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# Executive summary

## 1. Calculating equilibrium wages

A 'lack of international competitiveness' is often put forward as an explanation of the high current account deficits and rising private and public indebtedness that are at the root of the euro crisis. The southern euro-area member states are deemed to have overspent before the crisis and thus are now uncompetitive, while northern European countries have implemented structural reforms and restrained wage increases. Hence, large economic imbalances have accumulated and wages are a crucial variable for overcoming the economic crisis that has paralysed the European economy for over seven years.

Standard measures of competitiveness such as unit labour costs use indices that depend on the choice of base year. In addition, the focus on unit labour costs implies that non-price competitiveness factors are excluded from the analysis. As a consequence, they do not provide sufficiently useful information on the relative levels of competitiveness at a given moment in time nor do they explain the causes behind lack of competitiveness.

We develop the concept of nominal equilibrium wages, which avoids problems with the base year of price indices and provides useful information on the levels of the variable. We measure competitiveness as the deviation of actual wage costs from nominal equilibrium wage levels for countries and sectors. Equilibrium wages are not market clearing wages, but the wage levels at which all sectors in the euro area would be on a balanced growth path, defined by having the same return on the capital stock, so that all regions and sectors grow at a uniform rate. Wages higher

than equilibrium are 'overvalued' and cause competitive disadvantages; below equilibrium, they are competitive and accelerate growth. By including the return on capital in the analysis of competitiveness we also take into account some non-price competitiveness components, which are related to the amount of capital in the economy, as well as productivity.

The concept and analysis of equilibrium wages take into account both long-run supply side and short-run demand side conditions. Because wages are part of production costs, they must be related to broader productivity developments, technological progress (innovation, R&D) and the accumulation of capital, skills and knowledge. But demand side dynamics affect the rate of capital accumulation and economic growth. Reducing nominal wages through 'austerity' could improve competitiveness, but the resulting reduced output per unit of capital will lower productivity and therefore the equilibrium wage, which could translate into lower competitiveness. The alternative wage-led growth strategy would be counterproductive when wages are already above the equilibrium, although they may be appropriate when wages are significantly below equilibrium.

The famous *Rehn-Meidner rule*, whereby wages ought to increase by the rate of inflation plus labour productivity, ignores the impact of capital productivity on equilibrium wages. Balanced growth would require that nominal wages be equal to equilibrium wages and then vary with changes in national or sectoral equilibrium wages. Divergences may result from broad country-specific or sector-specific factors, such as infrastructure, R&D, skill building and so on, but they may also reflect different weights of economic sectors with diverse capital–output ratios.

The equilibrium wage will increase when labour and capital productivity rise. Higher productivity generates more output, which can be used to remunerate workers. If nominal wages do not increase in line with the higher efficiency of the aggregated capital stock, they will fall below the equilibrium wage level and the country's return on capital will rise above the euro average.

The long run supply-side conditions are related to capital productivity, the ratio of capital to labour and relative price effects. They depend on the international division of labour, skill distribution and biased technical change. In the European Union, an additional factor is the emergence of the central and eastern European countries as the main partner for the delocalisation of some stages of production.

We present empirical evidence for equilibrium and actual wage developments for country aggregates in section 1 and for economic sectors in section 2 (see also annexes). The main aggregate evidence indicates that in Germany, Spain and the United Kingdom, equilibrium wages have risen faster than actual wages, but in France and Italy the improvement of equilibrium wages has stagnated and nominal wages have outgrown them. Greece had moderately improved wage competitiveness before the crisis, but due to excessive austerity, equilibrium wages have fallen since then. In fact, for crisis countries, competitiveness levels do not seem to matter: Greece and Spain are always above the equilibrium wage, but Ireland and Cyprus are always below it. Portugal has improved its wage competitiveness since 2007, while

Italy has seen a persistent deterioration. Among the opt-out countries, Denmark has a stable negative wage gap, Sweden is too costly and the United Kingdom has gained cost advantages since the crisis.

Table 1 shows nominal amounts of actual and equilibrium wages and their gap. In 2015 the average monthly wage in the euro area was 3,250 euros (€); in Luxembourg it was €5,414, but the equilibrium level was €7,300. By contrast, in Lithuania actual wages were only €1,090 against the equilibrium wage of €1,803. German wages are in the middle with a gap of €146 below equilibrium, while Greek wages, at €1,884, are €512 above equilibrium.

In the transition economies of central and eastern Europe wages are highly undervalued. In Romania and Poland, nominal wages are more than a third below their equilibrium level; but even within the euro area, Lithuania, Slovakia and Latvia are more competitive. Polish wages could go up on average by €579 per month without pushing the return on capital below the euro area.

Wage gaps represent a competitive disequilibrium, which ought to be corrected over time. Unfortunately, the adjustment process is rather slow. Within the euro area, five countries, amounting to approximately 50 per cent of euro area GDP, are *above* equilibrium wage levels: Greece, Austria; Spain, Italy and France. Belgium, Finland and the Netherlands are *close* to equilibrium, Germany 4–5 per cent below. The other 10 member states – mainly in central and eastern Europe – all have massively *undervalued* wages, between 10 to 44 per cent. These wage gaps are important and they explain statistically the growth differentials between member states. Although we find that there is a tendency for the gaps to be corrected, the speed of adjustment is slow; on average less than 20 per cent of a given wage gap is corrected.

## 2. Sectoral equilibrium wages

In this section, we enter into the core of the report and show how the competitiveness of the different branches of the economy can be described and analysed by using our definition of competitiveness; namely, the gap between actual and equilibrium wages. We built a dataset including 14 EU member states, covered with sectoral breakdowns including 30 sectors (see Appendix Figure A4.1), with 13 manufacturing industries, 12 service activities, two primary sectors, construction and utilities (electricity, gas and water). The time span covers the period 1995–2012.

The sectoral composition of value added and the implied specialisation are important in explaining competitiveness patterns; in particular, the distinction between manufacturing and services is fundamental to understanding the aggregate dynamics. The manufacturing sector in Germany, Austria and in the eastern European member states (Slovenia and Slovakia) is important with a weight above 20 per cent of GDP in 2012, with some significant changes during the crisis (for example, in Finland). These countries form the main manufacturing production network of the European Union with strong vertical linkages. Due to the development of financial bubbles in the real estate market, the construction

industry had an exceptionally high share of GDP before the crisis, especially in Spain and Ireland. This dynamic halted and reverted after the global financial crisis. Figures 4–6 show that specialisation is quite varied between member states.

The ability to improve competitiveness by reducing the gaps between actual and equilibrium wages also depends crucially on labour market flexibility. One measure for estimating such flexibility is the wage spread between sectors. According to this measure, the northern Scandinavian countries have the most uniform wage levels across sectors, while the Anglo-Saxon leaning economies have the widest wage spreads. While this form of wage flexibility is uncorrelated with our wage gap *levels*, the more successful countries in coming out of the crisis, such as the United Kingdom, Denmark, Germany and the Netherlands, have *increased* their sectoral wage differentials, while the less successful countries (Spain, Belgium, France) have *reduced* these differences. In Germany sectoral wage variety increased with the Hartz reforms, suggesting an additional channel though which the country has improved its competitiveness with regard to the rest of Europe.

In the sectoral analysis the wage gaps are calculated in two different ways: first, by considering the average return on capital of the available EU countries; second, by considering the sector-specific return on capital for the average of EU countries. The former is our preferred measure as it includes also the effect of changes in the sectoral composition of output. The data are shown in Annex A. The overall picture is complex, highly diversified between sectors, countries and time periods. The dynamics of equilibrium wages seem to reflect in part sectoral specialisation, in particular for Germany, Italy and Spain, whereas for France such an association is not clear on a descriptive level.

While equilibrium wages were calculated by using average compensation per employee as a benchmark, we also calculated data based on hours worked. There are no significant differences between these two measures in manufacturing, although in services the match is less precise due to the higher importance of non-standard contractual forms of employment. This leads us to conclude that the analysis of labour remuneration per worker is not biased by neglected movements in the average number of hours worked per person employed. We therefore stick to the first measure as we have more complete data for this set.

Our theory in section 1 emphasised the importance of the relative efficiency of the capital stock, which depends on relative price effects and technical productivity. Figures 8–10 decompose these effects for major sectors of the member states divided into before and after the crisis. The sectoral dynamics provide interesting explanations for the competitiveness gains in terms of rising equilibrium wages in the manufacturing sector. In Germany, Austria and the Netherlands this effect was driven by capital accumulation, whereas in the two central and eastern European countries (the Czech Republic and Poland) catch-up output growth explains the result. Since the crisis, the overall change has been fairly low, with less significant sectoral differences. The service sector does not seem to be particularly affected by important changes in the relative ACE in either period, except in Italy and Poland.

The section concludes with an assessment of the performance of our measure of equilibrium wage and wage gap in explaining changes in the sectoral composition of value added. We find that while there is no large difference between our equilibrium wage and the wage gap – that is, the deviation from the equilibrium – both these indicators have better explanatory power and are, in general, more significant in explaining the recomposition of output across sectors. This confirms that wage gaps are a better measure of competitiveness than the traditional real exchange rate measures.

## 3. Determinants of competitiveness

In this section we provide empirical evidence, using econometric exercises, on the determinants of competitiveness at sectoral level. Because our theoretical definition of equilibrium wages (equation 9) links competitiveness to capital intensity, capital productivity and relative price effects, we inquire into the determinants of these factors. In a first step, we focus on the capital–labour ratio and use a production function approach to derive an empirical specification relating capital accumulation to the dynamics of relative factor prices and to factor biased technical change. The latter is a measure of how capital intensity has changed due to technological factors (the bias in technical change) and to exogenous movements in factor prices. In a second step, we use the measure of bias in technical change as a determinant of equilibrium wages, together with relative price effects. In both steps we introduce as additional explanatory variables two proxies for the globalisation process that have characterised both advanced and developing countries since the start of the 1990s: import outsourcing and export intensity. We test whether these factors explain the specific changes that have occurred in the different countries under our analysis. We find that in general

— a rise in equilibrium wages can be the consequence of actual wage increases, provided they are not inflationary and cause interest rate increases;
– a fall in the equilibrium wage may be caused by economic uncertainty and higher risk premiums in the interest rate;
– a rise in the equilibrium wage may be the consequence of capital-biased technological change;
– to the degree that outsourcing of low-skilled labour increases capital-biased technological change and the capital share (see below), outsourcing increases equilibrium wages and incentives for ‘keeping jobs at home’ may lower the equilibrium wage and competitiveness.

The importance of the bias in technical change is shown in Table 14. In Germany 75 per cent of all manufacturing sectors have shifted to more labour-saving technology, while in France only 25 per cent and in Spain even less. By contrast, in the service sector, the distribution is close to 50:50 in all countries.

Our estimates confirm recent findings in the literature on outsourcing lowering the K/L ratio, but they also indicate that the manufacturing and service sectors behave differently in all countries. We also find that the impact of inward outsourcing

– that is, of buying intermediary inputs abroad rather than producing them locally – is negative and significant in Germany and the Netherlands. While this effect would imply a reduction in equilibrium wages (see formula 9), the total effect of outsourcing on equilibrium wages depends nevertheless on its impact on capital productivity (see section 3.3).

We then check how the bias in technical change, relative price effects, inward outsourcing and export intensity affect competitiveness. The results are shown in Table 12 for manufacturing and in Table 13 for services, where a positive impact coefficient means a deterioration of competitiveness. The main results can be summarised as follow:

— in manufacturing, the common result is, not surprisingly, that above average inflation is bad for competitiveness. The only exception is Austria;
— the inward outsourcing variable is negative and significant in Germany, France and Austria, leading to higher competitiveness, whereas it is positive in Spain, causing competitiveness losses;
— the export intensity coefficient is positive and significant in all countries except Spain (where it is negative), while it is insignificant in Belgium and Finland;
— the bias in technical change has a differentiated effect: in Germany, Spain, Austria and the Netherlands, it is positive, lowering competitiveness; in Italy, Finland and France the coefficient is negative, increasing competitiveness;
— in the service sector (Table 13) the evidence is much weaker and we do not find significant associations between variables, mainly because of the heterogeneity of service activities and the lower effect of the two globalisation variables.

Our results indicate that the bias in technical change, outsourcing and export intensity exerts a strong impact on wage competitiveness and that these effects are concentrated in the manufacturing sector. We also find an interesting explanation for the German case:

— the outsourcing process has improved the country's competitiveness because the negative effect on capital intensity is more than compensated by the positive effect on capital productivity;
— on the other hand, the increased export intensity has lowered competitiveness because it has reduced both capital intensity and capital productivity.
— the actual changes in these two variables suggest that the net effect is positive, meaning an improvement in competitiveness.

## 4. Policy-relevant conclusions

Our measure for equilibrium wages and competitiveness defines conditions under which wage increases are compatible with competitiveness.

With regard to balanced growth in the European Union, it might be justifiable to accept competitive wage *undervaluations* in catch-up regions with low per capita income, but this cannot be a sustainable strategy for more advanced countries. In

fact, it would be reasonable to have wage levels slightly above equilibrium in rich countries and below it in poor countries.

Left to market forces – that is, relying on Philips-curve dynamics without deliberate wage policies – a correction of disequilibria is slow; a deliberate one-off wage increase would generate a significant demand boom in all member states. An increase of 20 per cent in all those countries in which actual wages are more than 20 per cent below equilibrium would yield a demand stimulus of 1.9 per cent for the EU (2.1 per cent for the euro area) in terms of GDP and 17.6 per cent in terms of intra-EU trade.

Trade unions seek higher wages for workers. Because the margins for wage increases depend on the development of equilibrium wages, capital productivity, technological change and the transformation of an economy's supply side, the process of wage bargaining must include these factors.

Consequently, wage setting rules become more complex than the *Rehn-Meidner* rule, whereby nominal wages ought to increase at the rate that is the sum of labour productivity growth and inflation.

In decentralised regimes, in which wage increases reflect marginal labour productivity, the gap between actual and equilibrium wages can be expected to be minimal. By contrast, with centralised wage setting, where actual wage levels reflect *average* productivity levels – for example, in Scandinavia (see Table 5) – highly productive sectors will gain competitiveness at the margin, therefore attracting investment, which might further improve productivity. By contrast, decentralised wage bargaining, as in Anglo-Saxon countries, can sustain competitiveness by wage flexibility, but this will slow down productivity improvements and technological progress.

The average efficiency of capital, which is a crucial variable in explaining competitiveness, depends not only on technological factors, but also on the relative prices of capital inputs and output relative to the euro area. In order to minimise distortions, economic and monetary policy ought to focus not only on the stability of average consumer prices, but also on regional and sectoral GDP deflators and capital goods prices.

What matters most in the long run, however, is the development of capital productivity. The long-run factors determining sectoral and regional capital and labour productivity are complex and require further research. We found that

— equilibrium wages in euro-area member states depend crucially on changes in the capital–labour ratio, which is dependent on the importance of relative factor prices (the cost of labour relative to the cost of capital) and technical change biases;
— actual performance in different countries varies partly because different sectors respond differently to changes in technological change: while technological progress has a tendency to affect manufacturing and services in similar ways, outsourcing and exports do not have the same effect;

— wage bargaining in different sectors has to be careful to take into account the effects that technology and the related reorganisation of labour relations will have on the productivity of capital and labour.

This analysis is of great importance for designing a balanced growth strategy for Europe. There is no simple rule of thumb, although better knowledge would help in negotiating wage deals that generate sustainable wage increases. When nominal wage setting affects productivity and production functions, wage restraint can be as detrimental as wage exuberance. A sustainable approach would require a coherent economic policy approach that removes inhibitions to technological progress and focuses on supporting the growth of productivity in labour and capital.

The European Commission has suggested that national governments set up **'National Competitiveness Boards'.** However, uncoordinated national boards will not take into account relative competitive positions, which depend on the average performance of the euro area. It would be a better idea to set up a **European Competitiveness Board**, possibly in the European Economic and Social Committee (EESC), where the national social partners are already represented.

# Introduction

Lack of international competitiveness has emerged as a prominent explanation of the high current account deficits and rising private and public indebtedness that are at the root of the euro crisis.[1] The southern euro-area member states are thought to have overspent before the crisis and now lack competitiveness, while the northern member states implemented structural reforms and restrained wage increases. Hence, large economic imbalances have accumulated and wages are a crucial variable for overcoming the economic crisis which has paralysed the European economy for over seven years.

However, the role of wages is ambivalent. On one hand, they are an important component of production costs and therefore affect profitability and competitiveness. On the other hand, wages are spent on consumption and therefore affect effective demand. Both dimensions contribute to the volume of employment and general welfare. A priori it is not clear which aspect dominates.

Moreover, it is impossible to say whether wages are competitive without comparing the overall productive capacities of an economy. This puts wage determination in the context of economic growth theory. If wages are an important part of production costs, they must be related to the production process, technological progress and productivity developments. Thus, the accumulation of capital, skills and knowledge, innovation, R&D and the broad conditions of the legal and political environment will play an important role in determining the right level of wages. In other words,

**1.** See European Commission (2014); Chen *et al.* (2013); CESifo (2013); Sinn (2013); European Commission (2010), Guerrieri and Esposito (2012); Flassbeck and Spiecker (2010). For a critique see Collignon (2014).

competitiveness is not just explained by wage bargaining, but also, and maybe even more importantly, by the factors contributing to capital accumulation.

This insight opens up new perspectives for determining wage strategies in the euro area. We will develop a method for measuring the equilibrium wage levels for member states and their economic sectors in the euro area. Our equilibrium wage is not a market clearing wage, as in models of the 'natural rate of unemployment' or the NAIRU, but the wage level at which all sectors in the euro area would be on a balanced growth path.

We define 'competitiveness' as the relation of actual wages to equilibrium. When a country or economic sector operates with wages higher than the equilibrium level, we say it is overvalued and suffering from competitive disadvantages; by contrast, when wages are lower than equilibrium, the sector has a competitive advantage. Because the equilibrium wage is determined by productive capacities in a broad sense, our concept of competitiveness includes elements of non-price competitiveness.[2] Hence, the policy implications of our approach go beyond structural reforms that reduce nominal and real rigidities. Our methodology allows us also to take a fully integrated European approach rather than falling into the trap of rigid and dysfunctional national labour market discussions.

Two opposing wage strategies have been suggested in order to overcome the euro crisis. Mainstream orthodoxy, as defended by the European Commission, has argued that because the exchange rate is no longer an adjustment tool in the euro area, nominal wages must be reduced in order to restore competitiveness. Austerity policies are meant to accomplish this task.[3] However, if the equilibrium wage rises, wage reductions are not necessary to restore competitiveness. In this case, austerity may actually prevent improvements in competitiveness because it not only adjusts domestic costs and prices relative to foreign competitors, but also depresses demand in the non-tradable sector, with negative effects for investment and productivity. Greece is a salient example of this.

Alternatively, some heterodox papers have recently suggested a strategy of wage-led growth to overcome the effects of austerity in Europe. They have observed a significant correlation between the reduction in the wage share and low economic growth and conclude that, inversely, higher wages would increase growth and employment (Stockhammer 2015; Onaran and Obst 2015). However, we will show that when the productivity of the local capital stock remains behind the euro area benchmark, this reduction in local wage shares is necessary to maintain equilibrium. In a context in which wages are already above the equilibrium, wage-led growth

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**2.** 'The differences in export performance of some Member States over the decade preceding the crisis are in fact difficult to explain solely on the basis of measurable price and cost considerations. Non-price competitiveness is difficult to assess as it depends on a range of factors such as product quality or technological content, after-sale services or distribution services and cannot be captured in a single indicator. However, structural factors such as sectoral or technological specialization played a role in the observed divergence of Member States' export dynamics' (European Commission 2010: 9).

**3.** 'Large losses in competitiveness combined with persistent accumulation of large current account deficits cannot be sustained forever and can be reversed only at the cost of protracted periods of painful adjustment' (European Commission 2010: 1).

strategies would be counterproductive, but they may be appropriate when wages are significantly below equilibrium.

Hence, in order to judge correctly the role of wages in a strategy to overcome the euro crisis, it is necessary to assess cost competitiveness in Europe by determining equilibrium wages. This is the purpose of this paper.

## The shortcomings of unit labour cost approaches to measuring competitiveness

There are many ways to measure competitiveness. International institutions frequently use real effective exchange rates or indices for unit labour costs (ULC).[4] However, all indices suffer from the assumption of an arbitrary base year at which all countries start from supposedly equal conditions. This approach ignores that substantial disequilibria may prevail at the moment when the index starts, so that the future evolution might reflect the adjustment of levels toward the equilibrium.

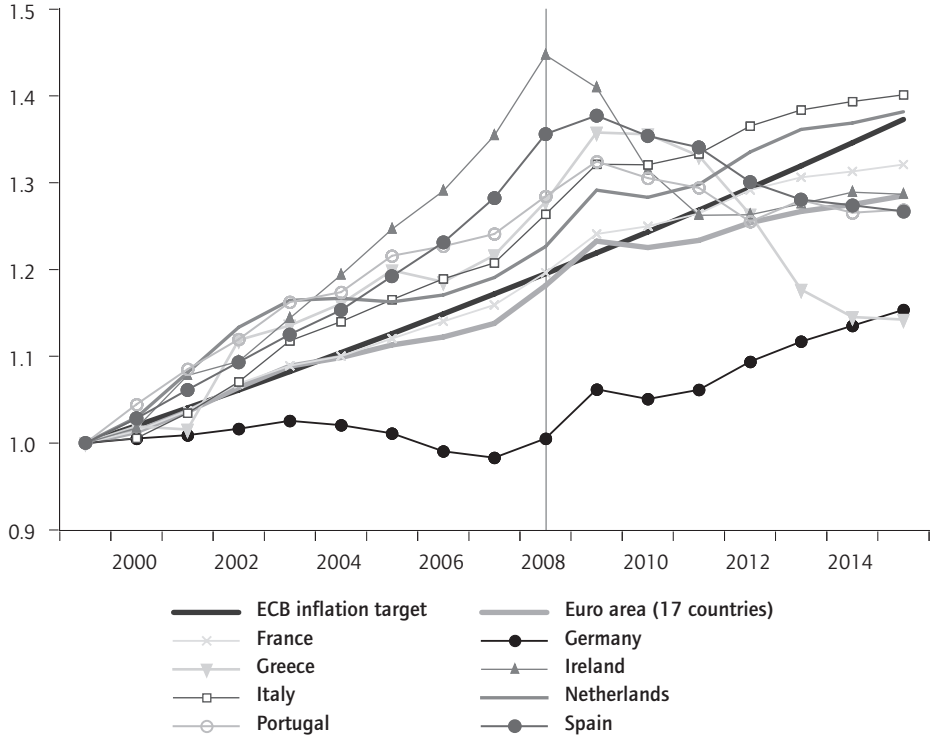
A typical example of the fallacious use of indices is provided by Figure 1, which shows the index of unit labour costs for some selected euro area member states, with 1999 as base year (the year when monetary union started). The thick red straight line represents the 2 per cent price stability target of the ECB and the blue curve the average performance of the euro area. There is a clear divergence in unit labour costs between northern and southern member states. While the average performance was close to the ECB target, unit labour costs have stagnated in Germany and exceeded the ECB target in the crisis economies. But how do we know whether Germany was not just correcting previous overvaluations, or whether the south has been catching up with euro-standards? A proper assessment must have an equilibrium condition against which one can evaluate actual performances.

An index shows *cumulative changes*; it says nothing about the *level* of relative costs and whether they reflect an equilibrium or disequilibrium in the arbitrarily chosen base year. In order to circumvent the arbitrary base year problem, some economists have divided the unit labour costs index by a long-run average of 40 decades (see Wyplosz 2013). While this approach dampens the distortions, it remains an ad hoc and a-theoretical assumption. The proper approach would be an index that shows the *absolute levels* of relative wage cost competitiveness.

One way to solve this problem is to derive the equilibrium from the assumption that in perfect markets the return on capital in a given country ought to be equal to the return of competitors, or, more generally, that the specific return on capital of a sector or country is equal to the average return for the euro area as a whole (see Collignon and Esposito 2014). This is, of course, only a theoretical benchmark and not a description of facts, but it allows measuring the handicap of attracting

**4.** The usual measures are indices for real exchange rates, based on relative prices of commodities and export baskets converted by given exchange rates. See: Eurostat (http://ec.europa.eu/eurostat/en/web/products-datasets/-/TSDEC330), OECD (http://stats.oecd.org/Index.aspx?querytype=view&queryname=168) and IMF https://www.imf.org/external/pubs/ft/fandd/2007/09/pdf/basics.pdf).

