MoSUS

Work Package 5.1.

Economic Evaluation

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Executive summary

In this report, we present an evaluation of the economic results of the MOSUS project simulations. The evaluation is divided into 8 themes that loosely map on to the 'economic development' sub-set of the EU's sustainable development indicators[1]. The 8 themes are:

1. Output and wealth
2. Investment
3. Competitiveness
4. Employment
5. Public finance
6. Integration with the global economy
7. Taxes
8. Prices

The main body of the report tells a broadly positive story about the impact of the low and high sustainability scenarios on the economic performance of the EU-25. As section 1 explains, the low and high scenarios exert upward pressure on real GDP per capita in the EU-25 during the modelling period, such that it reaches a maximum in the high scenario. Average GDP per capita in the EU-25 is around 4% higher in the high scenario than in the baseline by 2020. To put this in context, total per capita growth in the baseline is 34% between 2005 and 2020, so the difference between the two scenarios amounts to, very approximately, 1.5 years worth of growth. In the high scenario, the EU-25 reaches a level of wealth in 2020 that would hitherto have been reached by about mid 2021.

Thus the differences between the scenarios are small, but it is nevertheless important to conclude the implementation of policies primarily geared towards decoupling economic activity from material and energy throughput can be *conducive* to economic growth, contrary to the popular assumption that such policies will have an opportunity cost in terms of foregone output. It is the Aachen scenario, in which Member State governments introduce an information and consulting programme to increase material efficiency in the manufacturing sector, that drives this result, exerting a strong positive effect on growth through productivity gains that drive prices down and increase profit margins[2]. Indeed, with the exception of positive returns to public R&D investment in some Member States (that is, in those states where the growth-enhancing effect of decreasing production costs exceeds the fall in public consumption brought about by a shift in government expenditure), the Aachen scenario is the only component of the low and high scenarios to increase output.

[1] Commission of the European Communities, 2005, *Communication from Mr Almunia to the Members of the Commission: Sustainable Development Indicators to Monitor the Implementation of the EU Sustainable Development Strategy*, Brussels, Commission of the European Communities.
[2] Lutz, C., Meyer, B. and Wolter, M.I., 2005, *MOSUS Scenarios and Simulation Results: Work in Progress*, Osnabrück, GWS.

There are regional disparities in the effects of the low and high scenarios. In particular, the basket of policies introduced is more beneficial to growth in the 'old' EU-15 than it is to growth in the new Member States. Within the EU-15, there are further differences in national performance, with France and Spain growing notably quickly in the high scenario, in contrast to the UK, which experiences only a small increase in growth. Within the group of new Member States, the Czech Republic and Hungary perform well in the high scenario, but the other nations perform less well. Poland is one example where growth is, in fact, lower in the high scenario than the baseline. However, these disparities must be set against baseline growth, which is higher in the new Member States than in the EU-15. Indeed, absolute growth remains higher in the new Member States in the high scenario, so the scenario is not significantly detrimental to the convergence of EU-25 wealth (although it must be pointed out that, no matter the scenario, these disparities remain huge).

It is no surprise that some industrial sectors will have to 'take pain' in the low and high sustainability scenarios. Section 1 demonstrates that sectors associated with the domestic extraction and supply of materials and energy (i.e. mining and quarrying, electricity, gas and water supply), as well as manufacturing sectors associated either with the production of material and energy products (e.g. oil refining) and/or with a material- and energy-intensive production process (e.g. iron and steel making) contribute less gross value added in the high scenario than in the baseline. On the other hand, such is the increase in productivity and competitiveness brought about by the Aachen Scenario, the manufacturing sector actually increases its overall share in total gross value added in the high scenario.

An important question behind these trends in growth is which of the basic macro-components of output – consumption (private or public), investment (private or public) or net exports – is driving it? Some aspects of this are addressed in section 2. It shows that investment in the Eurozone and selected EU Member States, as measured by gross fixed capital formation, is higher in the two sustainability scenarios than in the baseline (it is, in fact, highest in the low scenario). Two policy measures that are likely to promote investment are the Aachen scenario and state-subsidised R&D (for which government expenditure is re-allocated from consumption).

However, with the exception of Spain, the scenarios actually lead to a fractional decrease in gross fixed capital formation as a percentage of GDP compared to the baseline. Section 2 goes on to demonstrate that this is because, across the Eurozone as a whole and in most selected countries, the increases in output in the low and high scenarios described above are largely attributable to (i) increases in net exports, which are indicative of the improving international competitiveness of the EU manufacturing sector due to the Aachen scenario, and (ii) increases in household consumption. Section 6, on integration with the global economy, shows that this increase in international competitiveness is manifest in increasing goods exports, to the detriment of some of our major trading partners (e.g. the United States). Encouragingly from the perspective of 'small government', government consumption is a very small and often negative component of the difference in growth

between the baseline and high scenarios. Section 5, on public finance, shows that the average share of government expenditure in GDP for the EU-15 decreases as we move from the baseline, through the low to the high scenario. This is due to a relative decrease in both government consumption and investment.

Section 3 presents some specific data on the competitiveness of the EU, which sections 1 and 6 indicate is increased through the implementation of sustainability policies, especially the Aachen scenario. In line with these outcomes, EU-25 labour productivity, which increases in the baseline by an annual average rate of 1.4%, is driven upwards by the low and high scenarios, so that, in 2020, labour productivity per employee is 3.8% above the baseline in the high scenario. This represents the effect of increasing output, since employment levels in the high scenario are fractionally above those in the baseline (see section 4). In keeping with data on output, the sustainability policies have a greater positive effect on labour productivity in the EU-15 than in the new Member States. On the other hand, baseline growth in labour productivity is almost twice as high in the new Member States than in the EU-15. Thus the productivity gap between the EU's two main regions is closing, albeit the sustainability scenarios are actually slightly detrimental to this cohesive process. Looking at the EU-15's major global competitors, labour productivity in the United States and Japan increases more quickly than in the EU-15 in the high scenario, so the improvements seen are insufficient to close the shortfall between, for example, US productivity and European productivity that has been pinpointed in recent times.

Section 4 presents data on employment. It shows that the high scenario leads to a very small increase in total employment in the EU-25 compared to the baseline, while the low scenario leads to a fractional decrease in total employment, also relative to the baseline. These relative differences sit against a baseline trend of increasing total employment, from just under 200 million people in 2005 to around 217 million people in 2020.

The unemployment rate in the EU-25 is 2.6 percent lower in the high scenario than in the baseline, dropping to around 8.4% in 2020, compared to about 8.6% in the baseline (again, the very marginal nature of these scenario-related effects is evident). Analysis of the unemployment rate goes on to reveal that the benefits of the high scenario in terms of reduced unemployment are more pronounced in the new Member States than they are in the EU-15. In the new Member State bloc, the high scenario reduces unemployment by a considerable 5 percentage points from the baseline. In the EU-15, the reduction is around 1 percentage point. Thus, as section 4 points out, not only would the sustainability scenarios close regional disparities in respect of employment, they would actually reverse them by 2020. On a sectoral level, the major scenario-related losses in employment are in agriculture, hunting, forestry and fishing, as well as the industrial sector (including mining and quarrying and energy supply). Although there are insufficient data, one assumes based on the sectoral breakdown of gross value added (section 1) that the major losses are sustained in the material and energy extraction and supply sectors, together with manufacturing sectors that are material- and energy intensive.

As with scenario-related effects on output, the trends we see in employment represent the competing forces of various policy measures. Most depress employment by a small amount due a downward push on production (exceeding any positive consequences of falling real wages, for example in the transport cost scenario). The key exception is, once again, the Aachen scenario. Although this policy measure ramps up real wages, any negative effect on employment propagated by increasing labour costs is overwhelmed by the demand for labour created through expanding production.

Section 5 discusses two aspects of public financial policy: (i) the balance of government spending to income and (ii) the size of the state as measured by combined government consumption and investment. The latter was discussed above in relation to the drivers of increasing output. In relation to trends in government lending/borrowing, section 5 shows that there are no substantial differences between the scenarios, with the baseline trend being a decrease in government borrowing across the EU-15 and in one selected new Member State: Poland. Some Member States run deficits, while others enjoy surpluses. The only EU Member State to move from deficit to surplus in the modelling period is France.

Section 6 discusses the integration of the EU-25 in the global economy: that is, patterns in the international trade of goods and services to and from the EU-25. The low and high scenarios have a mild negative effect on trade intensity – total trade in goods and services (exports plus imports) as a percentage of GDP – compared to the baseline, although trade intensity is still increasing for all countries analysed, even in the high scenario. There are two main reasons for this slight fall in international trade intensity in the low and high scenarios. The first is higher transportation costs that fall on trade with the EU due to the inception of a transport pricing policy that adds a 5% mark-up in the low scenario and a 10% mark-up in the high scenario. Both exports and imports are affected by this. The second is the impact of the Aachen scenario. This depresses demand for material imports to the EU considerably, while at the same time bringing about productivity and output growth.

Breaking aggregate trade patterns down into their four components – goods exports, goods imports, services exports and services imports – section 6 shows that the sustainability scenarios (specifically the high scenario) lead to a marked fall in goods imported to the EU. This is the particular effect of the Aachen scenario. On the other hand, the positive impetus the Aachen scenario gives to the global competitiveness of the EU manufacturing sector is evident in the fact that goods exports increase in many Member States in the high scenario compared to the baseline. Indeed, those countries benefiting most from the Aachen scenario, such as France and Spain, see the largest relative increases in goods exports.

Section 7 discusses trends in tax revenue. Total tax revenue as a percentage of GDP in the EU-15 decreases fractionally in the baseline scenario, with the low and high scenarios effectively following an identical path. Within the EU-15, some Member States with a below

average total tax burden see increasing revenue as a percentage of GDP in the modelling period (France, Germany and Spain), while other Member States, notably the UK, see a drop in revenue/GDP. Turning to the total *household* tax burden, data illustrate that it decreases as a percentage of disposable household income in the EU-15 between 2005 and 2020, from 20.2% to 19.7%. Again, the effect of the scenarios on this trend is minimal.

Section 8 analyses price trends in the modelling scenarios. It first looks at inflation trends, based both on the GDP deflator (i.e. economy-wide inflation) and household consumption expenditures (which approach the most commonly used indicator of inflation: the consumer price index or CPI). The baseline trend in inflation varies across the EU-25's Member States, but may generally be regarded as within acceptable limits. The low and high scenarios actually reduce inflation – as measured by household consumption expenditures – in the EU. The reductions on the baseline generated by the high scenario in 2020 vary from one or two percent (e.g. Czech Republic) to over 13% (Spain). It is likely that this reduction represents the combined effect of the Aachen scenario and state-subsidised R&D/technical progress, both of which drive production costs and product prices downwards. The other policy measures, such as transport pricing and a carbon tax, work in the opposite direction, pushing prices upwards. The deflationary effects of the Aachen scenario and R&D-driven technical progress are further brought into focus by data on baseline energy and electricity prices, which are also increasing year-on-year, although not dramatically.

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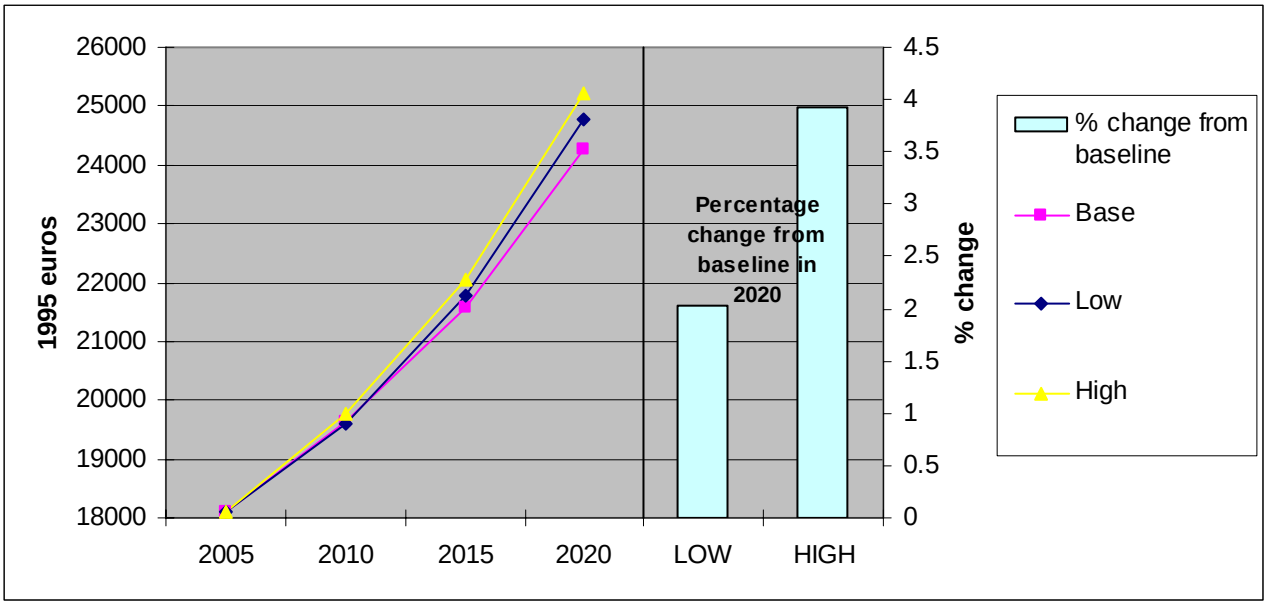
1. Output and wealth

1.1. Growth rate of GDP per capita

We begin by presenting growth of real GDP per capita in the EU-25 according to the baseline, low and high sustainability scenarios (figure 1.1). While real GDP per capita rises at an increasing rate in the baseline scenario, it grows even more quickly in the low and high scenarios, reaching a maximum of €25224 in the high scenario in 2020.

Real GDP per capita is around 2% higher than the baseline in the low scenario in 2020, and 3.9% higher than the baseline in the high scenario. Clearly, the package of sustainability policies simulated in GINFORS is beneficial from the perspective of economic growth. Furthermore, there are clear benefits to implementing these policies fully, as the increase in GDP brought by the high scenario relative to the low scenario demonstrates. It is the Aachen scenario, in which Member State governments introduce an information and consulting programme to increase material efficiency in the manufacturing sector, that drives this result, exerting a strong positive effect on growth through productivity gains that drive prices down and increase profit margins[3].

Figure 1.1. Real GDP per capita in EU-25

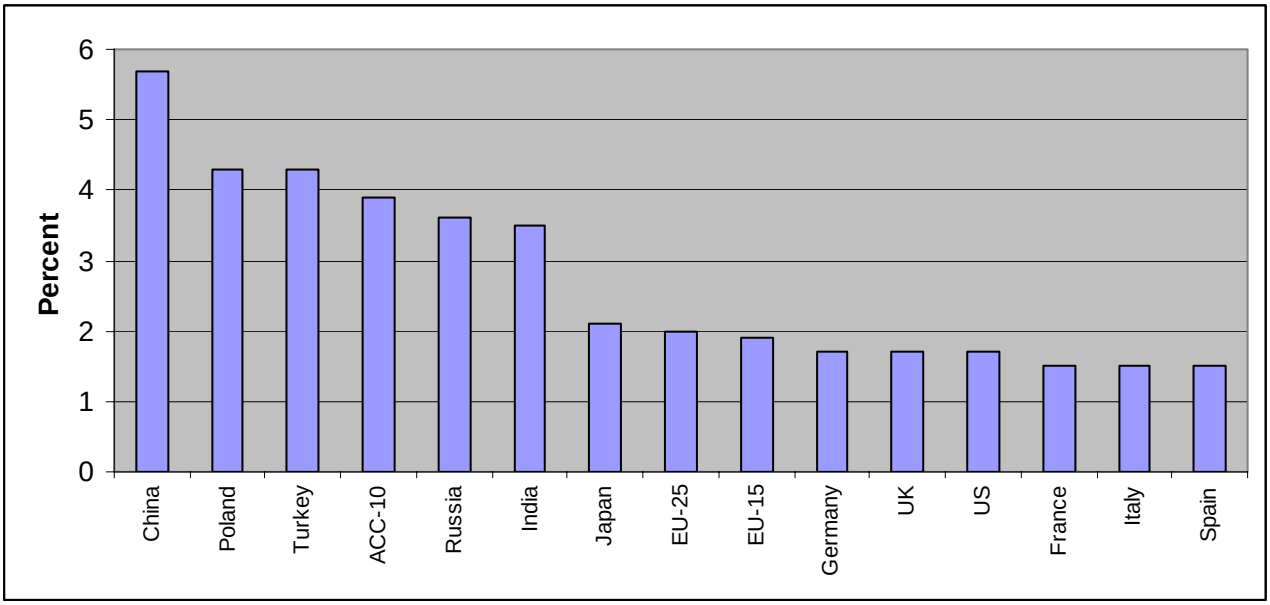


Before examining the region and country specific impacts of the low and high scenarios, it is insightful to examine the distribution of growth under the baseline scenario. Figure 1.2 presents annual average growth rates of real GDP per capita for selected countries and country-groups, including the EU-25, the EU-15, the 10 Accession countries (ACC-10) and 6 Member States contributing more than ¾ of Europe's aggregate GDP, population and

[3] Lutz, C., Meyer, B. and Wolter, M.I., 2005, *MOSUS Scenarios and Simulation Results: Work in Progress*, Osnabrück, GWS.

energy consumption: France, Germany, Italy, Poland, Spain and the UK. Other significant world economies are added as a point of comparison.

Figure 1.2. Annual average growth of real GDP per capita 2005-2020 in the baseline scenario.



As one would expect, the industrialising economies of China, India and Turkey, as well as the transition economies (most of the ACC-10, including Poland, and Russia), grow most quickly. Aggregate growth in India and Turkey is higher still, but the per capita effect is dampened by population growth that is substantially faster than any of the other countries and country-groups in focus.

There is a step change evident as one moves from the selected developing and transition economies, where annual per capita growth ranges from 3.5% (India) to 5.7% (China) on average, to the major developed economies, where growth ranges from 1.5% (France, Italy and Spain) to 2.1% (Japan) on average. In terms of the EU-15's objective of 3% annual average growth in the coming years[4], results under the baseline are somewhat disappointing (technically, this target relates to aggregate growth, but this is very close to per capita growth given the regional and national populations are virtually stable).

Comparing the ACC-10 with the EU-15, baseline growth will help close regional disparities, as the former grows some 2 percentage points faster per annum. However, as figure 1.3 demonstrates, these disparities remain very large indeed. Although per capita GDP in the ACC-10 rises from just 17% of per capita GDP in the EU-15 in 2005 to 23% in 2020, it is forecast to be just €6384 in 2020, compared to €27567 in the EU-15 (both in €1995).

[4] From the Presidency Conclusions of the Lisbon European Council: *Presidency Conclusions: Lisbon European Council, 23 and 24 March 2000* - http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/00100-r1.en0.htm

Figure 1.3. Per capita GDP in the ACC-10 and EU-15 in 2005 and 2020 (in €1995).

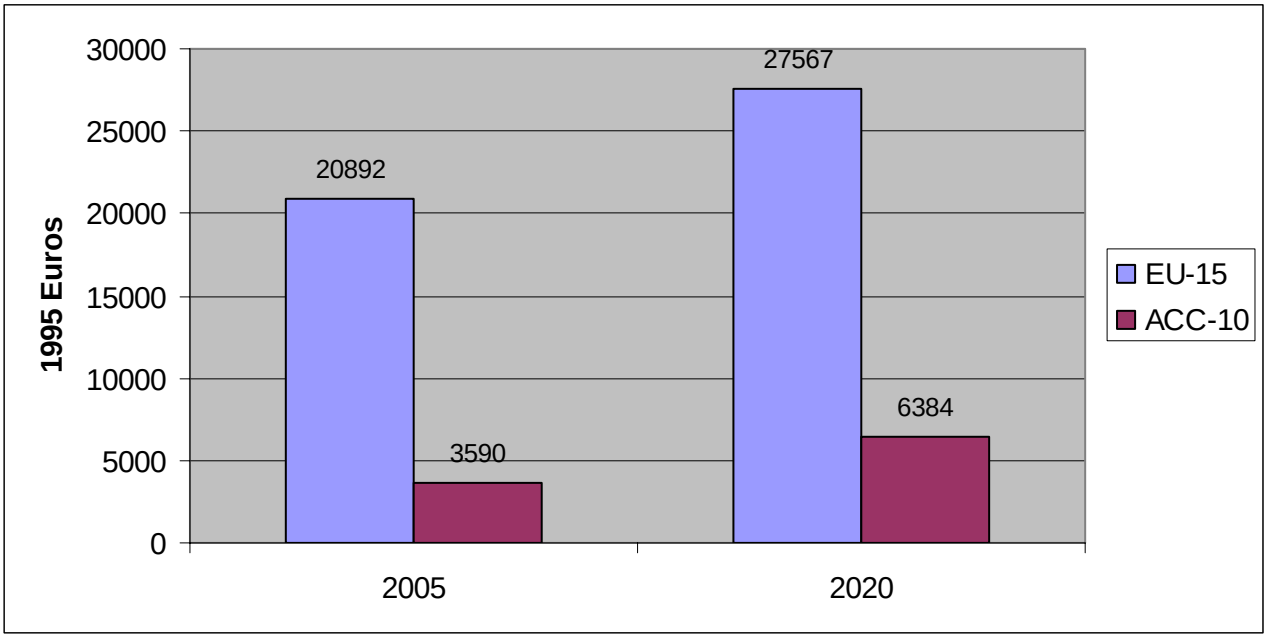
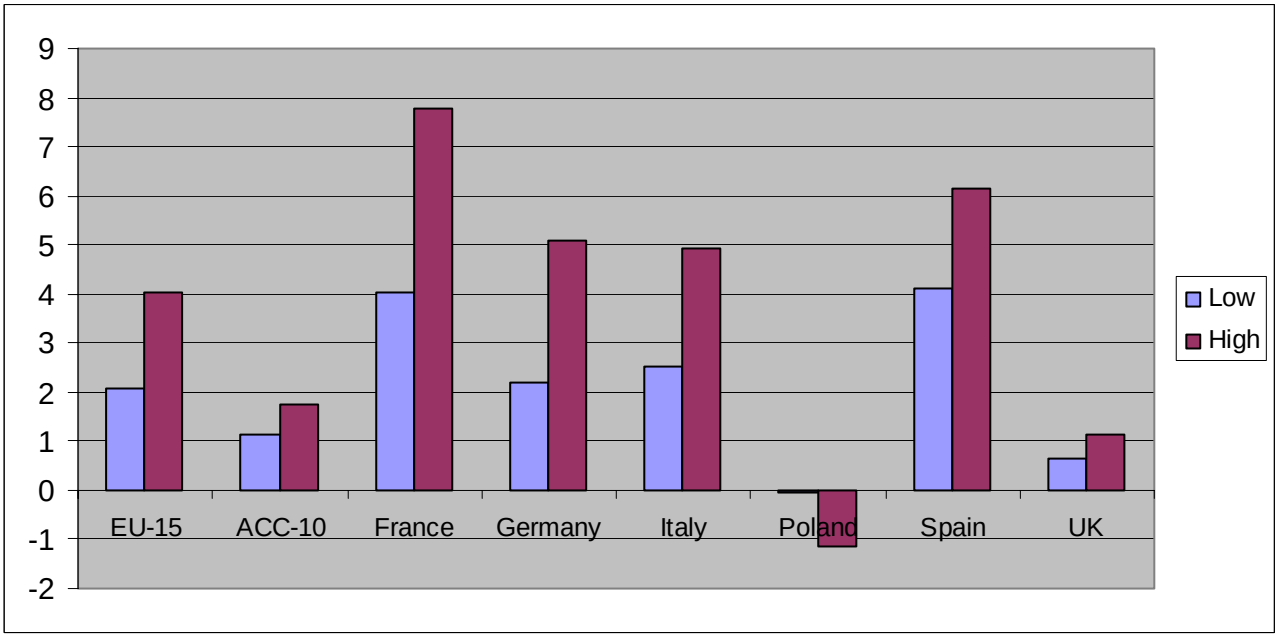


Figure 1.4 investigates in more detail the impacts of the low and high sustainability scenarios within the EU-25, presenting the percentage difference in per capita growth between the low and high scenarios and the baseline for the EU-15, the ACC-10, France, Germany, Italy, Poland, Spain and the UK. The increase in growth achieved through the implementation of sustainability policies is greater in the EU-15 than in the ACC-10. On the other hand, we know that baseline growth is stronger in the ACC-10, so growth continues to be higher in absolute terms in the ACC-10 under the low and high scenarios.

Figure 1.4. Differences in growth of real GDP per capita between scenarios for selected countries and country-groups (in percent).



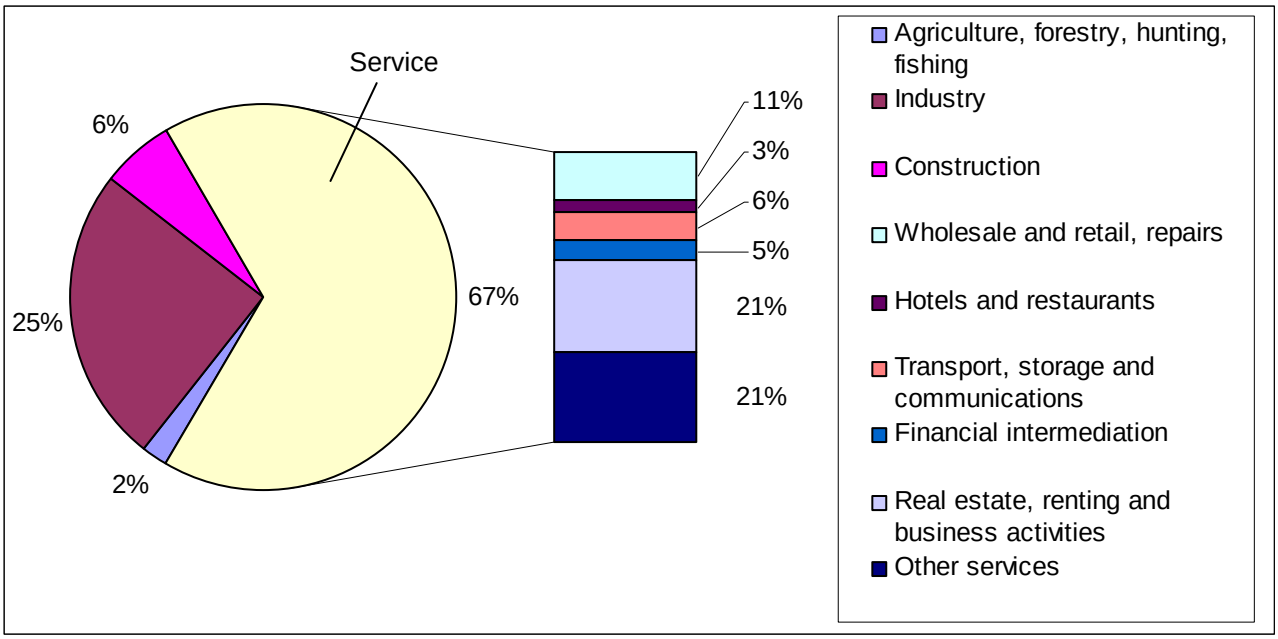
In fact, the positive impact of the low and high scenarios in the ACC-10 is in large part a reflection of impacts in the Czech Republic and Hungary, where policies achieve large increases in GDP. For the remaining accession countries, including Poland, the scenarios either have a small positive or a small negative effect. Once again, this difference can be largely attributed to the Aachen scenario and the rapid expansion in output it brings about in the Czech Republic and Hungary.

Within the EU-15, the low and high scenarios achieve impressive results in France, Germany, Italy and Spain, but UK growth is only marginally higher, because the Aachen scenario has a lesser effect.

1.2. The structure of output and output growth

The current structure of output in the EU-15 is tilted towards the service sector, which accounted for around 67% of gross value added[5] in 2000 (GVA: figure 1.5). Within the service sector, the two most quantitatively important sectors were real estate, renting and business activities (21%), and other services (also 21%)[6]. Industry (i.e. mining and quarrying, manufacturing, and electricity, gas and water supply) accounted for 25% of GVA and construction for 6%, while agriculture, hunting, forestry and fishing accounted for just 2%.

