potential GDP for the euro area overall is equal to the level it would have been at if growth had been equal to the pre-crisis trend also the period 2008–2020.

In the low-growth alternative, we assume that the employment targets in "Europe 2020" will not be reached before 2030. As in the baseline scenario, we assume convergence in investment and depreciation rates, but not before 2030. The contribution from TFP is unchanged from the baseline scenario. Finally, hours worked per person employed is set so that growth potential for the euro area overall in the period 2013–2020 is equal to the Japan's growth potential around the turn of the millennium.

DEVELOPMENTS IN THE ALTERNATIVE SCENARIOS

For the euro area overall, the high-growth alternative would entail growth potential of 2.7 percent in the period 2013–2020 (Table 4). This seems hardly likely. Developments in hours worked per person employed would entail developments totally the opposite of what has been

Table 4. High growth alternative
Average potential percentage growth and contributions in percentage units

	Total	Distribution			Labour productivity		Labor force utilization			Demographics		
	Growth	Labour productivity	Labour force utilization	Demographics	Capital intensity	Total factor productivity	Hours worked per person	Employment rate	Participation rate	Age structure	Total population	
Germany	2.3	2.1	0.7	-0.6	1.3	0.9	0.7	0.0	0.1	-0.3	-0.3	Germany
France	2.9	1.3	1.7	-0.1	0.8	0.5	0.4	0.6	0.8	-0.5	0.5	France
Italy	2.0	-0.1	1.9	0.2	0.1	-0.2	0.8	0.6	0.6	-0.2	0.4	Italy
Spain	3.1	-0.3	3.3	0.1	-0.1	-0.2	0.5	1.4	1.4	-0.4	0.5	Spain
Netherlands	2.5	1.8	0.9	-0.1	1.0	0.7	0.5	0.0	0.4	-0.5	0.4	Netherlands
Belgium	3.2	1.8	1.3	0.2	1.3	0.5	0.2	0.4	0.7	-0.4	0.6	Belgium
Austria	3.5	2.0	1.4	0.1	0.9	1.1	1.2	0.1	0.1	-0.1	0.2	Austria
Greece	4.1	-0.5	4.7	-0.1	-1.4	0.8	0.5	3.9	0.3	-0.3	0.3	Greece
Finland	3.7	2.8	1.2	-0.4	1.3	1.6	0.5	0.2	0.5	-0.8	0.4	Finland
Portugal	2.4	0.3	1.9	0.2	-0.1	0.4	0.4	0.5	1.0	0.0	0.2	Portugal
Ireland	3.7	2.1	1.9	-0.2	0.0	2.1	0.9	1.1	-0.1	-0.8	0.6	Ireland
Luxembourg	5.2	3.0	1.3	1.0	2.2	0.8	1.0	0.0	0.3	-0.1	1.1	Luxembourg
Euro Area	2.7	1.0	1.80	-0.11	0.6	0.4	0.7	0.5	0.6	-0.4	0.3	Euro Area

Source: Norges Bank

Table 5. Low growth alternative

Average potential percentage growth and contributions in percentage units

	Total	Distribution			Labour productivity		Labor force utilization			Demographics		
	Growth	Labour productivity	Labour force utilization	Demographics	Capital intensity	Total factor productivity	Hours worked per person	Employment rate	Participation rate	Age structure	Total population	
Germany	0.3	1.2	-0.3	-0.6	0.8	0.4	-0.3	0.0	0.1	-0.3	-0.3	Germany
France	0.5	1.0	-0.4	-0.1	0.7	0.3	-0.9	-0.3	0.8	-0.5	0.5	France
Italy	0.6	-0.5	0.9	0.2	-0.2	-0.3	0.4	-0.1	0.6	-0.2	0.4	Italy
Spain	1.1	-0.4	1.4	0.1	-0.1	-0.3	0.1	-0.1	1.4	-0.4	0.5	Spain
Netherlands	0.6	0.8	-0.1	-0.1	0.4	0.4	-0.3	-0.2	0.4	-0.5	0.4	Netherlands
Belgium	1.6	0.2	1.2	0.2	0.0	0.2	0.7	-0.2	0.7	-0.4	0.6	Belgium
Austria	1.7	0.8	0.8	0.1	0.2	0.6	0.7	0.0	0.1	-0.1	0.2	Austria
Greece	2.4	-0.2	2.7	-0.1	-0.7	0.4	0.6	1.8	0.3	-0.3	0.3	Greece
Finland	1.2	1.2	0.4	-0.4	0.4	0.8	0.1	-0.2	0.5	-0.8	0.4	Finland
Portugal	1.1	-0.3	1.2	0.2	-0.5	0.2	0.5	-0.3	1.0	0.0	0.2	Portugal
Ireland	0.9	1.5	-0.4	-0.2	0.4	1.0	-0.8	0.6	-0.1	-0.8	0.6	Ireland
Luxembourg	1.8	0.9	0.0	1.0	0.5	0.4	-0.2	-0.2	0.3	-0.1	1.1	Luxembourg
Euro Area	0.7	0.4	0.45	-0.11	0.3	0.1	0.0	-0.1	0.6	-0.4	0.3	Euro Area

Source: Norges Bank

observed over the past 20 years, and the growth rate in fixed capital investment would need to more than triple to attain such growth.