Figure 1 **Unit labour costs index since 1999**




investment to particular sectors or countries. With free flow in the European market, capital ought to be invested where it yields the highest return, while diminishing returns will erase this advantage over time.

We have developed this method in previous work for calculating equilibrium unit labour costs in the euro area, using Eurostat and Ameco data before 2015 (Collignon 2013); Collignon and Esposito 2014). The methodology showed differences in unit labour cost *levels*, although our calculation of nominal equilibrium unit labour costs was still dependent on the price index. However, with the shift of the base year of the GDP deflator to 2010, we found that some important inconsistencies in time series have emerged.

Nevertheless, these difficulties can be circumvented when we reformulate the equilibrium concept for the *nominal wage level* and not for nominal unit labour costs. This is what we present in this report. It will explain the new concept and show how wage competitiveness depends on nominal wages and on the intricate dynamics of equilibrium wages. Our new formulation incorporates also a measure for *real* equilibrium unit labour costs.

The debate on wage competitiveness usually focuses on aggregate data for member states of the European Union. However, aggregate indices have been criticised from several angles. Felipe and Kumar (2011) have summarised the critique as follows:

> 'Current discussions about the need to reduce unit labor costs (especially through a significant reduction in nominal wages) in some countries of the eurozone (in particular, Greece, Ireland, Italy, Portugal, and Spain) to exit the crisis may not be a panacea. First, historically, there is no relationship between the growth of unit labor costs and the growth of output. This is a well-established empirical result, known in the literature as Kaldor's paradox.[5] Second, construction of unit labor costs using aggregate data (standard practice) is potentially misleading. Unit labor costs calculated with aggregate data are not just a weighted average of the firms' unit labor costs. Third, aggregate unit labor costs reflect the distribution of income between wages and profits. This has implications for aggregate demand that have been neglected.'

In this report we go beyond the determination of aggregate unit labour costs and shall calculate nominal equilibrium wages and a competitiveness index representing the ratio of actual to equilibrium labour compensation for 30 sectors in the major EU member states for which data are available. We will calculate two benchmark measures: equal return on capital with regard to the euro area and equal return on capital with regard to the European average of a specific sector.

In section 1, we explain the methodology behind our concept of equilibrium wages and present evidence for aggregate data. In section 2 we present sectoral data and our calculated equilibrium wage levels. Section 3 discusses factors for change in sectoral competitiveness and shows some econometric evidence on the determinants of our competitiveness measure. Section 4 concludes, drawing some policy conclusions.

**5.** See Kaldor (1978).

# 1. Calculating equilibrium wages

## 1.1 Theory

We define the equilibrium wage as the level of total labour compensation, at which the average return on the capital stock in a given economy or in a given sector is equal to the average return in the euro area as a whole. The return on capital (RoC) is the ratio of non-wage value added relative to the historical value of the aggregate capital stock of a country or sector. Hence, it is the return on the capital stock before taxes. It can be described as the product of the capital share (which is the complement to the wage share $\sigma_k=1-\sigma_w$) and the average efficiency of capital. The average capital efficiency (ACE) is measured in nominal terms, which means it is determined by a relative price effect, defined as the ratio of the GDP deflator $P$ to the price deflator for capital goods $P_k$, and by capital productivity in the narrow sense as output to capital at constant prices. The inverse of ACE is the capital–output ratio (COR).

(1) $$RoC=\frac{Py-wL}{Py}\frac{Py}{P_kK}=\sigma_k ACE=(1-\sigma_w)ACE$$

(1a) $$ACE=\frac{Py}{P_kK}=\frac{1}{COR}$$

We also define nominal labour productivity as nominal output per person employed:

(1b) $$\lambda=\frac{Py}{L}$$

where $Py$ is GDP or sectoral value added at current prices and $P_kK$ is the value of the accumulated capital stock at historical cost; $w$ stands for the labour remuneration per worker (the 'wage') and $L$ is the number of people employed.

We can then set the equilibrium condition as:

(2) $\mathrm{RoC}_{xi} = \mathrm{RoC}_{€}$

(3) $(1-\sigma_{wx})ACE_x = (1-\sigma_{w€})ACE_€$

where $\mathrm{RoC}_{xi}$ is the return on capital in country $x$ for sector $i$, calculated as the non-wage share of GDP or sectoral value added relative to the nominal value of the aggregate capital stock (ACE) and $\sigma_{wx}$ is the wage share of country $x$. We assume that the average wage share in Europe is an exogenous variable, which is true at least for small countries, and that it changes over time.

The equilibrium wage share of a country or sector is then:

(4) $\sigma_w^* = 1 - (1-\sigma_{w€})\frac{ACE_€}{ACE_x} = 1 - \sigma_{k€}\frac{COR_x}{COR_€}$

The wage share is identical to real unit labour costs,[1] so that equation (4) also represents a country's equilibrium real unit labour costs. Thus, if a country's capital productivity is higher than the average European capital productivity, so that $\frac{ACE_€}{ACE_x} < 1$, its equilibrium wage share (and therefore its real unit labour costs) will be above that of the euro area. This is the same as saying that a larger share of value added can be used to remunerate labour because capital is more productive. We will see that this is consistent with skill-biased technical change, for the use of more productive capital equipment often requires more highly skilled operators, who will be paid higher wages. On the other hand, if in some countries the labour share has fallen over time, it may simply reflect lower capital productivity. Assuming equilibrium as a starting position, voluntarist increase in wages, as suggested by wage-led growth theorists, would only generate deviations from equilibrium and harm competitiveness.

Because the nominal wage $w$ is identical to the product of nominal labour productivity $\lambda = \frac{Py}{L}$ times the wage share $\sigma_w = \frac{wL}{Py}$, the country-specific nominal equilibrium wage level is:

Equilibrium wage = labour productivity $\lambda$ x equilibrium wage share ($\sigma_w^*$):

(5) $w^* = \lambda\sigma_w^* = \lambda - \lambda\,(1-\sigma_{w€})\frac{ACE_€}{ACE_x} = \lambda\left(1-\sigma_{k€}\frac{COR_x}{COR_€}\right)$

It is clear that the equilibrium wage so defined is a function of the average wage share in the euro area, national or sector-specific labour productivity and the relative development of nominal capital productivity, that is, relative prices of goods and capital and the national (or sectoral) capital–output ratio relative to that of the

1. Unit labour costs are defined as wage costs per unit of output: $ULC = \frac{wL}{Py} = \frac{w}{\lambda}$. Hence real unit labour costs are $RULC = \frac{ULC}{P} = \frac{wL}{Py} = \sigma_w$

euro area. The productivity of labour and capital are related through the production function, as we shall discuss below.

To measure competitiveness, we will match actual labour compensation against the equilibrium wage. If actual wages are higher than the equilibrium wage, the return on capital in a particular country or industry will be lower than the euro-average. We interpret this as a competitive disadvantage, for lower profitability is likely to deter investment until the return on capital is improved, while highly competitive sectors and countries would attract capital and boost economic growth until over-accumulation reduces the return. Hence, wage cost competitiveness depends on actual wages as they emerge from wage negotiations and on structural factors that shift the equilibrium wage. It also depends on the average wage share of the euro area; in other words, on how aggregate wages develop relative to inflation and productivity in the euro area as a whole. If a particular region or industry deviates from the average performance, it will gain or lose competitiveness. This means that if wage increases are slowing down in the euro area as a whole, all countries will have to follow suit if they wish to remain competitive. This is one reason why Germany as the largest economy is a trend setter for the whole of the euro area.

Our concept of equilibrium wage is important as it defines the limits for wage increases that are consistent for stimulating demand and pursuing a wage-led growth strategy. The famous *Rehn-Meidner rule* recommended that nominal wages ought to increase at the rate of productivity plus inflation, so that the wage share remains constant. In the euro area that has been amended to say that wage increases should take into account labour productivity and the inflation target of the ECB (see Koll 2005; European Commission 2005). However, this rule ignores the impact of capital productivity on equilibrium wages. Balanced growth would require that nominal wages be equal to equilibrium wages and then vary with changes in national or sectoral equilibrium wages.

As equation (5) shows, the effect of capital productivity on equilibrium wages is far from trivial. Even if all countries had exactly the same rate of nominal wage increases in line with the Rehn-Meidner rule, their competitiveness could still be distorted by diverging capital productivity developments. Such divergence may be a consequence of broad country-specific factors, such as infrastructure, R&D, skill building and so on, but it may also reflect different weights of economic sectors with diverse capital–output ratios. For example, it is well-known that productivity is more likely to improve in manufacturing than in most service industries, so that an industrial hub such as Germany is prone to reap larger competitive advantages than service-intensive economies. For this reason it is important not only to analyse aggregate, but also sectoral equilibrium wages.

From (5) we know that the equilibrium wage will increase when labour and capital productivity rise. Higher capital productivity implies that the capital–output ratio in a given country or sector will fall faster than in the euro area as a whole. However, we have seen above that higher capital productivity generates more output, which can be used to remunerate workers. If nominal wages do not increase in line with the higher efficiency of the aggregated capital stock, actual wages will fall below the

equilibrium wage level and the country's return on capital will rise above the euro average.

This raises the question of how capital accumulation and capital efficiency affect labour productivity. Labour productivity can be expressed as the product of capital productivity and capital intensity. Thus, in order to understand what the determinants of competitiveness changes are, we need to investigate the reasons underlying changes in capital productivity and in the relative use of capital and labour in domestic production.

Assuming that the average wage share in Europe is an exogenous variable, the equilibrium wage depends on nominal labour productivity λ and on the relative average capital efficiency (ACE). As mentioned above, the relative ACE can be decomposed into the relative price effect caused by the deflators for GDP and capital equipment and relative capital productivity. We speak of capital efficiency when we refer to nominal values, which include the price effect, and we call capital productivity the ratio of output per unit of capital when prices are assumed to be constant. The decomposition assumes the following form:

$$(6) \qquad \frac{ACE_{€}}{ACE_{x}} = \frac{P_{€}}{P_{x}} \frac{P_{kx}}{P_{k€}} \frac{Y_{€}}{K_{€}} \frac{K_{x}}{Y_{x}} = Peff \cdot Kprod_{€} \cdot \frac{K_{x}}{Y_{x}}$$

where $Peff = \frac{P_{€}}{P_{x}} \frac{P_{kx}}{P_{k€}}$ is the combined effect of the relative GDP and capital stock's deflators. By expressing nominal labour productivity as:

$$(7) \qquad \lambda = P_{x} \frac{Y_{x}}{K_{x}} \frac{K_{x}}{L_{x}} = ACE \frac{\mathrm{P}_{k}K}{L}$$

we see that nominal labour productivity is related to the average capital efficiency (ACE) by the nominal factor intensity $\frac{\mathrm{P}_{k}K}{L}$ and we obtain a definition of equilibrium wages depending on capital productivity and the capital–labour ratio (also called capital intensity):

$$(8) \qquad w^{*} = P_{x} \frac{K_{x}}{L_{x}} \left[ \frac{Y_{x}}{K_{x}} - \psi_{€} Peff \right] \qquad \text{where } \psi_{€} = (1 - \sigma_{w€})\ Kprod_{€}$$

Thus the equilibrium real wage is:

$$(9) \qquad \frac{w^{*}}{P_{x}} = \frac{K_{x}}{L_{x}} \left[ \frac{Y_{x}}{K_{x}} - \psi_{€} Peff \right]$$

Assuming for the moment constancy in prices, average euro capital productivity and the euro wage share, **the (real) equilibrium wage will depend positively on the capital–labour ratio and on the country's capital productivity**. If the capital productivity increases, an increase in the capital intensity of production (higher capital/labour ratios, due, say, to automisation) will amplify the competitiveness effect.

As shown in equation (7), with no change in factor intensities and constant prices, the two productivities are proportional and must grow at the same rate as total factor productivity (TFP). This is a special case in which the Rehn-Meidner rule for wage bargaining is valid, because capital productivity does not distort competitiveness. However, in general and ceteris paribus, the equilibrium real wage will increase if the capital intensity (K/L) increases more than the capital productivity (K/Y). This situation is often describes as Harrod-neutral technological progress or labour-saving technical change.

However, factor intensities are rarely constant. The recent literature has explained these changes by shifts in relative factor prices and by factor-biased technical change or by the development of global production networks. As shown by (Timmer *et al.* 2014), since the mid-1990s global value chains have increased at a rapid pace, causing a change in international specialisation in terms of factor intensity. The authors used the World Input-Output database and matched it with the evolution of domestic capital and labour, with the latter further divided into low, medium and high skilled labour, in order to understand which factors have been favoured by the dis-integration of production to different countries. They find that the international division of production increased the use of capital and skilled labour and that this effect is common to all countries, not only to those abundant capital and skills. On the other hand, low and medium skilled labour have lost relative importance in production. The explanations for these findings point to the role of skill biased technical change (Acemoglu 2002; Autor *et al.* 2003) as a pervasive technological change in both advanced and catching-up economies. Within this framework, the increase in the capital share can be explained by assuming capital–skill complementarity, meaning that skill-biased technological change is associated with capital-biased technological change.

In the European context, an additional explanation is provided by the emergence of central and eastern European countries as main partner for the delocalisation of some stages of production. Given their inherited industrial structure and the skill composition of the workforce, the delocalisation of heavy industries and capital-intensive stages of production has been more convenient for the countries in western Europe. The increase in the share of capital may also reflect the importance of financial capital as a means to reduce transaction costs and favour the development of outsourcing.

These changes at regional and global level have affected all countries, but Germany has benefitted relatively more from these developments due, on one hand, to the geographical proximity of the most advanced central and eastern European countries and, on the other hand, to the specialisation of the country in medium-high tech industries – in particular, machinery and automotive – whose production is more easily divided between different countries. A wide literature has investigated the pattern of outsourcing for Germany and the other main EU countries; it has provided evidence that Germany has gained relatively more from outsourcing to central and eastern Europe in terms of productivity and export market shares (see, among others, Marin 2006, Guerrieri and Esposito 2012, Guerrieri and Esposito 2013).

In section 3 we will provide some econometric evidence on the impact of outsourcing and biased technical change on the relative use of capital and labour at sectoral level and on equilibrium wages, but first we shall present empirical evidence for equilibrium wages and our competitiveness index. We start with aggregate country data here and present sectoral data in section 2.

## 1.2 Aggregated empirical evidence

Our aggregated evidence for EU member states is based on Ameco data, the sectoral analysis in the next chapter on Eurostat. Unfortunately, for some countries data are missing, usually capital stock estimates. We distinguish four country groups: northern euro area, southern crisis countries, new member states in the east and outside the euro area in the west.

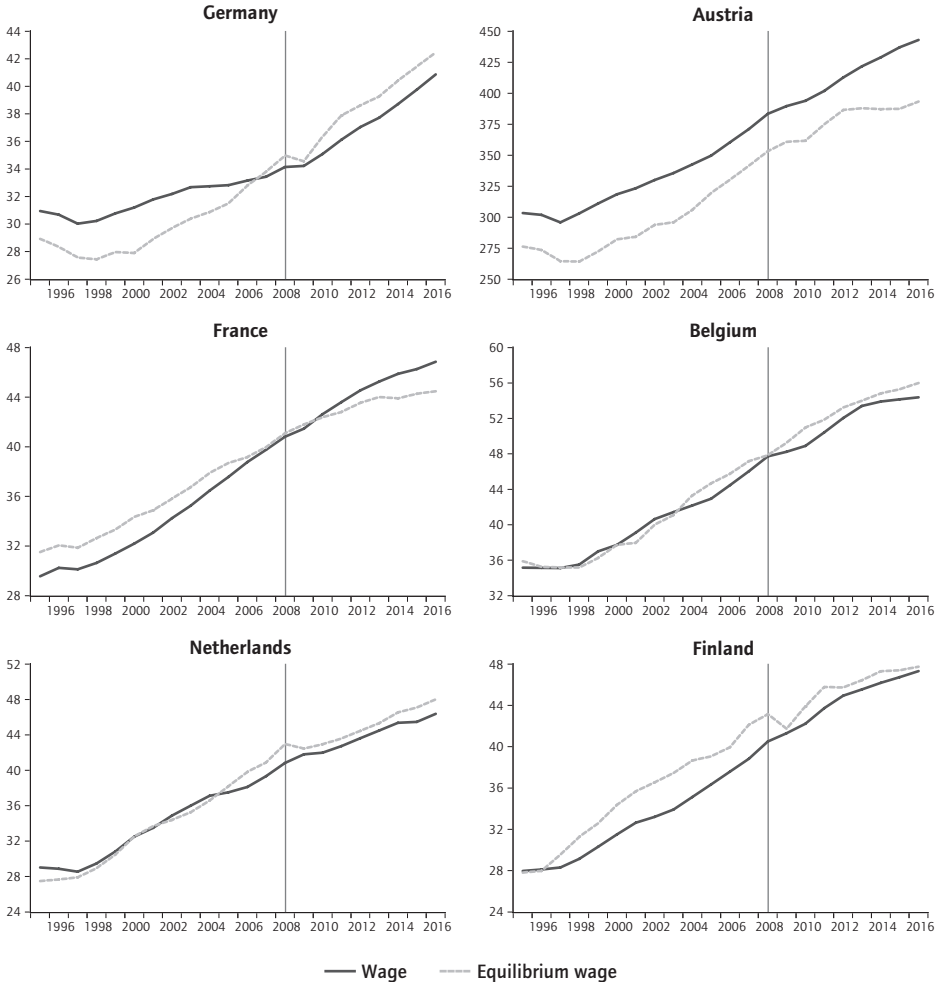
Figure 1 shows the evolution of actual and equilibrium wages in selected EU member states. The gap between the two may be caused by excessive nominal wage settlements or by changes in the equilibrium wage due to variations in capital and labour productivity. The figure shows that the adjustment process varies significantly between countries. In Germany, Spain and the United Kingdom, equilibrium wages have risen faster than actual wages, but in France and Italy the improvement of equilibrium wages has slowed down and nominal wages have outgrown them. Greece had moderately improved its wage competitiveness before the crisis, but since then the equilibrium wage has fallen even more rapidly than nominal wages, largely reflecting the negative developments in capital productivity resulting from insufficient use of productive capacities. Sustained lack of demand due to austerity has caused a slow and gradual reduction of the capital stock and potential output. Hence, insofar as wages are a major factor of aggregate demand, *cutting wages* is not necessarily a strategy that improves competitiveness, while *slowing down wage increases* may do so, under certain conditions.

We can condense this information into a single competitiveness indicator (Comp henceforth) by calculating the ratio of actual to equilibrium wages, as in Figures 3a-3e. The horizontal line indicates a wage level at which the return on the country's capital stock would be equal to the euro area average. A wage gap above 1 implies that wages are too high and the return on capital too low to be attractive within the euro area. A wage gap below 1 indicates a competitive advantage.

Among the Northern countries, Germany has eliminated an important competitive disadvantage in the 2000s that was inherited from unification in the early 1990s and it has now a nominal wage level of approximately 4 per cent below the equilibrium. By contrast, France has gone in the opposite direction. Finland and the Netherlands have lost their competitive advantage but are still below equilibrium; Austria always has a positive wage gap, while Belgium is usually below equilibrium. For crisis countries, competitiveness does not seem to matter: Greece and Spain are always above the equilibrium wage, which could support the view that the crisis was caused by lack of competitiveness, but Ireland and Cyprus are always below and still had a serious crisis. Portugal has improved its wage competitiveness since 2007; Italy

Figure 2a **Actual versus equilibrium wages**

**Northern euro area**

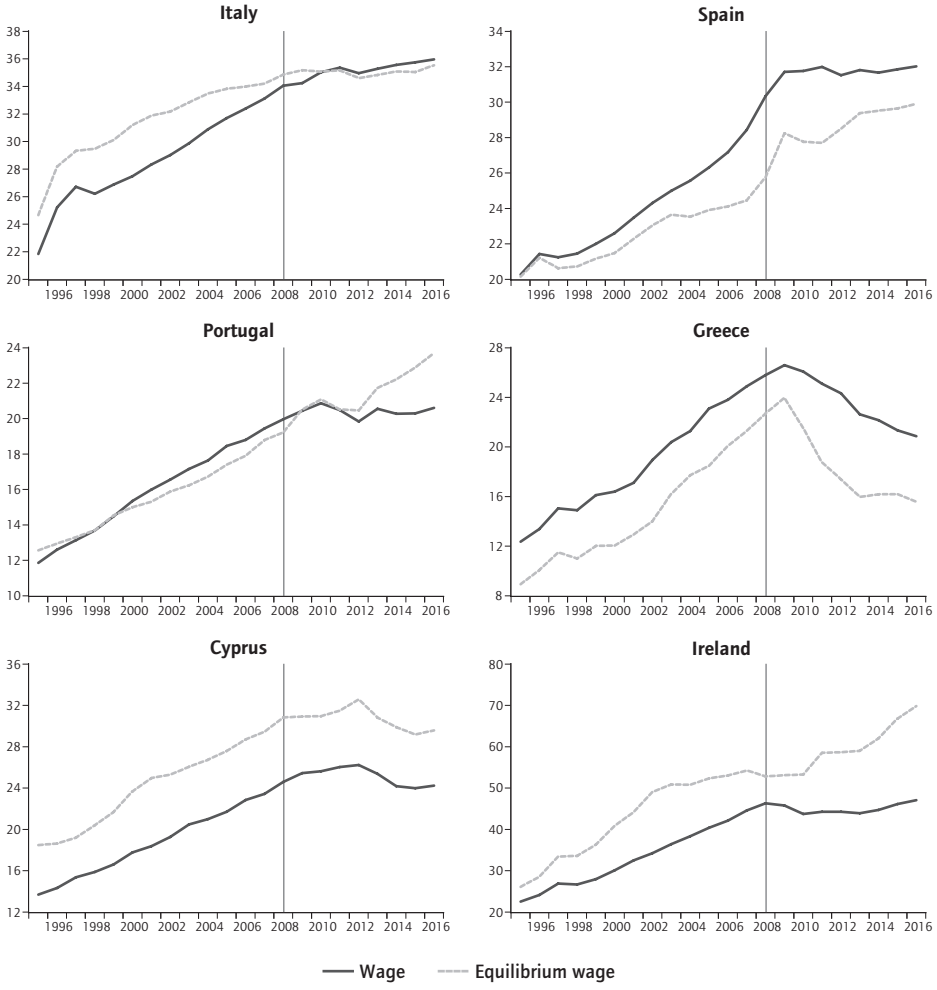



Source: Authors' elaboration on AMECO.

has seen a persistent tendency to lose wage competitiveness since the beginning of monetary union. The most consistent pattern in accordance with standard theory is represented by the low wage levels in the new member states, irrespective of whether they are inside or outside the euro. Among the opt-out countries, Denmark has a stable negative wage gap, Sweden is too costly and the United Kingdom has gained cost advantages since the crisis. Internationally, the euro area is at a disadvantage relative to the United States, but it has a narrowing cost advantage over Japan.