Figure 1.5. The structure of output in the EU-15 in 2000, measured as GVA (excluding Finland, Ireland, Italy, Luxembourg and Portugal due to lack of data).

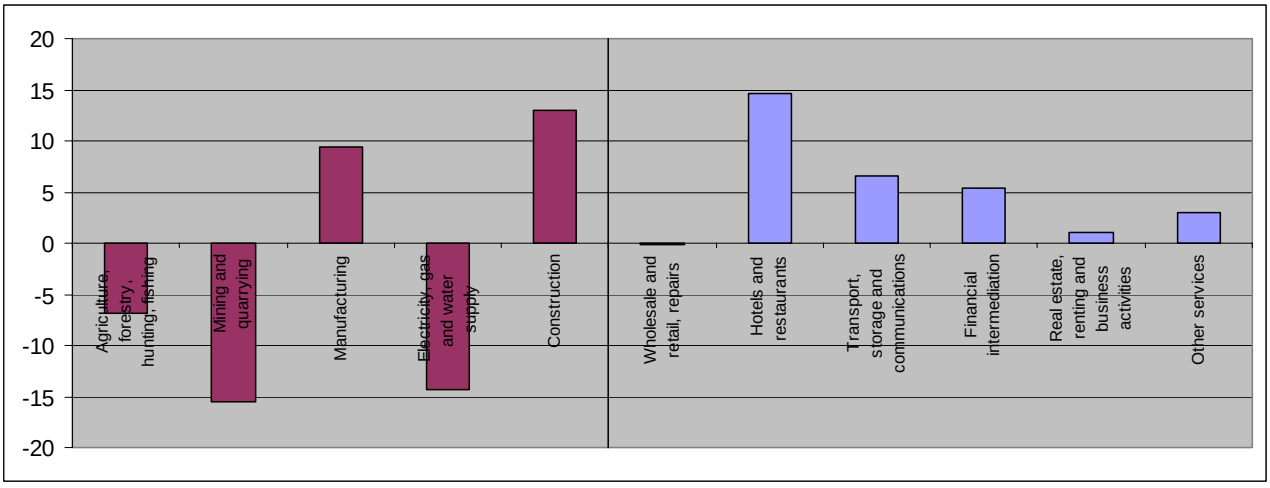


[5] Gross valued added + financial intermediation services + taxes less subsidies on products = GDP. We can assume a more or less constant relationship between gross value added and GDP.
[6] The category 'other services' includes predominantly public sector activities: public administration and defence, compulsory social security; education; health and social work; other community, social and personal service activities; private households with employed persons and extra-territorial organisations and bodies.

Following the baseline scenario, there is some change in these shares between 2000 and 2020. The share of the service sector as a whole falls to 63% of total EU-15 GVA, at the expense of industry, which increases to 30%. The shares of construction and agriculture, hunting, forestry and fishing remain at 6% and 2% respectively. Within the service sector, the share of GVA is little changed from 2000. This broad pattern is also reflected in the high scenario, where the shares of the service, industrial, construction and agricultural etc. sectors are 64%, 31%, 6% and 2% respectively.

Figure 1.6 looks in a different way at the structure of EU-15 output in 2020, comparing the baseline and high scenarios. It illustrates percentage differences in GVA between the baseline and high scenarios for a selection of sectors. On the left-hand side can be seen differences for the primary, industrial and construction sectors, while the right-hand side breaks the service sector down into sub-sectors. The big 'winners' from the high scenario are manufacturing, which increases its GVA by 9.5% overall in the high scenario compared to the baseline, construction, which increases its by 13%, and some elements of the service sector. Within the service sector, the sub-sector that benefits most from the high sustainability policies is hotels and restaurants (+14.7%). The big losers are mining and quarrying, which is 15.6% down on the baseline, and electricity, gas and water supply, which is 14.3% down. GVA in agriculture, forestry, fishing and hunting is 6.8% lower in the high scenario compared to the baseline, although the sector does expand fractionally in real terms[7].

Figure 1.6. Percentage changes in GVA between the baseline and high scenarios for the EU-15 in 2020 (excluding Finland, Ireland, Italy, Luxembourg and Portugal due to lack of data).



The relative decline in the fortunes of the primary sector (especially mining and quarrying), as well as the electricity, gas and water supply sector, is a consequence of a package of policy measures and underlying technological changes that reduces demand for material and energy inputs. The policy measures include transportation pricing, a material input tax, the Aachen scenario (in some countries only: in others, this actually pushes material and

[7] Real GVA is calculated by deflating nominal GVA using the GDP deflator.

energy demand upwards), public subsidy of R&D and, most importantly in relation to energy demand, a carbon tax.

Figure 1.7 examines in more detail the impact of the high scenario on the manufacturing sector compared to the baseline, showing the five sub-sectors that perform worst in percentage terms and the five sub-sectors that perform best. In line with the above explanation, it is the manufacturing sub-sectors associated either with the production of material and energy products and/or with a material- and energy-intensive production process that fare worst.

An example of reduced demand for material and energy products is given by a technological change in the production of motor vehicles that depresses demand for iron and steel[8]. At the same time, the introduction of a material input tax reduces demand for non-metallic mineral products, while the introduction of a carbon tax hits demand for coke and refined petroleum products. In terms of the production process, the pulp and paper industry sees its production costs rise and its price-competitiveness fall through the increasing cost of energy and material inputs.

In this context, it is interesting to see the increase in GVA contributed by material recycling (+20.6% on the baseline when combined with manufacturing not elsewhere classified), in large part a consequence of the increasing competitiveness of recycled materials relative to primary materials that results from the material input tax. The remaining sectors to expand GVA in the high scenario are food, drink and tobacco products (+32.3% on the baseline), textiles, leather and footwear (+17.7%), motor vehicles and trailers (+15.8%) and radio, television and communication equipment (+14.7%).

There are very limited data available on the ACC-10, being restricted to the Czech Republic and Hungary. In 2000, the service sector in these two countries accounted for 58% of combined GVA, the industrial sector accounted for 31%, the construction sector 8% and the agriculture, hunting, forestry and fishing sector 4%. In the baseline scenario, the service sector retreats to 54% of GVA in 2020, the industrial sector grows to 33%, the construction sector remains at 8% and the agriculture, hunting, forestry and fishing sector increases its share fractionally to 5%.

Figure 1.8 compares the impact of the high scenario to the baseline on a selection of sectors in 2020. On the left-hand side can be seen differences for the primary, industrial and construction sectors, while the right-hand side breaks the service sector down into sub-sectors. GVA in the mining and quarrying sector falls the furthest, being 27.2% lower in the high scenario relative to the baseline, driven by a particularly steep decline in the Czech Republic (-75.9%). GVA in the agriculture, hunting, forestry and fishing sector is also down in the high scenario (-6.5%).

[8] Lutz, C., Meyer, B. and Wolter, M.I., 2005, *MOSUS Scenarios and Simulation Results: Work in Progress*, Osnabrück, GWS.

Figure 1.7. Percentage changes in the structure of manufacturing output (GVA) between the baseline and high scenarios for the EU-15 in 2020 (excluding Finland, Ireland, Italy, Luxembourg and Portugal due to lack of data).

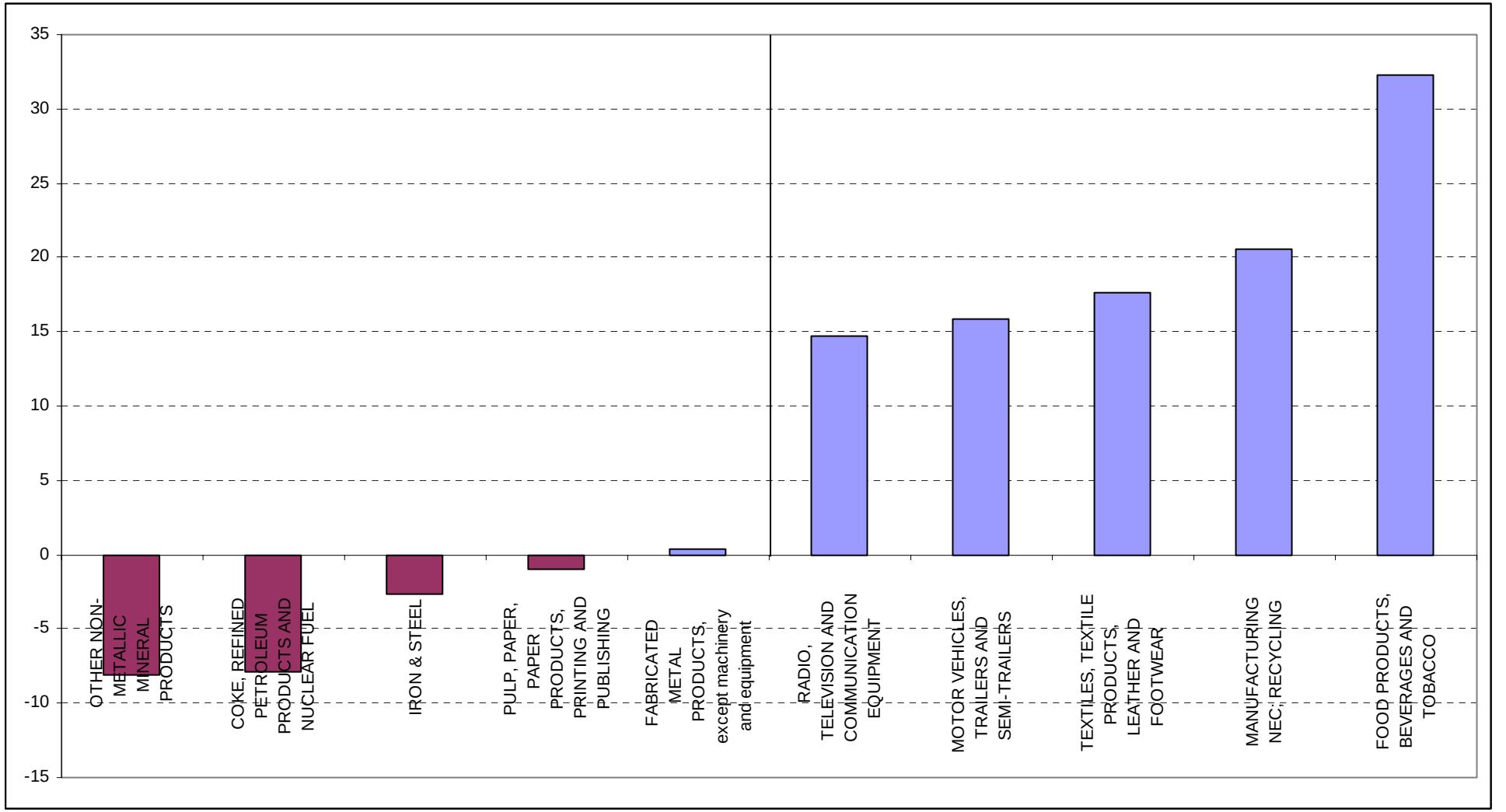
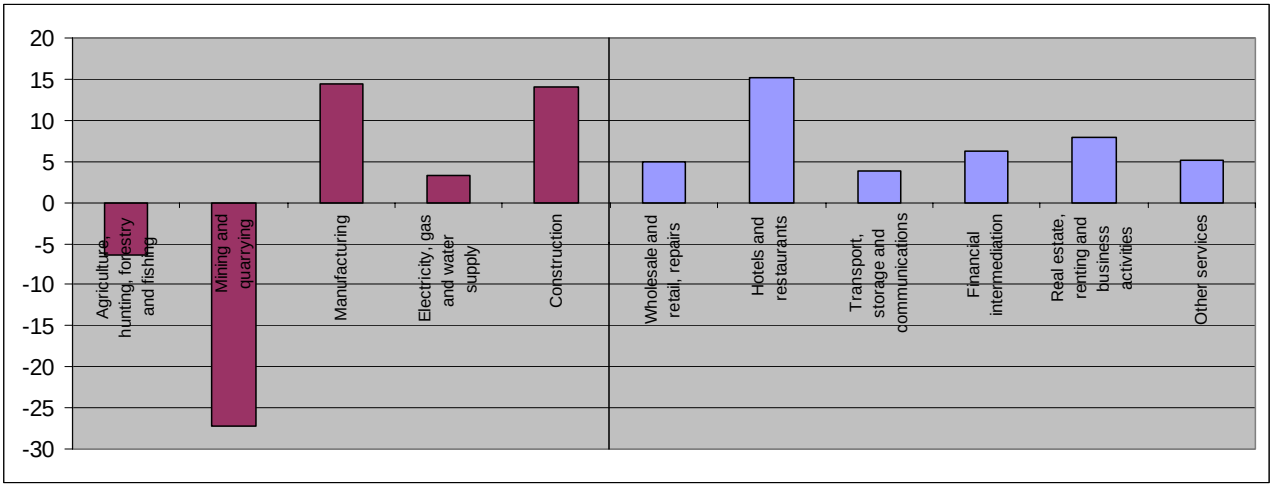


Figure 1.8. Percentage changes in GVA between the baseline and high scenarios for the Czech Republic plus Hungary in 2020.



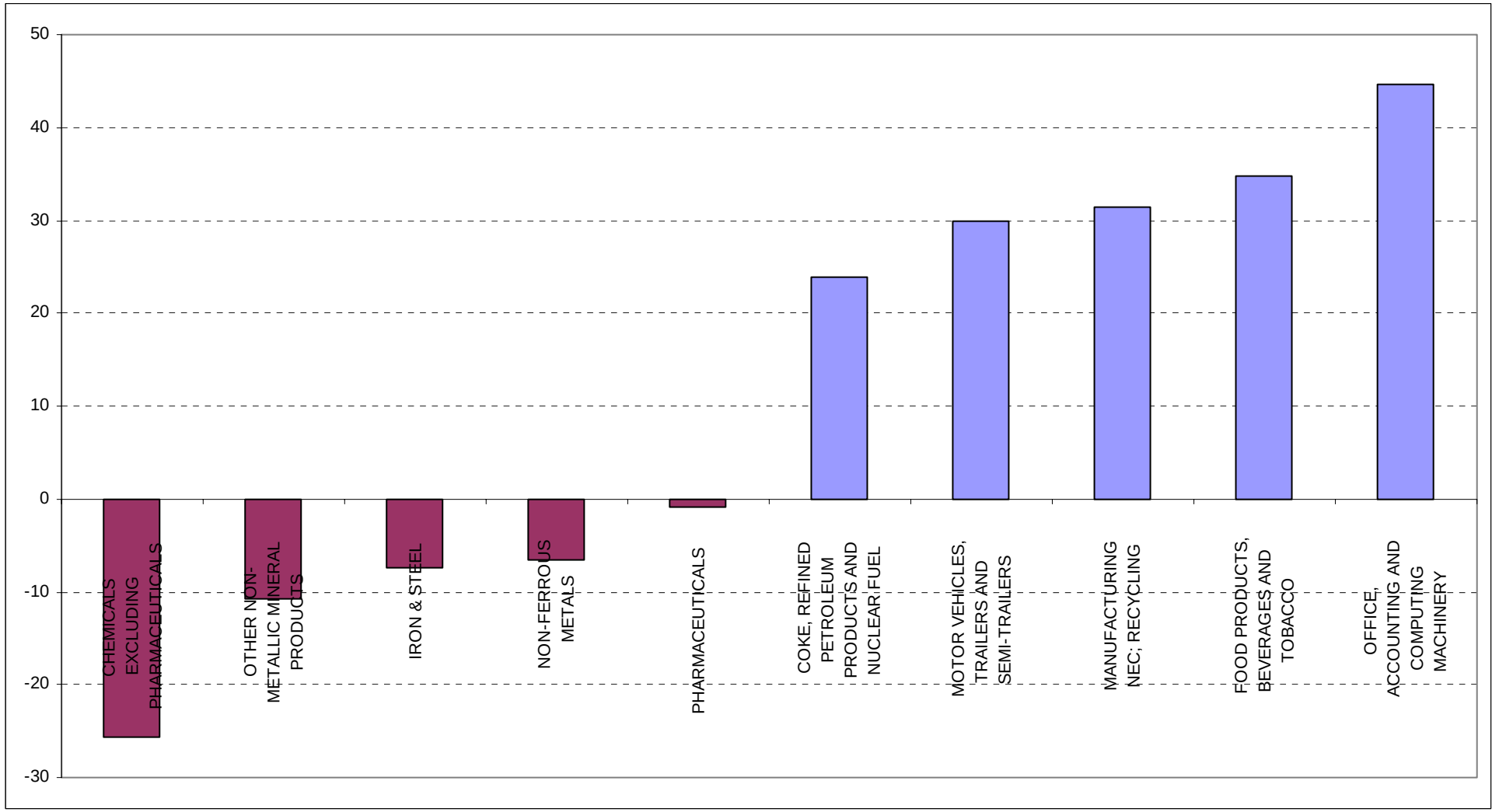
However, manufacturing, construction and service sector growth is strong in the Czech Republic and Hungary in the high scenario. For the manufacturing sector, GVA is 14.5% higher in the high scenario than in the baseline; for construction it is 14.1% higher, while it is higher across all the service sub-sectors. Even the electricity, gas and water supply sector sees its GVA expand in the high scenario compared to the baseline (+3.3%), although it benefits least. Within the service sector, strongest growth relative to the baseline is in the hotel and restaurants sub-sector (+15.2%). It is worth bearing in mind, however, that the high scenario has a greater positive effect on output in the Czech Republic and Hungary than in their neighbouring accession countries. Elsewhere the prognosis is likely to be less favourable, especially for sectors that produce material and energy products and sectors with a material- and energy-intensive production process.

Figure 1.9 looks at the structure of manufacturing in the high scenario compared to the baseline scenario in 2020, showing the five sub-sectors that perform worst in percentage terms and the five sub-sectors that perform best. Similar to the EU-15, the sectors that perform worst are those that either supply materials or are reliant on a material- and energy-intensive production process. Across these two countries, it is the chemicals sub-sector that is hardest hit: GVA is 25.7% down on the baseline. A range of factors can be at play here, including a particular (non-policy) technological development in the agriculture sector, whereby the diffusion of biotechnology reduces the consumption of chemicals by an annual average rate of 0.5% between 2010 and 2020. Once again, the non-metallic mineral product sub-sector (-10.7%) and the iron and steel sub-sector (-7.4%) decrease in importance, as do the non-ferrous metals (-6.6%) and pharmaceuticals (-0.9%) sub-sectors.

An interesting trend in the Czech Republic and Hungary compared to the EU-15 is an expansion of the coke, refined petroleum products and nuclear fuels sub-sector in the high scenario (+23.9% on the baseline). In fact, this growth is mainly located in the Czech Republic, where one possible explanation is the high elasticity of carrier substitution and energy productivity, which results in a rather low cost and price push following the

introduction of a carbon tax. Especially if carrier substitution occurs within the fossil energy product sub-sector (i.e. from coke to refined petroleum products), then there should be a comparatively minor effect on the performance of the sub-sector compared to other countries. In spite of this, a 23.9% increase in GVA on the baseline is almost certainly an over-estimate, because the high scenario has no impact on private consumption in the Czech Republic due to a lack of available data. Increasing real GDP hence leads to an increase in private consumption, including of fossil and nuclear energy products.

Figure 1.9. Percentage changes in the structure of manufacturing output (GVA) between the baseline and high scenarios for the Czech Republic plus Hungary in 2020.



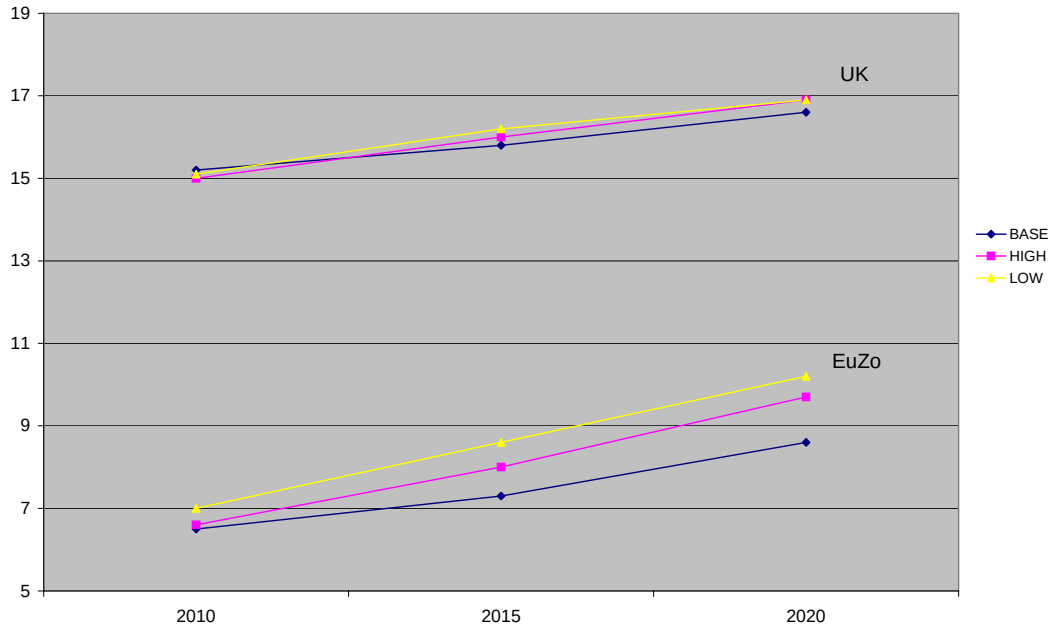
2. Investment

2.1. Gross fixed capital formation

We analyse gross fixed capital formation (GFCF) in the Euro zone (EUZO) and in selected Member States of the EU-15. Some transformed ACC-10 economies are also investigated in detail. For comparison, rapidly industrialising economies (China) and developed economies outside Europe (Japan and the United States) are also mentioned.

In figure 2.1, five-year growth rates in GFCF according to the baseline scenario and the low and high sustainability scenarios are presented for the EUZO and the UK. It can be seen that investment growth in the EUZO is highest in the low scenario, increasing by 7.0% between 2005 and 2010 and by 10.2% between 2015 and 2020. This is followed by growth in the high scenario, with the lowest growth registered by the baseline.

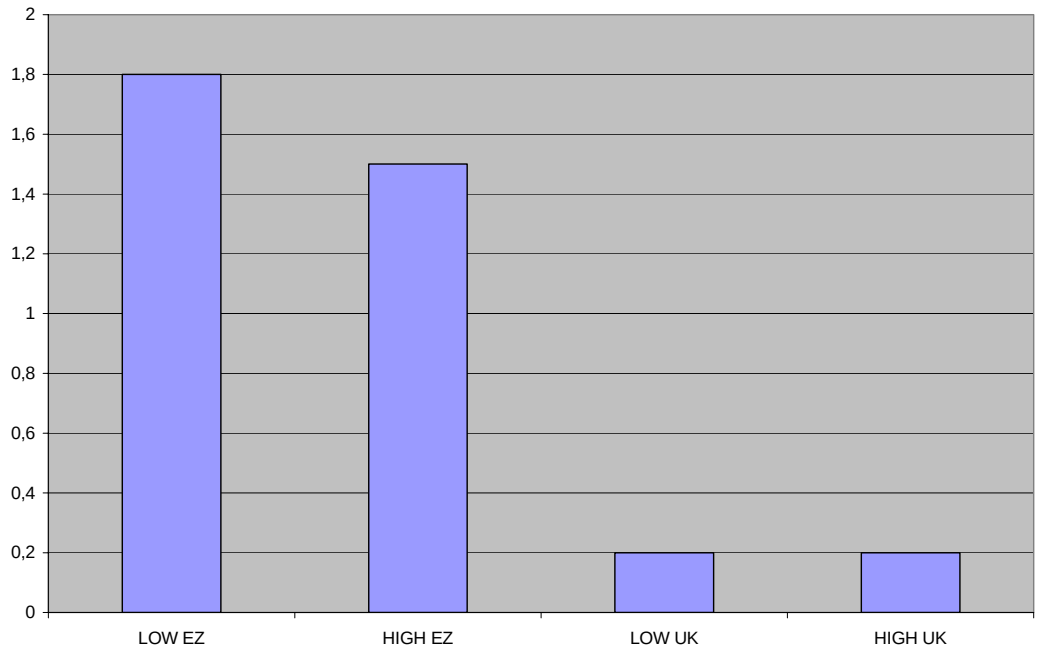
Figure 2.1 Five-year growth in gross fixed capital formation in the EUZO and UK.



Percentage deviations from the 2020 baseline in the low and high scenarios are presented in figure 2.2. In the EUZO, GFCF is +1.8% in the low scenario and +1.5% in the high scenario.

In the UK, baseline growth in GFCF is higher than in the EUZO, peaking at nearly 17% in the five year period 2015-2020. In this case, however, the low and high scenarios have a very small impact.

Figure 2.2. Percentage changes in GFCF from the baseline in 2020 (EUZO, UK).



Examining particular EUZO countries (see figures 2.3-2.6), clear differences in five-year growth rates and in the impact of the low and high scenarios on capital formation can be seen. For example, in the case of Germany there is little difference between the scenarios. In Spain, however, the percentage change from the baseline ranges from 3.4 in the low scenario to 5.3 in the high scenario. Clearly, Spain is the country that benefits most from sustainability polices in terms of gross capital formation.

Figure 2.3. Five-year growth in gross fixed capital formation in Italy and Spain.

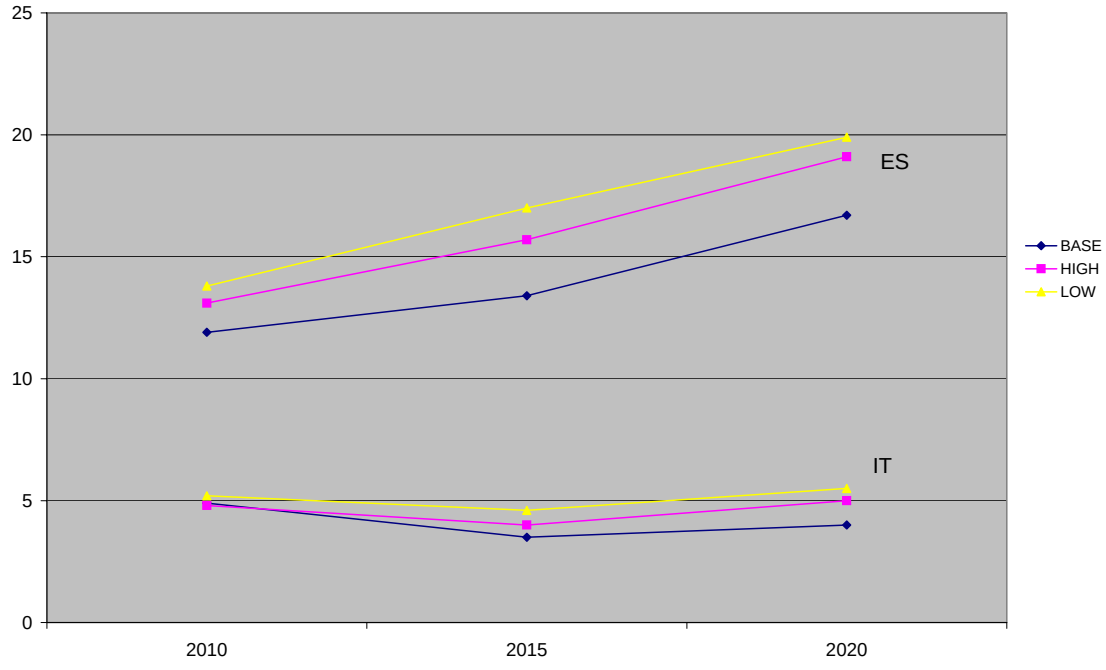


Figure 2.4. Percentage changes in GFCF from the baseline in 2020 (Italy, Spain).