Thus, the low-growth alternative seems to be more probable (Table 5). The total employment rate continues to increase and, also in this scenario, ends at a historically high level. The pace of change is lower than in the pre-crisis period, but as we have mentioned, this may be explained in part by high structural unemployment. On the other hand, growth in hours worked per person employed will be better than in the pre-crisis period. To be sure, hours worked will decline slightly year by year, but at a substantially slower pace than prior to the crisis. Conversely, we have assumed fairly weak developments in the capital stock, with average annual growth in fixed capital investment of around 1.2 percent.

Appendix 1: Growth accounting exercise

The production function is specified by

$$(1) \quad Y_t = A_t K_t^{1-\alpha} T_t^\alpha = A_t \frac{K_t^{1-\alpha}}{T_t} T_t$$

Where: Y = GDP, A = total factor productivity, K = capital stock, T = total hours worked and α is the labour share of income. In line with the literature, we set $\alpha = 0.65$

Total hours worked (T) depends on the number of persons employed (S) and the number of hours each person employed works (h).

Employment depends on the size of the labour force (N) and the employment rate (s) (percentage of the labour force that is working).

The labour force is a function of the participation rate (dr) and number of persons of working age (F^{AF}). (Working age is ages 20–64).

The working age population, in turn, depends on the percentage of working age (af) and the total population (F^{TOT})

I.e.:

$$(2) \quad T = \frac{T}{S} S = h * S$$

$$(3) \quad S = N * s$$

$$(4) \quad N = dr * F^{AF}$$

$$(5) \quad F^{AF} = af * F^{TOT}$$

Thus, total hours worked is specified by

$$(6) \quad T = h * s * dr * af * F^{TOT}$$

Plugging in (1) gives us

$$(7) \quad Y = A \frac{K^{1-\alpha}}{T} h * s * dr * af * F^{TOT}$$

Expressed in growth form, it becomes

$$(8) \quad g_Y = g_A + (1-\alpha) * (g_K - g_T) + g_h + g_s + g_{dr} + g_{af} + g_{F^{TOT}}$$

Thus, the contribution from labour productivity is specified by

$$(9) \quad g_A + (1-\alpha) * (g_K - g_T)$$

While the contribution from labour utilisation is specified by

$$(10) \quad g_h + g_s + g_{dr}$$

And the contribution from demographic developments is specified by

$$(11) \quad g_{af} + g_{F^{TOT}}$$

As an input into the projections of growth potential, we use the total employment rate (s^{TOT}) (percentage of the working age population that is employed). The reason is that in EU growth targets, the employment target is specified by the total employment rate rather than the unemployment rate or participation rate.

Therefore, in the projections, we combine the contributions to growth from employment (s) and the participation rate (dr)

$$(12) \quad s^{TOT} = \frac{S}{F^{AF}} = \frac{s*N}{F^{AF}} = s * \frac{N}{F^{AF}} = s * dr$$

Expressed in growth form, this results in

$$(13) \quad g_{s^{TOT}} = g_s + g_{dr}$$

Data for demographic developments, total employment rate and labour force participation by gender are from Eurostat. All other data are from the AMECO database.

Appendix 2: Marginal product of labour and capital

That developments in capital input across countries covary to some extent with developments in labour input is a logical consequence of the declining marginal productivity of capital and labour. Marginal product of labour refers to the marginal change in GDP from a marginal change in hours worked, keeping the capital stock constant. If the change in GDP and hours worked is specified ΔY and ΔT ,

$$(1) \text{ Marginal product of labour} = \frac{\Delta Y}{\Delta T} = \alpha A k^{\alpha}$$

where k is the capital stock per hours worked, also referred to as capital intensity. From (2) it follows that lower capital intensity results in a fall in the marginal product of labour. When total hours worked increases, the capital stock must be increased to maintain labour productivity. Similarly, for capital input,

$$(2) \text{ Marginal product of capital} = \frac{\Delta Y}{\Delta K} = \frac{\frac{\Delta Y}{T}}{\frac{\Delta K}{T}} = \frac{\Delta y}{\Delta k} = (1-\alpha) A k^{-\alpha}$$

where k is GDP per hours worked. The interpretation is what when production is already very capital intensive, there is little effect of further investment in means of production.