Figure 2b **Actual versus equilibrium wages**

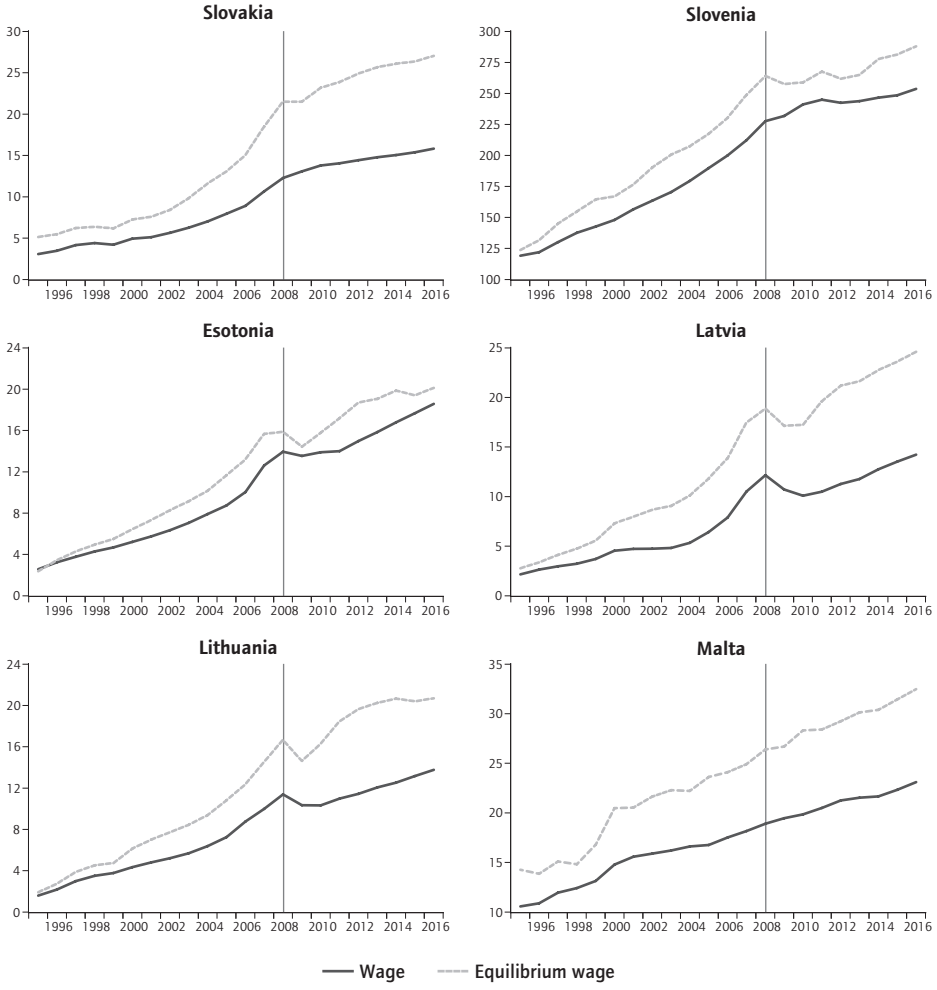
## Southern crisis countries




Source: Authors' elaboration on AMECO.

Figure 2c **Actual versus equilibrium wages**

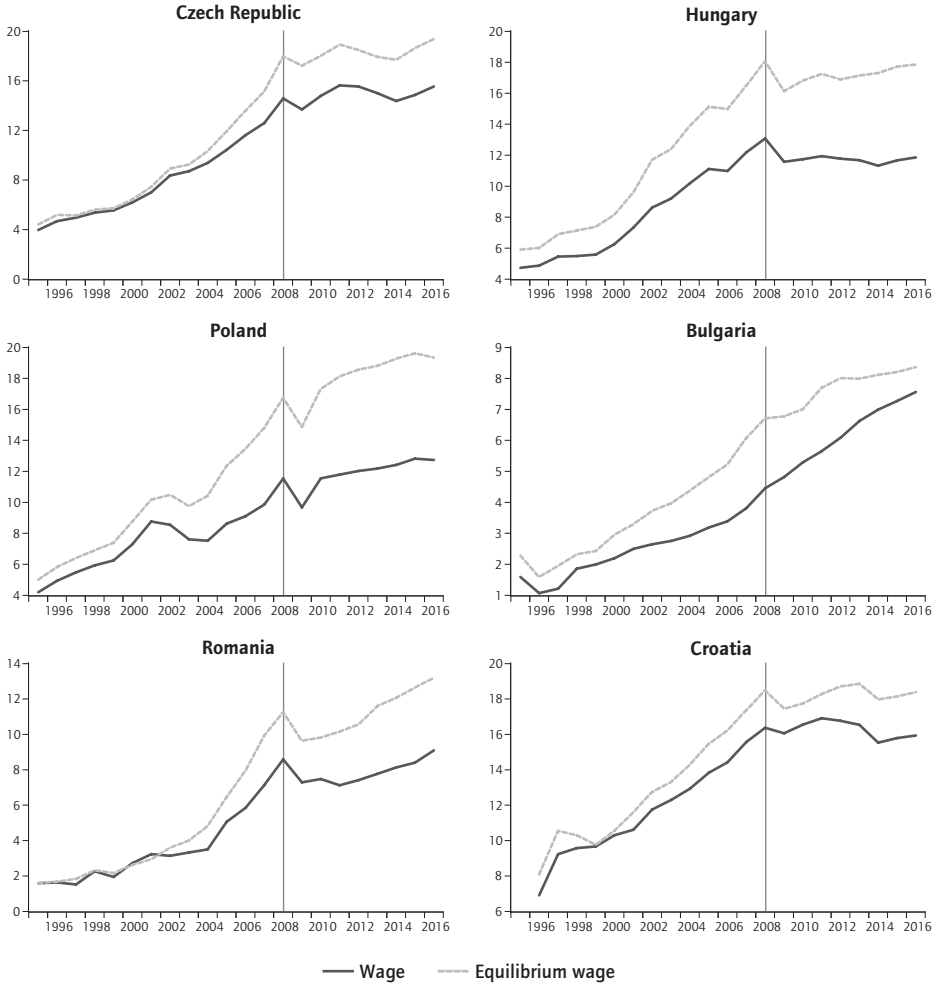
## New member states




Source: Authors' elaboration on AMECO.

Figure 2d **Actual versus equilibrium wages**

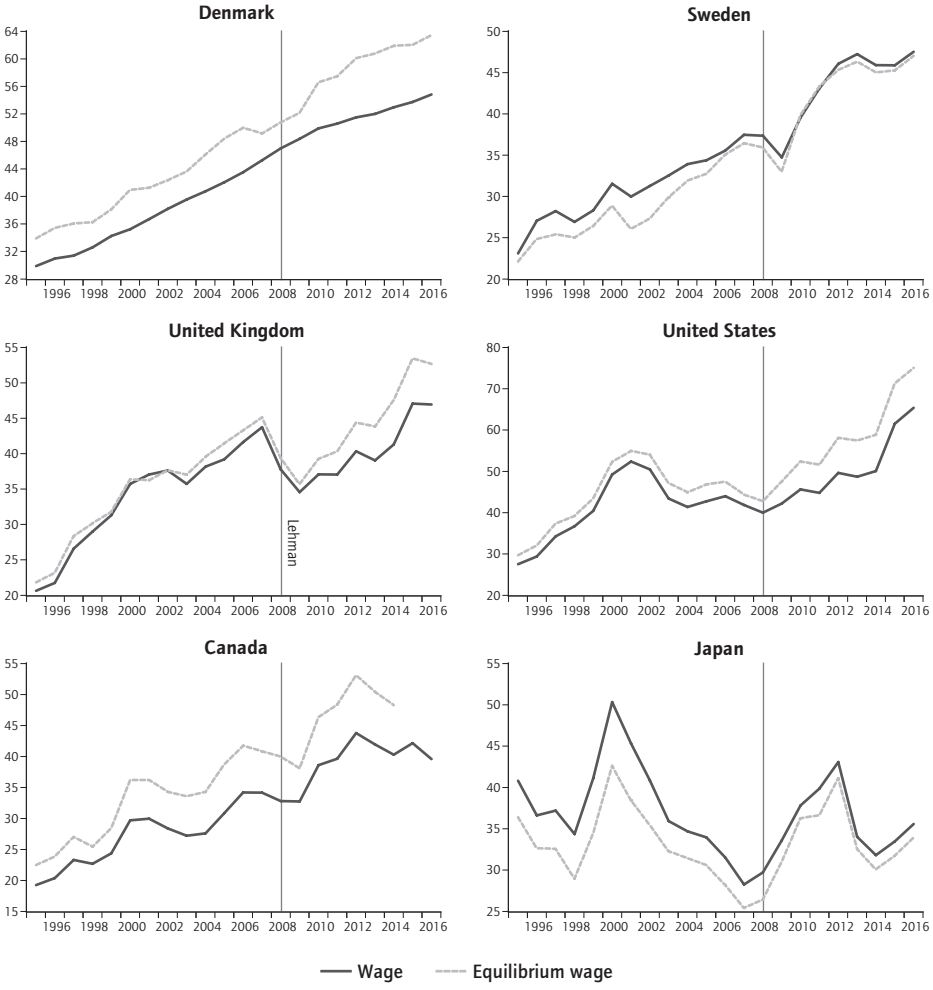
## Central and eastern European countries




Source: Authors' elaboration on AMECO.

Figure 2e **Actual versus equilibrium wages**

## Non-Euro area countries




Source: Authors' elaboration on AMECO.

Figure 3a **Competitiveness index in the old euro area members**

## Northern Euro Area

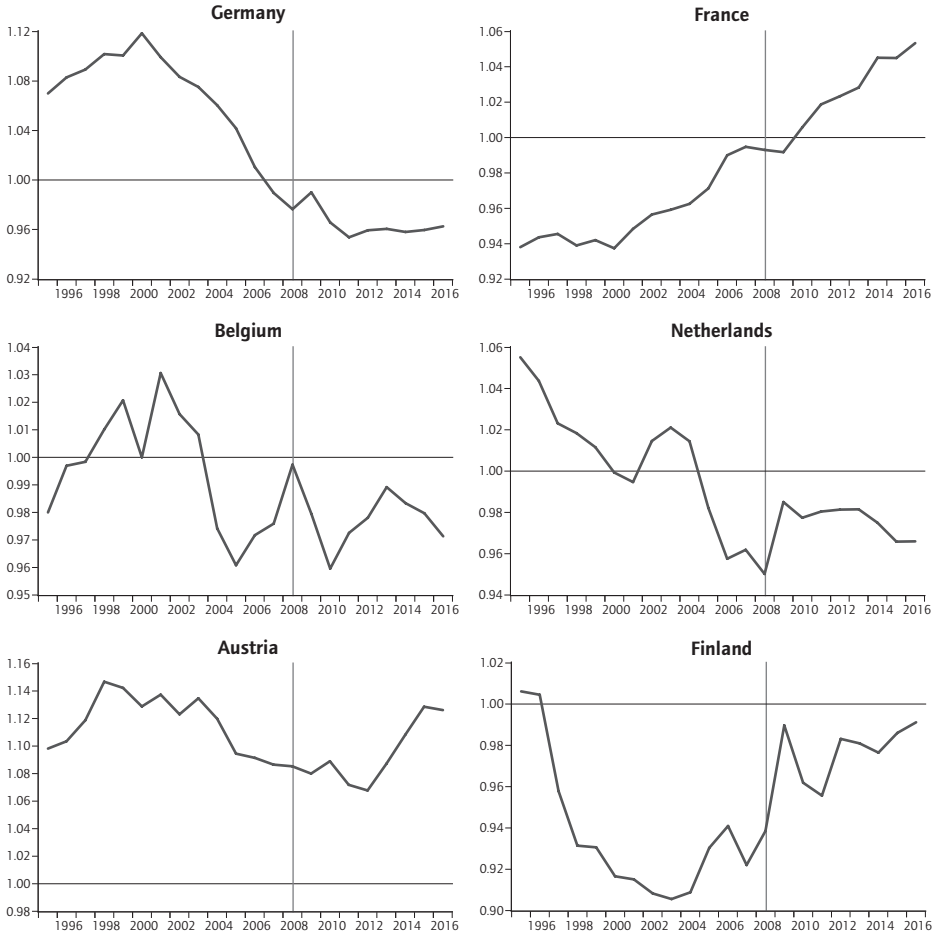


Figure 3b **Competitiveness index in the old euro area members**

## Crisis coutries

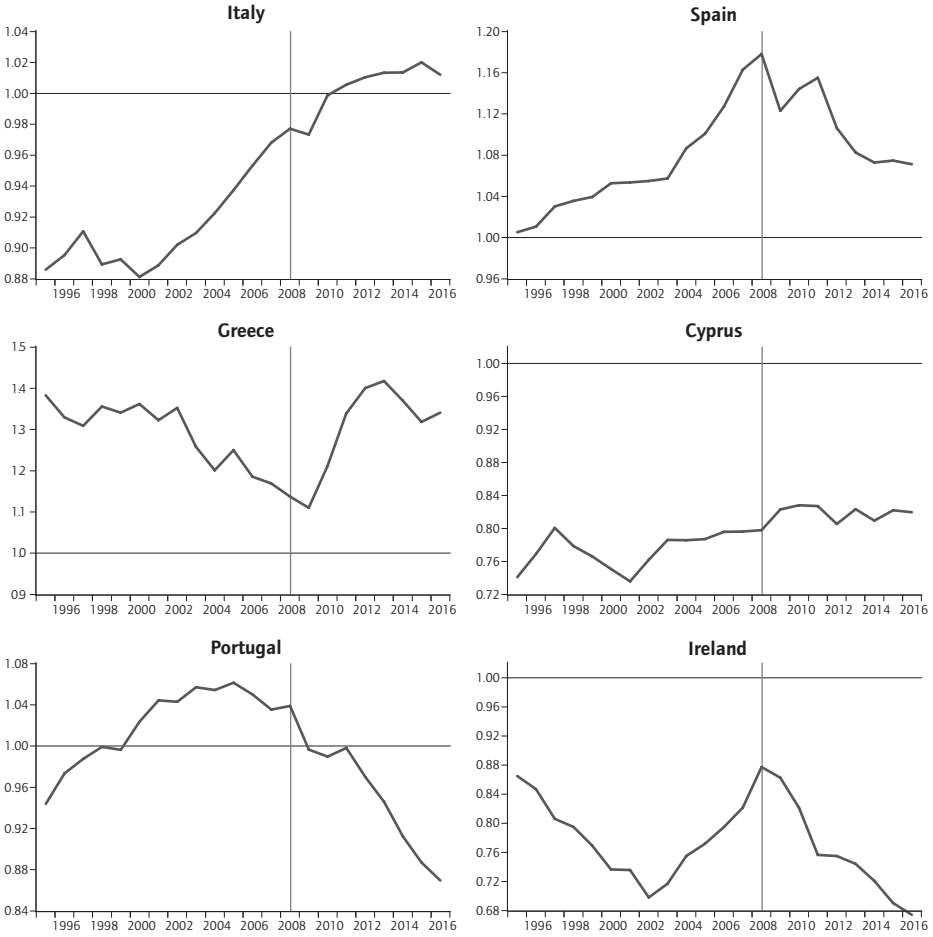


Figure 3c **Competitiveness index in the old euro area members**

## New Member States

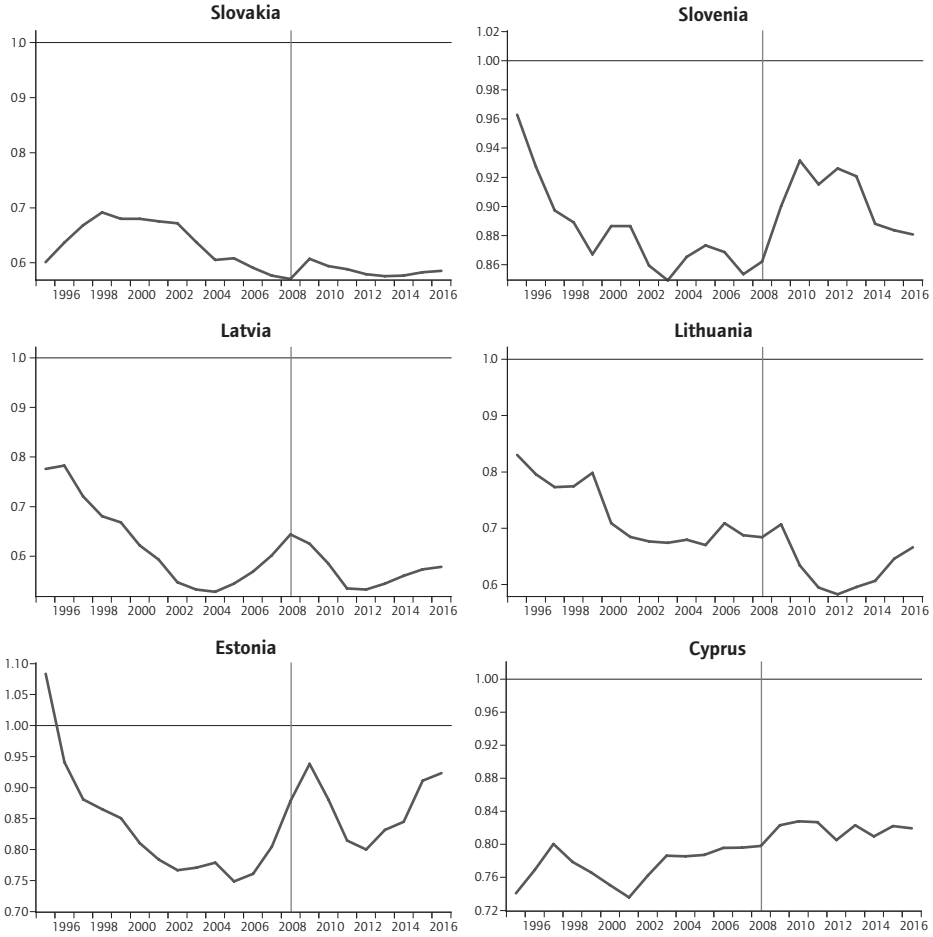


Figure 3d **Competitiveness index (Comp) in the old euro area members**

## Central and Eastern Europe

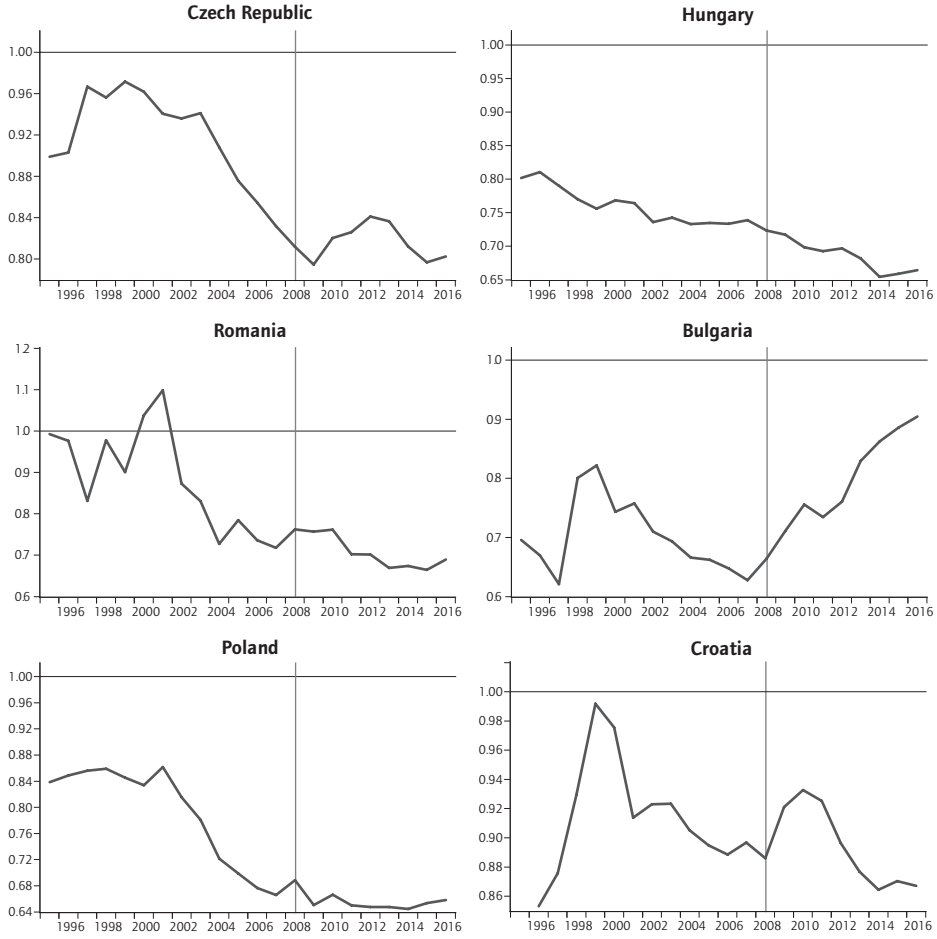


Figure 3e **Competitiveness index (Comp) in the old euro area members**

## Opt out and extra-EU countries

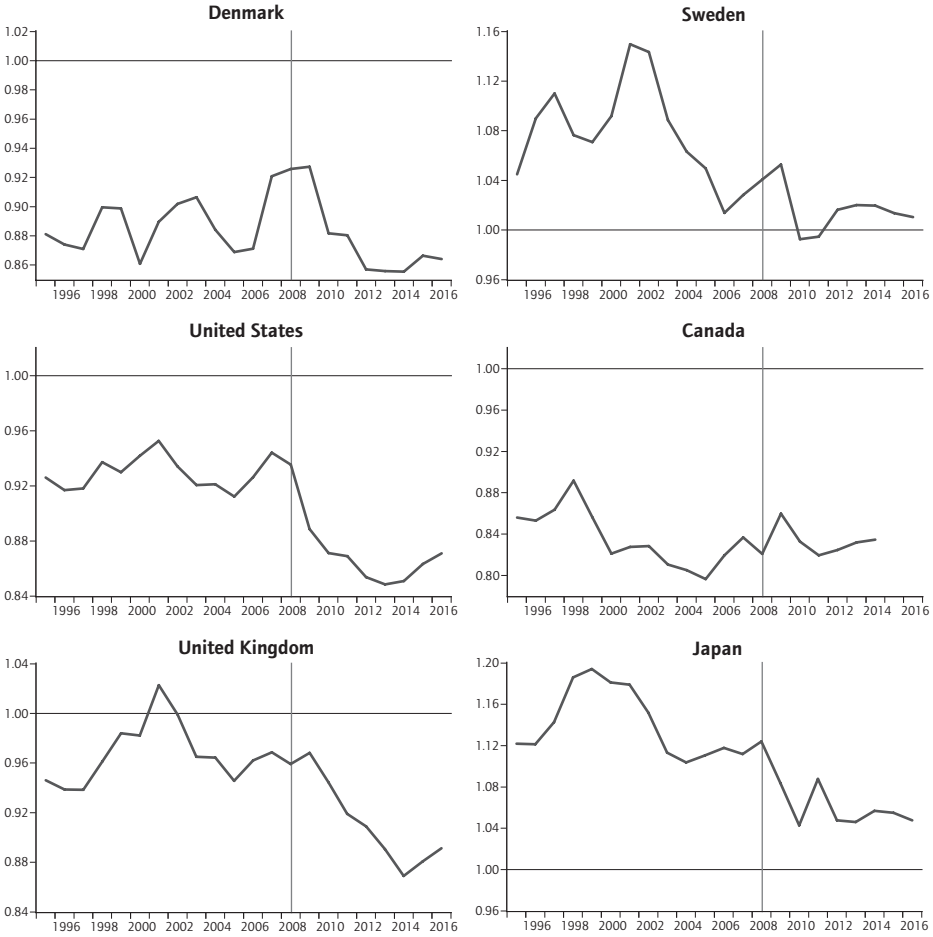


Table 1 shows actual and equilibrium wages before and after the Lehman crisis, as well as the wage gap in absolute euro amounts and as a percentage of equilibrium. In 2015 the average monthly wage in the euro area was €3,250, in Luxembourg it was €5,414 but the equilibrium level was €7,300. By contrast, in Lithuania actual wages were only €1,090 against the equilibrium wage of €1,803. German wages are in the middle with a gap of €146 below equilibrium, while Greek wages, at €1,884, are €512 above equilibrium. In the Non-Euro Area wages are undervalued in all countries except Sweden. On average the relative wage gap is higher because of the larger weight of the transition economies in central and eastern Europe. In Romania and Poland, nominal wages are more than a third below their equilibrium level, but even within the euro area Lithuania, Slovakia and Latvia are more competitive. Polish wages could go up on average by €579 per month without pushing the return on capital below the euro area average. Among the old opt-out member states, the United Kingdom and Denmark have gained significant competitive advantages, while Sweden has reduced its cost disadvantage. In the United Kingdom, monthly wages could go up by €356 and in Denmark even by €685, but in Sweden they would have to fall by €180. Note that Denmark has a fixed exchange rate to the euro, but the United Kingdom and Sweden do not.

Within the euro area, five countries – amounting to approximately 50 per cent of euro-area GDP – are above equilibrium wage levels: Greece, Austria; Spain, Italy and France. In Italy and France, wages are a bit more than 2 per cent above equilibrium levels, while in Germany wages are 4.2 per cent below equilibrium, with a falling trend. Portugal and Ireland have benefitted from very low wage costs. Greece had reduced its comparative disadvantage significantly before the crisis, but due to the adverse effects of austerity, the equilibrium wage has fallen more rapidly than actual wages, so that Greek actual wages are now 37.3 per cent per cent *above* equilibrium. It is clear that closing such a wage gap cannot be done by nominal wage cuts but requires changes in productivity.