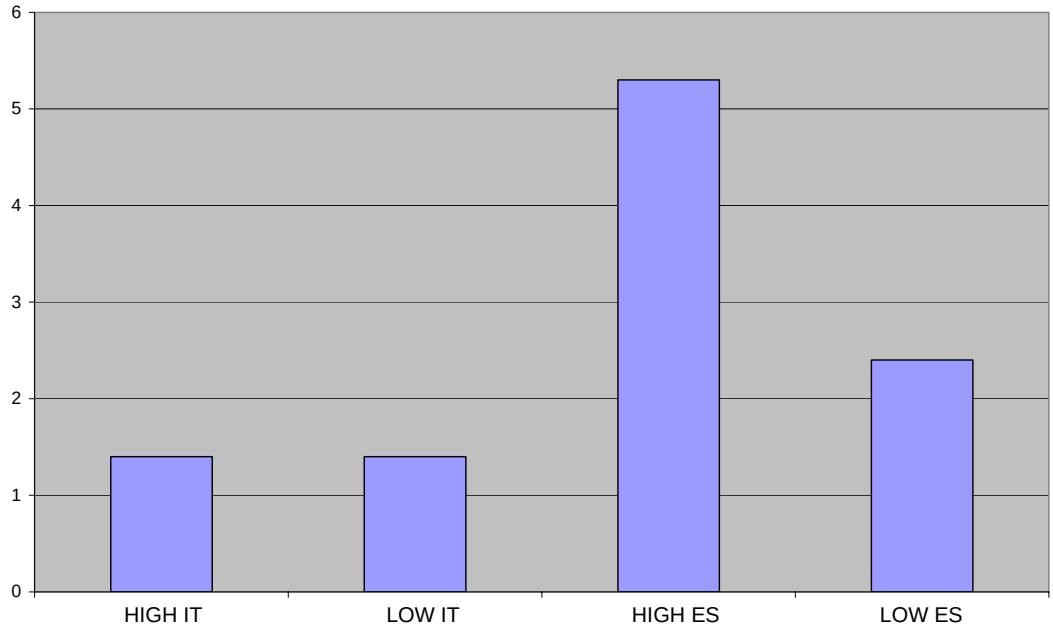


Figure 2.5. Five-year growth in gross fixed capital formation in France and Germany.

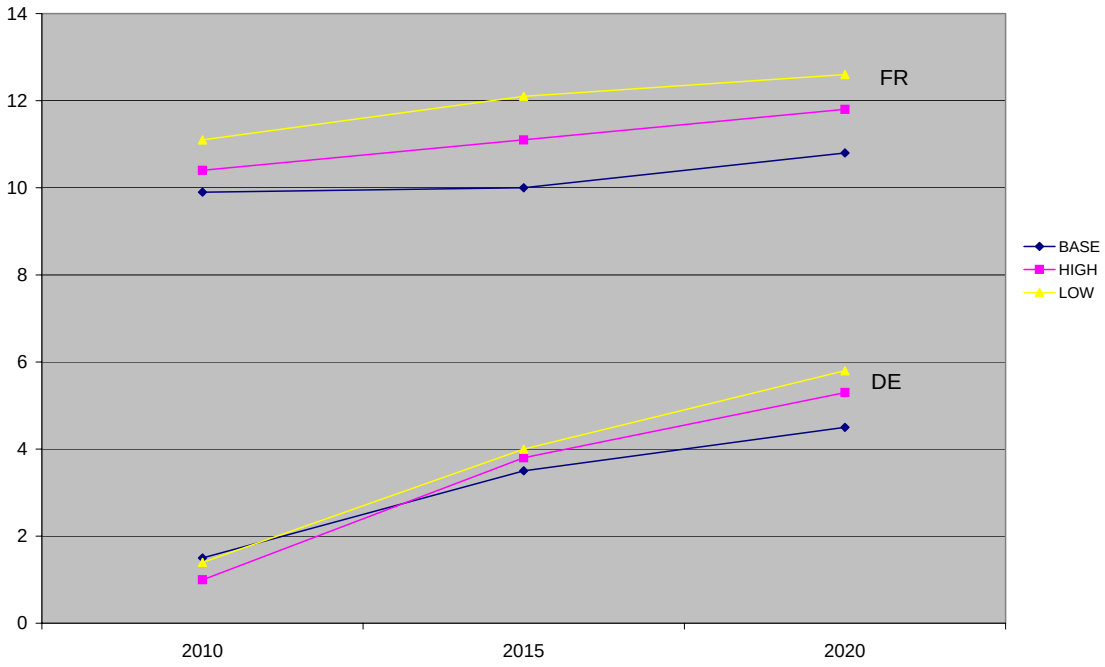


Figure 2.6. Percentage changes in GFCF from the baseline in 2020 (France and Germany).

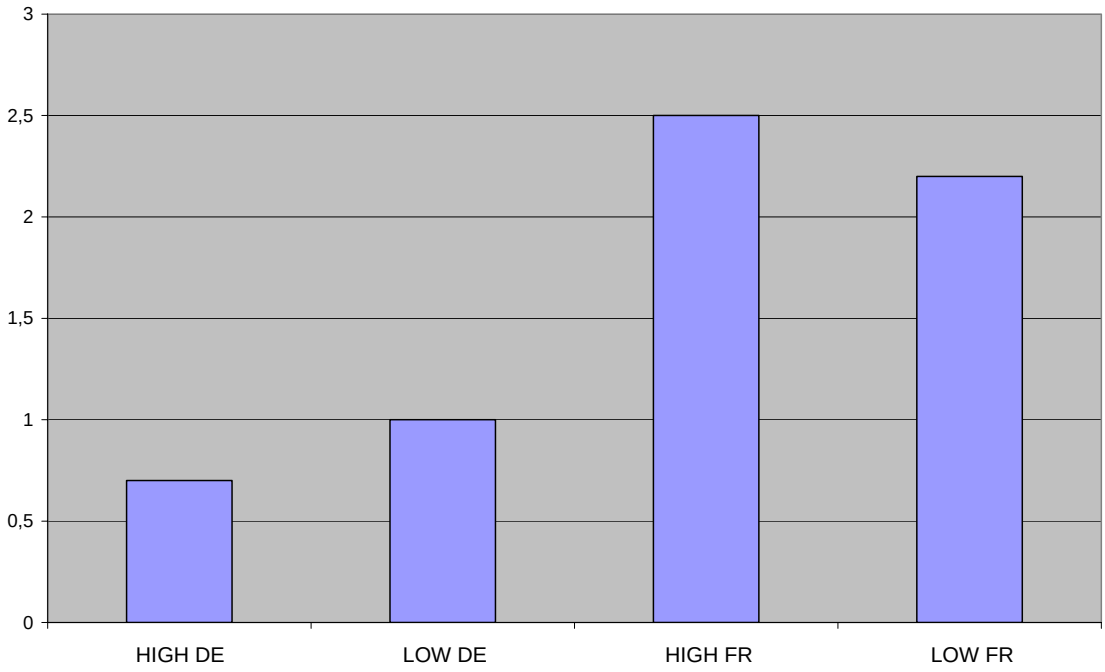


Figure 2.7 presents five-year growth rates in GFCF for two representatives of the ACC-10: Hungary and the Czech Republic. In Hungary, the baseline scenario simulates strong but decreasing growth. The low and high scenarios track this trend, but the low scenario achieves the highest overall growth, followed by the high scenario, which is in turn an improvement on the baseline. In the Czech Republic, baseline growth begins below Hungary's in the period 2005-2010, but overtakes it by the period 2015-2020. In a now familiar pattern, growth is highest in the low scenario, followed by the high scenario, and is lowest in the baseline scenario. Figures 2.8 and 2.9 present scenario-related differences in 2020. The impact of the scenarios is towards the high end of the range of effects presented thus far (Spain experiences the biggest push on investment).

Figure 2.7. Five-year growth in gross fixed capital formation in the Czech Republic and Hungary.

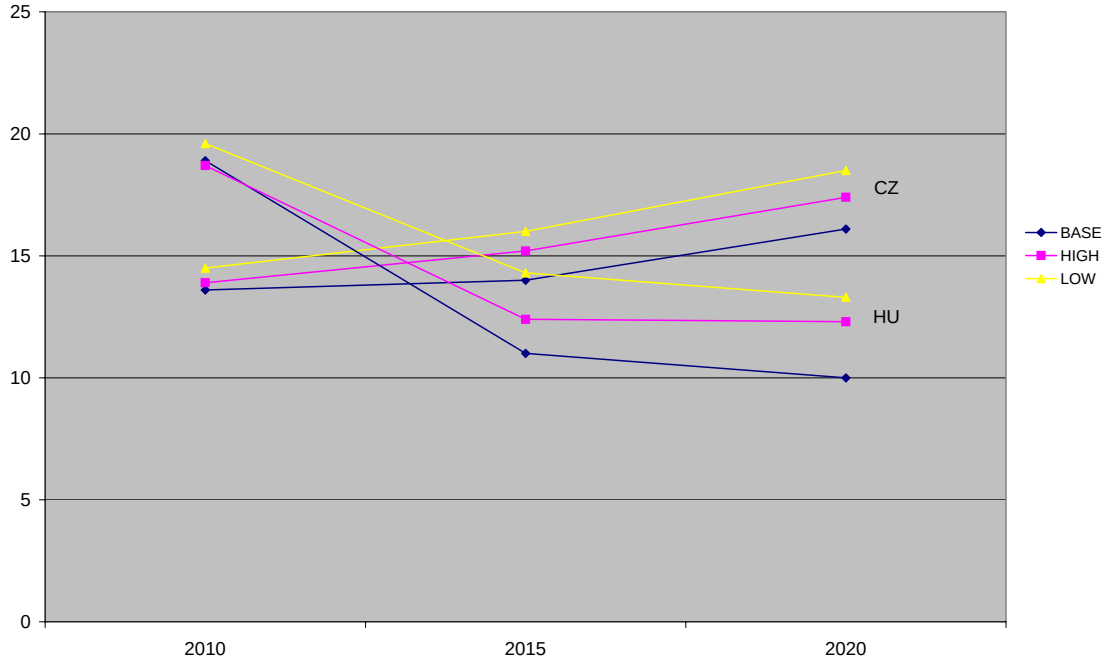
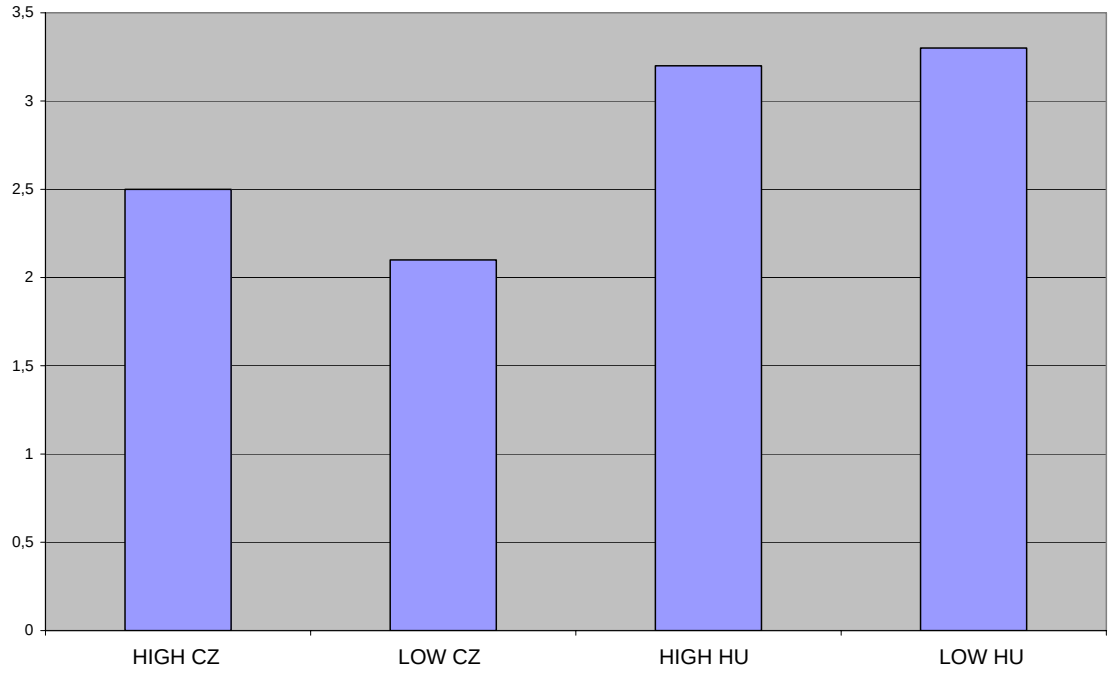


Figure 2.8. Percentage change in GFCF from the baseline in 2020 (Czech Republic and Hungary).



There is no simulation scenario in constant prices for Poland, but it is worth adding that in Poland, like Hungary, a decreasing tendency in the growth of gross fixed capital formation is forecast by different institutions, with optimistic predictions ranging from a five-year rate of approximately 10% between 2005 and 2010 to 7% between 2015 and 2020.

2.2. Gross fixed capital formation as a percentage of GDP

The ratio of gross fixed capital formation to growth shows the intensity of investment activities, being still the decisive factor in growth. Its value of around 20% seems typical for mature countries. The emerging markets, and transition economies in particular, need a higher intensity of investment activities, which reach as much as 35%. However, the long-term tendency may be disturbed due to changing cycles and growing investment risks, both economic and political.

In extreme cases the share may exceed 40%, as it does in China. It is worth underlining that such industrialised countries as Japan and the US also have relatively high ratios of GFCF to GDP – up to 30%, as can be seen from fig. 2.12 below.

There are evident country disparities in the share of investment in GDP and in the impact of sustainability polices on them in the EUZO.

Figure 2.9. Gross fixed capital formation as a percentage of GDP in France and Germany.

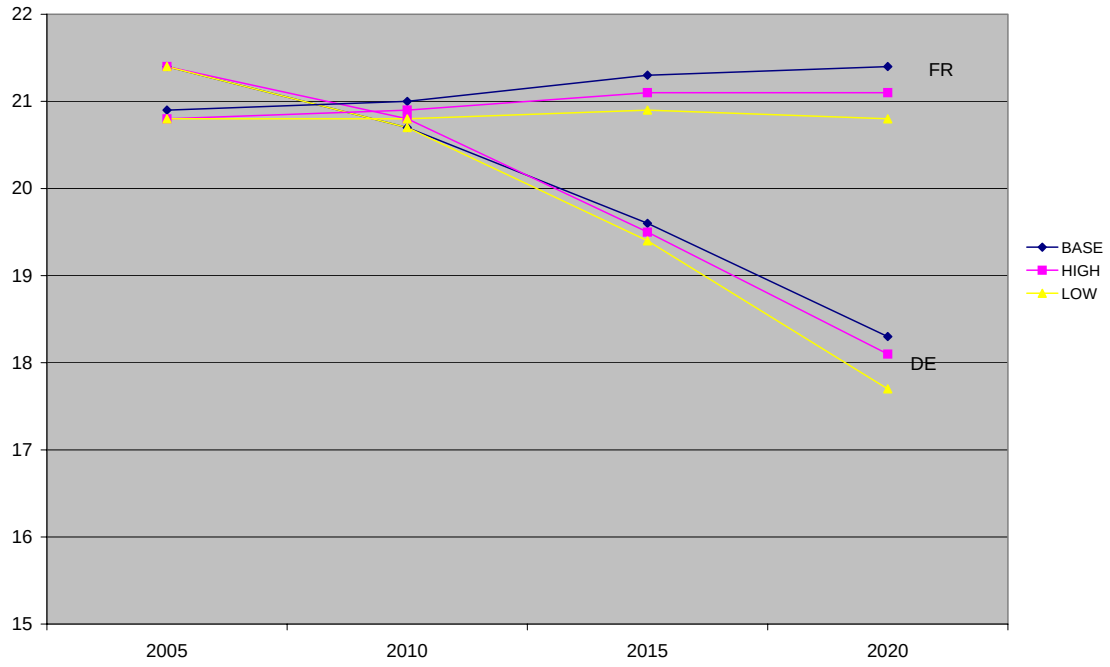


Figure 2.10. Gross fixed capital formation as a percentage of GDP in Italy and Spain.

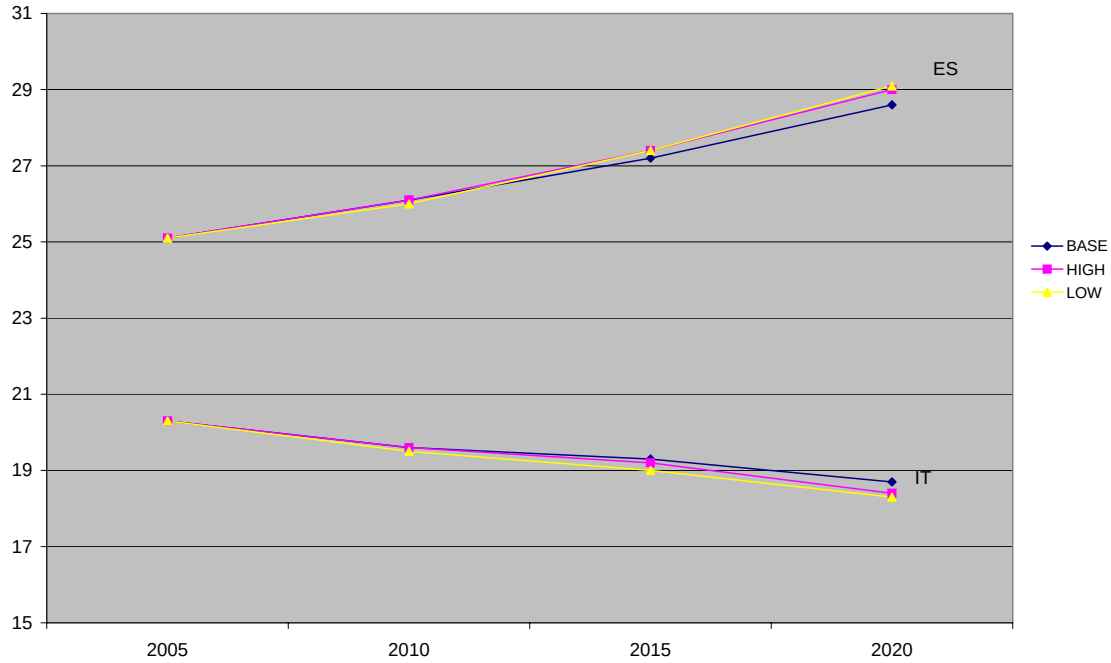
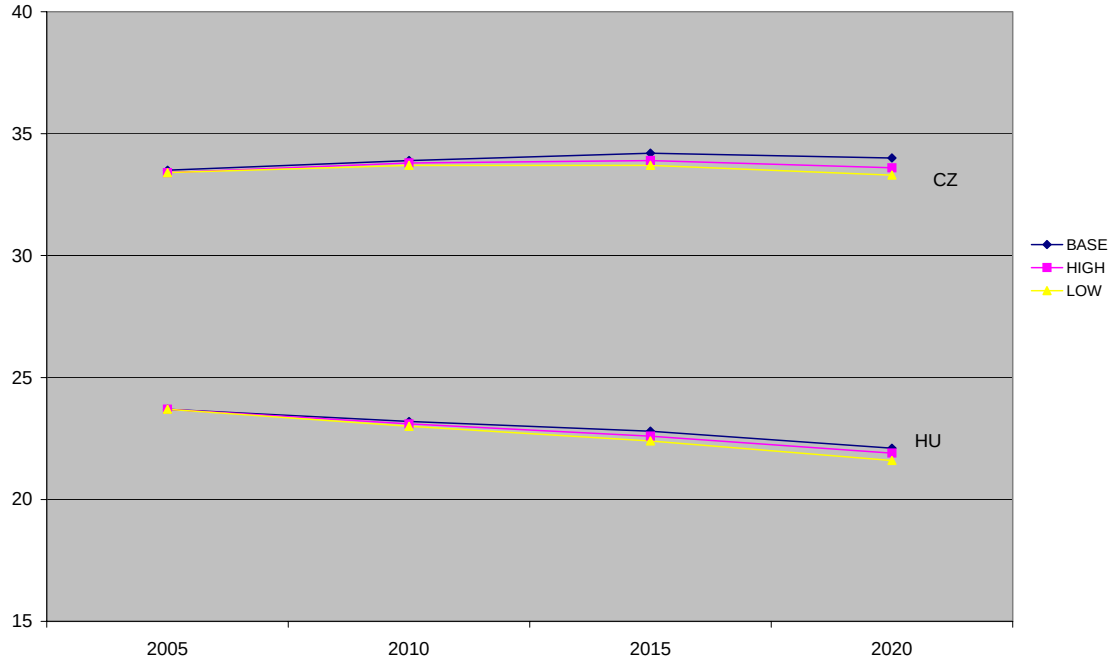


Figure 2.11. Gross fixed capital formation as a percentage of GDP in the Czech Republic and Hungary.



Generally, in Germany, Italy and France the share oscillates around 21% in 2005 (see figures 2.9, 2.10), showing a rather decreasing tendency in the baseline and in each of the scenarios (excluding France, in which it is rather stable). In Spain, the share of GFCF in GDP is increasing.

Figure 2.12. Gross fixed capital formation as a percentage of GDP in China, the United States and Japan.

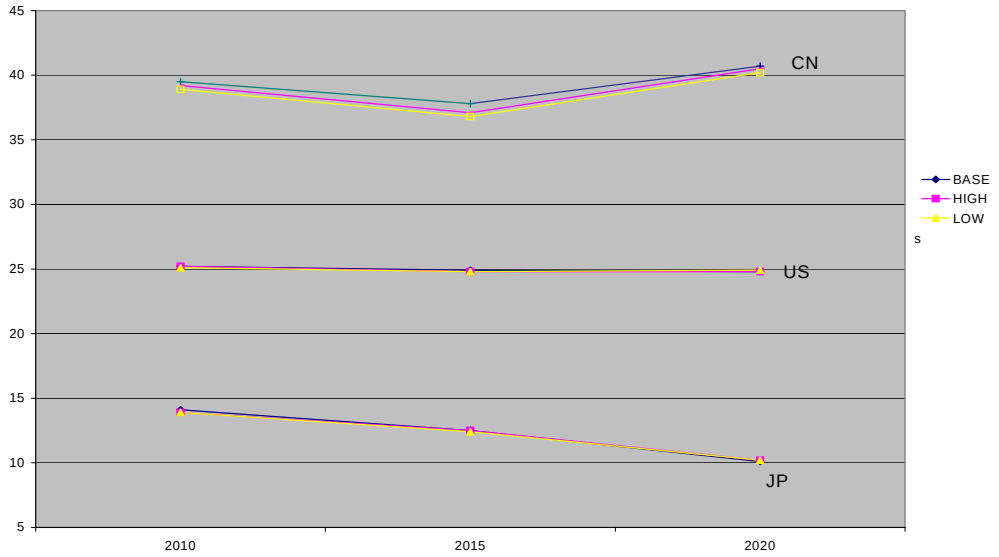


Figure 2.13. Percentage changes in GFCF (% GDP) from the baseline in 2020.

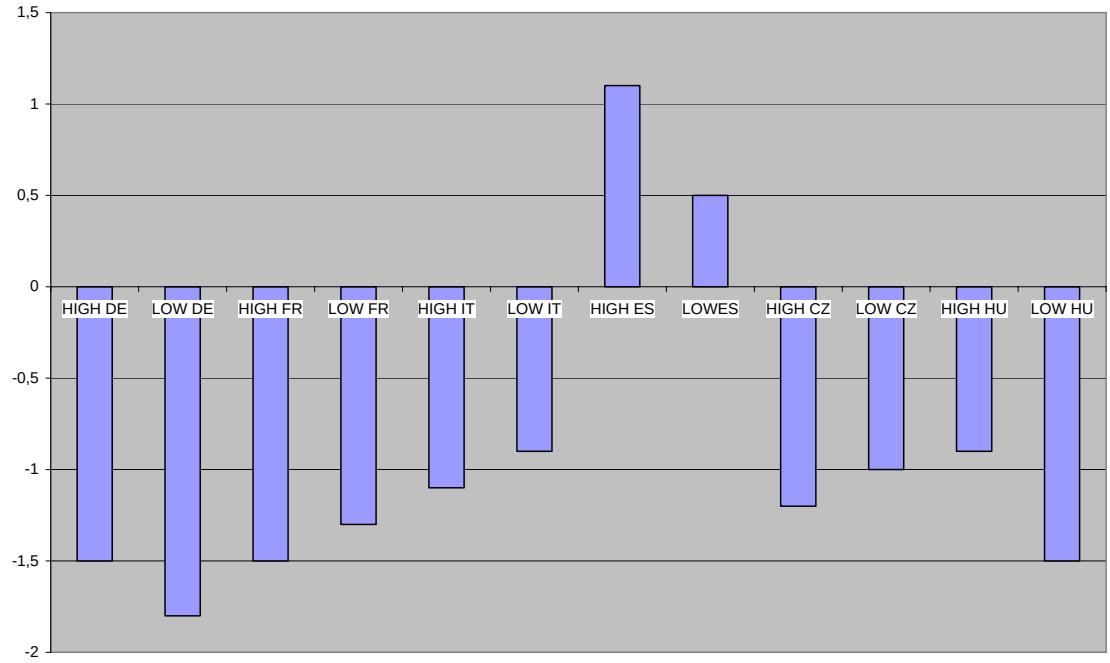


Figure 2.13 shows that sustainability policies, both in the low and high scenarios, have a negative impact on the ratio of investment to GDP, with the exception of Spain. Given growth in absolute GFCF, this is due to underlying GDP growth. It is worth noting that the ratio in Spain resembles that for transition economies (above 25%). However, the transformed economies, unlike Spain, do not see a positive impact on investment/GDP in the low and high scenarios.

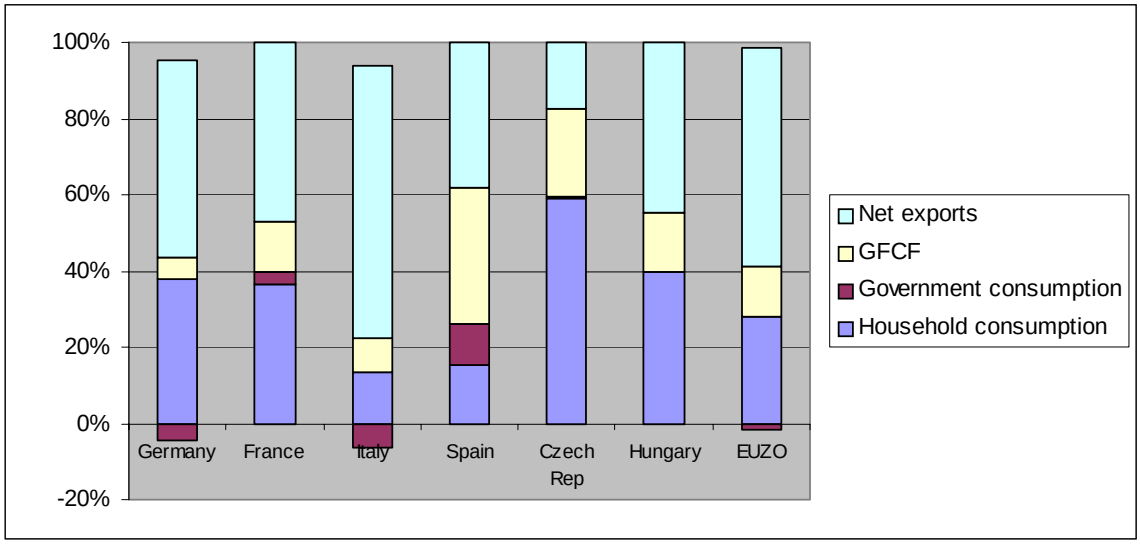
2.3. The macro-determinants of growth

This begs the question what is driving the impressive growth performance of the EU in the low and high scenarios? On a very general level, it could be consumption (private or public), investment (private or public) or net exports. To this end, figure 2.14 presents data showing how much of the increase in GDP growth achieved in the high scenario relative to the baseline can be attributed to each of these macro-drivers. It is clear that, for the EUZO as a whole and for most of the selected EU-25 Member States, the majority of the increase in growth between the baseline and the high scenario can be attributed to:

1. Net exports, reflecting the increasing global competitiveness of the EU manufacturing sector, particularly under the positive influence of the Aachen scenario.
2. Household consumption.

GFCF is a rather smaller driving force, except, as we have also seen previously in this section, in Spain. Note that, encouragingly from the perspective of controlling the 'size' of government, government consumption tends to command a small and in some cases negative share of the difference (see also section 5).

Figure 2.14. The macro-drivers of extra growth in the high scenario.



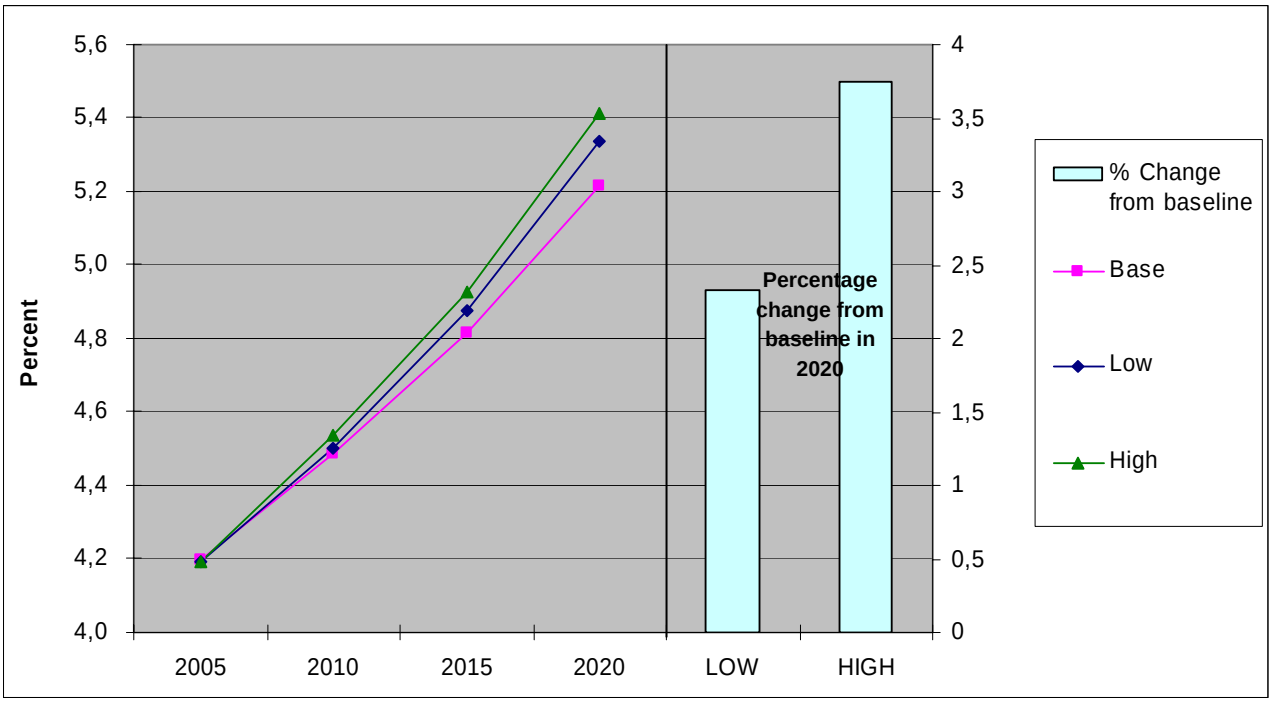
3. Competitiveness

3.1. Labour productivity

The development of labour productivity is seen as an important indicator of changes in competitiveness. Labour productivity is expressed as output per employee. Changes in labour productivity can therefore express either a rise in output with unchanged employment levels or unchanged output levels with declining employment. On the development of employment levels in the three scenarios, see section 4.

Labour productivity, in terms of real GDP per employee, is given for EU-25 Member States as well as for other economies. We begin by presenting growth in labour productivity in the EU-25 according to the baseline, low and high scenarios (figure 3.1).

Figure 3.1. Labour productivity (GDPTR per employee) in the EU-25.



Labour productivity grows at an annual average rate of 1.4% (baseline) to 1.7% (high) in the EU-25, which corresponds largely to the annual average rate in the EU-15. In the new Member States, annual average growth ranges from 2.7% to 2.8%.

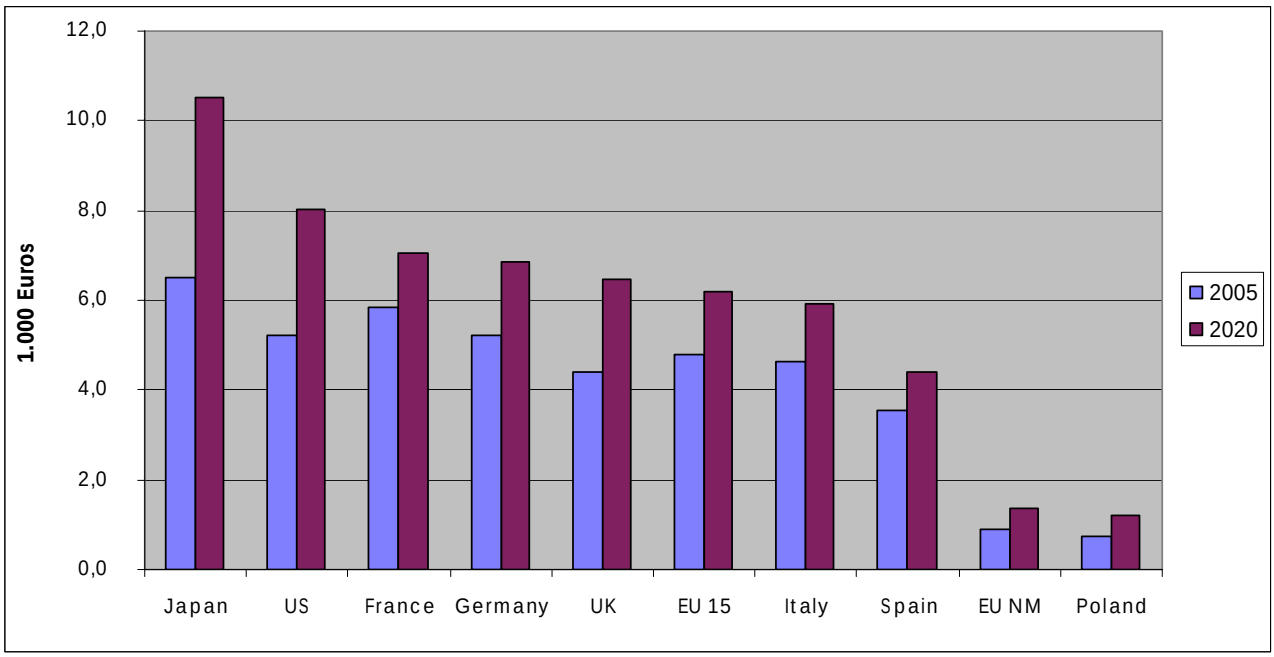
In 2020, labour productivity is 2.3% above the baseline in the low scenario. In the high scenario, the difference is +3.8%, pointing to an improvement in competitiveness. With comparative increases of 1.0% (low) and 1.3% (high) on the 2020 baseline, the differences are smaller in the new Member States. Thus the sustainability policies are, in fact, slightly detrimental to the convergence of labour productivity between the EU-25's main two regions.

Figure 3.2 takes a closer look at developments in labour productivity in the high scenario, focusing on the EU-15, the new Member State group (EU NM), the 6 most significant individual Member States in terms of GDP, population and energy consumption (France, Germany, Italy, Poland, Spain and the UK), together with other significant world economies (the US and Japan) that serve as a point of comparison.

In both 2005 and 2020, Japan has the highest labour productivity and even improves its position relative to the EU-15 due to high annual average growth (3.3%). The US starts at a level 7% higher than the EU-15 average and ranks second in 2020, with annual average growth of 2.9%.

Generally, the discussion on the economic performance of the EU-15 versus the US focuses to a large extent on differences in productivity levels and productivity growth. During the second half of the nineties and also in the recent past, the US showed better performance in productivity growth than Europe. Calculations of the differences between these two regions yield a rather wide range of results, depending on the data basis and the denominator (employment or hours worked)[9] used. The differences in the model simulations considered here seem to be at the lower end.

Figure 3.2. Labour productivity (GDPTR per employee) in selected countries and country-groups in the high scenario.



Within the EU-15, France, Germany and the UK perform best in terms of the level and growth of labour productivity. In 2005, the UK lies slightly below the EU-15 average, but

[9] See e.g. current values as described in O'Mahony and van Ark (*EU Productivity and Competitiveness: An Industry Perspective. Can Europe Resume the Catching-up Process?*, Luxembourg, 2003), which correspond largely to the results described above, OECD (*International Comparisons of Labour Productivity Levels - Estimates for 2004*, September 2005) and van Ark, Stuivenwold and Ypma (Unit Labour Costs, Productivity and International Competitiveness, *Research Memorandum GD-80*, Groningen Growth and Development Centre, August 2005).

due to the highest annual average growth rate (2.6%) in the EU-15, labour productivity improves considerably. Other EU-15 countries with annual growth rates of labour productivity above the EU-15 average are Greece (2.4%), Denmark (2.1%), Sweden (1.9%) , Belgium and Germany (1.8% each).

There is a step change when one moves to the average of the new Member States (incl. individual data for Poland), where labour productivity is about one fifth the EU-15 average. However, annual average growth rates in this region are considerably higher than in the EU-15. Poland, for example, returns annual average growth of 3.3%, the highest of all large states selected. New Member States with levels of labour productivity above the EU NM average are the Czech Republic, Estonia, Slovenia, Malta and Cyprus. The latter two nearly reach the level of Spain.

3.2. Unit labour cost growth

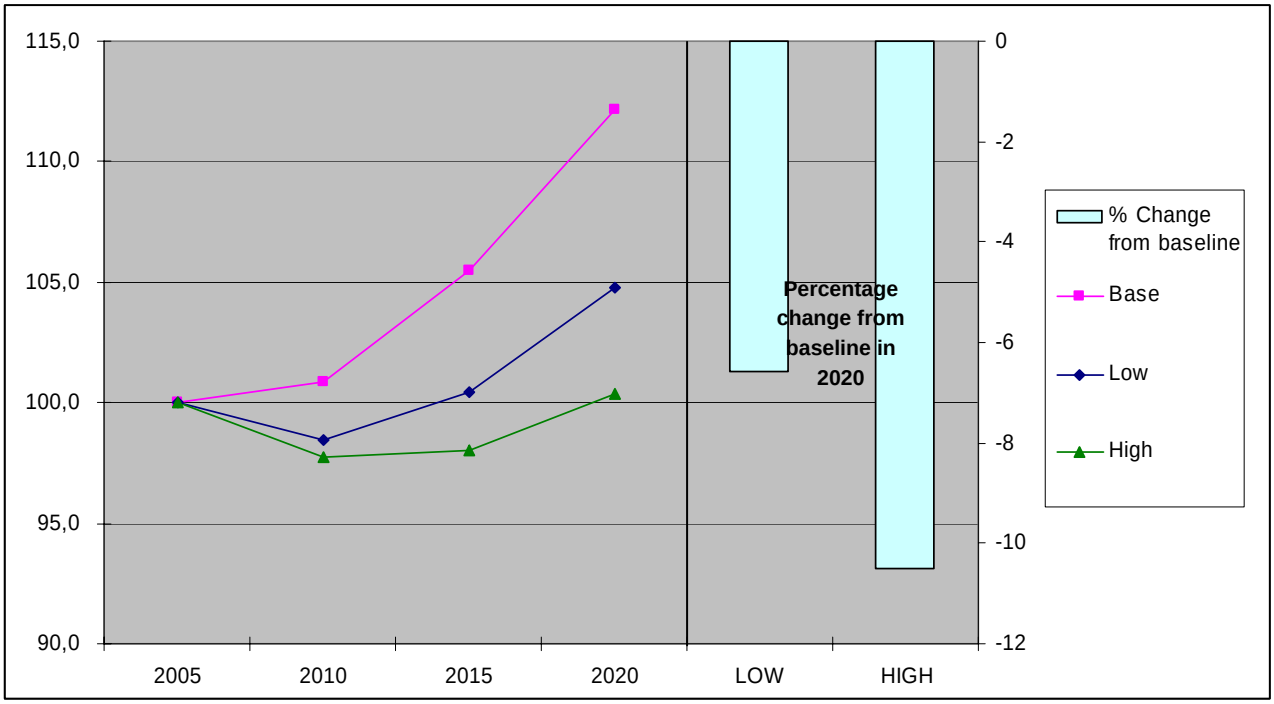
Unit labour costs are another indicator of competitiveness. In themselves, they are only a crude measure of the competitive position of countries and industries. High unit labour costs pose a competitiveness constraint if an economy is mostly active in low quality segments. Thus, countries with high unit labour costs need to specialise in high quality segments, which are less exposed to price competition. In order to interpret unit labour costs in terms of a competitive disadvantage, the specialisation of countries would need to be included. Such an exercise is beyond the scope of the present analysis.

The following paragraphs discuss the development of unit labour costs, quantified as compensation for employees per GDP (at constant prices). To illustrate the development of this indicator for the EU-15 (excluding Luxembourg, Ireland and Portugal), figure 3.3 displays indexed unit labour costs (2005 = 100) in the three scenarios.

In the baseline scenario, unit labour costs grow by about 12 percentage points between 2005 and 2020, which corresponds to an annual average growth rate of 0.8%[10]. In the low and high scenarios, annual growth is weaker (on average 0.3% and 0.03% respectively) and from 2005 to 2010 even an absolute fall can be seen. This leads to changes relative to the 2020 baseline of -7% (low) and -12% (high). This means that, on average, unit labour costs clearly grow more slowly than labour productivity.

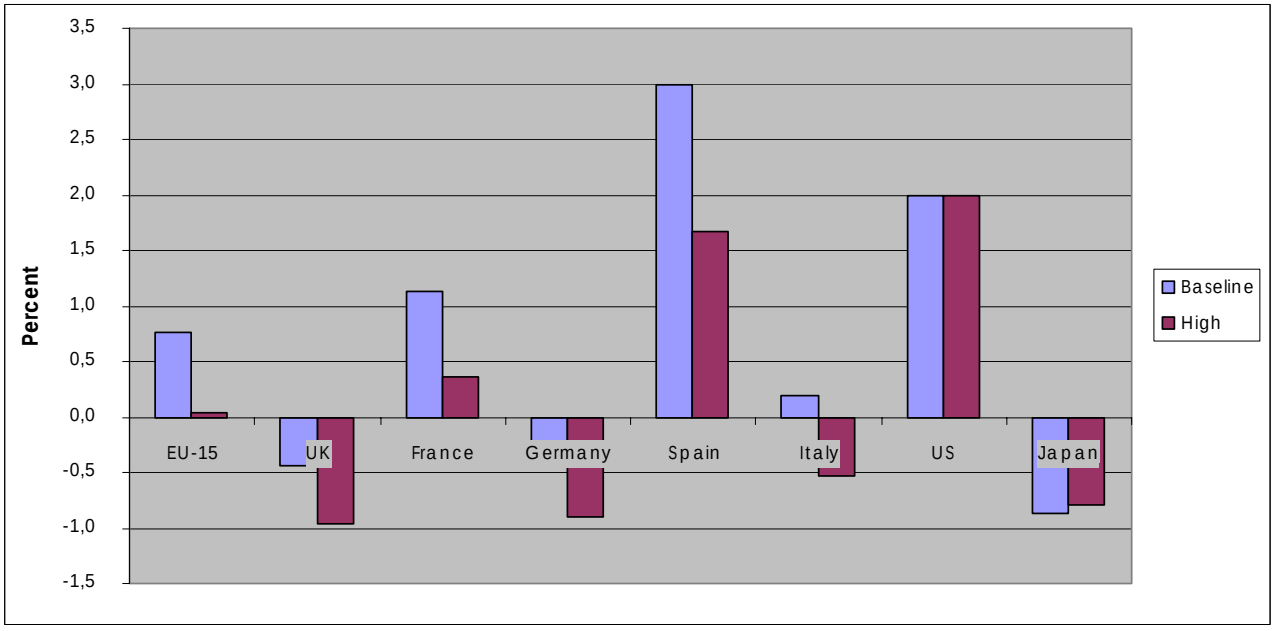
[10] The increase is due to the difference between GDP growth and growth in total labour costs.

Figure 3.3. Growth of unit labour costs (employment compensation per GDP) in the EU-15 (2005 = 100).



Again, different regional developments can be observed in the selected countries and the US and Japan, which are represented in figure 3.4 for the baseline and high scenarios[11].

Figure 3.4. Annual average growth rates of unit labour costs (employment compensation per GDP) for selected countries and the EU-15.



Within the EU-15 (excluding Luxembourg, Ireland and Portugal), for which on average slight increases in unit labour costs occur (by 0.8% p.a. in the baseline and 0.03% p.a. in the high scenario), France and Spain show a rising trend, albeit dampened by 1.3

[11] The results for the low scenario lie midway between the baseline and the high scenarios.

percentage points in the high scenario. In the UK and Germany, unit labour costs decrease in both scenarios (by 0.4% p.a. in the baseline and 1% p.a. in the high scenario), while in Italy this is the case only in the high scenario. In these countries, total labour costs grow at a lower annual rate than GDP and – at least in the UK and Germany – average annual labour productivity growth is the highest within the selection of EU-15 Member States. On the other hand, Spain returns annual average growth in total labour costs (4.0%) well above the EU-15 average and nearly twice as high as GDP growth.[12]

The other two world economies, Japan and the US, show opposing trends. While unit labour costs in Japan decrease in both scenarios (on average by 0.9% p.a. in the baseline and 0.8% p.a. in the high scenario), they increase by an annual average of 2% in the US in both scenarios.

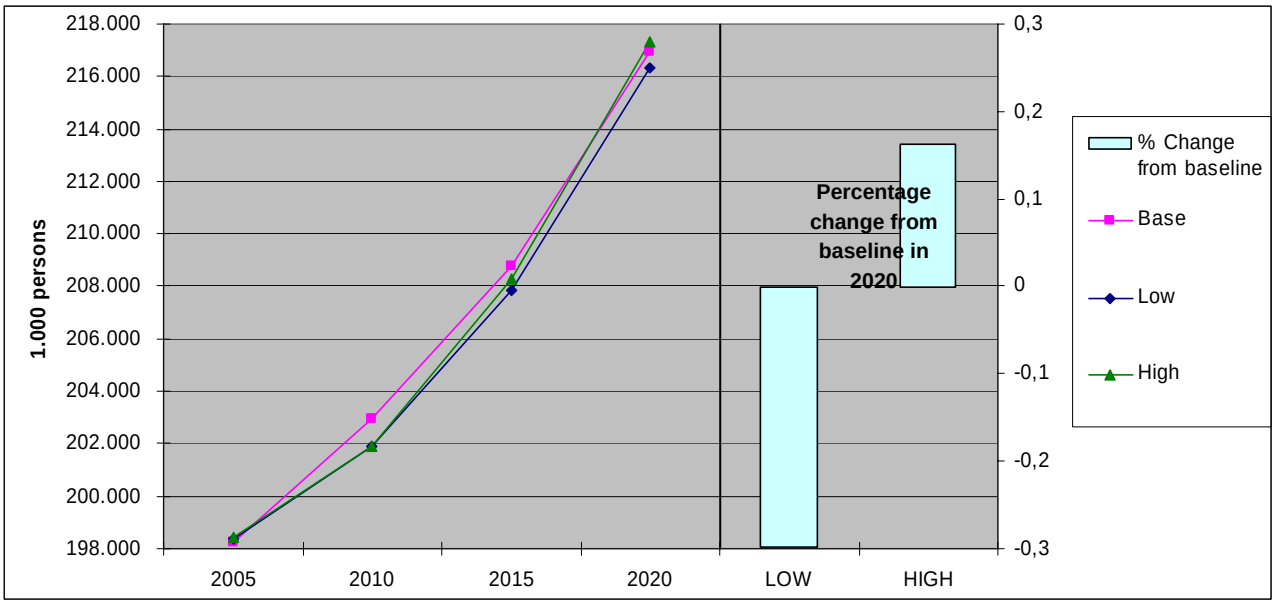
[12] Other EU-15 Member States with above average annual growth in total labour costs are the Benelux and Scandinavian countries, as well as Greece and France.

4. Employment

4.1. Total employment

We begin by presenting growth in total employment in the EU-25 according to the baseline, low and high sustainability scenarios (figure 4.1). Total employment rises in all three scenarios by an annual average rate of around 0.6%. Total employment is slightly lower than the baseline in the low scenario in 2020 (-0.3%), and marginally higher than the baseline in the high scenario (+0.2%). The package of sustainability policies simulated in GINFORS is slightly beneficial from the perspective of employment in the EU-25, at least in the high scenario.

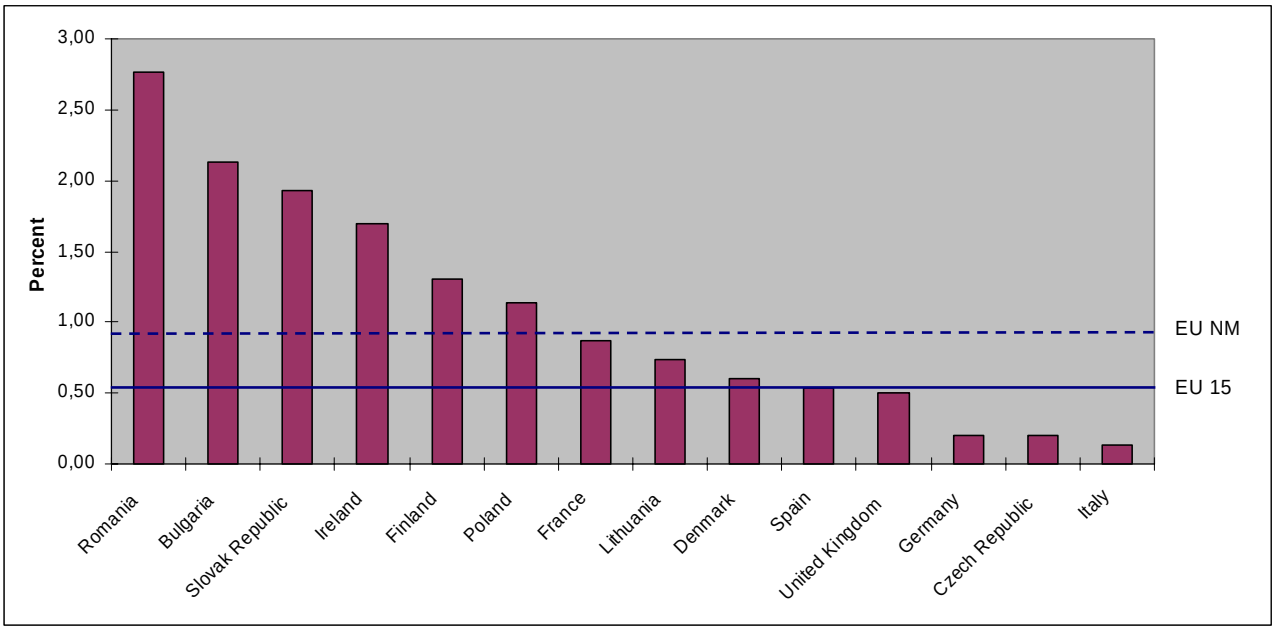
Figure 4.1. Total employment in the EU-25.



Total employment growth is higher in the new Member States, with annual average growth for the 10 states as a whole ranging from 0.93% (baseline and low) to 0.97% (high), and higher employment levels in both the low (+0.2%) and high scenarios (+0.5%) relative to the baseline in 2020. In the EU-15, annual average growth rates are around 0.5% (baseline, low and high), with employment lower than the baseline in the low scenario (-0.4%) and marginally higher (+0.1%) in the high scenario.

Figure 4.2 presents annual average growth rates of total employment in the baseline scenario for selected countries and country-groups, including the EU-15, the 10 accession countries (EU NM), the 6 selected Member States contributing more than ¾ of Europe's aggregate GDP, population and energy consumption (France, Germany, Italy, Poland, Spain and the UK), as well as some other Member States (current and prospective) showing employment growth rates above or below the average.

Figure 4.2. Annual average growth of total employment (2005-2020) in the baseline scenario.



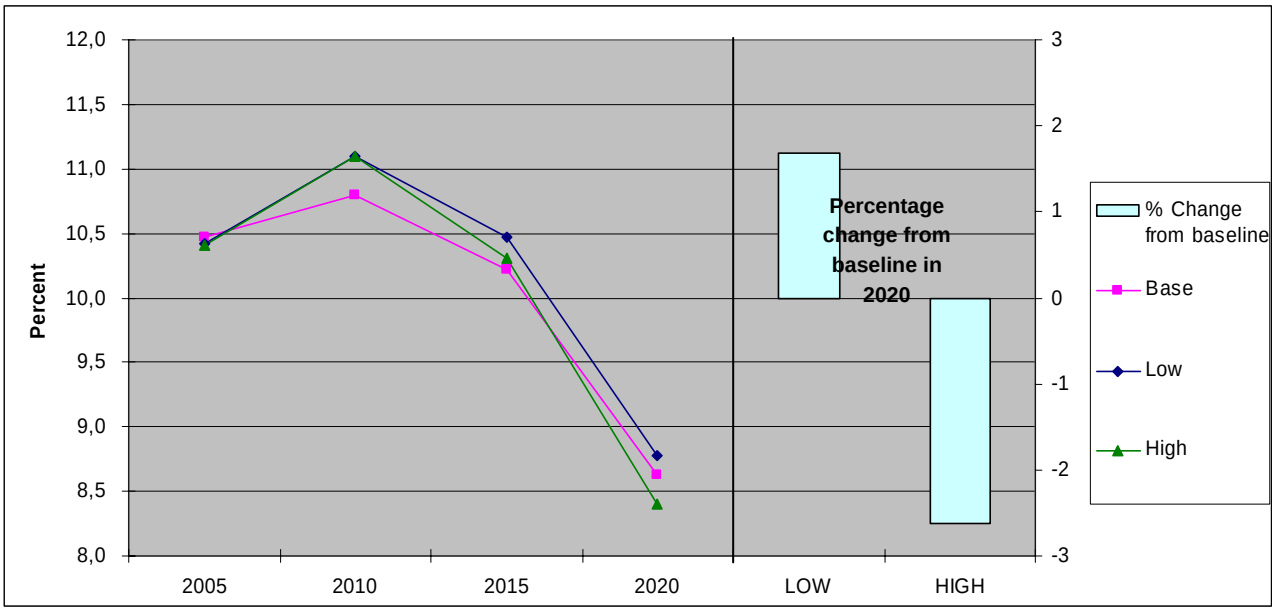
On average, the annual growth rate of employment is higher in the new Member States (0.93%) and the candidate countries Romania and Bulgaria (2.45%)[13] than it is in the EU-15 (0.53%), as is average GDP growth (see section 1.1). Generally, the transition economies, as well as some of the smaller, peripheral EU-15 Member States (Ireland, Finland, Sweden, Portugal), experience the highest growth in total employment. On the other hand, some new Member States (the Baltic states, Slovenia and the Czech Republic), together with most of the large EU-15 Member States (except France), show employment growth rates below the average.

4.2. Unemployment rates

Again, we begin by presenting the development of unemployment rates in the three scenarios for the EU-25. The unemployment rate in the EU-25 falls by approximately 2 percentage points over the period 2005 to 2020 in each of the scenarios (figure 4.3). As with total employment, the effects of the low and high scenarios in terms of changes on the baseline work in different directions. Thus, the unemployment rate is above the 2020 baseline in the low scenario (+1.7%), while in the high scenario it is 2.6% below the baseline. Again, the effects are more pronounced in the new Member States than in the EU-15. In the former, the unemployment rate declines continuously in all three scenarios and is also below the baseline in the low scenario. Thus, the temporary rise in the EU-25 unemployment rate shown in figure 4.3 is due to developments in the EU-15, where unemployment rises in some countries (Germany, UK, Netherlands, Ireland, Greece).

[13] In Turkey the annual average growth rate of employment in the baseline scenario of 1,4% is considerably lower.

Figure 4.3. Unemployment rates in EU-25.