Table 1 **Average monthly wage in € 000**

| | Gross wage (monthly, €) | | | Change (%) | | Equilibrium wage (monthly, €) | | |
|---|---|---|---|---|---|---|---|---|
| | 1999 | 2007 | 2015 | 1999-2007 | 2007-2015 | 1999 | 2007 | 2015 |
| European Union | 2045 | 2613 | 2983 | 27.8% | 14.2% | 2016 | 2643 | 3083 |
| **Euro area (18)** | **2310** | **2801** | **3250** | **21.3%** | **16.0%** | **2310** | **2801** | **3250** |
| Luxembourg | 3398 | 4584 | 5414 | 34.9% | 18.1% | 4900 | 6363 | 7300 |
| Belgium | 3072 | 3829 | 4490 | 24.6% | 17.3% | 2955 | 3876 | 4545 |
| Finland | 2526 | 3236 | 3396 | 28.1% | 4.9% | 2730 | 3527 | 4010 |
| Ireland | 2329 | 3724 | 3896 | 59.9% | 4.6% | 2975 | 4483 | 5235 |
| Netherlands | 2568 | 3278 | 3841 | 27.6% | 17.2% | 2556 | 3432 | 3882 |
| France | 2616 | 3313 | 3834 | 26.6% | 15.7% | 2791 | 3348 | 3757 |
| Austria | 2592 | 3093 | 3656 | 19.3% | 18.2% | 2287 | 2866 | 3249 |
| Germany | 2565 | 2787 | 3316 | 8.7% | 19.0% | 2348 | 2828 | 3461 |
| Italy | 2240 | 2759 | 3035 | 23.2% | 10.0% | 2537 | 2888 | 2967 |
| Spain | 1833 | 2370 | 2655 | 29.3% | 12.0% | 1774 | 2052 | 2558 |
| Slovenia | 1189 | 1769 | 2102 | 48.8% | 18.8% | 1376 | 2079 | 2331 |
| Greece | 1369 | 2068 | 1884 | 51.1% | -8.9% | 890 | 1623 | 1372 |
| Cyprus | 1384 | 1890 | 1868 | 36.6% | -1.2% | 1813 | 2469 | 2595 |
| Malta | 1095 | 1514 | 1858 | 38.3% | 22.7% | 1395 | 2060 | 2550 |
| Portugal | 1207 | 1621 | 1732 | 34.3% | 6.8% | 1217 | 1574 | 1924 |
| Estonia | 379 | 1056 | 1476 | 178.6% | 39.8% | 454 | 1317 | 1673 |
| Slovakia | 350 | 888 | 1302 | 153.7% | 46.6% | 517 | 1542 | 2223 |
| Latvia | 308 | 876 | 1132 | 184.4% | 29.2% | 450 | 1457 | 2029 |
| Lithuania | 315 | 833 | 1090 | 164.4% | 30.9% | 396 | 1214 | 1803 |
| *unweighted mean* | *1754* | *2394* | *2736* | *61.7%* | *16.9%* | *1914* | *2684* | *3130* |
| *standard deviation* | *993* | *1122* | *1254* | *59.0%* | *13.5%* | *1163* | *1300* | *1448* |
| Denmark | 2854 | 3771 | 4520 | 32.1% | 19.9% | 3190 | 4112 | 5205 |
| United Kingdom | 2632 | 3675 | 3789 | 39.6% | 3.1% | 2615 | 3687 | 4145 |
| Sweden | 2359 | 3122 | 3782 | 32.3% | 21.1% | 2098 | 2922 | 3602 |
| Croatia | 800 | 1289 | 1427 | 61.1% | 10.7% | 815 | 1452 | 1495 |
| Czech Republic | 463 | 1049 | 1222 | 126.6% | 16.5% | 481 | 1267 | 1525 |
| poland | 520 | 821 | 1048 | 57.9% | 27.6% | 607 | 1232 | 1627 |
| Hungary | 474 | 1038 | 1000 | 119.0% | -3.7% | 617 | 1375 | 1421 |
| Romania | 162 | 594 | 681 | 266.7% | 14.6% | 181 | 829 | 1038 |
| Bulgaria | 166 | 317 | 575 | 91.0% | 81.4% | 208 | 491 | 659 |
| *unweighted mean* | *1159* | *1742* | *2005* | *91.8%* | *21.3%* | *1201* | *1930* | *2302* |
| *standard deviation* | *1115* | *1375* | *1555* | *74.5%* | *24.5%* | *1126* | *1303* | *1593* |
| United States | 3371 | 3488 | 4857 | 3.5% | 39.2% | 3643 | 3712 | 5788 |
| Japan | 3408 | 2354 | 2707 | -30.9% | 15.0% | 2879 | 2129 | 2365 |

Average monthly wage = annual nominal compensation (HWCDW) per employees (NWTD)/12
Source: Own elaboration on AMECO.

| Change (%) | | Wage gap (€) | | | Wage gap (%) | | |
|---|---|---|---|---|---|---|---|
| 1999-2007 | 2007-2015 | 1999 | 2007 | 2015 | 1999 | 2007 | 2015 |
| 31.1% | 16.6% | 29000 | -30000 | -100000 | 1.4% | -1.1% | -3.2% |
| **21.3%** | **16.0%** | **0** | **0** | **0** | **0.0%** | **0.0%** | **0.0%** |
| 29.9% | 14.7% | -1502000 | -1779000 | -1886000 | -30.7% | -28.0% | -25.8% |
| 31.2% | 17.3% | 117000 | -47000 | -55000 | 4.0% | -1.2% | -1.2% |
| 29.2% | 13.7% | -204000 | -291000 | -614000 | -7.5% | -8.3% | -15.3% |
| 50.7% | 16.8% | -646000 | -759000 | -1339000 | -21.7% | -16.9% | -25.6% |
| 34.3% | 13.1% | 12000 | -154000 | -41000 | 0.5% | -4.5% | -1.1% |
| 20.0% | 12.2% | -175000 | -35000 | 77000 | -6.3% | -1.0% | 2.0% |
| 25.3% | 13.4% | 305000 | 227000 | 407000 | 13.3% | 7.9% | 12.5% |
| 20.4% | 22.4% | 217000 | -41000 | -145000 | 9.2% | -1.4% | -4.2% |
| 13.8% | 2.7% | -297000 | -129000 | 68000 | -11.7% | -4.5% | 2.3% |
| 15.7% | 24.7% | 59000 | 318000 | 97000 | 3.3% | 15.5% | 3.8% |
| 51.1% | 12.1% | -187000 | -310000 | -229000 | -13.6% | -14.9% | -9.8% |
| 82.4% | -15.5% | 479000 | 445000 | 512000 | 53.8% | 27.4% | 37.3% |
| 36.2% | 5.1% | -429000 | -579000 | -727000 | -23.7% | -23.5% | -28.0% |
| 47.7% | 23.8% | -300000 | -546000 | -692000 | -21.5% | -26.5% | -27.1% |
| 29.3% | 22.2% | -10000 | 47000 | -192000 | -0.8% | 3.0% | -10.0% |
| 190.1% | 27.0% | -75000 | -261000 | -197000 | -16.5% | -19.8% | -11.8% |
| 198.3% | 44.2% | -167000 | -654000 | -921000 | -32.3% | -42.4% | -41.4% |
| 223.8% | 39.3% | -142000 | -581000 | -897000 | -31.6% | -39.9% | -44.2% |
| 206.6% | 48.5% | -81000 | -381000 | -713000 | -20.5% | -31.4% | -39.5% |
| *70.3%* | *18.8%* | *-159263* | *-290000* | *-394053* | *-8.1%* | *-11.1%* | *-12.0%* |
| *73.2%* | *14.7%* | *415536* | *490696* | *603087* | *20.4%* | *18.5%* | *20.4%* |
| 28.9% | 26.6% | -336000 | -341000 | -685000 | -10.5% | -8.3% | -13.2% |
| 41.0% | 12.4% | 17000 | -12000 | -356000 | 0.7% | -0.3% | -8.6% |
| 39.3% | 23.3% | 261000 | 200000 | 180000 | 12.4% | 6.8% | 5.0% |
| 78.2% | 3.0% | -15000 | -163000 | -68000 | -1.8% | -11.2% | -4.5% |
| 163.4% | 20.4% | -18000 | -218000 | -303000 | -3.7% | -17.2% | -19.9% |
| 103.0% | 32.1% | -87000 | -411000 | -579000 | -14.3% | -33.4% | -35.6% |
| 122.9% | 3.3% | -143000 | -337000 | -421000 | -23.2% | -24.5% | -29.6% |
| 358.0% | 25.2% | -19000 | -235000 | -357000 | -10.5% | -28.3% | -34.4% |
| 136.1% | 34.2% | -42000 | -174000 | -84000 | -20.2% | -35.4% | -12.7% |
| *119.0%* | *20.0%* | *-42444* | *-187889* | *-297000* | *-7.9%* | *-16.9%* | *-17.1%* |
| *101.2%* | *11.5%* | *156439* | *187346* | *268770* | *11.1%* | *14.8%* | *14.0%* |
| 1.9% | 55.9% | -272000 | -224000 | -931000 | -7.5% | -6.0% | -16.1% |
| -26.1% | 11.1% | 529000 | 225000 | 342000 | 18.4% | 10.6% | 14.5% |

Wage gaps represent a competitive disequilibrium, which ought to be corrected over time. In Table 2, we show the result of a simple econometric exercise in which the change in the competitiveness indicator – that is, the wage gap – is regressed on its level in the previous period for the EMU countries. The result indicates that the adjustment process is rather slow, on average less than 20 per cent of the wage gap is corrected in Europe each year.

Table 2 **Adjustment of wage gap and adjustment of relative GDP growth rates**

| Dependent variable: change in the wage GAP (DComp where D=Δ) | | | | |
|---|---|---|---|---|
| $Comp_{t-1}$ | -0.180*** | $R^2$=0.07 | Obs 361 | |
| | [0.028] | | | |
| **Dependent variable: deviation of GDP growth from the EMU average** | | | | |
| $Comp_{t-1}$ | -0.139*** | log(GDPpc)t-1 | -0.093*** | $R^2$=0.35 Obs 361 |
| | [0.043] | | [0.010] | |

In a second exercise, we regress deviation of GDP growth rates from the EMU average on the initial wage gap and per capita log-GDP. The results (Table 2 lower panel) indicate that wage gaps are important and provide an explanation for the different paces of growth and the different performances in overcoming the crisis. The deviation of growth rates is negatively correlated with the wage gap (ratio of actual to equilibrium wages) and with per capital income levels. In other words, competitive wages accelerate the catch-up of low-income countries.

However, as already pointed out, the aggregate data may hide very different dynamics in production sectors. We turn therefore to a sectoral analysis of European wage dynamics.

# 2.
# Sectoral equilibrium wages

In the previous section we introduced the theoretical concept of the equilibrium wage as the wage level that would allow the return on capital in a country to be equal to the EMU average. We also showed evidence based on aggregate data in order to highlight the additional information provided by the levels of our measure with regard to the standard indicators, which assess only the competitive performance over time. In this section, we enter into the core of the report and show how the competitiveness of the different branches of the economy can be described and analysed by using our definition of competitiveness; that is, the gap between actual and equilibrium wages.

Analyses at sectoral level find the main constraint in the availability of a comprehensive dataset for all sectors over a fairly long time period. A major effort has been made to collect and assemble data from different sources in order to calculate the measure described in section 1 for a period including also the years following the global financial crisis. The description of the construction of the database is provided in section 2.1. The next step is to provide a description of the evolution of the different sectors in terms of shares in value added and specialisation with regard to the European average and compare such evolution with that of our competitiveness measure in order to identify a possible relationship between sectoral competitiveness and the dynamics of specialisation in production and trade. This evidence is provided in sections 2.2 and 2.3. At this stage, we pay particular attention to two issues: first, the use of average wage per person employed versus wage per hour worked (section 2.4); second, the role of the relative average capital efficiencies of the countries with regard to the European average (section 2.5). Finally, in section 2.6 we test the performance of our indicator in explaining

changes in the sectoral composition of value added against the standard measure of cost competitiveness, namely unit labour costs.

## 2.1 The data set

We collected data at NACE (rev.2) level for the major 14 EU member states, namely: the euro area as a whole – Austria, Belgium, Germany, Spain, Estonia, Finland, France, Greece, Ireland, Italy, Netherland, Portugal, Slovakia and Slovenia. The sectoral breakdown originally included 38 sectors but due to missing data for some disaggregated sectors, in particular in services, we aggregated some branches to obtain a final breakdown of 30 sectors (see Appendix Figure A4.1), with 13 manufacturing industries, 12 service activities, two primary sectors, construction and utilities (electricity, gas and water). The time span covers the period 1995–2012.

We collected wage data (average compensation per employee) and a number of variables in order to build the equilibrium wage as defined in equation (5). Labour productivity is defined as the ratio of GDP at constant prices and employment; as measure of price dynamics, we use the GDP deflator. These data are from the Eurostat National Accounts Database.

In order to calculate the return on capital for each sector we use the sectoral capital stock provided by the OECD-STAN database, which contains data for 13 European countries from the end of the 1990s to 2011. The countries for which sectoral capital stock data are available are shown in Table 4. In order to maximise the coherence between OECD and Eurostat data, we used the former and calculated the capital stock by multiplying the capital output ratio derived from OECD by the Eurostat's real GDP series.

For some countries (see Table 3), the data coverage of capital stock data does not include the years since the crisis. For this reason, and in order to obtain data for the following period matching wage data, we integrated the dataset by using an econometric procedure. More specifically, we took data for gross fixed capital formation and consumption of fixed capital, both available from the Eurostat Database, and applied a recursive regression approach where the capital stock at time $t$ is estimated for each country using the following equation:

$$(10) \qquad logK_{i,t} = \alpha + \rho K_{i,t-1} + \beta_1 logGFCF_{i,t} + \beta_2 logCFC_{i,t} + \beta_3 logGDP_{i,t} + \gamma_i + \theta_t + \varepsilon_{i,t}$$

Where $K$ is the capital stock at constant prices, *GFCF* is gross fixed investment, *CFC* is the consumption of fixed capital and *GDP* is Gross Domestic Product. The model is estimated though the two-way fixed effects estimator (FE) where $\Upsilon$ and $\Theta$ represent the individual and time specific fixed effects. The capital stock is obtained by estimating equation (10) recursively and by using in each step the forecast capital stock of the first missing period. The capital stock at current prices is then obtained by multiplying the series at constant prices by the price deflator of the Gross Fixed Capital Formation. Table 4 shows the data coverage and the years for which econometric estimates were used.

Table 3 **Summary of capital stock data availability and imputation**

| | Classification | Data coverage | Imputation |
|---|---|---|---|
| Austria | Nace Rev-3 | 1995–2007 | 2008–2012 |
| Belgium | Nace Rev-4 | 1995–2011 | 2012 |
| Czech Republic | Nace Rev-4 | 1995–2011 | 2012 |
| Denmark | Nace Rev-4 | 1995–2012 | None |
| Finland | Nace Rev-4 | 1995–2011 | 2012 |
| France | Nace Rev-3 | 1995–2008 | 2009–2012 |
| Germany | Nace Rev-4 | 1995–2010 | 2011–2012 |
| Italy | Nace Rev-3 | 1995–2007 | 2008–2012 |
| Netherlands | Nace Rev-4 | 1995–2011 | 2012 |
| Poland | Nace Rev-3 | 2004–2008 | 2009–2012 |
| Norway | Nace Rev-4 | 1995–2011 | 2012 |
| Spain | Nace Rev-3 | 2000–2009 | 2010–2012 |
| UK | Nace Rev-3 | 1995–2008 | 2009–2012 |

Source: OECD STAN and authors' elaboration.

The use of capital stock data from OECD, as well as the imputation procedure return satisfactory results. This can be verified in particular by looking at the estimates of the equilibrium wage (Appendix 2) and capital productivity (Appendix 4) for the total economy, which return similar results to those shown in section 1. There are, however, some discrepancies between the totals calculated using AMECO data and those obtained by merging OECD and Eurostat data. This is due in part to the fact that we are using different sources and in part to the occasional use of econometric estimates to replace missing real data. An additional source of discrepancy comes from the fact that the European averages are calculated using only the 12 European countries for which data were available, namely, eight euro area countries and four EU countries not belonging to the EA18, whereas data shown in the previous chapter use the EA18 averages to calculate the benchmark return on capital.

## 2.2 Some descriptive evidence

In order to understand the importance of the different sectors in European countries, a broad picture is reported in Table 4, which gives the sectoral distribution of value added according to the standard division between manufacturing, services, construction and other sectors (including agriculture, mining and quarrying, electricity, gas and water supply). The main difference between countries lies in the high importance of the manufacturing sector in Germany, Austria and in the central and eastern European member states (Slovenia and Slovakia), where the share is above 20 per cent. These countries form the main production network of the European Union because of their strong vertical linkages. A distinguishing feature of some countries was the high share of construction in GDP before the crisis, due to the development of real estate bubbles, especially in Spain and Ireland, and the catch up process in most of the New Member States. In many cases this has changed since the global financial crisis.

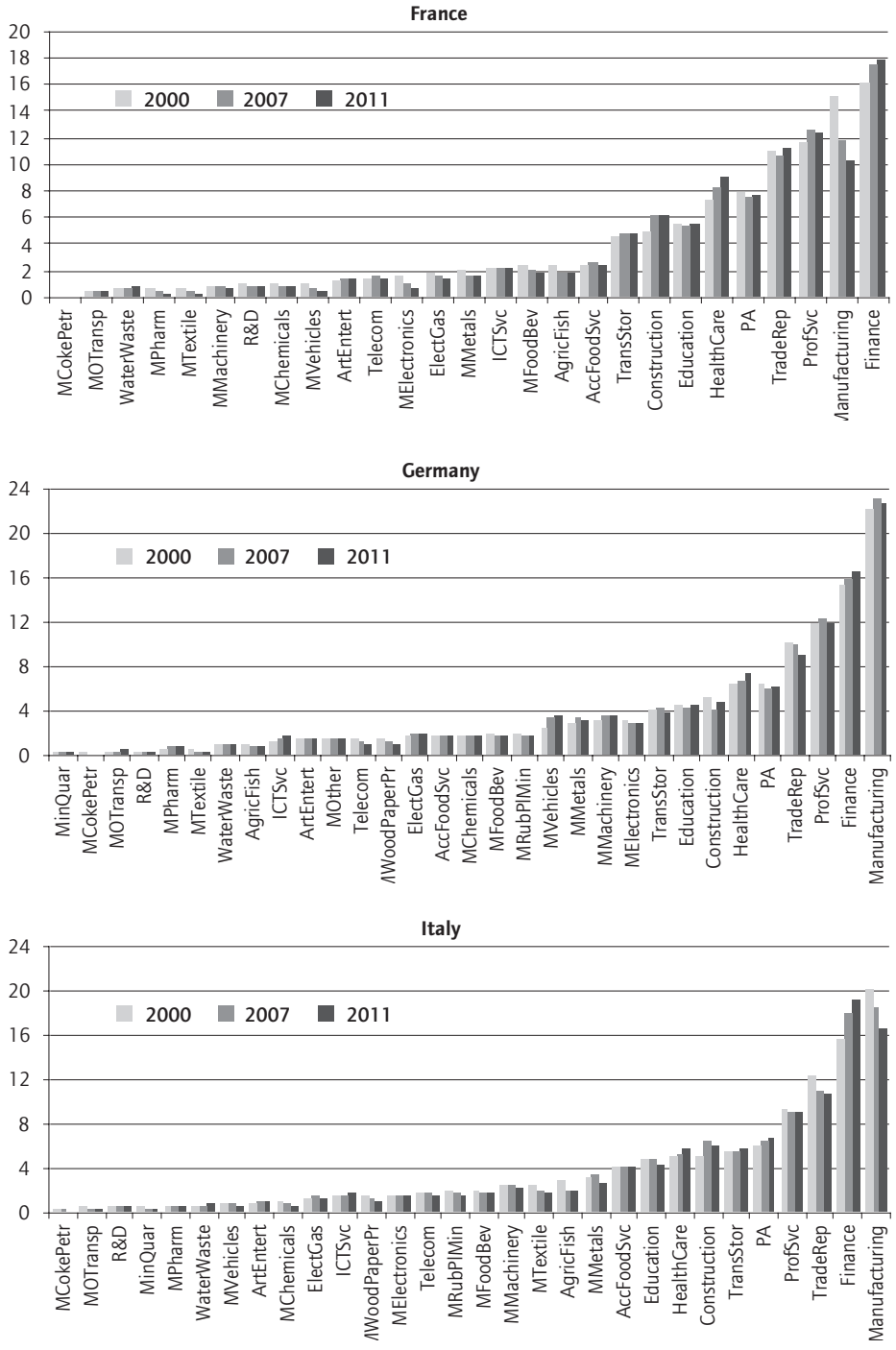
Table 4 **Economic structure for the macro-sectors (%)**

| | 2007 | | | | 2012 | | | |
|---|---|---|---|---|---|---|---|---|
| | Manuf. | Serv. | Constr. | Other | Manuf. | Serv. | Constr. | Other |
| Belgium | 17.0 | 73.9 | 5.4 | 3.7 | 14.5 | 76.2 | 5.7 | 3.5 |
| Germany | 23.3 | 68.8 | 3.9 | 4.1 | 22.6 | 68.4 | 4.5 | 4.4 |
| Estonia | 15.9 | 65.7 | 10.6 | 7.7 | 16.1 | 67.0 | 7.5 | 9.4 |
| Greece | 9.2 | 76.6 | 6.8 | 7.3 | 8.1 | 82.5 | 2.6 | 6.8 |
| Spain | 13.5 | 71.1 | 10.1 | 5.3 | 12.1 | 76.2 | 5.8 | 6.0 |
| France | 12.7 | 77.1 | 6.1 | 4.1 | 11.4 | 78.2 | 6.1 | 4.3 |
| Italy | 17.7 | 71.4 | 6.0 | 4.9 | 15.0 | 74.2 | 5.5 | 5.3 |
| Latvia | 11.5 | 72.0 | 9.7 | 6.8 | 12.9 | 72.5 | 6.1 | 8.5 |
| Lithuania | 17.7 | 63.2 | 11.2 | 7.9 | 20.7 | 64.9 | 5.9 | 8.5 |
| Luxembourg | 9.3 | 83.0 | 5.5 | 2.2 | 5.6 | 86.1 | 5.5 | 2.9 |
| Netherlands | 13.3 | 74.4 | 5.6 | 6.7 | 12.2 | 75.9 | 4.8 | 7.1 |
| Austria | 20.5 | 67.6 | 6.9 | 5.1 | 18.7 | 70.0 | 6.2 | 5.1 |
| Poland | 18.8 | 63.7 | 7.7 | 9.8 | 18.0 | 63.9 | 7.6 | 10.5 |
| Portugal | 14.1 | 73.3 | 6.8 | 5.8 | 14.1 | 73.3 | 6.8 | 5.8 |
| Slovenia | 23.3 | 62.7 | 8.0 | 6.0 | 21.6 | 66.1 | 5.8 | 6.5 |
| Slovakia | 23.2 | 57.9 | 8.3 | 10.6 | 21.0 | 61.1 | 8.9 | 9.0 |
| Finland | 25.3 | 62.3 | 6.7 | 5.7 | 16.9 | 70.2 | 6.6 | 6.3 |

Source: Authors' elaboration on Eurostat.

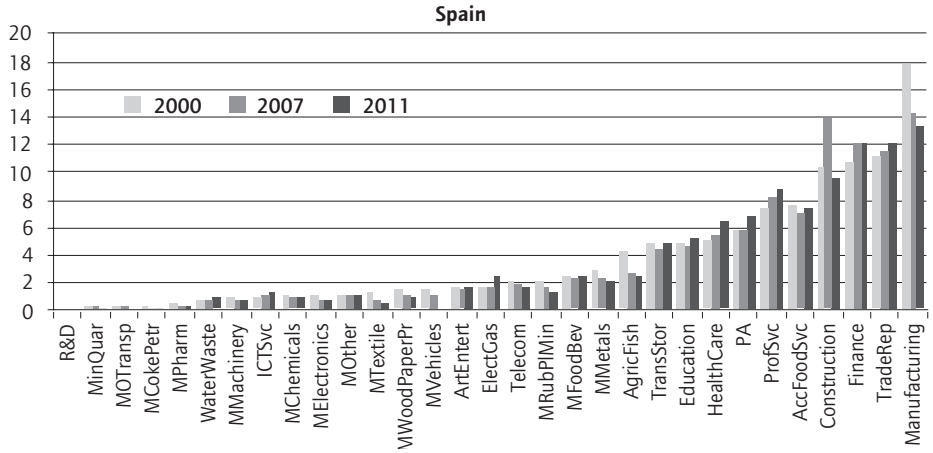
A more detailed picture comes from the sectoral distribution of value added (Figures 4a-4b). We have ordered the importance of the 30 sectors for each country according to their shares in value added in percentage terms. In the main countries of the euro area, finance, trade and professional services account for the highest share of value added. This is true in particular in France where the three sectors account for almost 40 per cent of GDP and manufacturing experienced a strong fall in relative terms between 2000 and 2008. In the other three countries manufacturing is more important and it has kept its share basically constant in Germany and Italy. In Spain the construction sector, even after the bursting of the real estate bubble, accounts for 10 per cent of GDP. Among manufacturing industries, we can see the strong importance of food and beverages in France and Spain, electronics and machinery in Germany, metals and textiles in Italy and Spain.