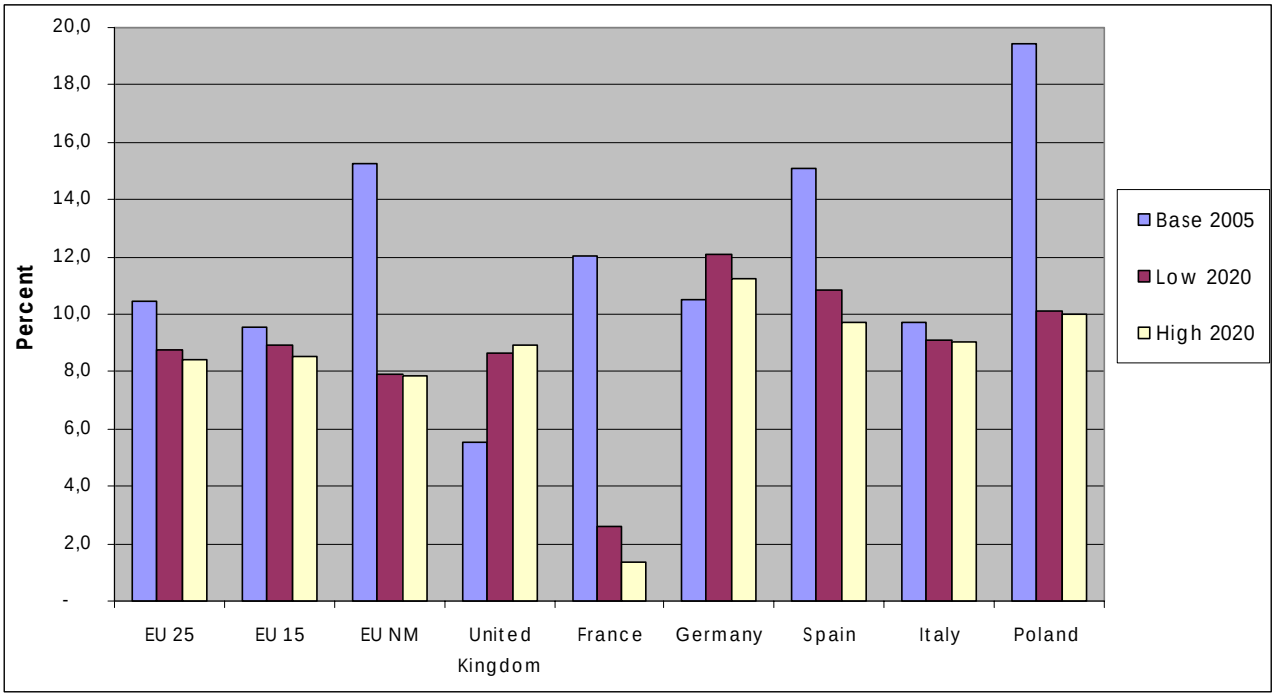


While the unemployment rate declines by about 1 percentage point in the EU-15 between 2005 and 2020, the reduction for the new Member states is more than 7 percentage points over the same period, mostly due to sharp falls in unemployment in the Slovak Republic and Poland[14] (in all three scenarios). This is shown in more detail in figure 4.4, which displays developments for the selected countries and country-groups.

Unemployment rates decline in all of the selected countries except Germany and the United Kingdom, where increases by 1 percentage point and 3 percentage points respectively can be observed. The highest reductions in the unemployment rate occur in France and Poland (more than 9 percentage points on average in both scenarios). In Spain, the reduction amounts to 4-5 percentage points; in Italy, it is 0.6 percentage points. In the high scenario, the average EU-15 unemployment rate drops by 1 percentage point.

[14] For the remaining accession countries, the scenarios either have a small positive or a small negative effect.

Figure 4.4. Unemployment rates in 2005 and 2020 for selected countries and country-groups (in percent).



Comparing the EU NM or ACC-10 country-group with the EU-15, economic development and the implementation of sustainability policies will not only help close regional disparities in unemployment, but reverse the picture. As figure 4.4 demonstrates, in 2020 the unemployment rate in the group of new Member States is 7.9% and is thus lower than its equivalent in the EU-15 (8.5%).

4.2. Sectoral employment trends

The current structure of employment in the EU-15 is tilted towards the service sector, which accounted for around 71% of employment[15] in 2000 (figure 4.5). Industry – including mining and quarrying, manufacturing and electricity, gas and water supply – accounted for 20% of employment, construction for 6%, while the agriculture, hunting, forestry and fishing sector (subsequently abbreviated to agriculture) had a share of just 2%.

In the baseline scenario, there is some change in these shares to be observed between 2000 and 2020. The share of the service sector as a whole rises to 76% of EU-15 employment, at the expense of the other sectors, especially industry, which declines to 16%. The shares of agriculture and construction slip one percentage point each. Within the service sector, the share of employment is little changed from 2000. This broad pattern is also reflected in the low and high scenarios, where the shares are largely the same.

Figure 4.5. The sectoral structure of employment in the EU-15 in 2000.

[15] Employment is here defined as the sum of the six sectors for which disaggregated data are available: agriculture (incl. hunting, forestry and fishing), industry, construction, and three service sector aggregates.

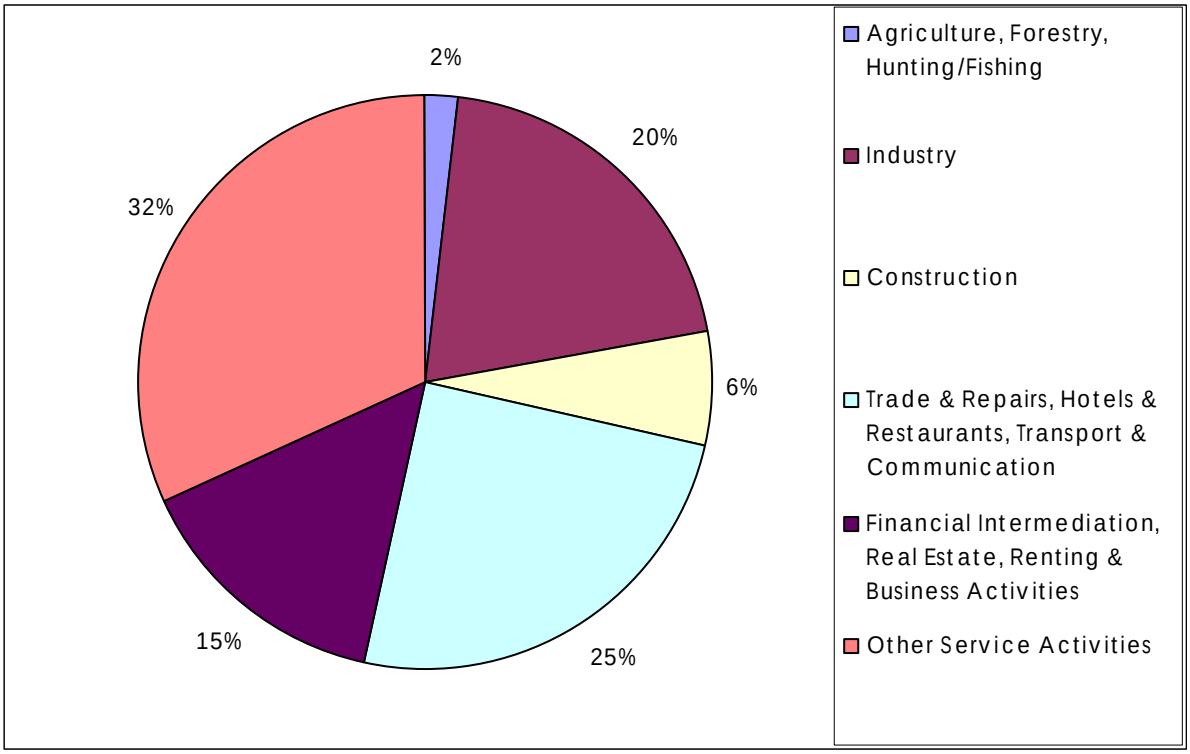
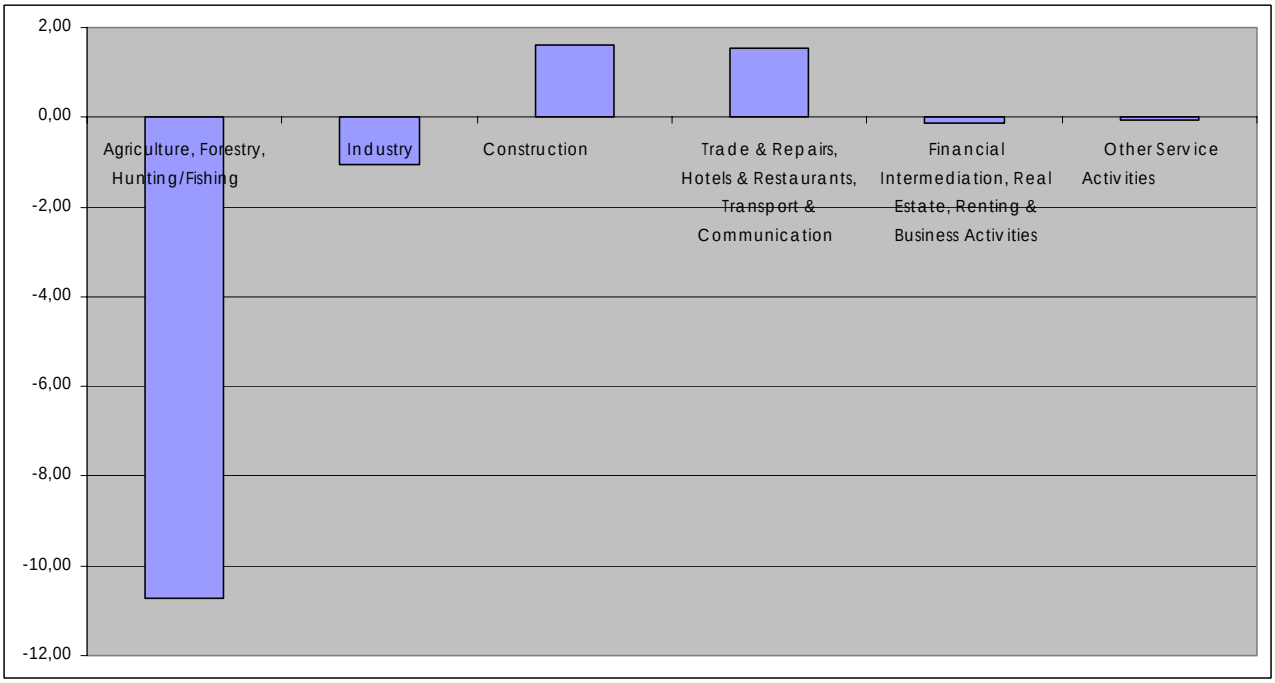


Figure 4.6 looks in a different way at the structure of EU-15 sectoral employment in 2020, comparing the baseline scenario and the high scenario. It illustrates percentage differences in employment between the baseline and high scenarios for the selected industrial sectors.

Figure 4.6. Percentage changes in sectoral employment between the baseline and high scenarios for the EU-15 in 2020.

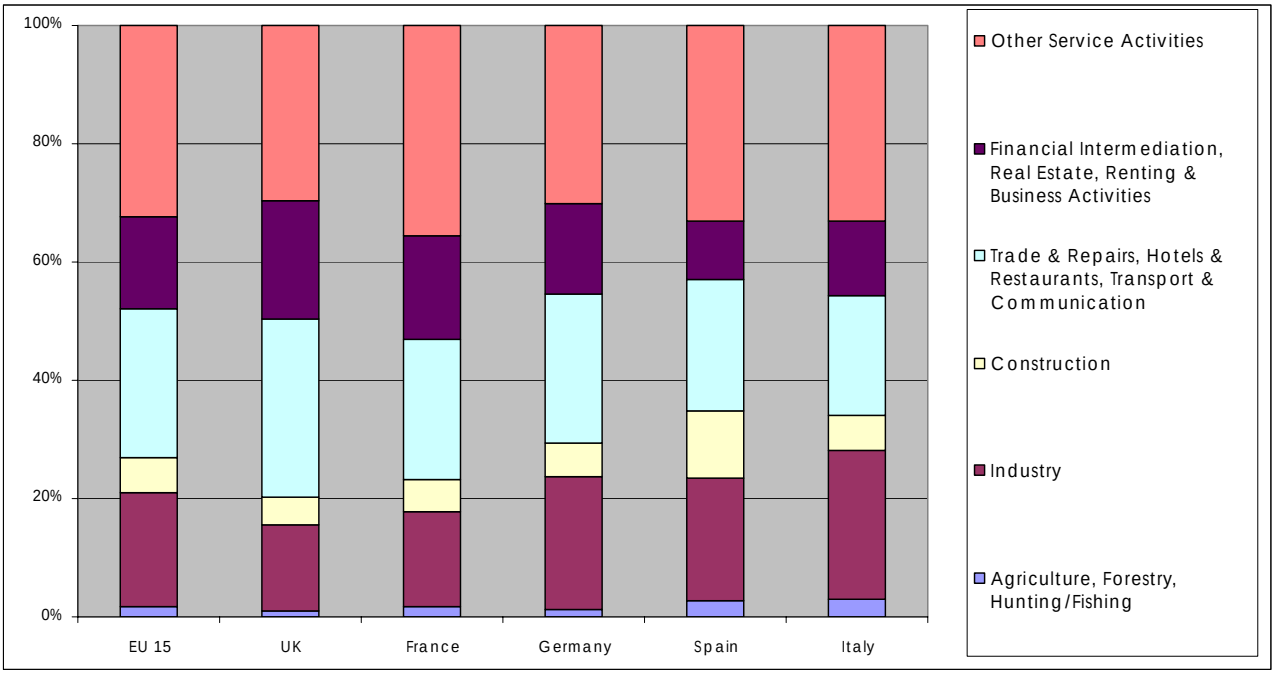


Employment in agriculture is around 11% lower in the high scenario compared to the baseline. Also, industrial employment is 1% lower in the high scenario. Employment in financial intermediation, real estate, renting and business activities and other service activities (largely public sector) declines slightly. Increases in employment by 1.6% relative to the baseline can be observed in construction and the service aggregate including trade, repairs, hotels and restaurants, transport and communication.

The relative decline in employment in the agricultural sector, as well as in industry (including mining and quarrying, electricity, gas and water supply), reflects the developments described in the analysis of the structure of output shown in section 1.2, which emphasised the role of reduced demand for material and energy inputs due to the implemented sustainability policies.

Figure 4.7 examines the sectoral structure of employment in the baseline scenario in the selected countries (except Poland, for which no disaggregated employment data are available) compared to the EU-15 in the year 2005.

Figure 4.7. The sectoral structure of employment in the EU 15 and the selected countries (excluding Poland due to a lack of data) for the baseline scenario in 2005.

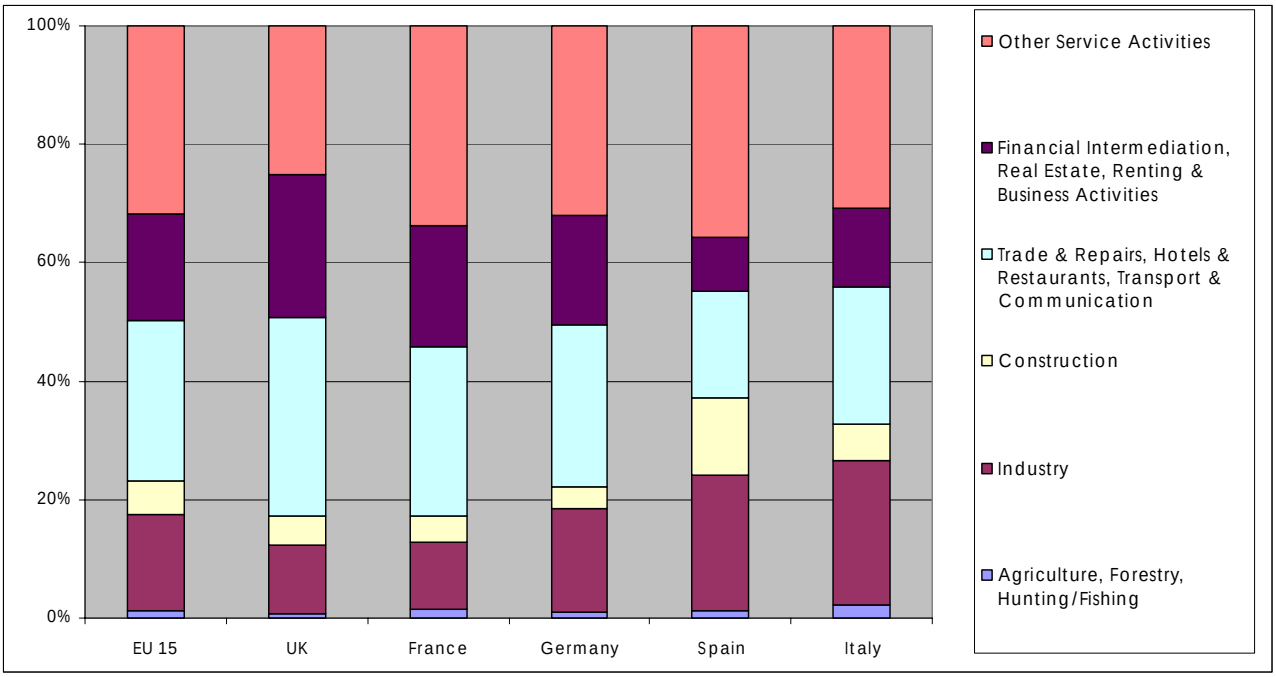


It shows that there are some regional differences in sectoral structure, especially in the shares of the service sectors, which range from 80% in the UK to 65% in Spain. In return, the UK has the smallest share of industry (15%), whereas, with 25%, Italy has the highest share.

Figure 4.8 represents the sectoral structure of employment in the EU-15 and selected Member States in the high scenario in 2020. Comparing the years 2005 and 2020, one

sees that, on average, the service sector share in EU-15 employment increases by 4 percentage points to 77%.

Figure 4.8. The sectoral structure of employment in the EU 15 and the selected countries (excluding Poland due to a lack of data) for the high scenario in 2020.



The largest increase takes place in France and Germany (+6 and +7 percentage points respectively) at the expense of a reduction in industry (-5 percentage points) and construction. Germany and the UK have the highest share of services in employment (83%). On the other hand, in Spain the share of services declines by 2 percentage points, which is balanced by an equivalent increase in industrial employment.

5. Public finance

For the purposes of this analysis, we assume a transition from budget deficit (net government borrowing) to budget surplus (net government lending) is beneficial. We further assume a relative reduction in total public spending over time is, in general, a positive trend. Though economic theories do not define an optimum size of state intervention in the economy – measured, for example, by the share of government spending in GDP – it is nevertheless widely accepted that the levels of government spending observed at present are excessive. We do not consider the structure of government spending (consumption versus investment).

5.1. Public financial performance

Available data allow us to calculate one key indicator of public finance, namely net government borrowing/lending in proportion to GDP. The data cover most of the EU-15 (minus Ireland, Luxembourg, Portugal and Sweden) plus one new Member State (Poland).

There are two fundamental conclusions one may draw from the analysis of the data:

i. **There is no substantial difference between the three scenarios in terms of public financial performance in the EU-15**, measured by net government borrowing/lending as a percentage of GDP.

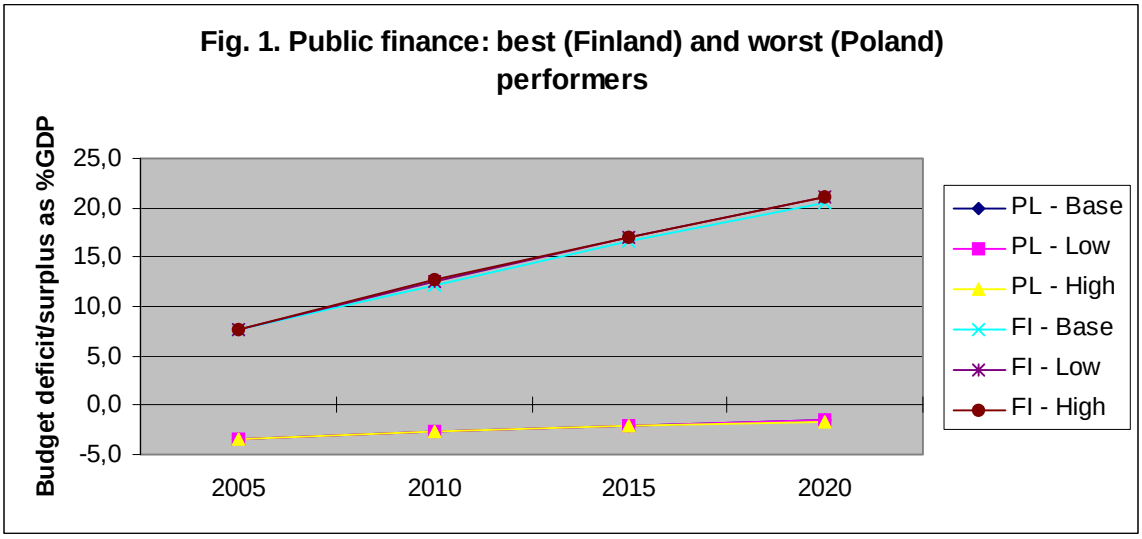
ii. **By 2020, all countries, except Denmark, will have enjoyed an improvement in their public financial performance**; what is more, **in several countries this improvement will have been very large indeed**.

The lack of any substantial difference between the scenarios is evident in the fact that patterns of government lending/borrowing for the best performing country and the worst performing country are very similar in all three. Finland, the best performing country, is forecast to enjoy a large budget surplus in 2020, ranging from 20.5% of GDP (baseline scenario) to 21.2% (high scenario). Poland, the worst performing country, is to have a budget deficit of between 1.5% of GDP (base and low scenarios) and 1.6% (high scenario) – see fig. 5.1.

Looking at the five next-best performing EU Member States (Belgium, Greece, Italy, the Netherlands and Spain), the differences in their net budgetary position across scenarios are equally negligible. In 2020, the maximum differences between scenarios amount to:

- Belgium: 1.5 percentage points (14.8% baseline versus 13.3% low);
- Greece: 0.6 percentage points (7.7% high versus 7.1% baseline);
- Italy: 0.7 percentage points (9.4% high and low versus 8.7% baseline);
- Netherlands: 0.3 percentage points (15.6% low versus 15.3% baseline);
- Spain: 0.9 percentage points (11.5% baseline versus 10.6% high).

Figure 5.1. Public finance: best and worst performers



One cannot identify a consistent effect running from the three scenarios to public financial performance across individual countries. For some countries, it is the low scenario that produces the highest surplus (or the lowest deficit); for other countries, it is the baseline; for still others, it is the high scenario.

In six EU Member States (Belgium, Finland, Greece, Italy, the Netherlands and Spain), improvements in their net budgetary position will be extremely significant. In 2020, their budget surpluses will be much higher than today. In four cases, the budget surplus will exceed 10% of GDP (Belgium, Finland, the Netherlands and Spain), with Finland enjoying the highest (20.5-21.1%).

France is forecast to be the only country to shift its position from deficit in 2005 (-2.8%) to surplus in 2020 (1.3-2.3%). Poland, Germany and the United Kingdom will continue to run budget deficits, though these will be gradually reduced (except for Poland).

Denmark is the only exception to this trend in budgetary improvement. Its budgetary position is forecast to slightly deteriorate. However, regardless of the scenario, Denmark is expected to remain on the 'safe side', with a budget surplus falling from 1.5% of GDP in 2005 to 0.9% in 2020.

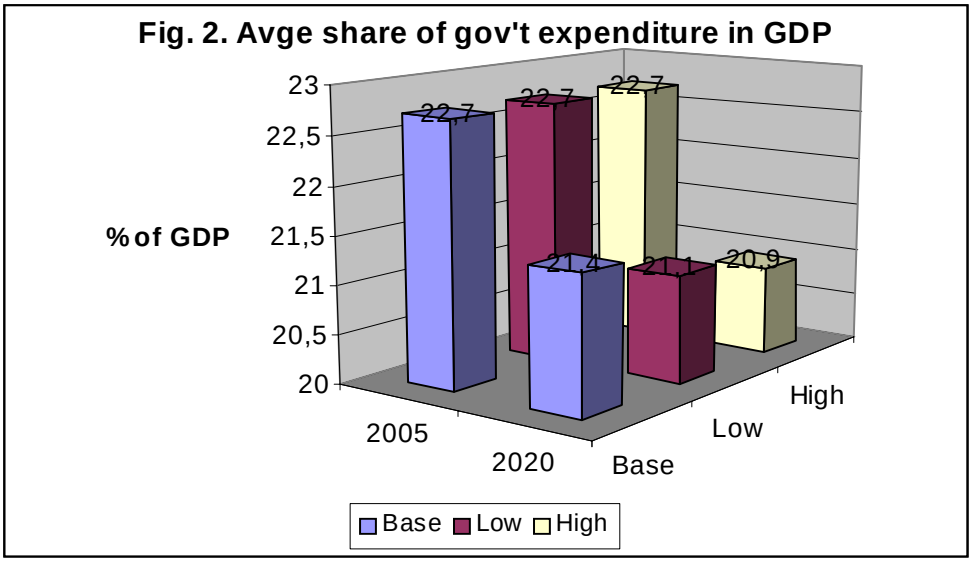
5.2. 'Size' of government

In addition to the basic indicator (budget balance/GDP) described above, it is possible to calculate the share of total government spending in GDP. Total government spending comprises that part of gross fixed capital formation made by government and government consumption. Again, data are available for most of the EU-15, plus Poland.

In 10 cases out of 12, this indicator diminishes over time in all three scenarios. In Greece and Finland, the share of government spending in GDP rises, in Finland by a negligible

amount (0.5 percentage points from 24.5%), but in Greece by a larger amount (from 22% of GDP to 23.5-23.9%). The unweighted average for all 12 countries is 22.7% in 2005. By 2020, it will have decreased by 1.3-1.8 percentage points down to between 21.4% (baseline scenario) and 20.9% (high scenario).

Figure 5.2. Average share of government spending in GDP.



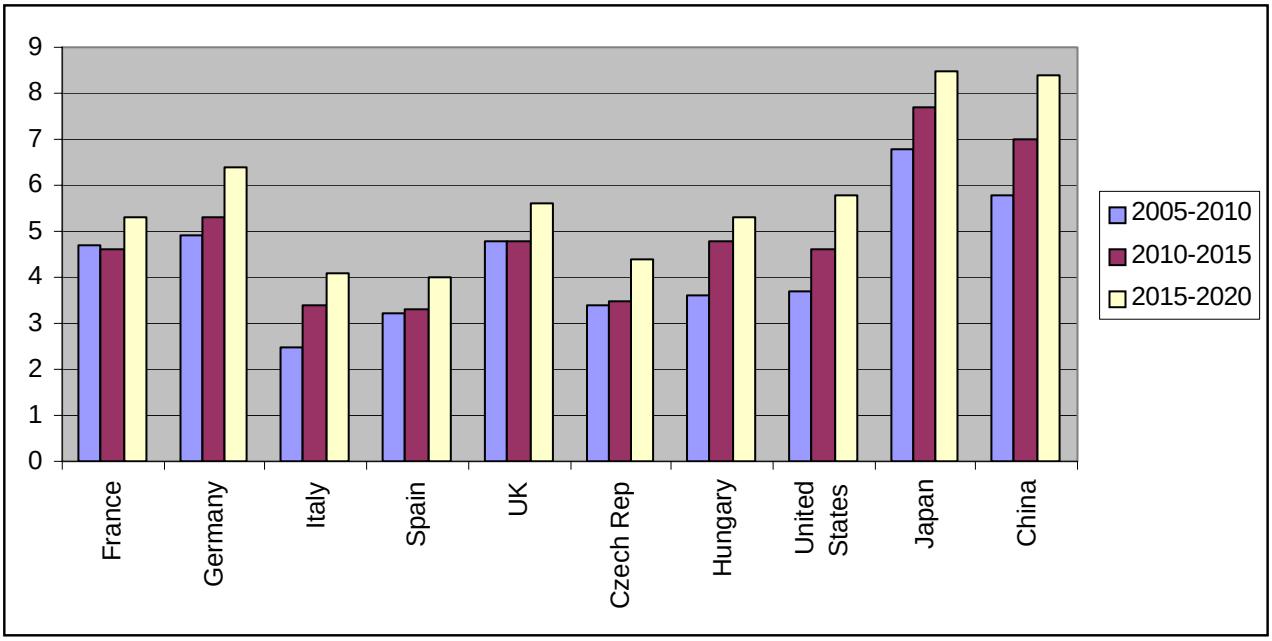
This decrease is likely to be attributed to higher GDP growth rates under the high and low scenarios. Higher GDP growth permits some government functions to be reigned in (in relative terms), in particular its spending on collective (e.g. police) and individual (e.g. social benefits) consumption.

6. Integration with the global economy

6.1. Growth in trade

We begin this section by presenting baseline growth in the international trade of goods and services for a selection of EU Member States and other major world economies[16]. Figure 6.1 shows annual average growth in the export of goods and services, while figure 6.2 shows equivalent growth in the import of goods and services. The selection of countries includes the five largest Member States of the EU-15 in terms of aggregate GDP, population and energy consumption (France, Germany, Italy, Spain and the UK), two new EU Member States for which data are available (the Czech Republic and Hungary) and three other major world economies (the United States, Japan and China).

Figure 6.1. Annual average growth in goods and services exports for a selection of countries, 2005-2020 (5 year averages).



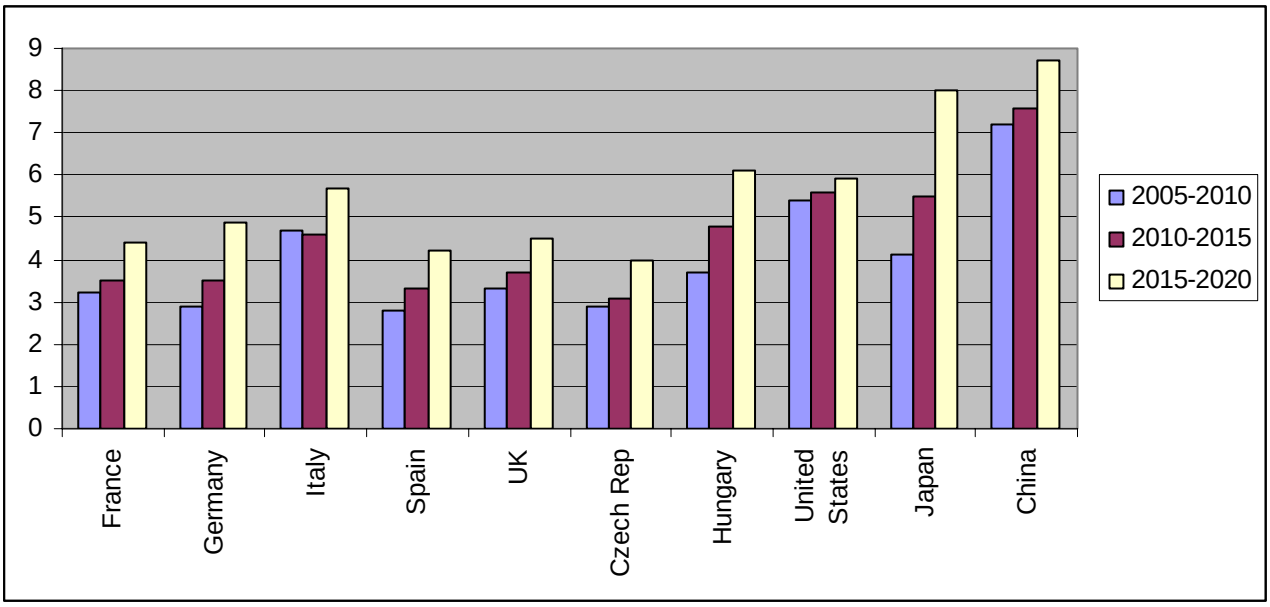
Annual average growth in the export of goods and services is positive and increasing for all countries selected. It is strongest in China and Japan, where the annual average growth rate peaks at above 8% between 2015 and 2020. Growth is weakest in Italy and Spain, but it nevertheless reaches approximately 4% per annum between 2015 and 2020.

A similar pattern of positive and increasing growth is correspondingly evident in goods and services imports. Once again, growth is strongest in China and Japan, where it is on or above 8% per year between 2015 and 2020. It is weakest in France, Spain, Italy and the Czech Republic, where annual average growth peaks in the five years to 2020 at 4-4.5%.

[16] Due to incomplete data, we cannot present patterns in the combined trade of goods and services for the EU-15 or EU-25 as a whole.

Placed in recent historical context, the baseline results represent a general continuation of the pattern of rapidly expanding trade that has characterised the last 25 years and beyond (with the exception in most parts of the world of a 'fallow' period in the early 2000s that reflected a general economic downturn). For example, annual average growth in the export of goods and services in Germany was roughly 5% between 1980 and 2005 and is forecast to be 5.5% between 2005 and 2020. Trade in goods is well in excess of trade in services throughout the modelling period and grows in most cases at least as quickly.

Figure 6.2. Annual average growth in goods and services imports for a selection of countries, 2005-2020 (5 year averages).



6.2. Trade intensity

Because it is perhaps unsurprising that exports and imports are increasing against a background of worldwide economic growth (cf. section 1), a more revealing statistic is trade intensity: that is, total trade in goods and services (exports plus imports) as a percentage of GDP. Since the 1950s, worldwide growth in trade has consistently outstripped that of economic output[17], particularly during the 1990s. Figure 6.3 shows trade intensity for the above selection of countries between 2005 and 2020.

Trade intensity is increasing for all countries and all time periods, except in Hungary for the period 2005-2015. In line with trends in the value of exports and imports, trade intensity grows at an ever increasing rate during the modelling period, being in most cases highest between 2015 and 2020.

[17] Neumayer, E., 2001, *Greening Trade and Investment: Environmental Protection Without Protectionism*, London, Earthscan.

Figure 6.3. Annual average growth in trade intensity for a selection of countries, 2005-2020 (5 year averages).

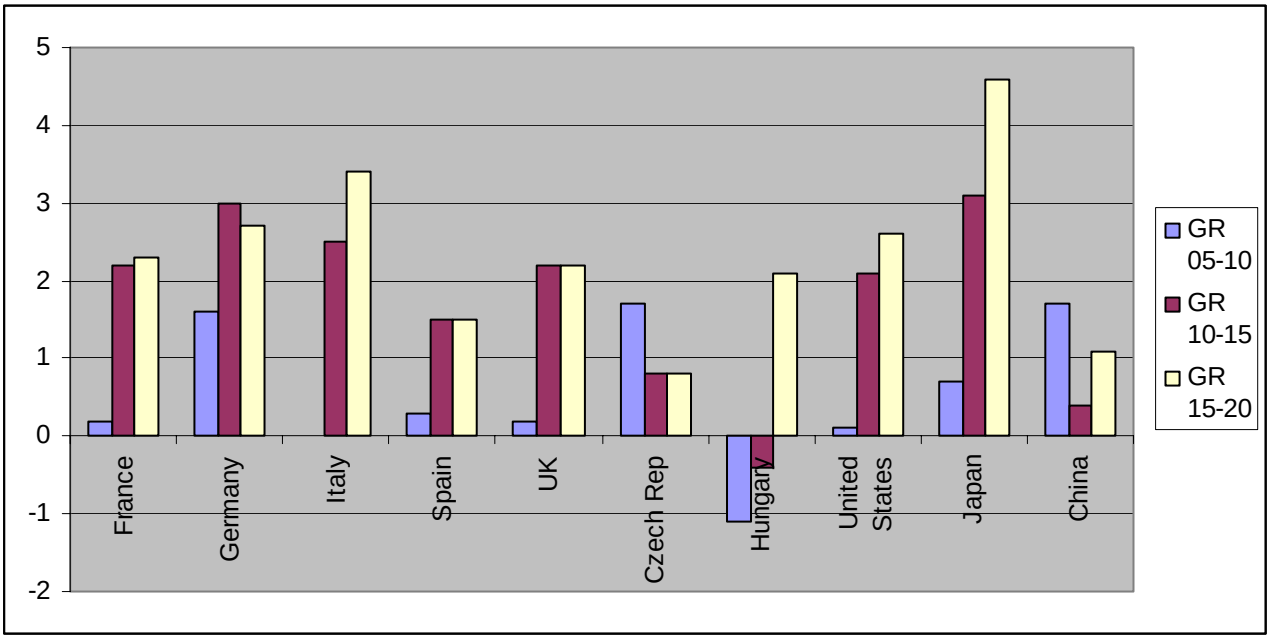
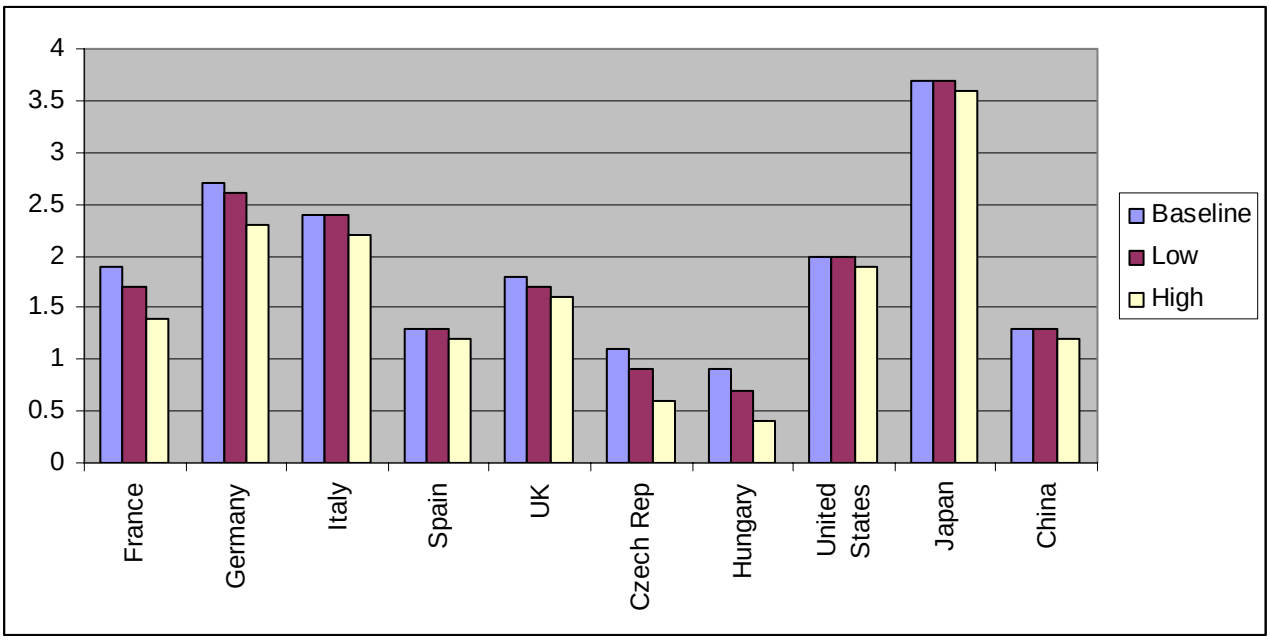


Figure 6.4 goes on to investigate the impact of the low and high sustainability scenarios on trade in goods and services via the trade intensity indicator. 15 year averages of annual growth in trade intensity are presented. It is evident that the package of underlying technological changes and sustainability policies introduced in the low and high scenarios has a mild negative effect on economic globalisation.

Figure 6.4. Effect of low and high sustainability scenarios on annual average growth in trade intensity for a selection of countries, 2005-2020.



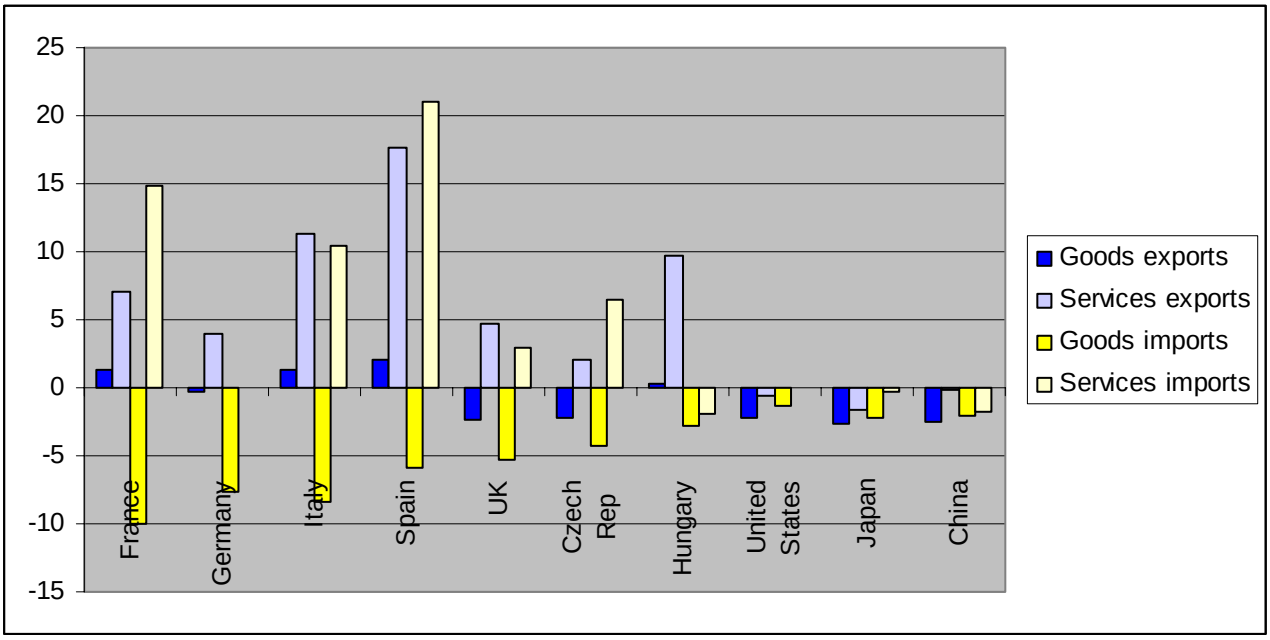
For most countries, trade intensity increases more slowly in the low scenario than in the baseline. For all countries, it increases more slowly in the high scenario than in the low scenario. However, as mentioned, the negative effect is small and combined trade in

goods and services continues to increase as a percentage of GDP in all cases: integration of the global economy continues.

There are two main reasons for this slight fall in international trade intensity in the low and high scenarios. The first is higher transportation costs that fall on trade with the EU due to the inception of a transport pricing policy that adds a 5% mark-up in the low scenario and a 10% mark-up in the high scenario. Both exports and imports are affected by this. The second is the impact of the Aachen scenario. This depresses demand for material imports to the EU considerably, while at the same time bringing about productivity and output growth.

Figure 6.5 presents more detail on these impacts. It shows percentage differences between the high scenario and the baseline in 2020 separately for the export and import of goods and services. One can immediately see the goods trade is worse affected than the services trade, in part a consequence of higher transportation costs that fall mainly on goods (depending on the service traded, there may be an indirect price push or no price push at all).

Figure 6.5. Percentage differences in trade between the high and baseline scenarios for selected countries in 2020.



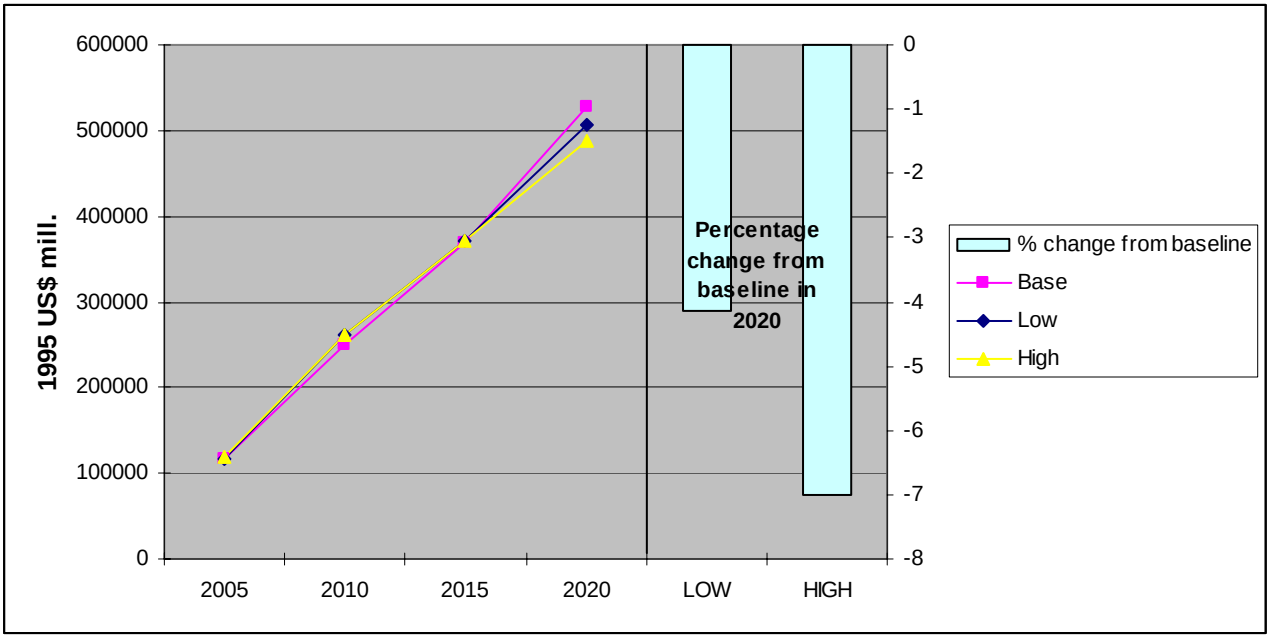
The particular effect of the Aachen scenario is evident in reduced imports of goods to the EU Member States, especially France, Germany and Italy. This will have some effect on goods exports from China, Japan and the United States, three of the EU's major trading partners. However, exports from China, Japan and the United States are also impacted by the increase in the global competitiveness of the EU that results from productivity improvements in the Aachen scenario. Both exports of services from, and imports of services to, the EU Member States are higher in the high scenario than in the baseline, reflecting the structural changes identified in section 1. That is, service sector output is

higher in the high scenario than in the baseline and one would to a certain extent expect international trade to track this expansion.

6.3. Current account balance

Figure 6.6 shows that the above trends, coupled with real changes in net investment income and net unilateral transfers, lead to a slight fall in the EU-25 current account balance relative to the baseline between 2015 and 2020. By 2020, the current account balance in the high scenario is around 7% lower compared to the baseline. However, this is insufficient to nullify the improvement in the current account balance made in the baseline, so that the region runs a substantial surplus by 2020.

Figure 6.6. Current account balance for the EU-25, 2005-2020.



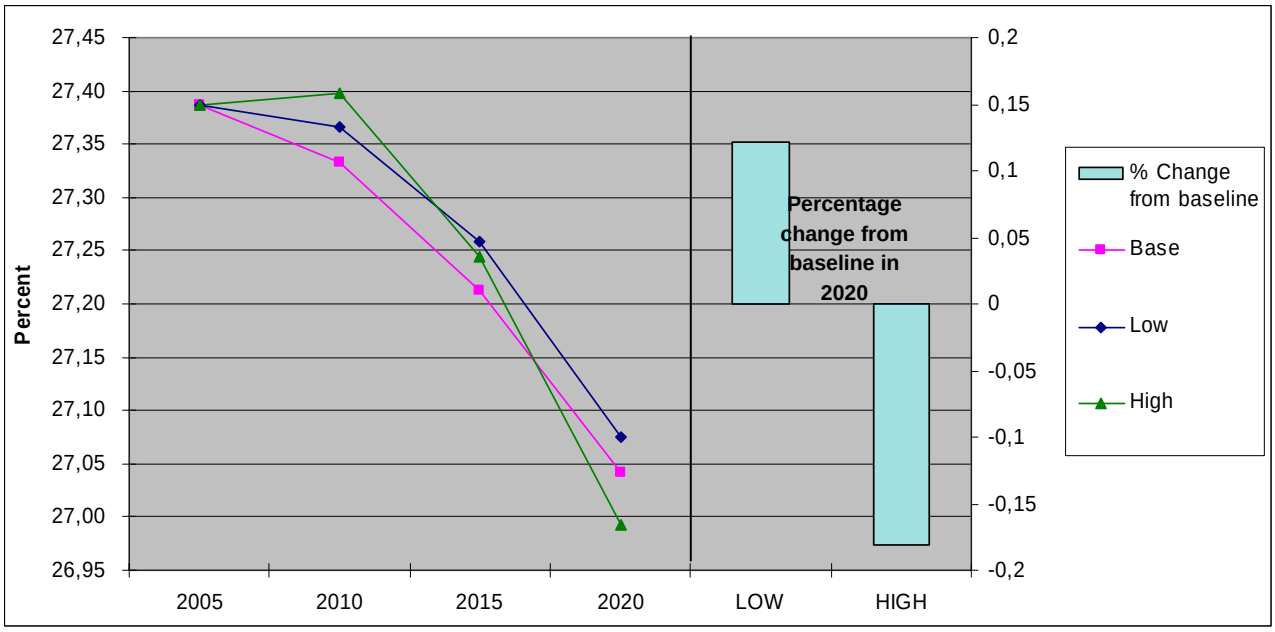
7. Taxes

7.1. Total tax revenue

Information on tax revenues is available for the EU-15 (excluding Sweden, Ireland, Portugal and Luxembourg). Total tax revenue includes taxes on production and imports and current taxes on income and wealth.

We begin by presenting total tax revenue as a percentage of GDP for the available countries in the EU-15 according to the baseline, low and high sustainability scenarios (figure 7.1). Total tax revenue falls marginally as a percentage of GDP in all three scenarios, from 27.4% in 2005 to around 27% in 2020, with very small differences between the baseline scenario and the low and high scenarios.

Figure 7.1. Total tax revenue as percent of GDP in the EU 15 (excluding Sweden, Ireland, Portugal, Luxembourg).

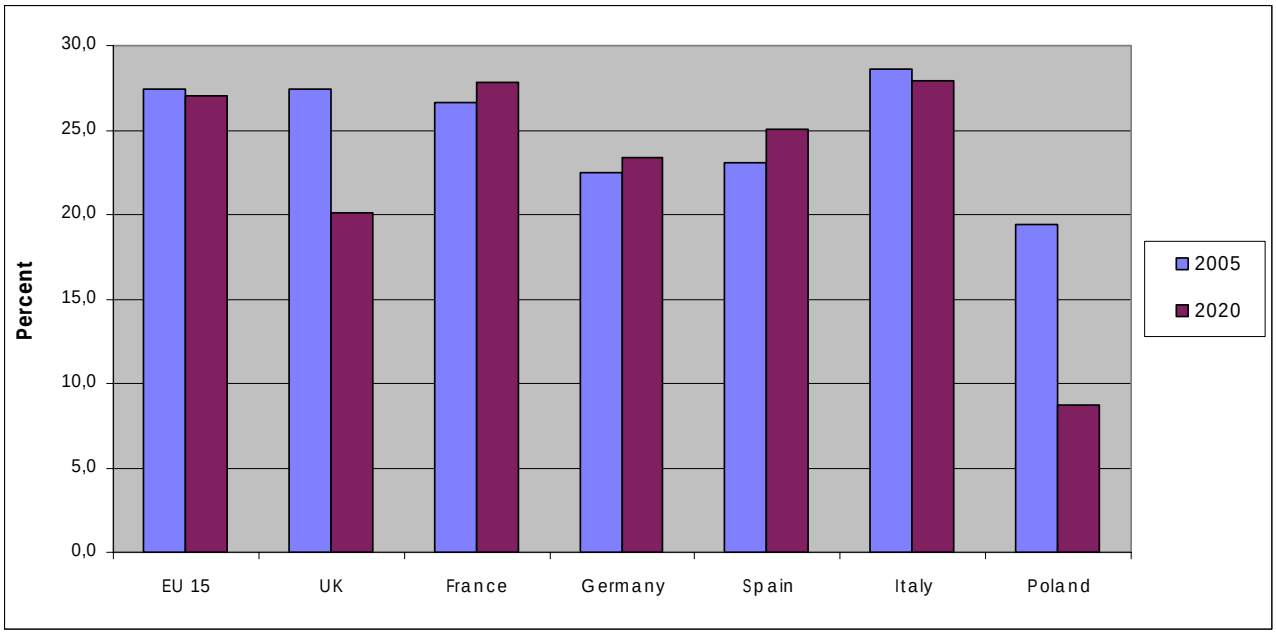


In order to highlight regional differences, figure 7.2 presents total tax revenue as a percentage of GDP for the years 2005 and 2020 in the high scenario, focusing on the EU-15 and 6 Member States contributing more than ¾ of Europe's aggregate GDP, population and energy consumption: France, Germany, Italy, Poland, Spain and the UK. Similar developments can also be observed in the other two scenarios.

In 2005, three of the selected EU-15 Member States lie below the EU-15 average (Germany, 22.5%; Spain, 23.1%; France, 26.6%). In contrast to the regional average, these Member States collect an increasing amount of total tax revenue as a percentage of GDP during the modelling period, with France even rising above the EU-15 average.

The UK, on the other hand, experiences a rather sharp fall-off in total tax revenue as a percentage of GDP, from 27.4% in 2005 to 20.1% in 2020. This is the lowest value of all selected EU-15 Member States in 2020[18]. In Poland, an even bigger decrease takes place. Here, total tax revenue drops from 19.4% of GDP in 2005 to 8.7% in 2020[19]. These developments in the UK and Poland can be explained by comparing absolute tax revenue in these countries, which is unchanged between 2005 and 2020, with real GDP, which grows at 4.5% p.a. in Poland and 2% in the UK on average.

Figure 7.2. Total tax revenue as a percentage of GDP in the EU-15 (excluding Sweden, Ireland, Portugal, Luxembourg) and selected countries in 2005 and 2020 (high scenario).

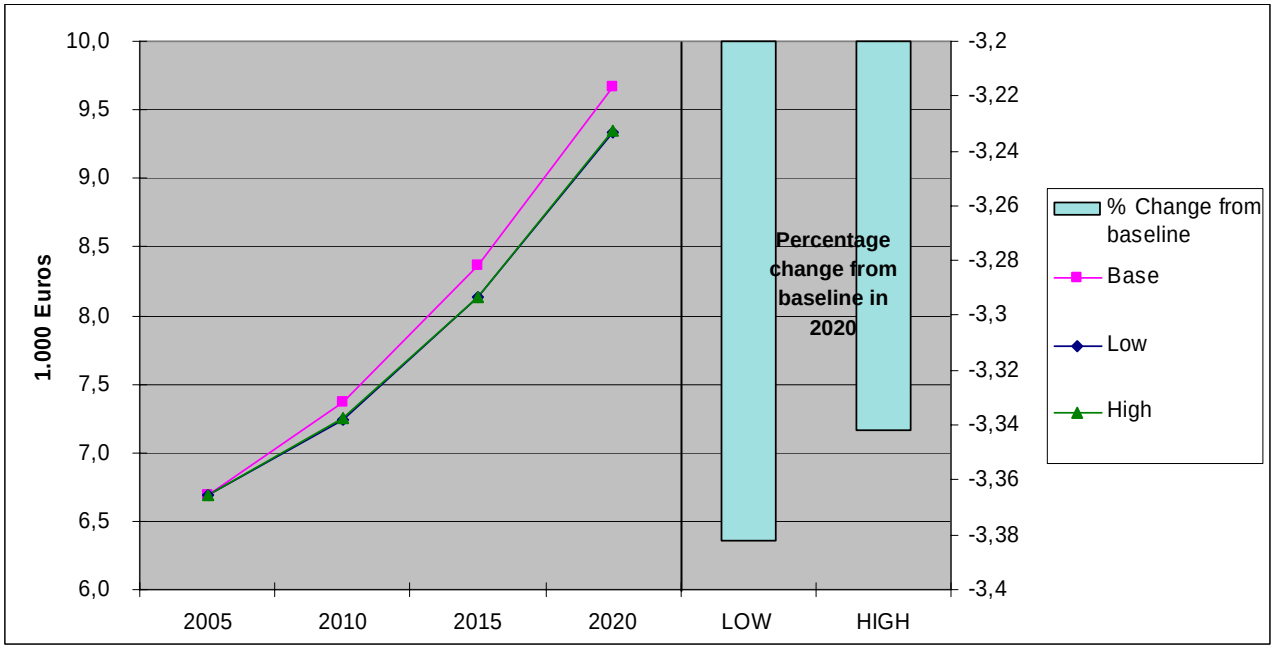


Generally, total tax revenue grows a little slower than GDP at current prices in the EU-15 as a whole, as well as in the UK and Italy. In France, Germany and Spain, annual average growth in total tax revenue is higher than equivalent growth in GDP. In the low and high scenarios, annual average growth in total tax revenue tends to be lower than in the baseline, but only fractionally so.