Figure 4a **Distribution of value added in the main EMU countries**[1]



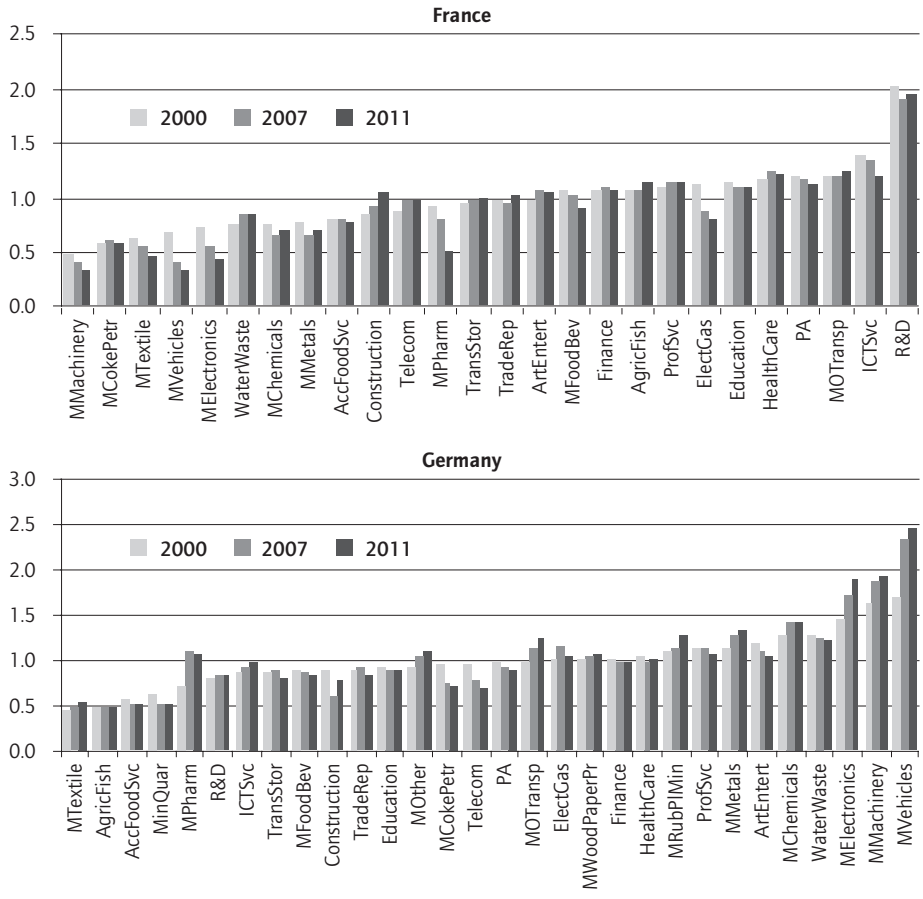

**1.** For the abbreviations of the sectors, please consult the list at page 142.

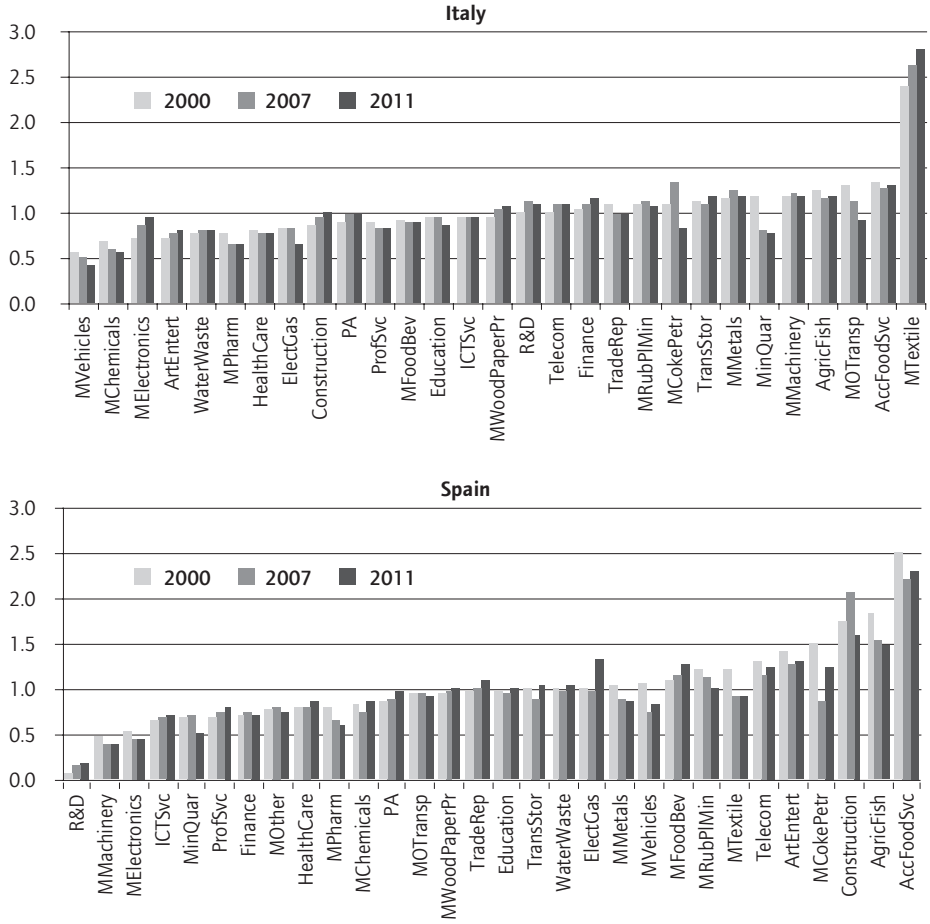
Figure 4b **Distribution of value added in the main EMU countries**




Source: Authors' elaboration on Eurostat.

Figure 5 **Specialisation indexes for the main EMU countries**

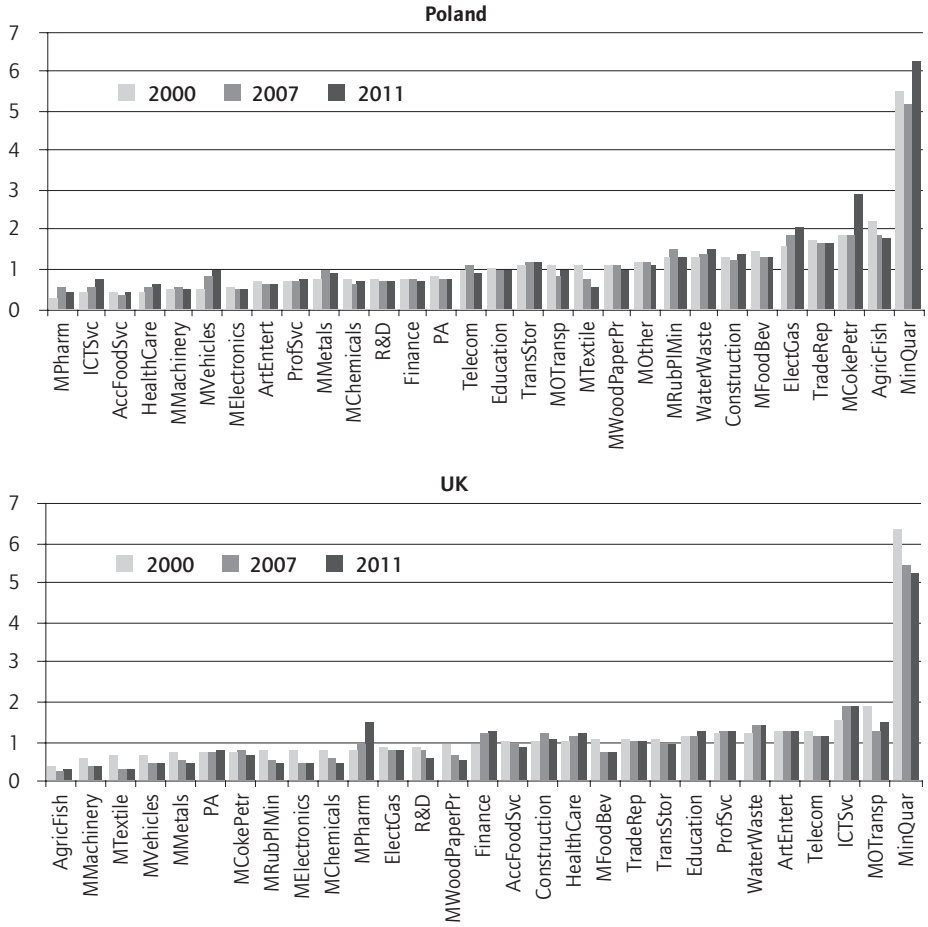





Source: Authors' elaboration on Eurostat.

The previous figures indicate that there are different specialisation patterns among the main EMU countries. This is made clearer in Figures 5 and 6, in which we show an index of specialisation as the share of sectors in different countries with regard to the euro area average. A value above 1 indicates specialisation, whereas values below 1 indicate that the country is less specialised in a specific sector. France is relatively specialised in R&D, ICT services, health, education and other transport equipment (mainly aircraft), whereas it is less oriented toward textiles, machinery and motor vehicles. The latter two are the sectors in which Germany is mostly specialised. The Italian economy is traditionally specialised in textiles and has further increased its specialisation over the past decade, although due to the development of outsourcing and increasing competition from low-wage countries, the share of this industry fell in Italy, as well as in the rest of Europe. Other important industries are mechanical engineering and food and beverages. Interestingly, Italy is least specialised in the manufacturing of motor vehicles and has experienced a further de-specialisation over time. Tourism, construction and agriculture are the main strength of the Spanish model, whereas we see a below average importance of high tech manufacturing (machinery and electronics) and knowledge-intensive services.

Figure 6 **Specialisation indexes for Poland and the United Kingdom**




Source: Own elaboration on Eurostat.

Turning to the main EU countries outside the EMU (Figure 6), Poland is highly specialised in the primary sector and especially in mining and quarrying and the energy sector, as well as in low tech branches, such as food and beverages and trade and repairs. On the other side, the country is least specialised in some high tech branches, such as pharmaceuticals, ICT services and machinery. The production of motor vehicles is becoming increasingly important, reaching an index value of 1 in 2011 from 0.5 in 2000. The main changes over time are the loss of importance of the textile industry and the increased specialisation in mining, coke and petroleum products, electricity and gas. Finally, in the United Kingdom, mining and quarrying is the branch with the highest value in the specialisation index, although its level fell from 2000 to 2011. The weight of finance is above the European average, although less than one might expect. The manufacturing of other transport equipment and ICT services are also highly represented in the country. Most of the other services show an index of around 1, whereas the country appears to be unspecialised in manufacturing. Over time, the most significant changes are the increased

specialisation in pharmaceuticals, for which the index doubled from 2000 and 2011, and in finance. The major loss of specialisation is recorded for chemicals, electronics, food and beverages and R&D.

To sum up, the evolution of relative specialisation indicates that France is becoming a post-industrial country, specialising in knowledge-intensive services, which might justify the loss of importance of manufacturing. This dynamic appears similar to that of the United Kingdom. Germany is specialised in medium and high tech manufacturing, whereas services – especially knowledge-intensive ones – are of much lower importance. Italy seems to be maintaining its traditional model based on the principle 'Made in Italy' and on capital-intensive manufacturing. Spain is more intensively specialised in non-tradables, whereas knowledge-intensive services are of little importance. Hence, while Germany and France seem to show models that might compete successfully in the world economy, the two southern European countries – especially Spain – would have to change their production structure in order to face the competition of both advanced and emerging economies. Among the latter, the role of Poland as supplier of low-tech and resource-intensive goods is dominant.

This preliminary evidence does not, however, say much about the real competitiveness of the sectors in which the countries are specialised. More detailed conclusions can be drawn from the joint analysis of wage development and profitability of the different industries by using the definition of equilibrium wages in section 1.

## 2.3 Sectoral equilibrium wages

The next step is the calculation of sectoral equilibrium wages. The relative figures for the countries with available data for the capital stock are reported in the Appendix 1. Each figure reports data for 28 sectors, for manufacturing as a whole and for the total economy. We exclude only some small sectors whose dynamics are not related to those of wages and competitiveness as we define it. In some cases, we exclude also the manufacturing of coke and petroleum products and of mining and quarrying, because they are dependent mainly on factor endowment and international prices of commodities. We already stressed that due to the discrepancies in the data sources there are some slight differences with regard to the aggregate measures calculated using AMECO, but the overall picture is unchanged.

In each figure we report the dynamics of actual wages (compensation per employee) and two equilibrium measures. We use alternatively the *aggregate return* for the euro area capital stock and the *sector-specific return* on capital in the euro area. These two equilibrium levels indicate whether the actual wage level in a given sector is competitive with regard to the euro area as a whole, or only with regard to the sector itself. Competitiveness relative to the euro area ought to attract investment and accelerate growth at the expense of other sectors. Lack of competitiveness within a sector would cause delocalisation and outsourcing within a given industry. The number beside the sector name in the title of each chart reports the sector's average share in value added in order to give an indication of its relative importance.

Competitiveness is often related to labour market flexibility. There are many measures for estimating such flexibility, but one of them is the wage spread between sectors. This can be measured by the coefficient of variation across sectoral wages (see Table 5).[2] We have ordered wage flexibility by the size of the coefficient and it appears that the northern Scandinavian countries have the most uniform wage levels across sectors, while the Anglo-Saxon-leaning economies have wider wage spreads. While this form of wage flexibility is uncorrelated with the wage gap levels in Table 5,[3] it is interesting that countries that have been more successful in coming out of the crisis – such as the United Kingdom, Denmark, Germany and the Netherlands – have increased their sectoral wage differentials, while the less successful countries (Spain, Belgium, France) have reduced these differences. In Germany the greater sectoral wage variety increased with the Hartz reforms. Some service sectors have seized on the low contractual power of 'self-employed' workers with atypical wage contracts and lower or no union coverage.

Table 5 **Coefficient of variation of wages across sectors**

| | 2000 | 2007 | 2011 |
|---|---|---|---|
| Finland | 0.2 | 0.22 | 0.23 |
| Denmark | 0.22 | 0.26 | 0.3 |
| Norway | 0.29 | 0.30 | 0.33 |
| Italy | 0.32 | 0.34 | 0.34 |
| Poland | | 0.39 | 0.34 |
| Czech Republic | 0.33 | 0.35 | 0.35 |
| Germany | 0.34 | 0.4 | 0.42 |
| Austria | 0.47 | 0.43 | 0.43 |
| Spain | 0.52 | 0.58 | 0.43 |
| France | 0.42 | 0.44 | 0.43 |
| Netherlands | 0.38 | 0.41 | 0.43 |
| Belgium | 0.44 | 0.51 | 0.48 |
| Estonia | 0.43 | 0.54 | 0.59 |
| UK | 0.90 | 1.24 | 1.66 |

Source: Authors' elaboration on Eurostat data.

We can summarise the main evidence on sectoral actual and equilibrium wages as follows. In **Germany** (Figure A1.7) wages became undervalued around 2007, but the competitive advantage in manufacturing started already at the end of the 1990s and continued to improve over the whole period due to moderate wage increases relative to the growth of equilibrium wages. Such a gain is common to most of German manufacturing sectors, in particular the medium-high tech ones. Lower gains are recorded in the food and textile industries and in the manufacturing of transport equipment. As for the service sector, the picture is partially reversed: there is a competitive advantage only in telecommunications (from 2005), trade and repairs (from 2003) and professional services, while strong disadvantages exist in transports, finance, education, arts and entertainments and – since 2001 – in ICT services.

**2.** The coefficient of variation is the ratio between the sectoral standard deviation and the average wage.
**3.** The coefficient of correlation is –0.016.

This picture is in line with many explanations for German competitiveness. Manufacturing has benefitted from fairly centralised wage bargaining, which has ensured that wages grow at similar rates across the economy, while capital productivity varies substantially between sectors. Skill biased technical change and outsourcing have increased the average efficiency of the capital stock in manufacturing (see section 2.4), while the service sector has created low wage/low value-added jobs (the mini-jobs) in sectors with low productivity increases.

For **Italy** (Figure A1.8) we have already documented the constant aggregate competitive loss from the mid-1990s to 2012. In manufacturing the country experienced a similar loss, but its wages are only slightly overvalued with regard to the average return on capital, while losing substantially in terms of sector-specific return on capital. This dynamic is common to most manufacturing industry and it is due mainly to the weakness of capital productivity and the consequential reduction of equilibrium wages starting in the past few years. The manufacturing of transport equipment has been most affected, together with wood and paper and rubber and plastic products. Electronics, and to a lesser extent textiles, retain a certain degree of competitiveness with regard to sector-specific return on capital. As for the service sector, there is a competitive advantage in health and care, arts and entertainments, finance and transport, while a strong overvaluation affects professional services and almost an equilibrium, although only with regard to sector-specific return on capital, in R&D activities.

**France** (Figure A1.6) experienced a moderate undervaluation due to its '*franc fort*' policies in the 1990s, but this advantage had been constantly eroded up to the global financial crisis. In manufacturing there is still a competitive advantage, although actual wage dynamics, in particular after the introduction of the euro, have been more pronounced than that of equilibrium wages. The advantage is eroding in particular in the pharmaceutical industry and in machinery. The reduction of equilibrium wages is due in particular to the low capital productivity (see Figure A2.7). Unfortunately, due to missing data for the capital stock, we do not have a complete picture of manufacturing industry.

Utilities and constructions are also undervalued, whereas in services we observe a mixed situation. On one hand, we observe a strong and increasing overvaluation in finance and professional services, which account for almost 30 per cent of GDP; on the other hand, telecommunications, trade and repairs, as well as health care are still highly competitive. The remaining sectors had a position between these two extremes, particularly R&D, tourism and education.

The **Spanish** case is peculiar (Figure A1.12). On average, the country has been strongly overvalued over the whole period. Manufacturing was overvalued with regard to its specific return on capital, whereas it is still undervalued with regard to the euro average because of the high overvaluation in services. The pattern in manufacturing is common to most industries, while the most recent data indicate a gain in the chemical industry and mixed dynamics in machinery, although both sectors are relatively small. Utilities still seem to be competitive, and so is construction. Some services, such as tourism (accommodation and food services),

followed by education and health care are also undervalued, whereas the remaining branches show a strong and increasing overvaluation. Given the high share of immigrant labour, one would expect the competitiveness in construction and tourism to be based on low-skilled low-wage migrant workers.

Among the other euro area countries, the **Netherlands'** (Figure A1.8) total economy is slightly overvalued but the manufacturing sector has become undervalued after the global financial crisis due in particular to motor vehicles, machinery, textile and chemicals. In services – except for finance and R&D – we observe a general undervaluation, in particular in trade, tourism, telecommunications and professional services. Austria is close to Germany in terms of competitive dynamics, with an undervalued manufacturing sector.

Calculating equilibrium wages for non-euro area countries involves the exchange rate. As a consequence, actual and equilibrium wages, expressed in euros, are more volatile (but note that **Denmark** has fixed its exchange rate to the euro, although the relationship between the wage series remains stable). The wage gap will be affected only to the degree that currency devaluations generate higher exports with larger profit content. Thus, the greater volatility of equilibrium wages in the **United Kingdom** (Figure A1.12) reflects movements in the exchange rate with the euro. Manufacturing is in equilibrium with regard to its specific return on capital, but in general we see a close correlation between equilibrium and actual wages and similar tendencies in most of the sector, with both measures falling from the second half of the past decade due probably to exchange rate appreciation. It is worth mentioning that transport and storage became overvalued after the introduction of the euro, whereas the financial sector became undervalued after the global financial crisis.

In the member states of central and eastern Europe, we lack data on capital stock, which prevents us from calculating sectoral equilibrium wages, except for the **Czech Republic** and **Poland**. The former, with few exceptions, shows similar levels and growth rates in actual and equilibrium wages, remaining consequently close to the equilibrium. Motor vehicles, a sector that has attracted a lot of German outsourcing investment, appears to be the most competitive industry; among services, ICT and professional services are undervalued, whereas finance is strongly overvalued. Poland is strongly undervalued in manufacturing and in most service activities. The main exception is in the primary sector, which accounts for more than 4 per cent of GDP and is strongly overvalued.

To sum up, the dynamics of equilibrium wages and the implied wage gap seem to reflect in part the pattern of sectoral specialisation, in particular for Germany, Italy and Spain whereas for France such an association is not clear on a descriptive level. More information will come from the econometric analysis at the end of the chapter.

## 2.4 Compensation per employee or compensation per hours worked?

In all the previous analyses, equilibrium wages were calculated by using the average compensation *per employee* as a benchmark because that allows us to maximise the data coverage. The main drawback is that it can hide movements in the number of hours worked per employee. Several factors affect the difference between the evolution of the number of employed persons and that of hours worked. First of all, it does not take into account the role of part-time workers, whose numbers have increased over time, making the number of employees a poor indicator for the amount of labour used in production. Other problems related to this measure are, on one hand, the reduction in working time which has taken place in most advanced countries since the mid-1990s and, on the other, the use of short-run automatic stabilisers such as the Cassa Integrazione Guadagni in Italy and short-time working in Germany. The latter was particularly important during the global financial crisis. Some countries also used it to reduce the social costs of the recession in the European sovereign debt crisis. Statistically, this means that employment calculated in terms of persons did not fall as much as the number of hours worked because workers in these programmes appear to be employed but with fewer or zero hours worked. At the same time, labour remuneration is not counted as a 'wage' but as a state social benefit. Both factors induce distortions in the calculation of average wages and of the actual use of labour. This problem shows up mainly in the service sector where flexible working contracts are common, whereas in manufacturing employment tends to be in the permanent full-time contract form. The figures in Annex 3 show actual and equilibrium wages for selected countries based on hours worked. As we can see, the data confirm that the differences between the two measures are fairly small in manufacturing, whereas in the service sector, some branches show significant divergences between the two measures. This is true in particular in health care services, trade and repairs, education and professional services, whereas in other branches such as public administration, R&D and telecommunications the differences between the two measures are relatively small.

Overall, then, we can conclude that the use of data based on the number of persons employed does not cause major biases in the analysis when we consider the manufacturing sector. In the case of services, by contrast, the approximation is less precise. For this reason, we will show them in the following chapter as a robustness check when the data availability allows us to run the econometric analyses with hourly measures.

## 2.5 Capital prices and capital productivity

Our theory explains that equilibrium wages and competitiveness are strongly influenced by the average efficiency of capital (ACE) stocks. In Figures 7 to 9 we show the decomposition of the relative ACE effect, as described in equation (6), for the main sectors of the member state economies during the periods 1999–2007 and

2008–2011.[4] Each variable is expressed in such a way that an *increase* leads to an increase in the relative ACE component and, hence, to a *reduction* in equilibrium wages. The macro-sectors are: agriculture, mining and quarrying (AMQ), construction (Constr), electricity, gas and water supply (EGW), manufacturing (Manuf) and services (Serv). Due to missing data for some service activities, the aggregation of the five macro-sectors might lead to slightly different results with regard to the data for the total economy.