A different way of looking at the development of total tax revenue is to calculate per capita amounts. Figure 7.3 looks at trends in total tax revenue per capita in the EU-15 during the modelling period. In 2005, it amounts to €6700. Since population growth (0.1% p.a. on average) is considerably lower than growth in total tax revenue (2.6% p.a. in the baseline, 2.4% in the low and high scenarios), total per capita tax revenue rises to €9700 in the baseline scenario and around €9300 in the low and high scenarios.

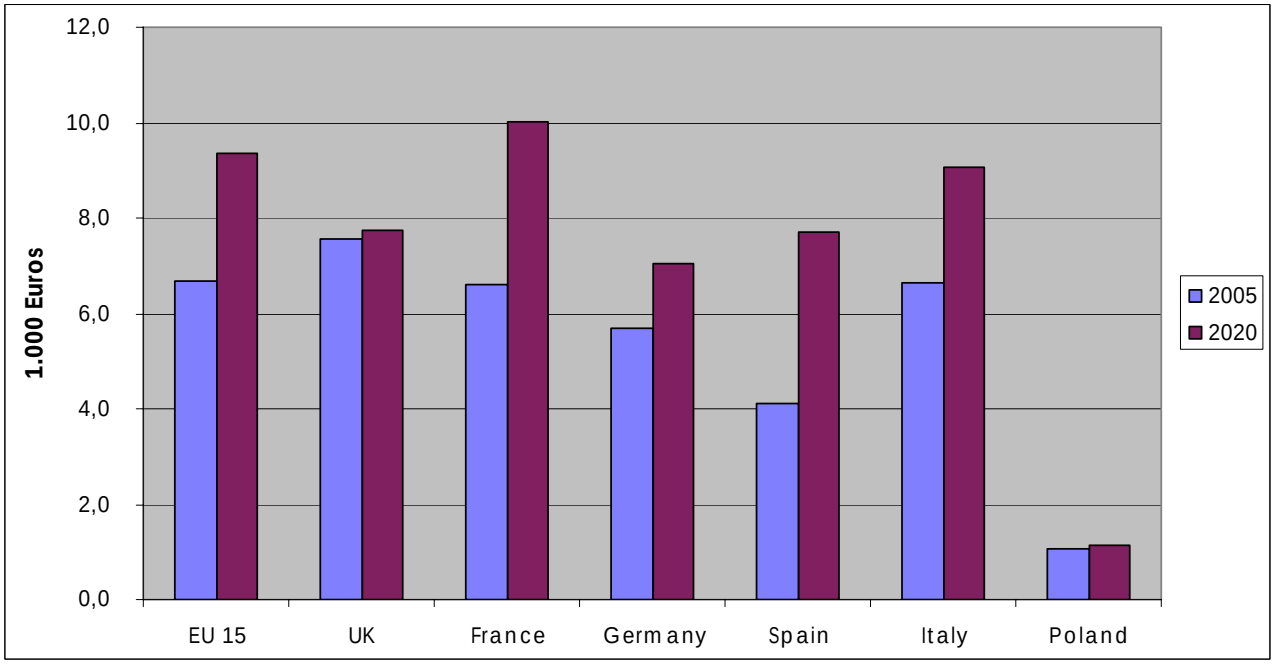
[18] The decline in total tax revenue as a percentage of GDP is a little weaker in the other two scenarios, where it drops to 20.2% (baseline) and 20.5% (low scenario).
[19] This decline is even stronger in the baseline and low scenarios, where total tax revenue as a percentage of GDP amounts to 8.2% and 8.5% respectively in 2020.

Figure 7.3. Total tax revenue per capita in the EU-15 (excluding Sweden, Ireland, Portugal, Luxembourg).



Comparing results for 2005 and 2020 in the high scenario, figure 7.4 shows that per capita tax revenues in France and Italy correspond to the EU-15 average in 2005 (€6700). In 2020, only France lies above the EU-15 average, with €10000 tax revenue per capita. Per capita tax revenue in Italy (€9100) corresponds largely with the EU-15 average in 2020.

Figure 7.4. Total tax revenue per capita in the EU-15 (excluding Sweden, Ireland, Portugal, Luxembourg) and selected countries in 2005 and 2020 (high scenario).



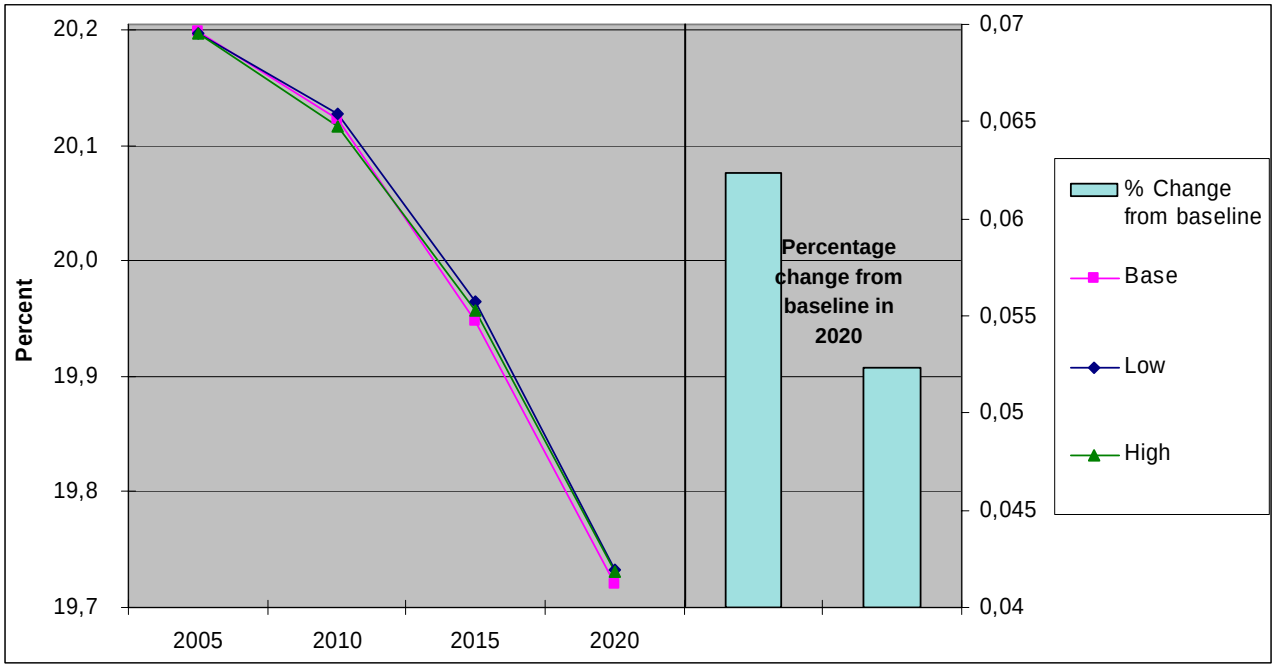
Spain, however, shows the highest relative increase in per capita tax revenue from €4100 in 2005 to €7700 in 2020. In contrast, the UK and Poland see only a minor increase of around 0.1 percentage points. Taking into account the other EU-15 countries for which

data are available, one sees that in the Benelux countries (the Netherlands and Belgium), Finland and Austria, per capita tax revenue is above average in both 2005 and 2020, while in Greece it is below the EU-15 level.

7.2. Total household tax burden

In addition to total tax revenue, the total household tax burden in the EU-15 can also be analysed (as a percentage of disposable income). As is shown in figure 7.5, the average household tax burden in the EU-15 is reduced by 2.3% (from 20.2% to around 19.7%) between 2005 and 2020 in all three scenarios, being marginally higher in the low and high scenarios than in the baseline.

Figure 7.5. Trends in the total household tax burden (% disposable income) of the EU-15 (excluding Sweden, Ireland, Portugal, Luxembourg).

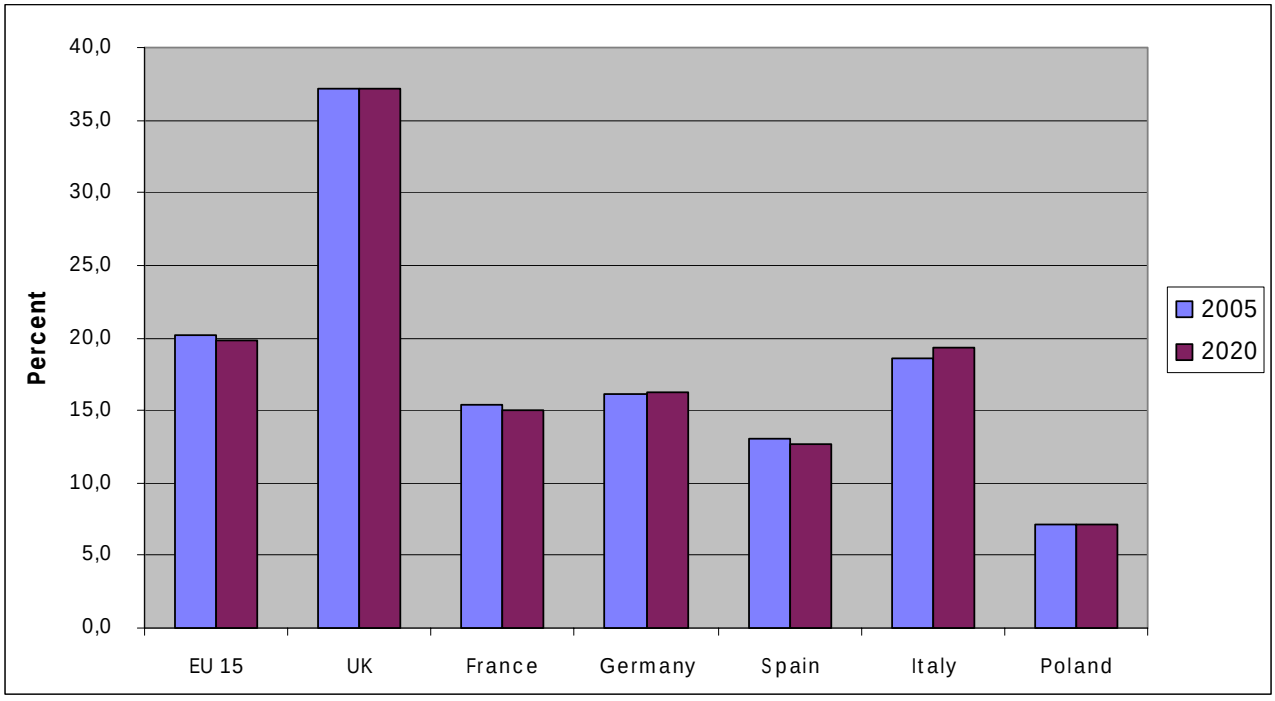


Looking at regional differences (figure 7.6) in the high scenario, the UK has the highest household tax burden (37.2%) in both years. The UK burden lies significantly above the EU-15 average (20.2% in 2005; 19.8% in 2020)[20]. Higher than average 'takes' can also be observed in Austria, Belgium, Denmark and Finland.

With 7.1% (in both years), Poland exhibits the lowest household tax burden within the group of selected countries, followed by Spain with 12.7% (in 2020). In contrast to the average development, the household tax burden increases in Germany and Italy from 2005 to 2020 as it does in a group of other EU-15 countries (Austria, Belgium, Greece, Finland).

[20] Again due to unchanged values of taxes as well as disposable incomes in local currency in UK and Poland there is no change in household tax burdens in these countries.

Figure 7.6. Total household tax burden (%disposable income) in the EU-15 (excluding Sweden, Ireland, Portugal and Luxembourg) and selected countries in 2005 and 2020 (high scenario).



8. Prices

8.1. Inflation: the GDP deflator

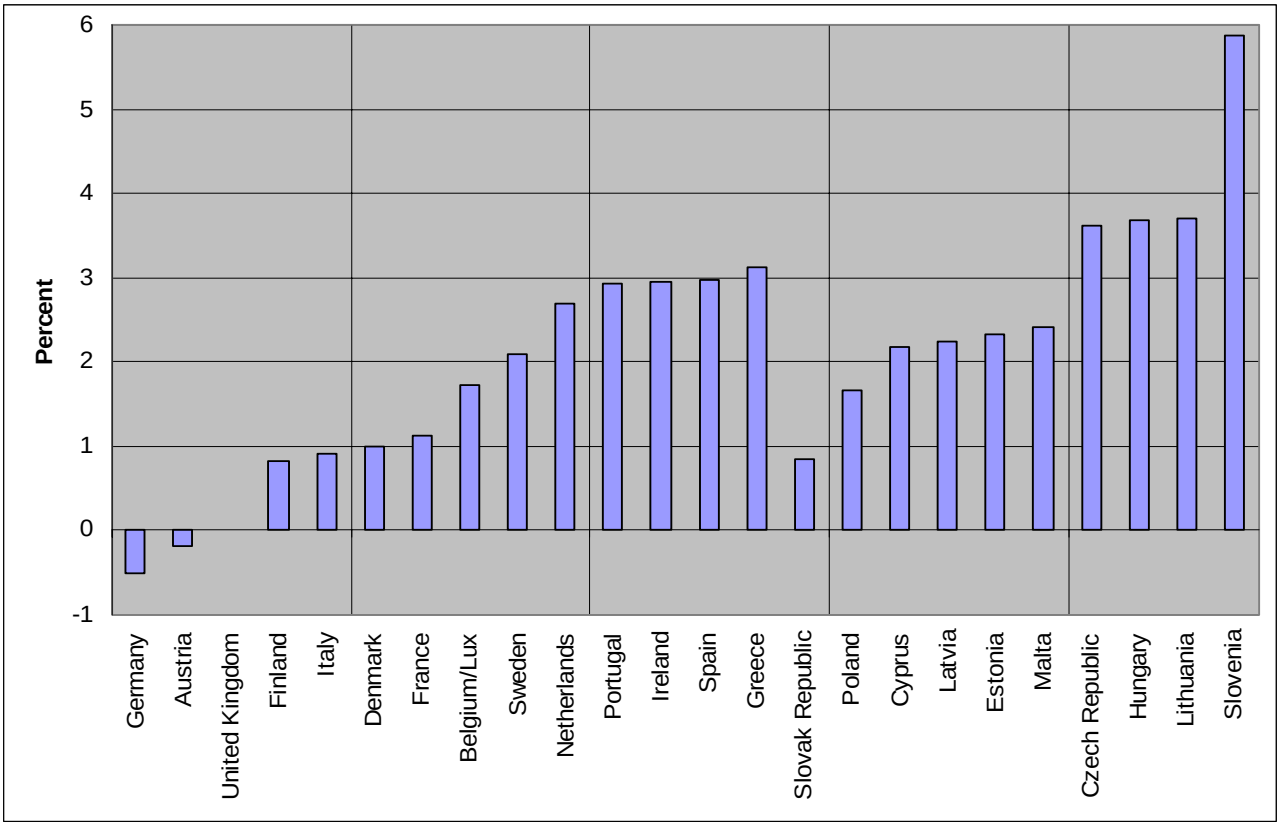
We begin with trends in inflation, as quantified both by the GDP deflator and the price index of household consumption expenditures (HCE). Inflation is usually judged according to the consumer price index (CPI), but we do not have the CPI at our disposal. The HCE, which is very close to the CPI, can be used instead, but, as it is generated through input-output modelling, it is not available for all countries. So, to compare general price changes across the widest range of countries, we begin with the GDP deflator[21].

The forecast for the GDP deflator in the baseline scenario varies between countries. Figure 8.1 presents annual average rates in the EU-25 on a country-by-country basis. It shows annual average GDP deflator rates for the period 2005-2020 in the baseline scenario. Countries are sorted in order of increasing inflation.

Generally, the forecast rates are moderate to low – they are significantly below 4% for new Member States and 3% for EU-15 Member States. The exception is Slovenia, where the annual GDP deflator reaches almost 6% on average. Excepting Slovenia, there are no major differences between old and new Member States. That said, annual inflation in the new Member State bloc falls under 2% in only two cases (in the Slovak Republic and Poland), whereas 8 members of the EU-15 exhibit annual inflation under 2%. It must be noted that in three cases, prices are stable (United Kingdom) or even fall (Germany and Austria).

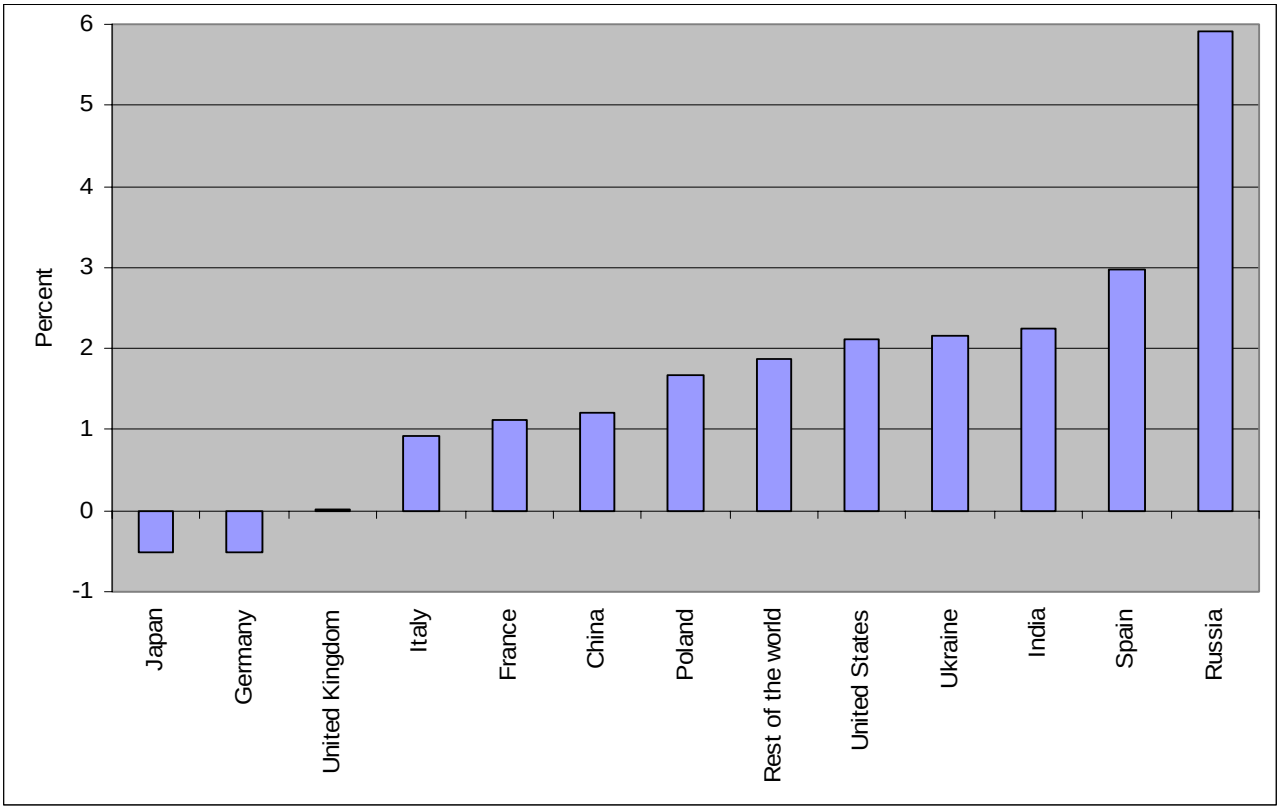
[21] Actually, the 'price' of GDP in GINFORS is a 'GDP deflator' only if a macro-model has been constructed. If the input-output technique has been used, it is instead called a 'GDP price index'. Here, we do not make this distinction, because, deliberately overlooking the modelling technique, the variables show the same economic phenomena: i.e. the 'price' of GDP.

Figure 8.1. Annual average GDP deflator rates for the period 2005-2020 in the baseline scenario (EU Member States).



Comparing the EU situation with other major world economies, figure 8.2 shows that annual inflation rarely exceeds 2%. The exception is Russia, which experiences annual average inflation of almost 6%. In Japan, a deflation tendency is observed at a rate similar to Germany (i.e. 0.5% per year). This means that prices in 2020 will be about 8% lower than in 2005. Prices in China rise at rather low rate of 1.2%. Inflation in the US, Ukraine, India and the rest of the world is around 2%.

Figure 8.2. Annual average GDP deflator rates for the period 2005-2020 in the baseline scenario (selected EU and world economies).



8.2. Inflation: the price index of household consumption expenditures

Annual average increases in the price index of household consumption expenditure (HCE) are shown in figure 8.3[22]. The same figure shows GDP deflators for comparison. For virtually every country selected, HCE price rates are positive (i.e. inflationary) and they are higher than GDP deflators in most cases. There are some striking differences between the two price measures, especially in Japan and Germany, where the difference is more than 1 percentage point.

Exempting Spain and the Czech Republic, the tendency for inflation as measured by the HCE to exceed the GDP deflator rate is observed everywhere, although its strength varies from one country to the next. The higher HCE rates mean that, in the period 2005–2020, consumption products become relatively more expensive in comparison with other final demand products (especially investment goods) in the baseline scenario.

[22] This is possible only for countries modelled using the input-output technique.

Figure 8.3. Annual average GDP deflator rates compared to HCE rates for the period 2005-2020 in the baseline.

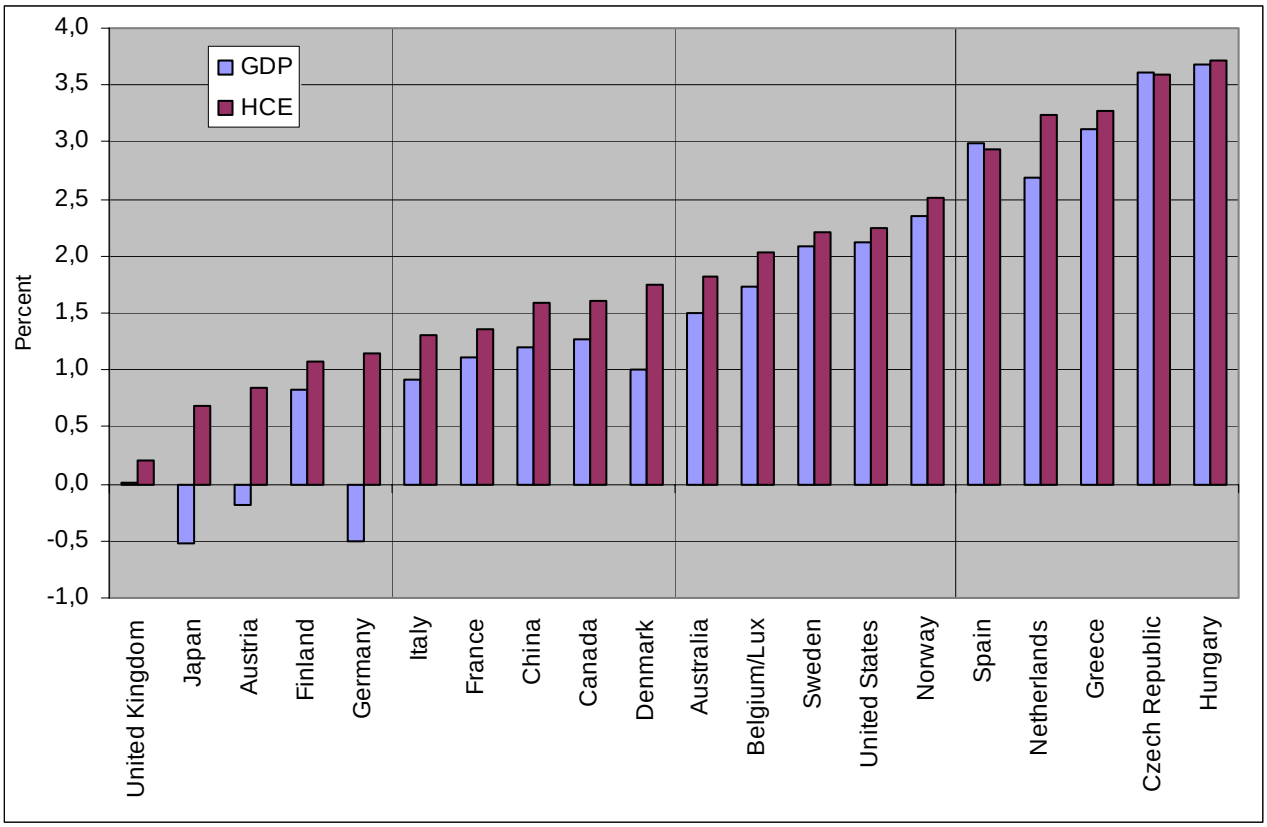
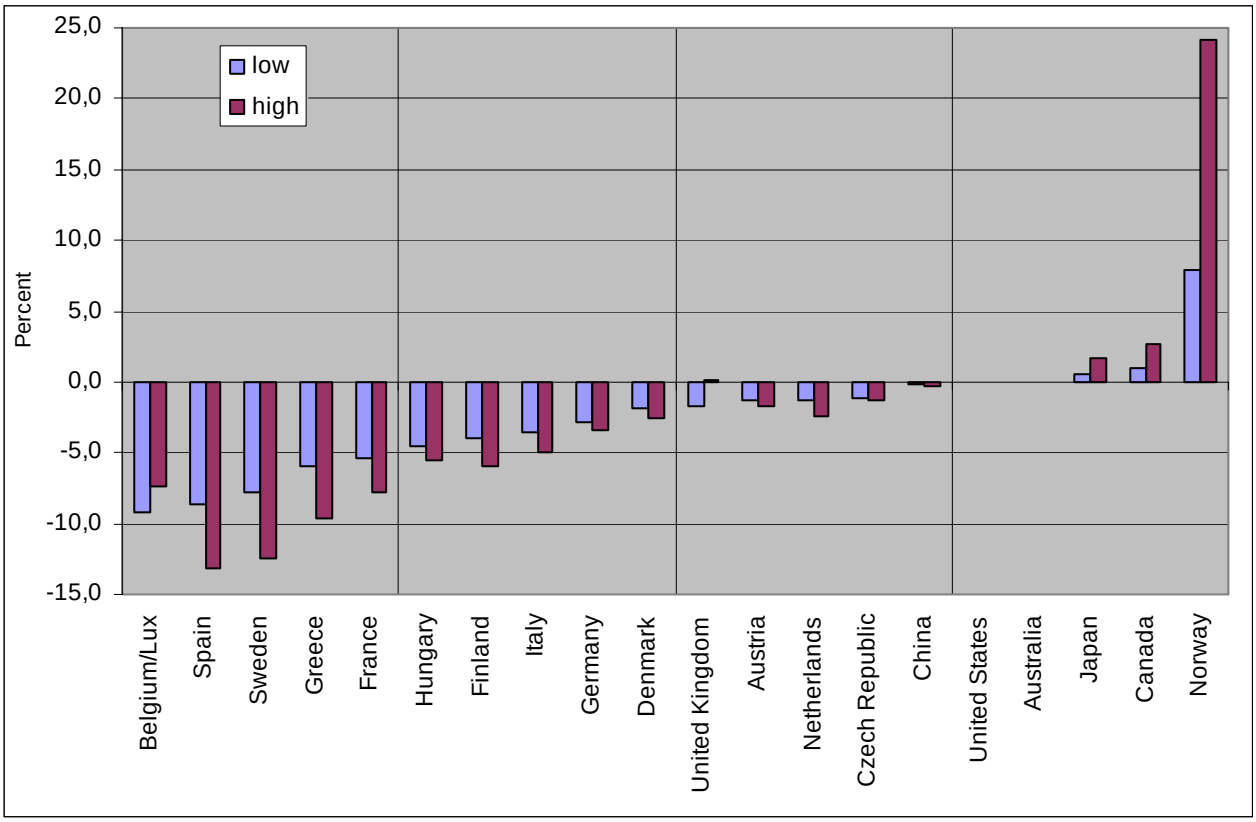


Figure 8.4 investigates the impacts of the low and high scenarios on HCE price indices, presenting percentage deviations from the 2020 baseline in the low and high scenarios. The implementation of measures in the scenarios has a deflationary impact on the prices of HCE goods, which tend to become cheaper in many countries. This effect is predictably stronger in the high scenario. For example, the HCE index in Spain is 13% below the baseline in the high scenario. However, in some cases the opposite effect can be seen, especially in Norway, where a price increase of almost 25% is observed in the high scenario relative to the baseline.