Figure 7 shows the decomposition for the four biggest members of the euro area. In **France** the total effect was slightly positive (below 1 per cent) between 1999 and 2007, with the main contributions coming from the primary sector, services and manufacturing. In the latter, the positive GDP deflator effect ($p_€ - p$) has been almost entirely compensated by the negative effect of capital accumulation. Similar dynamics are shown for EGW, while in agriculture the relative growth effect ($y_€ - y$) added to this pattern, resulting in a total effect of around 3.5 per cent. In the service sector, all variations are fairly small but positive except for the inflation effect. Between 2008 and 2011 the overall relative ACE effect for the total economy was close to 2 per cent, due mainly to the dynamics of manufacturing and services. In the latter, the negative effects of GDP growth and prices are more than compensated by capital accumulation and capital prices. In manufacturing, both price and growth dynamics contributed to push the relative ACE up (and the equilibrium wage down), while capital accumulation exerted the opposite effect. Similar dynamics are observed in the primary sector, while in construction the relatively low growth was compensated by price dynamics. Finally, in the EGW sector the relative ACE went down, and the equilibrium wage up, due to the combined effect of GDP growth and capital accumulation.

In **Germany**, the total ACE effect has been slightly negative (and therefore increasing equilibrium wages). Before the crisis, this development was driven largely by real and nominal effects of capital accumulation, while since 2008 GDP growth has been the main driver of competitive gains. Only the primary sector shows the opposite dynamics. It is worth noting that the composite effect has been more important in construction and manufacturing, where competitiveness improved the most – that is, equilibrium wages went up – whereas in services the change was almost nil. Since the crisis, the overall ACE effect has been slightly negative but relatively small in the two main macro-sectors of manufacturing and services. In the primary sector, too, the overall ACE effect was null as a result of opposite changes in the growth effect (+7 per cent) and in price dynamics (–7.5 per cent). The construction sector shows a strong negative impact due to both GDP and price growth. Thus, the German story is one of supply-side transformation during the Schröder years and demand-side improvements during the Merkel years.

In **Italy**, we can observe positive ACE dynamics and deteriorating equilibrium wages everywhere, except for EGW, up to the global crisis. The main cause of this result

4. In the Appendix 2 we show detailed sectoral data. For each figure, we show three series: the relative capital productivity and the relative price indexes for GDP and capital goods. In all series, the numerator is given by the EU value so that an increase implies lower growth with respect to the EU.

is the relative growth effect which has been particularly strong in manufacturing. In construction, the effect of capital accumulation more than compensated the negative output effect. Between 2008 and 2011 the overall effect for the total economy was close to zero mainly because of a 2 per cent increase in manufacturing and a 1 per cent reduction in services. In all macro-sectors capital accumulation and the GDP deflator had a negative impact, whereas output growth and capital prices had an opposite effect. This leads to the conclusion that recession and austerity have harmed Italy's competitiveness.

In **Spain**, the total ACE effect between 2000 and 2007 was 2 per cent, driving equilibrium wages down. This effect was driven mainly by capital accumulation and capital prices, in particular in the service sector and construction. In the latter, the effect is null due to the negative impact of output volumes and prices. The total effect between 2008 and 2011 was still slightly positive due to the contribution of construction and manufacturing. In both cases, the growth effect played the major role. In services, both GDP and capital prices pushed the overall effect to slightly negative values, although capital accumulation partly counterbalanced the result.

Among the other EMU countries (Figure 8), **Austria** experienced a strong reduction in relative ACE and improved equilibrium wages in the manufacturing sector due to capital prices and output growth, while in construction and utilities the negative impact was due mainly to capital accumulation. Thus, manufacturing competitiveness improved overall. The change in services was almost null, while the primary sector drove equilibrium wages down. In the post-Lehman period, the total effect was small everywhere as a result mainly of opposite dynamics in relative capital prices (positive), on one hand, and capital accumulation as well as GDP prices (negative) on the other.

In **Belgium, Finland** and the **Netherlands** the total effect for the overall economy was also relatively small in both periods due primarily to the dynamics in the service sector. In **Belgium**, the primary sector experienced a strong positive ACE effect in both periods due to output growth, whereas in the construction sector it increased strongly, essentially due to the relative capital accumulation effect. In **Finland**, it is interesting to observe that relative growth in manufacturing pushed the ACE effect down before the crisis, whereas this effect reversed in the following period.

Outside the non-Euro Area the United Kingdom and the Czech Republic and Poland are the most dynamic economies (Figure 9). In the **Czech Republic**, the ACE effect for the total economy was strongly negative (–3 per cent) before the crisis, mainly due to the relative price dynamics in all sectors but manufacturing. In the latter, relative output growth pushed down the overall effect. The following period seems to show a continuation of the previous dynamics in terms of price effects but this time the relative GDP deflator was not strong enough to counterbalance the positive impact of capital prices and output growth.

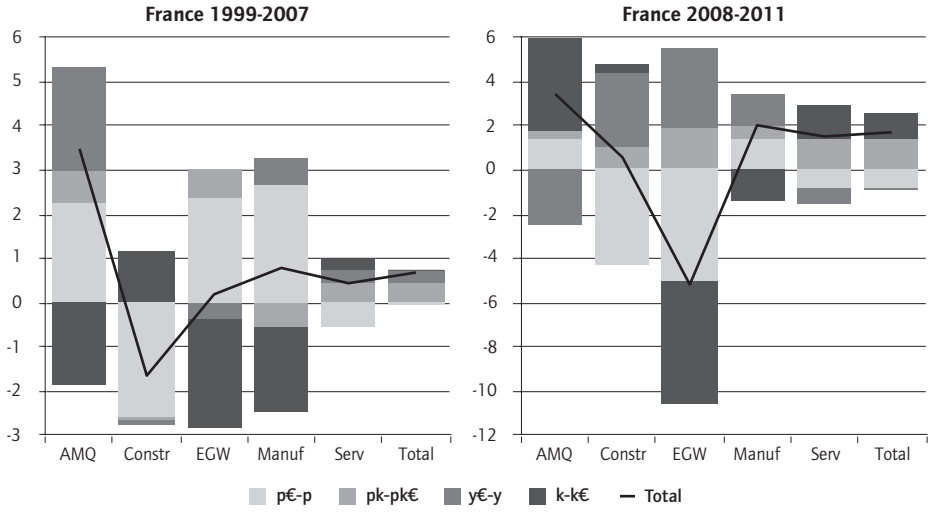
In **Poland**, too, the growth effect was the main driver for manufacturing up to 2007, whereas capital accumulation in the service sector partially compensated this result. After the crisis, capital accumulation became the main force in pushing up

the relative ACE in services and construction, whereas in manufacturing its effect was negative and reinforced by the high real growth.

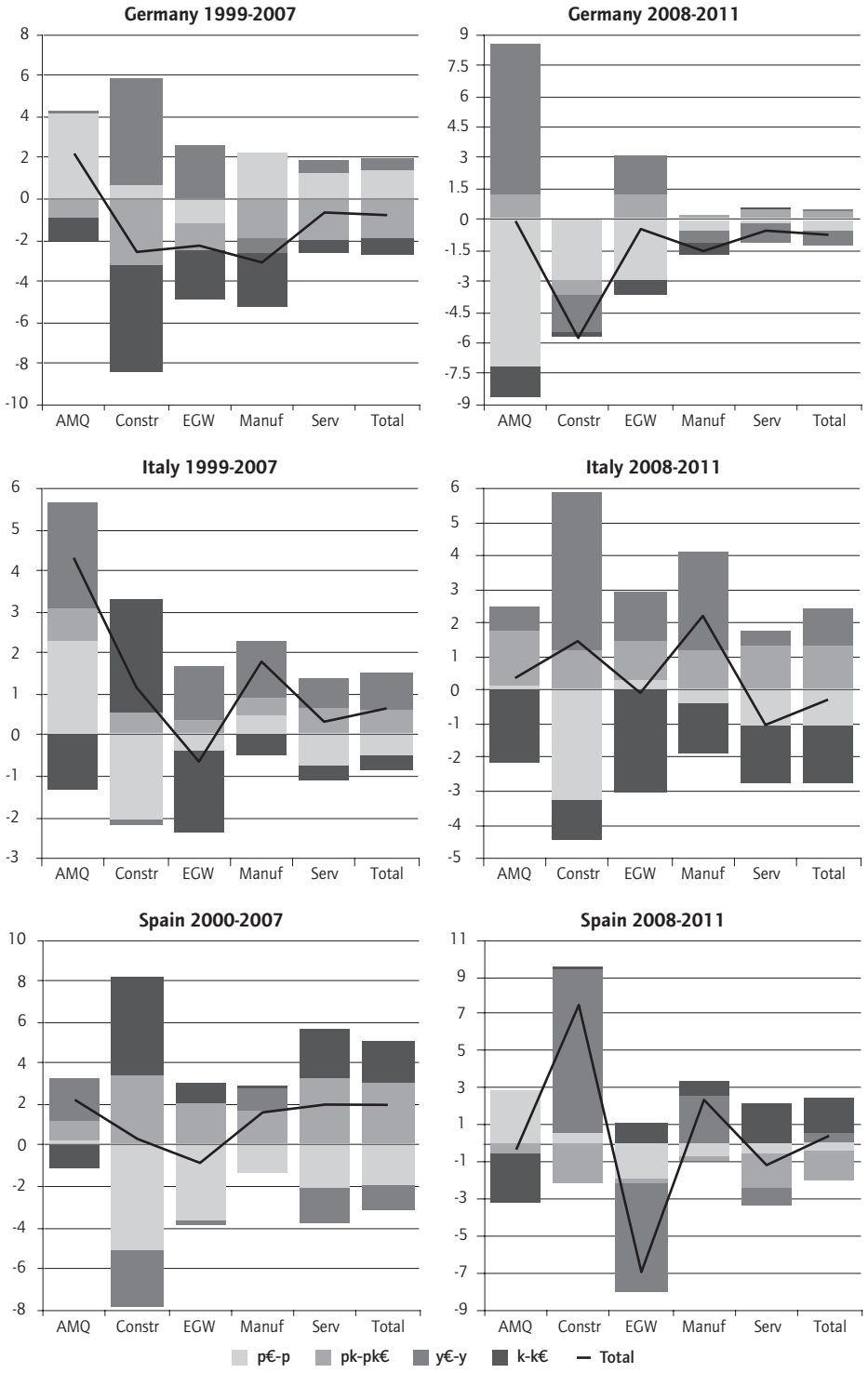
Lastly, in the **United Kingdom** the total effect was very small everywhere except for the primary sector and construction until 2007. After that, the relative ACE fell in total by approximately 4 per cent, driven everywhere by capital accumulation and capital prices, especially in manufacturing and construction. The relative price effect, driven also by the exchange rate dynamics, counterbalanced the effect of the price of capital goods in services and, to a lower extent, in construction. This explains the United Kingdom's improvement in competitiveness.

Summing up, the sectoral dynamics of the relative ACE provides an interesting explanation for the competitiveness gain in terms of rising equilibrium wages in the manufacturing sector before the global financial crisis. In Germany, Austria and the Netherlands this effect is driven essentially by capital accumulation, whereas in the two central and eastern European countries the catching-up in terms of output growth can explain the result. After the crisis, the overall change was fairly low and with less significant sectoral differences. The service sector does not seem to be particularly affected by important changes in both periods. Important exceptions are, in any case, the post-crisis effect in Italy and Poland. In the former, services partially counterbalanced the disappointing performance of the other sectors, driven by capital accumulation.

Figure 7 **Decomposition of the relative ACE effect in the main euro area countries**[5]

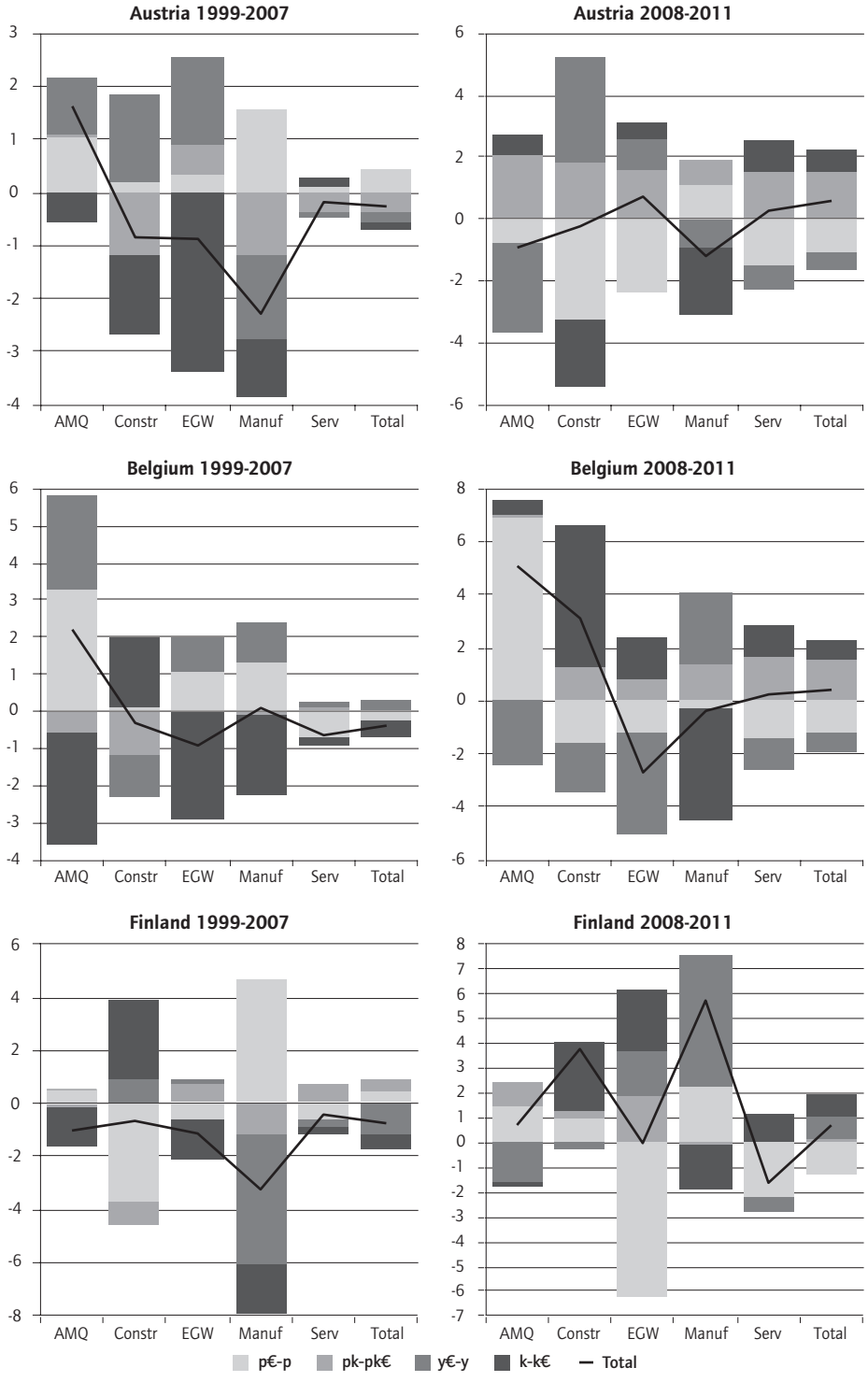


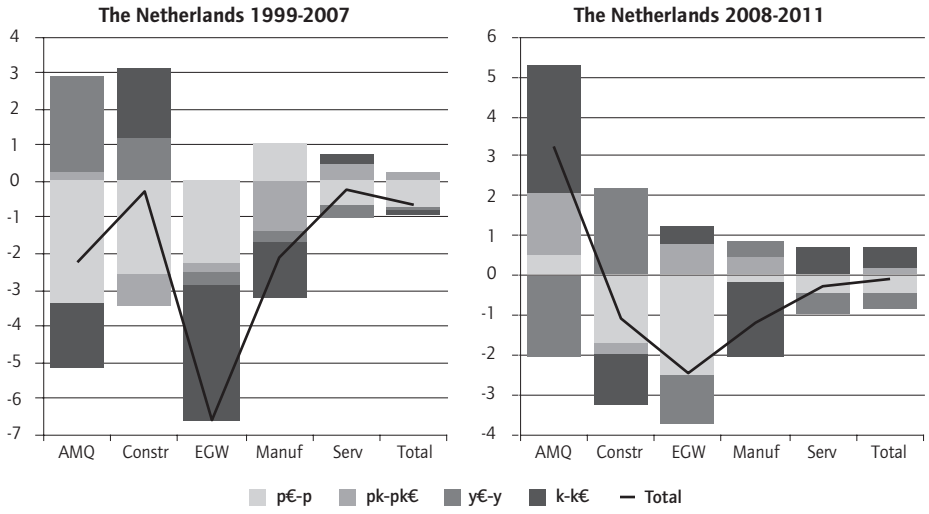

5. A positive increase in the ACE effect lowers the equilibrium wage




Source: Authors' elaboration on Eurostat and OECD data.

Figure 8 **Decomposition of the relative ACE effect in selected euro area countries**






Source: Authors' elaboration on Eurostat and OECD data.

Figure 9 **Decomposition of the relative ACE effect in the Czech Republic, Poland and United Kingdom**

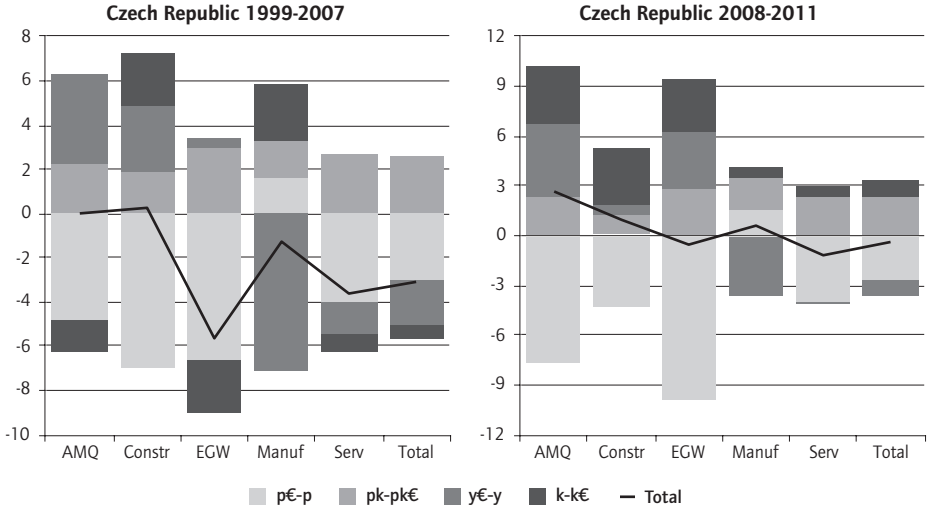
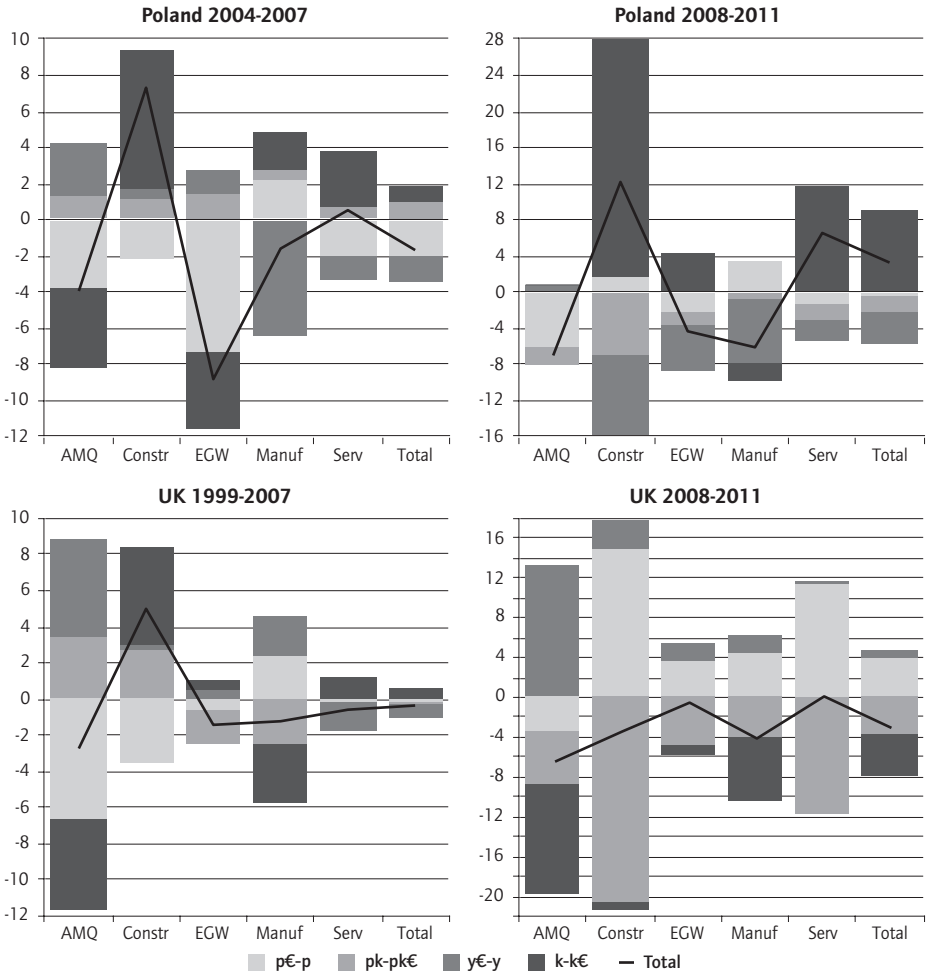


Figure 9 **Decomposition of the relative ACE effect in the Czech Republic, Poland and United Kingdom (cont.)**




Source: Authors' elaboration on Eurostat and OECD data.

## 2.6 Sectoral shifts and competitiveness: comparing equilibrium wages and unit labour costs

In this final part of section 2 we wish to compare the performance of our measure of competitiveness based on the wage gap, with the traditional measure of competitiveness at sectoral level, that is unit labour costs. Unit labour costs are the standard indicators for measuring the relative competitiveness of industries or countries. The OECD provides a full set of statistics related to the cost of labour and they are used to build a measure of real effective exchange rates.[6]

6. See OECD System of Unit Labour Cost Indicators, available at: http://stats.oecd.org/mei/default.asp?rev=3.

As pointed out in the introduction, comparing absolute developments of unit labour costs in different countries with regard to the EU average benchmark is not a suitable method. For this reason, we now compare our measure of equilibrium wages (using the EU average return on capital as benchmark) with relative nominal and real unit labour costs, expressed as a ratio to the EU average. We wish to test which of the two indexes can best explain changes in the sectoral shares of value added (see section 2.2). To do so, we use a simple regression equation of the following form:

$$\Delta VAsh_{i,t}^{k} = \alpha + \beta \Delta X_{i,t}^{k} + \varepsilon_{i,t} \quad (11)$$

The variable $X$ represents one of the measures of competitiveness, that is equilibrium wages ($Weq$), the implied competitiveness indicator (Comp=$W-Weq$) and the relative nominal ULC (ULCrel). We do not use the relative real unit labour costs as it is not a proper measure of competitiveness for countries in a monetary union. As explained by Peeters and den Reijer (2012), in a currency union internal devaluation is the standard way to restore competitiveness in terms of unit labour costs.

We use absolute changes in equilibrium wages instead of logs in order to make it more directly comparable with relative unit labour cost indicators, but the differences between the different forms of the variable are negligible. The above specification is estimated separately for each country using a panel of sectors $i$ over time $t$ ($t$ = 1995, …,2011). As for the estimation technique, we tested different models and found that neither random nor sectoral fixed effects are significant; similar conclusions apply to the significance of time-specific dummies. Hence we use a simple pooled OLS where the presence of heteroscedasticity and cross correlation among panels is addressed by using panel corrected standard errors (Greene 2012).

The results are shown in Table 6 for the eight countries with a full data set. For all specifications we used the same sample size in order to exclude the possibility that differences in the results are due to the different data coverage of the explanatory variables. The coefficients are expressed in standardised terms in order to allow a direct comparison among the estimates. As we can clearly see, equilibrium wages and the competitive indicator are significant determinants of the changes in the share of value added for all countries, whereas nominal unit labour costs are insignificant in Spain and France and in general have a lower explanatory power in terms of $R^2$. The differences between the explanatory power of equilibrium wages and our competitiveness indicator are largely insignificant, which might be because nominal wage dynamics present a drift and do not react to changes in relative productivity.

Looking at the coefficients, the higher impacts are found in Finland and the Netherlands, where a standard deviation increase in equilibrium wages is associated with a change in the sector's share by half a standard deviation. In Germany and Italy, the impact is slightly below 0.4, whereas in the remaining countries it is much lower and the explanatory power is rather low, suggesting that other factors played a major role in determining the sectoral recomposition of value added.