It is also worth noting not only that the price effects of introducing sustainability policies are negligible in most non-EU countries (e.g. in the US, Australia and China), but also that the effect is relatively weak for the Czech Republic, the Netherlands, Austria and the UK.

Figure 8.4. Differences in HCE price index between scenarios for selected countries in 2020 (% of base scenario).

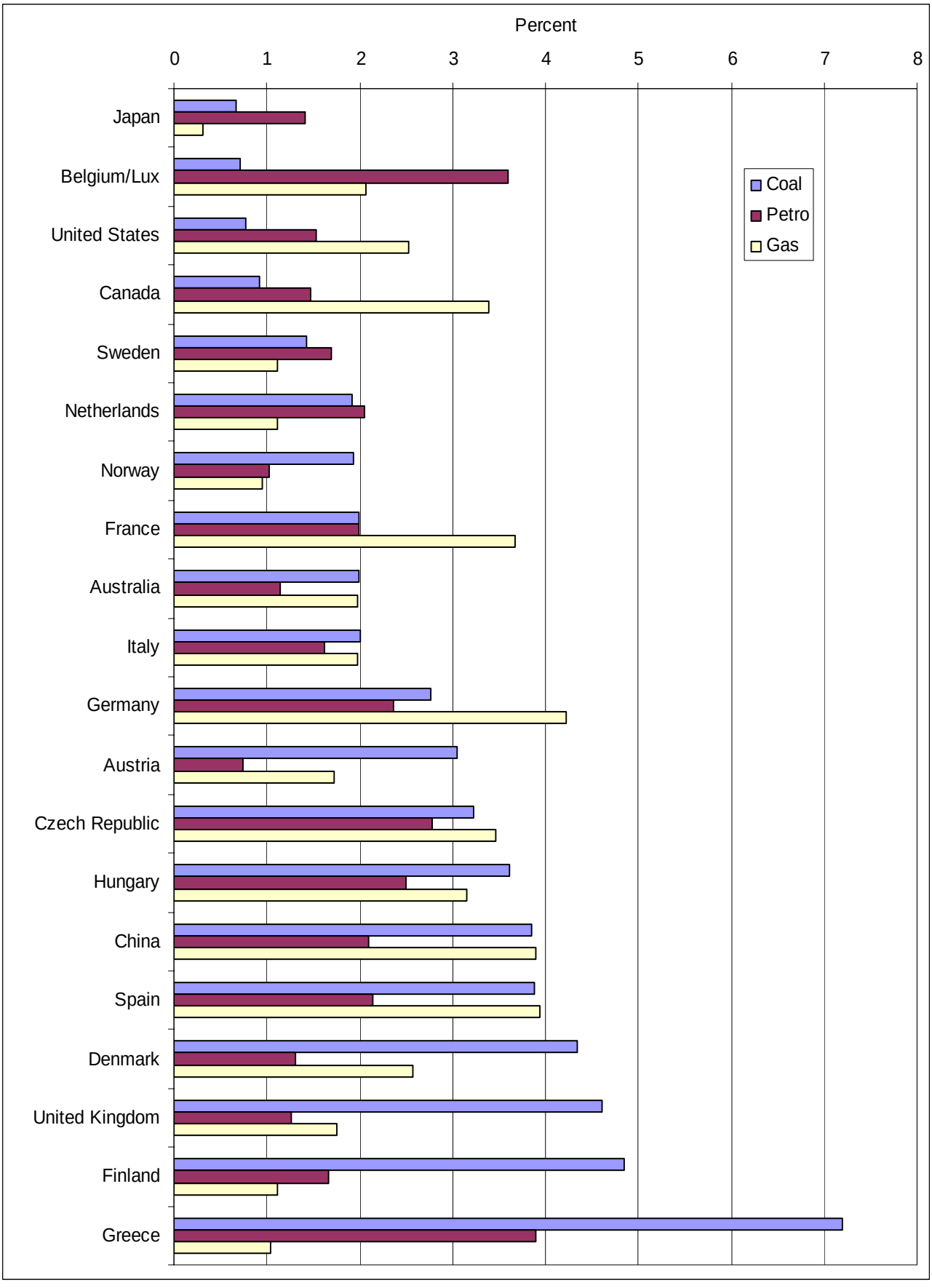


8.3. Natural resource prices

The baseline scenario assumes business as usual (BAU) behaviour in the prices of natural resources. In the low and high scenarios, however, these prices are exogenously altered by policy interventions. Here we will provide a background for the analysis by presenting baseline trends.

Figure 8.5 examines average growth rates in the price of basic energy carriers – coal, petroleum products and gas – in selected EU and non-EU countries. Coal prices increase annually at average rates from 0.7% in Japan to more than 7% in Greece. Gas prices also increase year-on-year, but by less – from 0.4% in Japan to 4.2% in Germany on average. Petroleum product prices increase at average rates from 0.7% in Austria to almost 5% in Greece. Relatively low rates of natural resource price inflation are observed in Japan, Sweden, the Netherlands, Italy and Norway (less then 2%), and high rates are observed in Greece, the Czech Republic, Hungary, Germany and China (3-4%).

Figure 8.5. Annual average increases in the price of energy carriers for the period 2005-2020 (baseline).

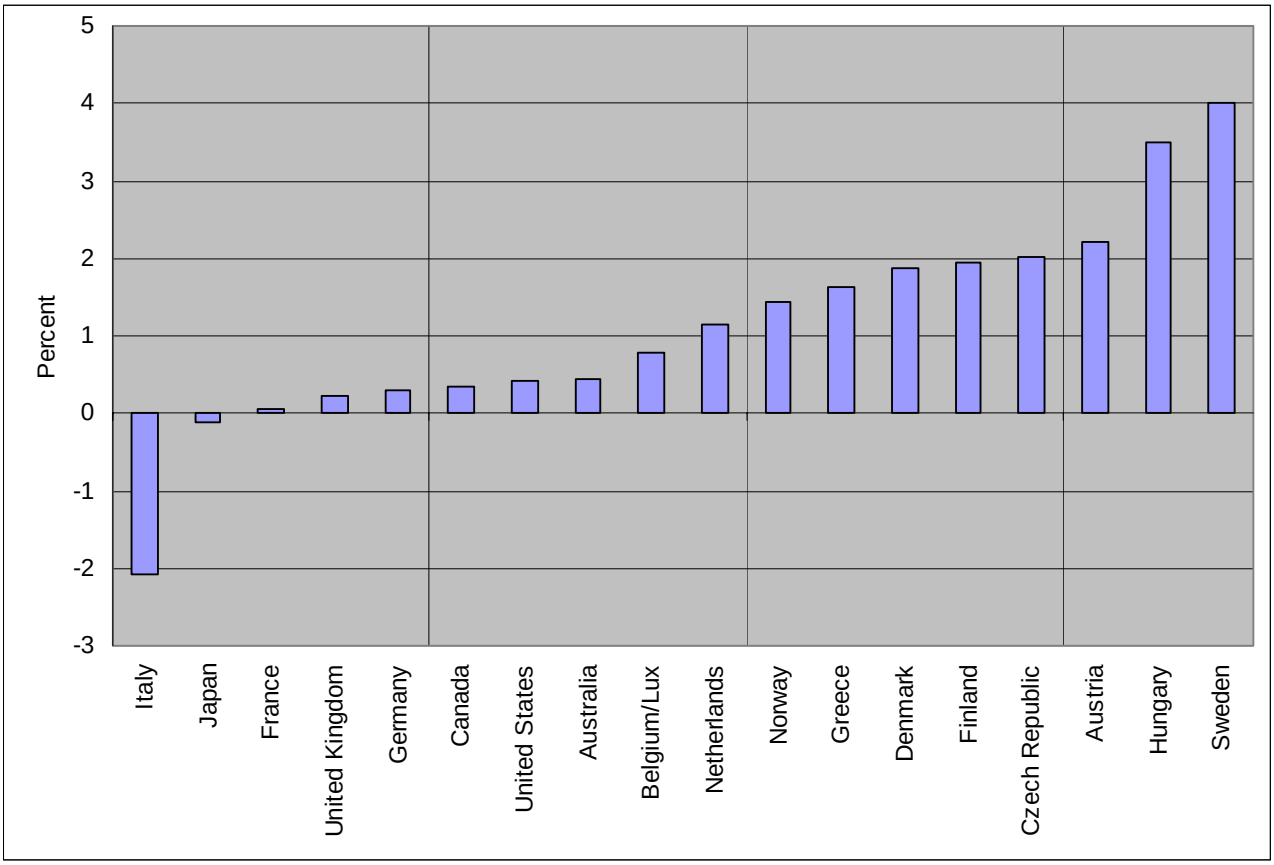


8.4. Electricity prices

Figure 8.6 looks at the annual average rate of electricity price inflation in the baseline scenario. It is striking that, according to simulation results, electricity in Italy and Japan will become cheaper. In Japan, the rate of price deflation is very small (-0.1%), but in Italy it is high (–2.1%).

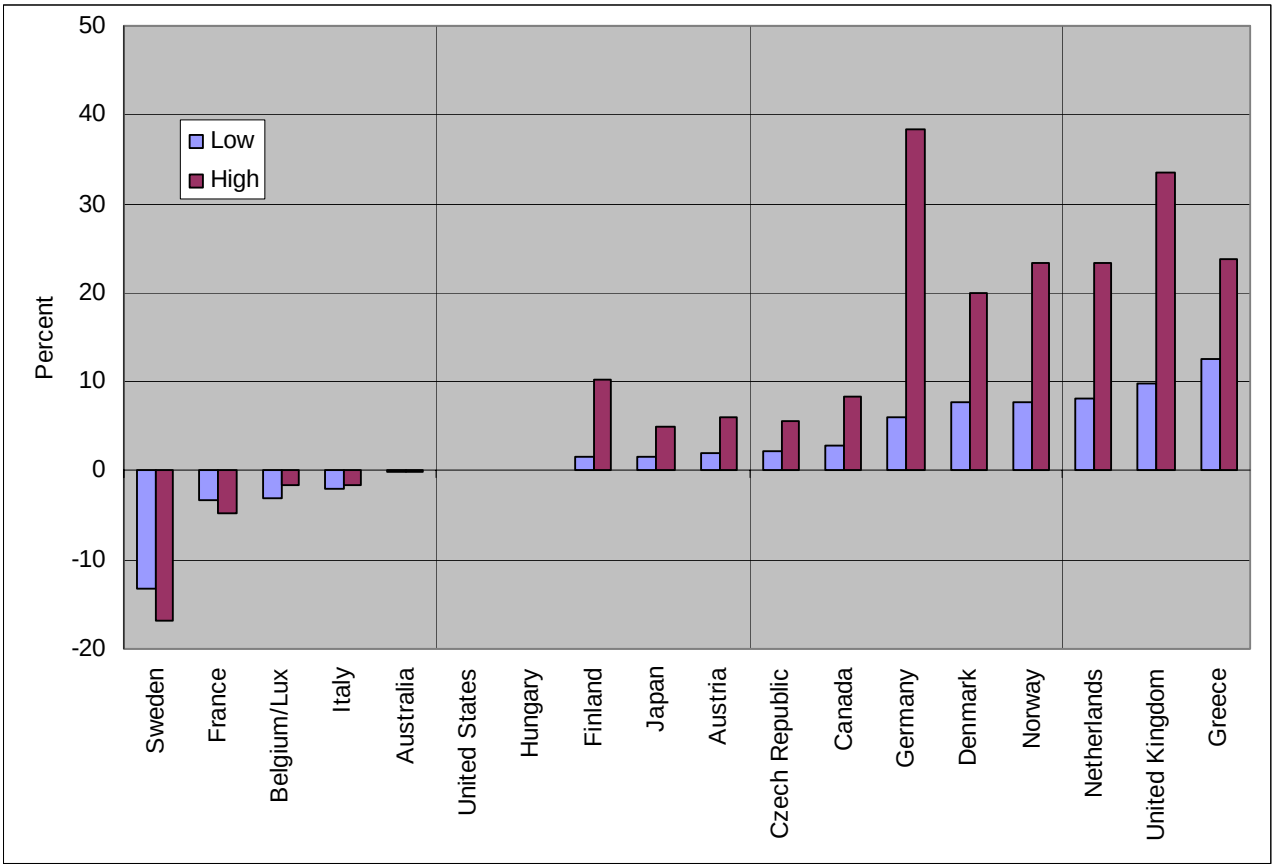
In France, the UK, Germany and non-European countries (Canada, the US and Australia), price inflation is relatively mild (less then 0.5% annually). In the remaining countries analysed, it is around 1-2% and only for Hungary and Sweden does it exceed 3%.

Figure 8.6. Annual average increases in electricity prices for the period 2005-2020 (baseline).



From the point of view of prices, the introduction of sustainability policies in the low and high scenarios actually results in cheaper electricity in some countries, especially Sweden. This result is demonstrated in figure 8.7, which presents differences in the electricity price index between the baseline and low and high scenarios in 2020. In most EU Member States, the price of electricity rises both under the low and high scenarios compared to the baseline. In the high scenario, this effect is sometimes very strong. In Germany for example, prices are almost 40% higher by 2020, in the UK they are 35% higher, and in Denmark, Norway, the Netherlands and Greece they are 20-25% higher.

Figure 8.7. Differences in the electricity price index between scenarios for selected countries in 2020 (% change from baseline)



8.5. Case studies

In this sub-section, we examine simulation results in more detail for specific countries. For each country, two graphs are presented. The first graph shows annual average rates of price inflation for natural resources, electricity, sector products, household consumer goods (HCE) and the economy as a whole (via the GDP deflator). The second graph shows percentage deviations between the low and high scenario results and the baseline for the same variables, except natural resource prices.

Several EU and non-EU countries have been selected. The EU-15 is represented by the UK, Germany, Italy (all figure 8.8), Spain, France, and Sweden (all figure 8.9). The Czech Republic represents the new Member States, while Japan and Norway represent non-EU countries (all figure 8.10).

Comparing the results of the low and high scenarios for Germany, the UK and Italy (figure 8.8), some similarities and some differences can be seen. Generally, there are many similarities between Germany and the UK with regard to the direction, as well as the magnitude, of price changes. The high scenario has a very strong influence on the price of electricity, which is 40% higher in the UK and 35% higher in Germany than the baseline price, whereas in the low scenario this inflationary effect does not exceed 10%. This is caused mainly by the huge increase in natural resource prices over the baseline that is

assumed in the high scenario. In addition, transportation prices rise, but not as sharply (by less than 10%). Nevertheless, electricity and transportation price inflation does not mean that prices of final products (like food) rise. On the contrary, the price of food, for example, is more than 10% below the baseline in the high scenario. This is possible because of the deflationary influence of other policies in the high scenario, mainly the Aachen scenario, as well as government measures to subsidise R&D for technological progress. The overall effect of the diversity of price changes observed in the high scenario is a decrease in the GDP deflator compared to the baseline, which is strongest in Germany.

Italy presents a rather different case due to trends in the baseline price of electricity. However, beyond deflation in the baseline price of electricity, against which the low and high scenarios have an understandably small effect, similar price trends are apparent. This is also largely true of the three Member States exposed in figure 8.9 – Spain, France and Sweden.

The combined effect of a carbon tax and a specific policy to price transportation according to the principle of short-run marginal social costs is to increase transportation prices, but the response of the model is such that transportation prices are actually lower in Spain and Sweden in the high scenario versus the baseline.

Looking at the Czech Republic, the general impression is that price trends follow those of the EU-15 Member States: i.e. electricity and transportation prices increase in the low and high scenarios compared to the baseline, but the prices of final products and prices across the economy as a whole fall. The characteristic feature of the Czech Republic is, however, that the deviations in prices from the baseline are rather moderate (less then 8%).

Non-EU countries are represented by Norway and Japan. Norway was selected for this special focus because of the notably strong effect of the high scenario on prices. The price differences from the baseline range from 17% to over 30% in the high scenario, whereas in the low scenario they fall in the range 5-10%. This is not only a strong reaction but also different in comparison with the EU Member States previously discussed. In Japan, all prices in the low and high scenarios are greater than the baseline, but the inflationary effect of the scenarios is fairly low.

Figure 8.8. Annual average price trends in the baseline and differences between scenarios for the UK, Germany and Italy.

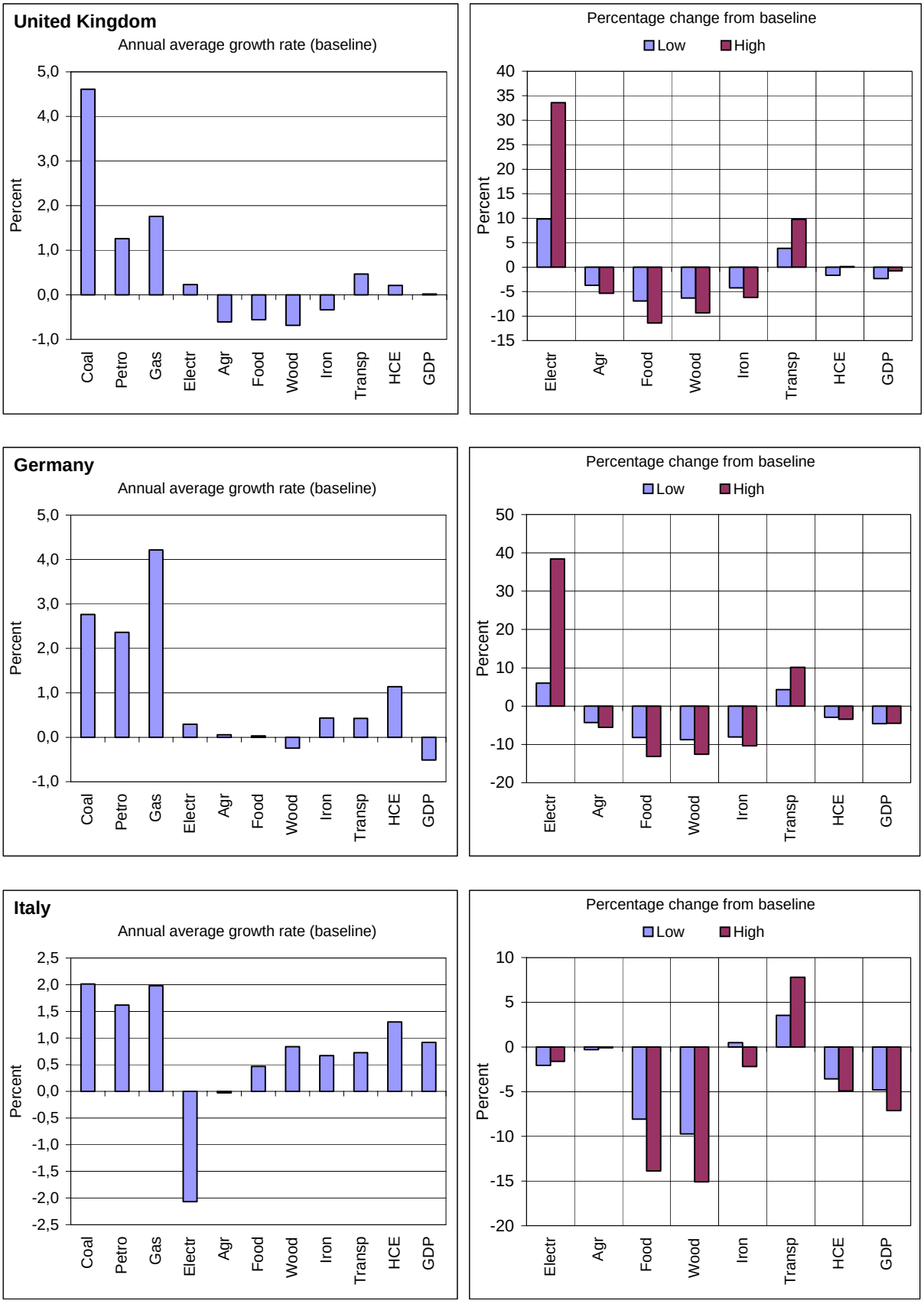


Figure 8.9. Annual average price trends in the baseline and differences between scenarios for Spain, France and Sweden.

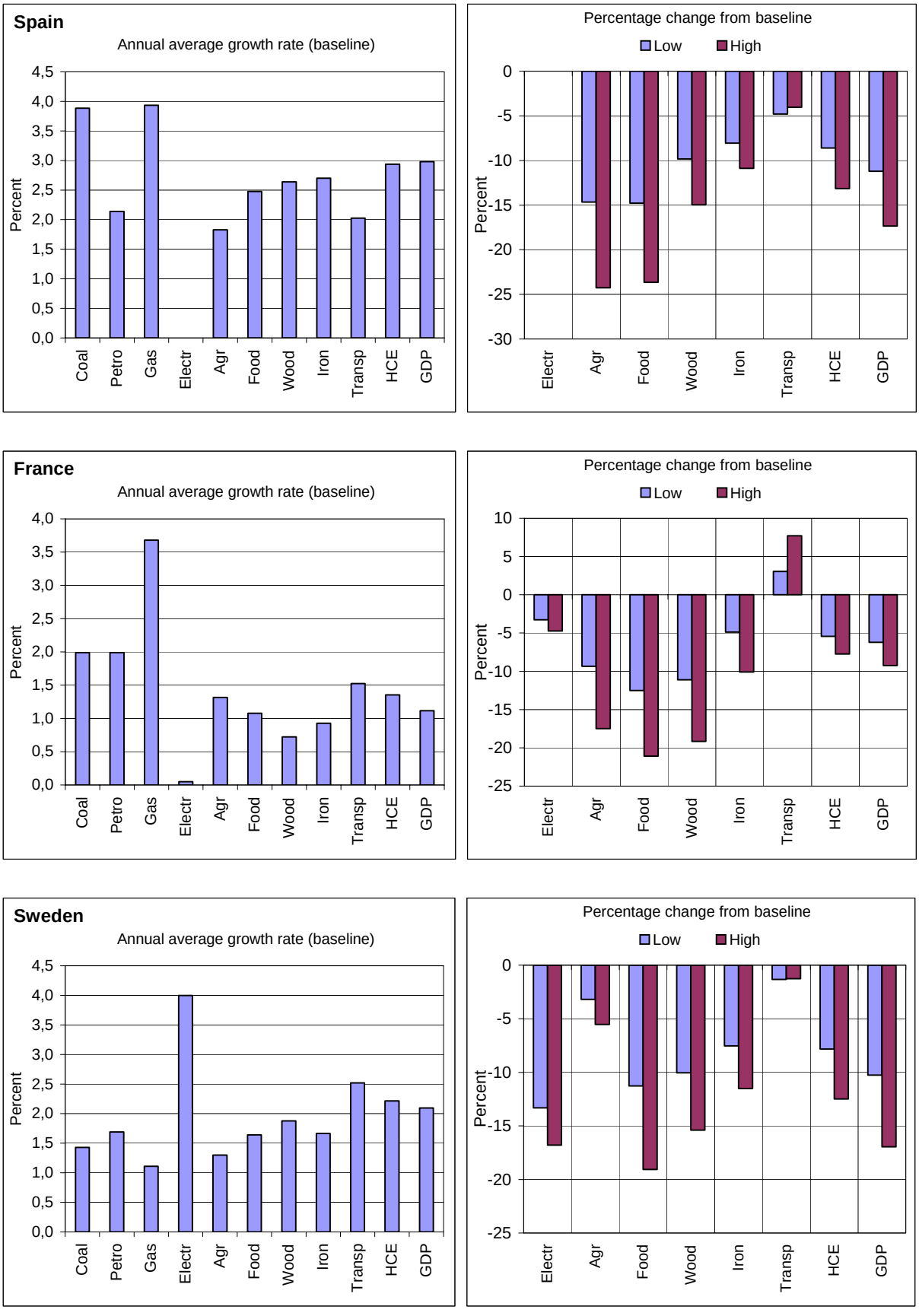
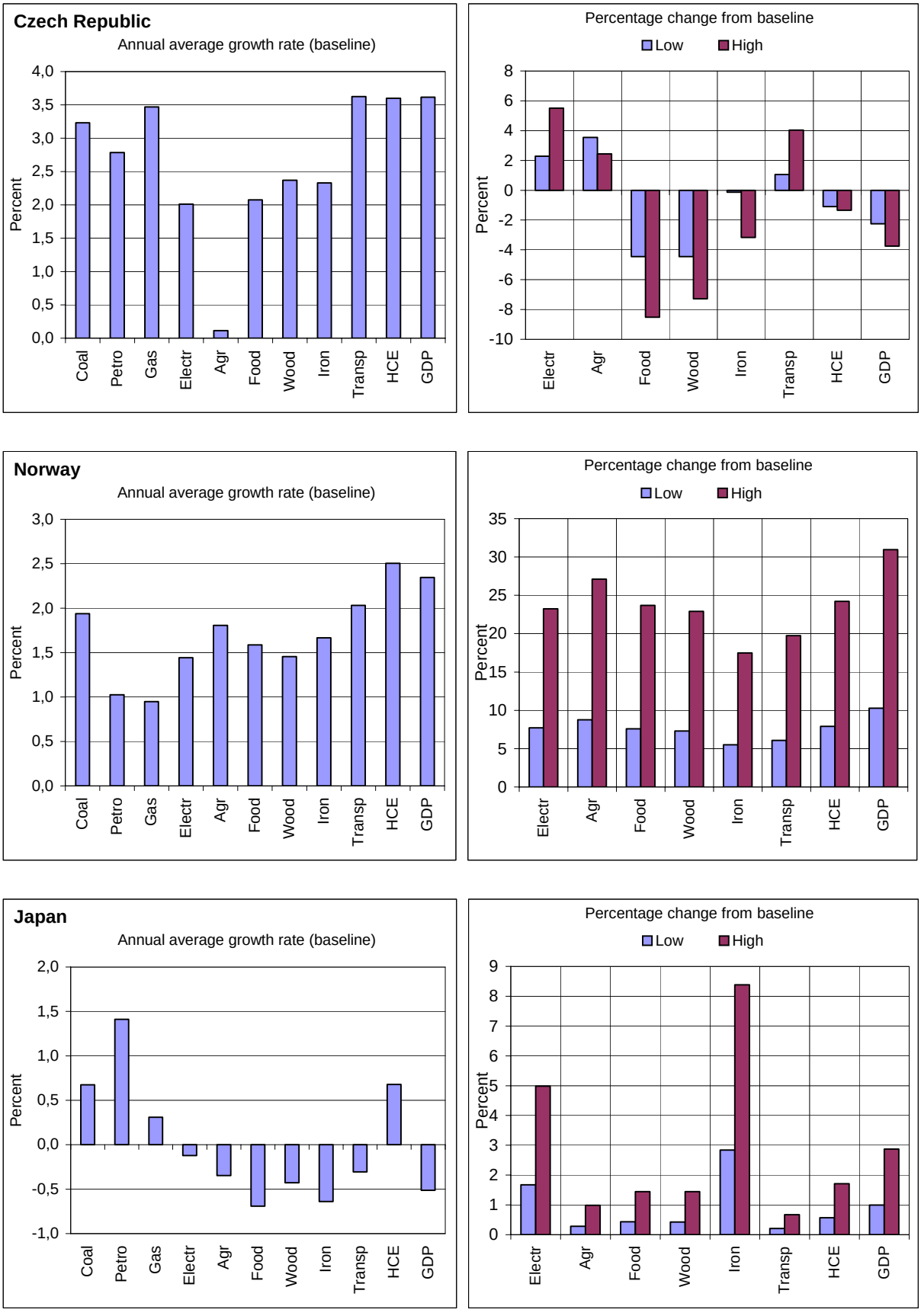


Figure 8.10. Annual average price trends in the baseline and differences between scenarios for the Czech Republic, Norway and Japan.



8.6. Conclusions

It is difficult to draw sweeping conclusions on price changes in the low and high scenarios. Results differ from country to country with regard both to the direction and the magnitude of change from the baseline. **For many countries**, however, **the deflationary impact of the high scenario is noticeable**. Although natural resource prices rise hugely, entailing in many countries major inflation in the price of electricity, many products get cheaper. This is possible because of large productivity gains made in the Aachen scenario especially, as well as to a lesser extent through government-subsidised R&D leading to technical progress.