As a robustness check, we replicated the previous estimates using hourly measures of equilibrium wages, competitiveness and unit labour costs. As we can see in Table 7, the results are practically unchanged in terms of significance and also the relative size of the impacts among countries is, in most of the cases, similar between the two specifications.

Thus, we can summarise the test results as follows: **while there is no large difference between our equilibrium wage and the wage gap, both these indicators clearly provide greater insights and more information than unit labour cost indicators, which are usually used in competitiveness assessments.**

Table 6 **Estimation results for the relationship between changes in the sectoral shares in value added and competitiveness**

| Dependent variable: change in the sectoral shares in total value added (ΔVA_share) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δ(Weq) | 0.379*** | 0.390*** | 0.123*** | 0.171*** | 0.508*** | 0.272*** | 0.328*** | 0.491*** |
| | [10.018] | [6.510] | [4.168] | [4.731] | [13.877] | [9.289] | [10.832] | [7.387] |
| $R^2w$ | 0.144 | 0.153 | 0.015 | 0.029 | 0.258 | 0.074 | 0.107 | 0.242 |
| RMSE | 0.125 | 0.17 | 0.221 | 0.148 | 0.173 | 0.123 | 0.138 | 0.25 |
| Wald | 100.4 | 42.4 | 17.4 | 22.4 | 192.6 | 86.3 | 117.3 | 54.6 |
| N | 464 | 480 | 295 | 384 | 464 | 480 | 464 | 464 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δ(Comp) | –.365*** | –.370*** | –0.118*** | –0.167*** | –0.507*** | –0.269*** | –0.314*** | –0.402*** |
| | [–9.918] | [–6.422] | [–4.180] | [–4.688] | [–13.891] | [–9.401] | [–10.820] | [–7.236] |
| $R^2w$ | 0.134 | 0.138 | 0.014 | 0.028 | 0.258 | 0.073 | 0.099 | 0.232 |
| RMSE | 0.126 | 0.172 | 0.221 | 0.148 | 0.173 | 0.123 | 0.139 | 0.252 |
| Wald | 98.4 | 41.2 | 17.5 | 22 | 193 | 88.4 | 117.1 | 52.4 |
| N | 464 | 480 | 295 | 384 | 464 | 480 | 464 | 464 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δ(ULCrel) | –0.125** | –0.273*** | –0.049 | –0.039 | –0.168*** | –0.298*** | –0.188*** | –0.283*** |
| | [–3.092] | [–6.072] | [–0.906] | [–1.112] | [–7.339] | [–7.882] | [–5.729] | [–5.142] |
| $R^2w$ | 0.016 | 0.075 | 0.002 | 0.002 | 0.028 | 0.062 | 0.035 | 0.08 |
| RMSE | 0.134 | 0.178 | 0.223 | 0.15 | 0.198 | 0.124 | 0.143 | 0.275 |
| Wald | 9.6 | 36.9 | 0.8 | 1.2 | 53.9 | 62.1 | 32.8 | 26.4 |
| N | 464 | 480 | 295 | 384 | 464 | 480 | 464 | 464 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level; R2w = within groups R squared; RMSE = Root Mean Square Error.

Table 7 **Estimation results for the relationship between changes in the sectoral shares in value added and competitiveness (hourly wage data)**

| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
|---|---|---|---|---|---|---|---|---|
| Δ(Weq_h) | 0.218*** | 0.427*** | 0.282*** | 0.329*** | 0.317*** | 0.349*** | 0.368*** | 0.919*** |
| | [5.302] | [10.553] | [4.338] | [5.456] | [6.992] | [8.830] | [5.710] | [9.359] |
| R2w | 0.11 | 0.155 | 0.033 | 0.135 | 0.148 | 0.187 | 0.154 | 0.272 |
| RMSE | 0.131 | 0.144 | 0.225 | 0.124 | 0.182 | 0.112 | 0.134 | 0.235 |
| Wald | 28.1 | 111.4 | 18.8 | 29.8 | 48.9 | 78 | 32.6 | 87.6 |
| N | 428 | 416 | 261 | 366 | 440 | 460 | 318 | 448 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δ(Comp_h) | –0.230*** | –0.416*** | –0.288*** | –0.318*** | –0.319*** | –0.343*** | –0.349*** | –0.874*** |
| | [–5.345] | [–10.775] | [–5.066] | [–5.318] | [–7.027] | [–8.790] | [–5.855] | [–8.635] |
| R2w | 0.115 | 0.148 | 0.035 | 0.129 | 0.148 | 0.186 | 0.148 | 0.254 |
| RMSE | 0.131 | 0.144 | 0.224 | 0.124 | 0.182 | 0.112 | 0.135 | 0.238 |
| Wald | 28.6 | 116.1 | 25.7 | 28.3 | 49.4 | 77.3 | 34.3 | 74.6 |
| N | 428 | 416 | 261 | 366 | 440 | 460 | 318 | 448 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δ(ULCrel_h) | –0.297** | –0.276*** | –0.303 | –0.049 | –0.384*** | –0.319*** | –0.509*** | –0.961*** |
| | [–2.546] | [–5.590] | [–1.446] | [–0.472] | [–6.206] | [–8.565] | [–7.238] | [-5.370] |
| R2w | 0.013 | 0.052 | 0.003 | 0.001 | 0.029 | 0.071 | 0.067 | 0.094 |
| RMSE | 0.138 | 0.152 | 0.228 | 0.133 | 0.194 | 0.12 | 0.141 | 0.262 |
| Wald | 6.5 | 31.2 | 2.1 | 0.2 | 38.5 | 73.4 | 52.4 | 28.8 |
| N | 428 | 416 | 261 | 366 | 440 | 460 | 318 | 448 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level; R2w = within groups R squared; RMSE = Root Mean Square Error.

# 3. Determinants of competitiveness

Having proven that our measure of competitiveness is more effective in explaining the relative importance of the different sectors, we will now assess what factors are driving the evolution of equilibrium wages and competitiveness. The theoretical definition of equilibrium wages (equation 9) links competitiveness, as expressed by the ratio of actual to equilibrium wages, to capital intensity, capital productivity and the relative price effect.

In order to shed light on the determinants of equilibrium wages and competitiveness, we use a two-step methodology. In the first step, we focus on the capital–labour ratio and use a production function approach in order to derive an empirical specification relating capital accumulation to the dynamics of relative factor prices and to the bias in technical change. The latter is a measure of how capital intensity changed due to technological factors and to exogenous movements in factor prices. In the second step, we use the measure of bias in technical change as a determinant of equilibrium wages, together with the relative price effect. In both steps we introduce as additional explanatory variables two proxies for the globalisation process that characterised both advanced and developing countries since the start of the 1990s: import outsourcing and export intensity. We test whether these factors explain the specific changes that have occurred in the different countries under our analysis.

## 3.1 Theoretical model: a CES production function approach

The constant elasticity of substitution (CES) function is a general class of production functions that includes the well-known Cobb Douglas as a special case with elasticity of factor substitution equal to 1. The Cobb Douglas formulation is not useful for our purposes because, on one hand, most of the evidence points to an elasticity of substitution substantially below 1. On the other hand, as we mentioned in the introduction, the Cobb Douglas function does not allow changes in the factor shares, which are of the utmost importance in explaining competitiveness changes.

A general form of the CES production function includes both labour augmenting and capital augmenting parameters ($a_L$ and $a_K$):

$$Y = A[(a_L L)^{\rho} + (a_K K)^{\rho}]^{1/\rho}$$

where $\rho$ is the elasticity of substitution. The long-run profit maximisation implies that in equilibrium $L$ and $K$ are remunerated according to their marginal productivity:

$$MPL = A\left[(a_L L)^{\rho} + (a_K K)^{\rho}\right]^{\frac{1-\rho}{\rho}} a_L^{\rho} L^{\rho-1} = \frac{W}{P} \tag{12}$$

$$MPK = A\left[(a_L L)^{\rho} + (a_K K)^{\rho}\right]^{\frac{1-\rho}{\rho}} a_K^{\rho} K^{\rho-1} = \frac{r}{P} \tag{13}$$

Hence, in equilibrium the marginal rate of transformation between labour and capital equals the relative price of the two factors:

$$MRT = \left(\frac{a_L}{a_K}\right)^{\rho} \left(\frac{K}{L}\right)^{1-\rho} = \frac{W}{r} \tag{14}$$

This is, of course, an indicator of the equilibrium distribution of value added. With higher wages or lower return on capital (which in equilibrium is equal to interest rates), the MRT becomes steeper. We assume that all variables are stochastic and can change over time; thus by transforming equation (12) into logs and adding a time subscript we get:

$$\rho\,(loga_{Lt} - loga_{Kt}) + (1-\rho)\,(k_t - l_t) = w_t - r_t \tag{15}$$

which can be solved for the log of the capital–labour ratio:

$$k_t - l_t = \frac{\rho}{1-\rho}\,(loga_{Kt} - loga_{Lt}) + \frac{1}{1-\rho}\,(w_t - r_t) = \frac{\rho}{1-\rho}\gamma_t + \frac{1}{1-\rho}\,(w_t - r_t) \tag{16}$$

where

$$(loga_{Kt} - loga_{Lt}) = \gamma_t \tag{17}$$

Equation (16) states that in equilibrium the capital–labour ratio is a function of the relative factor price and of the difference between logs of capital augmenting and labour augmenting technical parameters. The parameter γ can then be considered a measure of biased technical change. Capital biased change, which implies a positive sign for $\gamma_t$, will save labour and *increase the capital share* (lower the labour

share), while a negative value of $\gamma_t$ implies that technical change has augmented the efficiency of labour inputs more than the efficiency of capital, *with a consequent rise in the labour share*. Hence, a positive $\gamma_t$ indicates technologies that save more labour than capital (also called Harrod-neutral technological progress) and thereby increase the equilibrium wage.

By first differentiating equation (16) we obtain a relation between (log) growth rates:

$$(18) \qquad \Delta\,(k_t - l_t) = \frac{\rho}{1-\rho}\,\Delta\gamma_t + \frac{1}{1-\rho}\,(\Delta w_t - \Delta r_t) = \frac{\rho}{1-\rho}\,\Delta\gamma_t + \frac{1}{1-\rho}\,\Delta rfp_t$$

which states that the growth rate of the capital–labour ratio is a linear combination of changes in the relative factor prices and changes in the ratio between the capital and labour augmenting parameters of the CES production function (the bias in technical change). Note that these are technological processes, although the adoption of such technology depends on microeconomic relative costs. For example, falling prices in IT technology will increase the incentive to adopt capital augmenting (labour saving) technology, while lower minimum wages may increase labour augmenting (capital saving) technology. While a lower minimum wage may be compensated in aggregate by higher wages elsewhere (especially for high skilled labour), a fall in interest rates relative to wages is likely to increase the K/L ratio and, ceteris paribus, the equilibrium wage.

This is an interesting result. It means that

- under certain conditions, the rise in equilibrium wages can be the consequence of actual wage increases, provided they are not inflationary and do not cause interest rate increases;
- a fall in the equilibrium wage may be caused by economic uncertainty and higher risk premia in the interest rate;
- a rise in the equilibrium wage may be the consequence of capital-biased technological change;
- to the degree that outsourcing of low-skill labour increases capital-biased technological change and the capital share (see below), outsourcing increases equilibrium wages and incentives for 'keeping jobs at home' may lower the equilibrium wage and competitiveness.

Interestingly, the developments after European monetary union started had very differentiated effects. In many southern crisis countries, but not in Germany, interest rates came down, thereby raising the capital–labour ratio and the equilibrium wage. But when the global financial crisis hit, this process was reversed. By contrast, in Germany, where interest rates were relatively stable, the change in equilibrium wages must be explained primarily by technological change.

## 3.2 Estimation of the bias in technical change

In order to obtain an empirical equivalent of equation (18) we would need data on the cost of capital for each manufacturing sector. The cost of capital is usually calculated as a weighted average of the cost of the different sources of firms' financing (also called the weighted average cost of capital [WACC]), where a main distinction is between debt financing and equity financing. In order to obtain estimates of the weighted average cost of capital representative firm-level data are required. Assuming efficient capital markets means that the weighted average cost of capital is the same across sectors and varies only over time. We can then estimate equation (18) by assuming that common variations in the weighted average cost of capital are captured by yearly dummies and the empirical specification becomes:

$$\Delta(k_{i,t} - l_{i,t}) = \beta_1 + \beta_2 \Delta w_{i,t} + \theta_t + u_i + \varepsilon_{i,t} \quad (19)$$

Where $u_i + \varepsilon_{i,t}$ is the error component made up of sector-specific effects and the two-way error term, whereas $\theta_t$ is a set of time dummies that controls for common changes in the weighted average cost of capital and for any other shocks common to all sectors. In particular, both domestic and external demand can generate important common effects. The two factors are also influenced by the fiscal and monetary policy stances, which have played an important role since the global financial crisis. We estimate equation (19) on a panel of *i* sectors over time for each country and use the fixed effect estimator (FE).

A proxy of biased technical change could be obtained from the estimated residuals. In this way, it can be expressed as the sum of the constant term and the sector-specific effects multiplied by a function of the elasticity of substitution:

$$\beta_1 + u_i + \varepsilon_{i,t} = \frac{\rho}{1-\rho}\Delta\gamma_i \quad (20)$$

Due to the lack of sector-specific data on the weighted average cost of capital, our final measure is multiplied by the ratio $\frac{\rho}{1-\rho}$ but since the use of a CES production function implies that capital and labour have a degree of complementarity, the elasticity of substitution ρ is below 1, which means that the sign of $\Delta(loga_k - loga_l)$ and that of equation (20) are the same. This means that the indices of bias in technical change built in this way are a monotonic transformation of the real indexes, providing by consequence the same information on the dynamics of capital intensity due to biases in technology.

Among the determinants of factor intensities, the delocalisation of production, which can be classified as a form of technical change, plays an important role. Recent works on the subject (Timmer *et al.* 2014; Amador *et al.* 2015) indicate a transformation of the labour market. The increased fragmentation of production processes across different countries is usually associated with an increase in the relative use of capital and skilled labour. This is explained by the increased importance of new technologies embedded in capital equipment, especially ICT and financial capital in favouring the delocalisation of some stages of production. These

types of capital are a complement to skilled labour (Autor *et al.* 2003; Acemoglu 1999; Acemoglu 2002; Esposito and Stehrer 2012), and a substitute for medium and low skilled jobs. Finally, the effect on the capital–labour ratio depends on the recomposition of employment among skill groups. (Timmer *et al.* 2014) show that among the main euro area countries, the effect is positive – that is, it increases the capital share – for Germany, the Netherlands and Spain, null for France and negative for Italy. The effect for the latter is due to a small reduction in the capital share caused by the strong increase in the share of medium-skilled workers. This literature emphasises changes in factor shares and their dynamics. It is broadly consistent, on a descriptive level, with our sectoral measure of the profit shares which report a reduction in the wage share for most of the countries.

In order to control for the effect of outsourcing on factor intensities we augment equation (19) by introducing the share of imported intermediates in total intermediate inputs ($ImpII$), which represent the inward outsourcing process, and the share of exports in total value added ($ExpVA$) representing a general measure of export intensity. The two measures are taken from the OECD World Input Output Database (Timmer *et al.* 2015) and represent better proxies of outsourcing and export intensity than the standard national accounts and custom data. The estimated specification is as follows:

$$(21) \qquad \Delta(k_{i,t} - l_{i,t}) = \beta_1 + \beta_2 \Delta \log(w_{i,t}) + \beta_3 \Delta ImpII_{i,t} + \beta_4 \Delta ExpVA_{i,t} + \theta_t + u_i + \varepsilon_{i,t}$$

The difference in *btc* estimates between equations (19) and (21) is an indirect measure of how much of the change in factor intensities is due to the globalisation of production processes.

Equations (19) and (21) are estimated using the fixed effects (FE) estimator. In addition, separate specifications are estimated for the manufacturing sector and for services, given their different behaviour in terms of international competitiveness and outsourcing relations. Before discussing the estimation results, we must clarify that our approach is different from the studies mentioned above (Timmer *et al.* 2014) as we are interested in the determinants of the capital–labour ratio, which is on the LHS of equation (18), while they assessed the change in relative factor prices due to the outsourcing process.

The estimation results are shown in Tables 8 and and 10, while in Table 11 we show the distribution of biased technical change (see equation 20) in manufacturing and services for the different countries. In Table 10 we also show the same estimates for capital per hours worked rather than capital per worker; the results are fairly similar, which is why we stick to average wages in the other tables.

In manufacturing (Table 8), we find that the impact of the average wage on the capital–labour ratio has a significant coefficient close to unit in Spain and France, while in Finland its impact is around 0.3. In the other countries (Italy, Germany, Netherlands, Austria, Belgium), wage movements alone are not significant in explaining the change in the capital–labour ratio, because the coefficients are not significant and this is not an estimation of the elasticity of substitution.

Timmer *et al.* (2014) have found evidence for the thesis that firms in mature economies relocate their unskilled labour-intensive production activities to lower-wage countries, while keeping strategic and high-value-added functions concentrated at home where the skilled workers and intangible capital they need are available.

Our results tend to confirm the findings of Timmer *et al.* (2014). The impact of inward outsourcing – that is, of buying intermediary inputs abroad rather than producing them locally – is negative and significant in Germany and the Netherlands. This result is in line with the assumption **that capital intensive stages of production are more likely to be delocalised, reducing by consequence the ratio within each manufacturing industry**. It must be noted that while this effect implies a reduction in equilibrium wages (see formula 9), the total effect of outsourcing on equilibrium wages depends nevertheless also on its impact on capital productivity (see section 3.3 below). Finally, export intensity is positive and significant in Italy, Spain and, to a lower extent, in the Netherlands, whereas it is negative and significant in Germany. The positive impact implies that, having controlled for the outsourcing process, an increase in the export intensity of the first three countries is associated with higher capital intensity. This result can be intuitively explained by two factors: first, in order to compete in international markets firms must invest more in new technologies and in product quality; second, the role of firm size is important as larger firms are more likely to be stay competitive in international markets and larger firms are usually more capital intensive. The German case, instead, can be explained by the higher role played by inward outsourcing and by the labour market reforms that helped to maintain high levels of employment despite the overall technological progress taking place in the global economy. This is also coherent with Sinn's (2006) hypothesis that during the previous decade Germany had become a bazaar economy specialised in low value added exports.

Turning to the service sector (Table 10), we find wages to have a positive and significant impact on the capital–labour ratio in Italy, Spain and France, with coefficients ranging from 0.36 to 0.58. Outsourcing seems to play a role only in Finland, where the share of imported intermediate input increases the capital to labour ratio. The export intensity is, instead, never significant. These results are not unexpected as the bulk of outsourcing covers manufactured goods, benefitting the service sector through the use of globally built equipment goods. The heterogeneity in the sectoral requirements in terms of imported capital goods and the distinction between tradable and non-tradable services add to the difficulty of identifying significant correlations.

To sum up, the estimates indicate that the manufacturing and service sectors behave differently in all countries. In manufacturing, international outsourcing is particularly important in explaining the German dynamics of capital intensity, whereas export intensity seems to have a more generalised effect.

Table 8 **Dependent variable log of the capital–labour ratio for manufacturing**

| Basic specification (equation 19) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δw | 0.148 | 0.183 | 0.908*** | 0.928** | –0.156 | 0.181 | 0.229 | 0.322** |
| | [0.152] | [0.168] | [0.170] | [0.273] | [0.665] | [0.590] | [0.227] | [0.097] |
| $R^2w$ | 0.162 | 0.119 | 0.317 | 0.249 | 0.131 | 0.076 | 0.227 | 0.201 |
| N | 192 | 208 | 121 | 132 | 192 | 208 | 192 | 192 |
| **Outsourcing augmented specification (equation 21)** | | | | | | | | |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δw | 0.052 | 0.169 | 1.015** | 1.001** | 0.018 | 0.200 | 0.228 | 0.282** |
| | [0.144] | [0.140] | [0.319] | [0.339] | [0.592] | [0.641] | [0.229] | [0.113] |
| ΔImpII | –0.304 | –0.146** | –1.453 | –0.38 | –0.576* | 0.402 | –0.082 | 0.038 |
| | [0.234] | [0.066] | [0.861] | [0.260] | [0.273] | [0.297] | [0.138] | [0.215] |
| ΔExpVA | 0.026** | –0.034*** | 0.023* | –0.006 | 0.014*** | 0.000 | 0.007 | 0.019 |
| | [0.010] | [0.003] | [0.011] | [0.010] | [0.002] | [0.024] | [0.006] | [0.018] |
| $R^2w$ | 0.179 | 0.238 | 0.388 | 0.257 | 0.194 | 0.088 | 0.234 | 0.228 |
| N | 191 | 208 | 121 | 132 | 192 | 208 | 192 | 192 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. RoC=adjusted return on capital; Wage=average compensation per employee. Imp/II=Imports on intermediate inputs (from input output tables). Exp/VA=Exports on value added (from input output tables). R2w=within groups R squared.

Table 9 **Dependent variable log of the capital–labour (in hours) ratio for manufacturing; hourly wages**

| Basic specification (equation 19) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δw | 0.662** | 0.305 | 1.024*** | 0.685** | –0.195 | 0.049 | –0.078 | 0.641*** |
| | [0.181] | [0.188] | [0.189] | [0.192] | [0.405] | [0.388] | [0.106] | [0.111] |
| $R^2w$ | 0.403 | 0.357 | 0.361 | 0.236 | 0.107 | 0.09 | 0.369 | 0.405 |
| N | 160 | 176 | 121 | 128 | 192 | 208 | 120 | 192 |
| **Outsourcing augmented specification (equation 21)** | | | | | | | | |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δw | 0.664** | 0.251 | 1.042** | 0.772** | –0.102 | 0.091 | –0.072 | 0.587** |
| | [0.195] | [0.149] | [0.236] | [0.292] | [0.364] | [0.388] | [0.107] | [0.138] |
| ΔImpII | –0.360** | –0.168*** | –1.46 | –0.272 | –0.549* | 0.321 | 0.015 | –0.066 |
| | [0.098] | [0.034] | [0.813] | [0.265] | [0.253] | [0.349] | [0.257] | [0.244] |
| ΔExpVA | 0.01 | –0.034*** | 0.023 | –0.005 | 0.014*** | –0.005 | 0.002 | 0.023 |
| | [0.006] | [0.003] | [0.013] | [0.008] | [0.002] | [0.017] | [0.002] | [0.017] |
| $R^2w$ | 0.415 | 0.453 | 0.43 | 0.24 | 0.176 | 0.098 | 0.37 | 0.428 |
| N | 159 | 176 | 121 | 128 | 192 | 208 | 120 | 192 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. RoC=adjusted return on capital; Wage=average compensation per employee. Imp/II=Imports on intermediate inputs (from input output tables). Exp/VA=Exports on value added (from input output tables). R2w=within groups R squared.

Table 10 **Dependent variable log of the capital-labour ratio for services**

| Basic specification (equation 19) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δw | 0.301** | 0.092 | 0.401*** | 0.485* | 0.533* | 0.409 | 0.203 | 0.208 |
| | [0.104] | [0.097] | [0.079] | [0.223] | [0.274] | [0.249] | [0.127] | [0.248] |
| $R^2w$ | 0.32 | 0.1 | 0.427 | 0.328 | 0.106 | 0.117 | 0.124 | 0.105 |
| N | 192 | 192 | 119 | 192 | 192 | 192 | 192 | 192 |
| **Outsourcing augmented specification (equation 21)** | | | | | | | | |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| Δw | 0.367** | 0.022 | 0.395*** | 0.585** | 0.542 | 0.618 | 0.107 | 0.196 |
| | [0.082] | [0.113] | [0.080] | [0.199] | [0.368] | [0.363] | [0.075] | [0.242] |
| ΔImpII | 0.149 | 0.577 | −1.126* | −0.667 | −0.178 | 0.198 | 0.012 | 0.465** |
| | [0.375] | [0.389] | [0.599] | [0.487] | [0.413] | [0.497] | [0.170] | [0.149] |
| ΔExpVA | 0.384 | −0.102 | −0.114 | 0.372 | 0.123 | −0.07 | −0.051 | 0.057 |
| | [0.401] | [0.109] | [0.214] | [0.273] | [0.147] | [0.083] | [0.041] | [0.090] |
| $R^2w$ | 0.377 | 0.122 | 0.444 | 0.347 | 0.11 | 0.143 | 0.118 | 0.163 |
| N | 176 | 176 | 108 | 176 | 176 | 176 | 176 | 176 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. RoC=adjusted return on capital; Wage=average compensation per employee. Imp/II=Imports on intermediate inputs (from input output tables). Exp/VA=Exports on value added (from input output tables). R2w=within groups R squared.

The distributions of the capital biased (that is, labour saving) technical change in the two main macro-sectors – $\frac{\rho}{1-\rho}\Delta\gamma_i$ as calculated in equation (20) and derived from Tables 8 and 10 – are shown in Table 11. The numbers indicate the final value of the factor changes in the log of the ratio $a_k/a_l$, that is, $(loga_{Kt} - loga_{Lt}) = \gamma_t$ (multiplied by the term $\rho/1-\rho$) and its probability distribution in terms of percentiles. A positive value indicates a bias in favour of capital, while a negative value indicates a bias in favour of labour. Values on the 50 per cent column indicate the median change of the ratio, and a similar logic applies to the other percentiles. Thus, for example in Germany 75 per cent of all manufacturing sectors use labour-saving technology, but in France it is only 25 per cent and in Spain even less. By contrast, in the service sector, the distribution is close to 50:50 in all countries.

The estimates reveal useful information, which integrates the evidence collected so far. In aggregate, all euro area member states reveal capital-augmenting biased technological change, although the estimates confirm the difference between manufacturing and services, the former having experienced a higher tendency to a capital bias in technical change, as shown by the median values (50 per cent). In all countries and in both macro-sectors the results come from strong changes between individual sectors, with particularly large tails in Finland, Austria, and the Netherlands in manufacturing. The latter two show similar dynamics also in services, and Spain shows sectors with particularly low levels. The Spanish case can be explained by the large immigration from Latin America, which is concentrated in labour intensive sectors, whereas the peaks in capital biases might be due to the role of multinational investment and the high increase in the share of college graduates during the past 20 years.

Table 11 **Distribution of the log growth rate of biased technical change in manufacturing (percentiles)**

| Manufacturing | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0.01 | 0.05 | 0.10 | 0.25 | 0.50 | 0.75 | 0.90 | 0.95 | 0.99 |
| Austria | –0.31 | –0.11 | –0.04 | 0.01 | 0.04 | 0.07 | 0.11 | 0.17 | 0.28 |
| Belgium | –0.29 | –0.07 | –0.01 | 0.03 | 0.06 | 0.09 | 0.11 | 0.12 | 0.22 |
| Germany | –0.08 | –0.01 | 0.00 | 0.02 | 0.05 | 0.07 | 0.10 | 0.11 | 0.23 |
| Spain | –0.22 | –0.15 | –0.11 | –0.06 | –0.04 | 0.00 | 0.05 | 0.10 | 0.26 |
| Finland | –0.37 | –0.08 | –0.03 | 0.03 | 0.07 | 0.10 | 0.14 | 0.18 | 0.29 |
| France | –0.19 | –0.14 | –0.09 | –0.05 | –0.02 | 0.01 | 0.04 | 0.06 | 0.28 |
| Italy | –0.13 | –0.05 | –0.03 | 0.00 | 0.02 | 0.05 | 0.07 | 0.08 | 0.13 |
| Netherlands | –0.21 | –0.11 | –0.06 | –0.03 | –0.01 | 0.01 | 0.07 | 0.10 | 0.34 |
| Services | | | | | | | | | |
| | 0.01 | 0.05 | 0.10 | 0.25 | 0.50 | 0.75 | 0.90 | 0.95 | 0.99 |
| Austria | –0.37 | –0.13 | –0.08 | –0.04 | –0.01 | 0.02 | 0.05 | 0.08 | 0.17 |
| Belgium | –0.11 | –0.06 | –0.04 | –0.02 | 0.00 | 0.03 | 0.05 | 0.08 | 0.17 |
| Germany | –0.09 | –0.04 | –0.03 | –0.01 | 0.01 | 0.03 | 0.04 | 0.05 | 0.15 |
| Spain | –0.26 | –0.15 | –0.09 | –0.04 | –0.01 | 0.02 | 0.06 | 0.09 | 0.15 |
| Finland | –0.11 | –0.06 | –0.04 | –0.02 | 0.00 | 0.02 | 0.05 | 0.07 | 0.13 |
| France | –0.19 | –0.07 | –0.05 | –0.01 | 0.03 | 0.05 | 0.09 | 0.12 | 0.21 |
| Italy | –0.15 | –0.09 | –0.05 | –0.01 | 0.02 | 0.05 | 0.10 | 0.12 | 0.21 |
| Netherlands | –0.40 | –0.17 | –0.09 | –0.02 | 0.02 | 0.06 | 0.12 | 0.17 | 0.34 |

Source: Authors' estimation.

## 3.3 Biased technical change, outsourcing and competitiveness

From equation (9) we know that equilibrium wages depend crucially on the relative price effect, on the capital–labour ratio and on capital productivity. In the previous section we extracted the part of the changes in the capital–labour ratio due to factor price movements and assumed that the residual is a measure of the bias in technological change (*btc*), including the effects of outsourcing and export intensity. In this section, we seek to understand what forces are driving changes in wage competitiveness as described by the gap between equilibrium and actual wages.

The bias in technical change remains the main explanatory variable, but we also add the price effect (the relative GDP deflator) and the two measures of inward outsourcing and export intensity used in the previous analysis. The latter are included because they can affect competitiveness through other channels than the relative change in factor use. For example, by simply increasing the amount of trade they can foster the diffusion of international knowledge spillovers (Coe and Helpmann 1995) or the exploitation of economies of scale, or increase productivity due to efficient production delocalisation and to a market size effect (Rodrik 1988) (Yeaple 2005). All these factors imply an increase in capital productivity and therefore affect equilibrium wages as we have defined them.

The estimated specification is as follows:

$$(22) \qquad \Delta Comp_{i,t} = \alpha + \beta_1 btc_t + \beta_2 \Delta ImpII_{i,t} + \beta_3 \Delta ExpVA_{i,t} + \beta_4 \Delta PYeff_{i,t} + \theta_t + u_i + \varepsilon_{i,t}$$

where *PYeff* is the GDP price effects, defined as the log difference between European and national prices, and *Comp* is the measure of wage competitiveness given by the ratio of actual to equilibrium wages. Hence, **an increase in $\Delta Comp_{i,t}$ reflects a deterioration of competitiveness**. The coefficients $\theta$ and $u$ represent, as before, time and sector-specific dummies. We do not include the relative capital deflator as it turned out to be never significant. The equation is estimated, as before, with the fixed effect estimator.

The results are shown in Table 12 for manufacturing and in Table 13 for services. Each panel presents specifications adding one by one the variables of equation 22, starting with *btc* only. In manufacturing, the common result is the positive and significant impact of the relative price effect, the only exception being Austria. The inward outsourcing variable is negative and significant in Germany, France and Austria, leading to higher competitiveness, whereas it is positive, although only weakly significant, in Spain. Finally, the export intensity is positive and significant in all countries except Spain (where it is negative), while it is insignificant in Belgium and Finland.

The bias in technical change has a differentiated effect. In Italy it is negative but it turns insignificant when controlling for the price effect; in Germany it is positive but it becomes insignificant when export intensity is added; in France it is robustly negative and significant in all specifications, implying that having controlled for all other factors the capital bias in technical change has increased the competitiveness of the country; a similar result holds weakly for Finland. In Spain, Austria and the Netherlands it is instead positive and significant, implying that a bias in favour of capital and labour saving actually causes a reduction in competitiveness. The results for these countries can be explained by the negative dynamics of capital productivity caused by changes in the capital–labour ratio, not due to the effects of outsourcing and export intensity. This assumption seems to be in line with the reduced dynamics of manufacturing capital productivity, as shown in Figures A2.1, A2.6 and A2.10.

Turning to the service sector (Table 13) the evidence is much weaker. The price effect tends to be positive and significant, whereas neither inward outsourcing not export intensity play a role in explaining wage competitiveness. This result is in line with the previous finding. Finally, the bias in technical change is significant only in Germany and with a positive sign, which indicates deterioration in competitiveness in services. This suggests that in this country services absorbed most of the low wage-low value added jobs created as a consequence of the labour market reforms (Hartz IV and so on) and by the recomposition of employment in manufacturing.

Table 12 **Estimates of competitiveness for manufacturing industries**

| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
|---|---|---|---|---|---|---|---|---|
| btc | −0.468*** | 0.293** | 0.092* | −0.088*** | −0.565 | 0.677*** | 0.389 | −0.355 |
| | [0.084] | [0.070] | [0.045] | [0.012] | [0.678] | [0.100] | [0.242] | [0.207] |
| R2w | 0.14 | 0.172 | 0.218 | 0.367 | 0.156 | 0.357 | 0.174 | 0.153 |
| N | 189 | 208 | 119 | 128 | 187 | 208 | 192 | 192 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| btc | −0.01 | 0.295** | 0.054** | −0.013*** | 0.818** | 0.634*** | 0.491 | −0.416 |
| | [0.092] | [0.073] | [0.023] | [0.001] | [0.217] | [0.081] | [0.275] | [0.254] |
| ΔPYeff | 1.314*** | 0.251*** | 3.026*** | 0.996*** | 1.921*** | −0.211*** | 0.956*** | 0.933*** |
| | [0.045] | [0.007] | [0.145] | [0.033] | [0.064] | [0.013] | [0.177] | [0.127] |
| $R^2w$ | 0.617 | 0.243 | 0.829 | 0.789 | 0.673 | 0.46 | 0.365 | 0.415 |
| N | 189 | 208 | 119 | 128 | 187 | 208 | 192 | 192 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| btc_ | −0.04 | 0.517*** | 0.050** | −0.013*** | 0.767** | 0.615*** | 0.49 | −0.38 |
| | [0.054] | [0.066] | [0.022] | [0.001] | [0.232] | [0.075] | [0.274] | [0.242] |
| ΔPYeff | 1.322*** | 0.336*** | 3.036*** | 0.998*** | 1.951*** | −0.209*** | 0.946*** | 0.873*** |
| | [0.036] | [0.020] | [0.144] | [0.034] | [0.069] | [0.012] | [0.182] | [0.089] |
| ΔImpII | 1.109 | −1.783*** | 0.618 | 0.228 | 0.832* | −0.745** | −0.18 | 1.257 |
| | [0.946] | [0.255] | [0.594] | [0.302] | [0.446] | [0.174] | [0.376] | [0.865] |
| $R^2w$ | 0.632 | 0.336 | 0.83 | 0.789 | 0.68 | 0.477 | 0.365 | 0.444 |
| N | 188 | 208 | 119 | 128 | 187 | 208 | 192 | 192 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| btc_ | −0.015 | 0.109 | 0.048** | −0.024*** | 0.805** | 0.617*** | 0.488* | −0.194* |
| | [0.081] | [0.099] | [0.020] | [0.004] | [0.202] | [0.070] | [0.270] | [0.101] |
| ΔPYeff | 1.317*** | 0.335*** | 3.192*** | 0.871*** | 1.784*** | −0.200*** | 0.957** | 0.811*** |
| | [0.037] | [0.032] | [0.203] | [0.029] | [0.081] | [0.014] | [0.236] | [0.101] |
| ΔImpII | 0.855 | −3.302*** | 1.131* | −0.724** | 0.112 | −1.045*** | −0.145 | 0.224 |
| | [0.781] | [0.611] | [0.622] | [0.265] | [0.627] | [0.170] | [0.454] | [0.379] |
| ΔExpVA | 0.073 | 0.217*** | −0.133** | 0.210*** | 0.020*** | 0.164*** | −0.003 | 0.176*** |
| | [0.086] | [0.025] | [0.038] | [0.013] | [0.004] | [0.019] | [0.017] | [0.018] |
| $R^2w$ | 0.635 | 0.595 | 0.857 | 0.876 | 0.708 | 0.626 | 0.365 | 0.633 |
| N | 188 | 208 | 119 | 128 | 187 | 208 | 192 | 192 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. btc=bias in technological change. r2w=within groups R squared.

To sum up, our results indicate that the bias in technical change, outsourcing and export intensity exert a strong impact on wage competitiveness and that these effects are concentrated in the manufacturing sector. The results, combined with those in section 3.2 provide an interesting explanation for the German case:

— the outsourcing process has improved the country's competitiveness because the negative effect on capital intensity is more than compensated by the positive effect on capital productivity;
— on the other hand, the increased export intensity has lowered competitiveness as it reduced both capital intensity and capital productivity.

Table 13 **Estimates of competitiveness for manufacturing industries**

| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
|---|---|---|---|---|---|---|---|---|
| btc | −1.257 | 0.153 | 0.574* | −0.582 | −0.006 | −0.122 | 0.153 | 0.184 |
| | [1.054] | [0.206] | [0.280] | [0.393] | [0.050] | [0.163] | [0.160] | [0.170] |
| R2w | 0.222 | 0.087 | 0.372 | 0.24 | 0.058 | 0.145 | 0.058 | 0.085 |
| N | 191 | 176 | 87 | 174 | 176 | 176 | 186 | 176 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| btc | −1.222 | 0.202 | 0.508* | −0.524 | 0.098 | −0.01 | 0.229 | 0.152 |
| | [1.109] | [0.248] | [0.230] | [0.454] | [0.102] | [0.132] | [0.162] | [0.164] |
| ΔPYeff | 0.159 | 0.252 | 1.182*** | 0.35 | 1.289*** | 0.853** | 0.875* | 1.065** |
| | [0.594] | [0.186] | [0.200] | [0.394] | [0.243] | [0.334] | [0.403] | [0.239] |
| $R^2w$ | 0.222 | 0.096 | 0.396 | 0.244 | 0.312 | 0.196 | 0.101 | 0.35 |
| N | 191 | 176 | 87 | 174 | 176 | 176 | 186 | 176 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| btc_ | −1.688 | 0.454** | 0.504 | −0.596 | 0.092 | −0.029 | 0.137 | 0.138 |
| | [1.459] | [0.144] | [0.285] | [0.490] | [0.108] | [0.133] | [0.233] | [0.188] |
| ΔPYeff | 0.866 | 0.383** | 1.309*** | 0.283 | 1.261*** | 0.798** | 0.925** | 1.075** |
| | [0.577] | [0.138] | [0.206] | [0.487] | [0.245] | [0.352] | [0.415] | [0.236] |
| ΔImpII | 3.834 | 0.614 | −0.273 | −2.523 | 0.656 | 0.347 | 0.924 | −0.620** |
| | [2.655] | [0.533] | [1.644] | [2.476] | [0.547] | [0.904] | [0.743] | [0.264] |
| $R^2w$ | 0.262 | 0.142 | 0.4 | 0.276 | 0.311 | 0.199 | 0.115 | 0.37 |
| N | 175 | 160 | 76 | 158 | 160 | 160 | 170 | 160 |
| | ITA | DE | ESP | FR | NL | AUT | BEL | FIN |
| btc_ | −1.665 | 0.456** | 0.498 | −0.596 | 0.087 | −0.044 | 0.094 | 0.144 |
| | [1.449] | [0.142] | [0.290] | [0.491] | [0.101] | [0.135] | [0.237] | [0.190] |
| ΔPYeff | 0.723 | 0.381** | 1.374** | 0.28 | 1.154*** | 0.708* | 0.913* | 1.068** |
| | [0.590] | [0.138] | [0.287] | [0.509] | [0.221] | [0.346] | [0.430] | [0.233] |
| ΔImpII | 2.735 | 0.658 | −0.25 | −2.522 | −0.175 | 0.351 | 0.435 | −0.602** |
| | [2.399] | [0.513] | [1.669] | [2.481] | [0.618] | [0.972] | [0.641] | [0.263] |
| ΔExpVA | 2.268 | −0.249 | −0.253 | 0.054 | 0.390 | 0.381* | 0.436 | 0.12 |
| | [3.047] | [0.263] | [1.002] | [0.833] | [0.341] | [0.180] | [0.247] | [0.132] |
| $R^2w$ | 0.267 | 0.143 | 0.4 | 0.276 | 0.326 | 0.214 | 0.134 | 0.372 |
| N | 175 | 160 | 76 | 158 | 160 | 160 | 170 | 160 |

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. btc: bias in technological change. r2w=within groups R squared.

— the actual changes in these two variables suggest that the effect of inward outsourcing prevails, meaning that competitiveness has actually improved due to globalisation.

The effect of export intensity is common to most of the countries, suggesting that it is the result of a general tendency affecting the whole European economy, while *btc* appears to be particularly important in the other northern countries, as well as in Spain. Among core countries, France and, to a lesser extent, Finland, seem to be the only gainers from this process.

# 4.
# Policy-relevant conclusions

In this report we have developed an innovative measure for determining equilibrium wage levels. Our measure for equilibrium wages and competitiveness defines conditions under which wage increases are compatible with competitiveness. We have argued that wages matter for competitiveness, but without an appropriate benchmark it is impossible to say whether wages are too high or too low. However, it is also true that wages are an important component of aggregate demand. When austerity policies seek to lower wages in order to improve competitiveness, they cut demand and reduce output and therefore affect the productivity of capital and labour negatively, which in turn hampers competitiveness. Greece is the most dramatic example of such a vicious circle.

So-called wage-led growth theories have argued that because austerity is often associated with falling wage shares and rising unemployment, increasing the wage share could overcome the negative effects of austerity. But these theories ignore the effects of higher wages on competitiveness. They do not have an explanation for the equilibrium level of wages and the wage share (which is the same as real unit labour costs), and therefore suffer from not being able to assess whether the demand effect of higher wages is or is not compensated by a loss of competitiveness.

A reasonable benchmark for determining equilibrium wage levels in the European Union, we have argued, can be derived from the return on capital in a given country or industry relative to the average return on capital in the euro area. Wage levels are competitive if they are below equilibrium, contributing to levels of profitability that are above the euro area average, so that they can attract investment and accelerate economic growth. By contrast, wages above equilibrium hamper regional and

sectoral growth. We have found a clear relationship between deviations of national and sectoral growth rates caused by the wage gap, and this relationship is better explained by our index than by conventional unit labour cost–based measures. Thus, competitiveness positions within the currency area will determine regional and sectoral divergences in growth rates and they are therefore an important variable for designing strategies of balanced growth.

With regard to balanced growth in the European Union, it might be justifiable to accept competitive wage undervaluations in catch-up regions with low per capita income, but this cannot be a sustainable strategy for more advanced countries. In fact, it would be reasonable to have wage levels slightly above equilibrium in rich countries and below in poor countries. Table 1 has documented that the new member states in central and eastern Europe have huge wage undervaluations, which clearly distort balanced growth in the European Union.

A correction of these disequilibria would generate a significant demand boom in all member states. However, left to market forces – that is, relying on Philips-curve dynamics and no deliberate wage policy – the correction would be slow; our estimates indicate that it would take on average three years and 10 months to reduce a wage gap by half. By contrast, a deliberate one-off wage increase of 20 per cent in all those countries in which actual wages are more than 20 per cent below equilibrium would yield a demand stimulus of 1.9 per cent for the EU (2.1 per cent for the euro area) in terms of GDP and 17.6 per cent in terms of intra-EU trade. Such a stimulus could improve the fiscal position in Europe's southern crisis countries and contribute to price stability in an environment in which inflation is presently hovering at zero per cent or falling into negative territory, although it would also slow down catch-up growth. Wage developments always have structural implications.

## Implications for wage bargaining

Trade unions seek higher wages for workers. The margins for wage increases depend on the development of equilibrium wages. If we use the return on capital as the evaluative benchmark, capital productivity, technological change and the transformation of an economy's supply side move into the focus of analysis. In this case, wage setting rules become more complex than the frequently used Rehn-Meidner rule, whereby nominal wages ought to increase at a rate that is the sum of labour productivity growth and inflation. This rule ensures that the wage share remains constant, so that wage bargaining is distributionally neutral. However, the return on capital is defined as the product of the wage share and nominal capital productivity (which we have called average capital efficiency). Distributional neutrality becomes counter-productive when technological change modifies the capital intensity of production, thereby shifting the productivity of capital and labour and the share of capital required to remunerate capital. Hence, changes in average capital efficiency will affect the equilibrium wage and competitiveness and this needs to be taken into account in wage bargaining.

In general and ceteris paribus, the sector-specific equilibrium wage will increase if the productivity of capital increases faster in a given industrial sector or region than in the euro area as a whole. Thus, if an industry or country needs to improve its competitiveness, it must focus on policies that increase capital productivity. This is easily said, but difficult to do. Such a complex policy objective is not achieved by simple rules of thumb, such as the Rehn-Meidner rule.

Whether a sector will actually gain competitiveness will depend on whether actual wages reflect these improvements in capital efficiency. But this adjustment is usually determined by the political regime of wage negotiations. In decentralised regimes, where wage increases reflect marginal labour productivity, the gap between actual and equilibrium wages can be expected to be minimal. By contrast, with centralised wage setting, where actual wage levels reflect *average* productivity *levels*, the sectoral gaps may be substantial, so that the highly productive sectors attract additional investment. This is the case, for example, in Scandinavia, where highly productive sectors gain competitiveness at the margin, By contrast, decentralised wage bargaining, as in Anglo-Saxon-type countries, can sustain competitiveness by wage flexibility, but this will slow down productivity improvements and technological progress.

Because the average efficiency of capital in a sector or country is defined in nominal terms, competitiveness will depend not only on technological factors, but also on the relative prices of capital inputs and output relative to the euro area. In order to minimise distortive effects resulting from changes in average capital efficiency, economic and monetary policy ought to focus not only on the stability of consumer prices, but also on the relative stability of regional and sectoral indicators for GDP deflators and price indices for capital goods. If a country's average inflation (measured by the GDP deflator) exceeds that of the euro area, the equilibrium wage will temporarily increase, but as the prices for capital goods catch up with the general price level, the effect will be annulled (see equation 6). Thus, what matters most in the long run is the development of capital productivity.

The long-run factors determining sectoral and regional capital and labour productivity in real terms are complex and require further research. Our study has nevertheless revealed that equilibrium wages in euro area member states depend crucially on changes in the capital–labour ratio, which is dependent on the importance of relative factor prices (the cost of labour relative to the cost of capital) and technical change biases. We found that the actual performance in different countries varies partly because different sectors respond differently to varying technological change. While technological progress has a tendency to affect manufacturing and services in similar ways, outsourcing and exports do not have the same effect. This means that wage bargaining in different sectors has to be careful to take into account the effects of technology and the related reorganisation of labour relations on the productivity of capital and labour.

This analysis is of great importance for designing a balanced growth strategy for Europe. The relative importance of specific sectors varies significantly between member states of the euro area (see Table 3). As a consequence, the evolution

of equilibrium wages will change as well. However, the sectoral distribution of economic activity alone is not enough to determine a region's competitiveness. As the Figures A1 in the annex show, it is frequently the case that an industry has a competitive advantage with regard to the average of the euro area overall, but not with regard to the specific European industry. In other words, while a particular sector may be a growth sector with attractive returns to capital in general, a given member state may not perform as well as its neighbours in this sector. For example, manufacturing in Belgium, which represents 15.7 per cent of value added, is competitive relative to the European average, but not with regard to manufacturing in the euro area. By contrast, this country is highly competitive in agriculture and IT services. In France, manufacturing has lost its competitiveness with regard to other countries' manufacturing industries, but its manufacturing sector still yields higher returns on capital than the euro average. In Germany most sectors have undervalued wage levels, although less competitive sectors – mostly in services and agriculture – account for slightly more than 20 per cent of total value added.

Dealing with these discrepancies does not make policy advice easy. There is no simple rule of thumb, although better knowledge would help to negotiate wage deals that generate sustainable wage increases. Of course, sector-specific wage gaps and imbalances can be corrected up or down by diversified wages settlements in each sector and country. However, as the aggregate picture for Greece shows, when nominal wage setting affects productivity and production functions, wage restraint can be as detrimental as wage exuberance. A more sustainable approach would require a coherent economic policy approach that removes inhibitions to technological progress and focuses on supporting the growth of productivity in labour and capital. The European Commission has suggested that national governments set up **National Competitiveness Boards.** However, uncoordinated national boards will not take into account relative competitive, which depends on the average performance of the euro area. It would be better to set up a **European Competitiveness Board**, possibly in the EESC (European Economic and Social Committee), where the national social partners are already represented.

Cooperation between social partners, especially if it is institutionally founded, is surely more likely to generate positive results in the long run. This raises the question of what the right social model for Europe would be.

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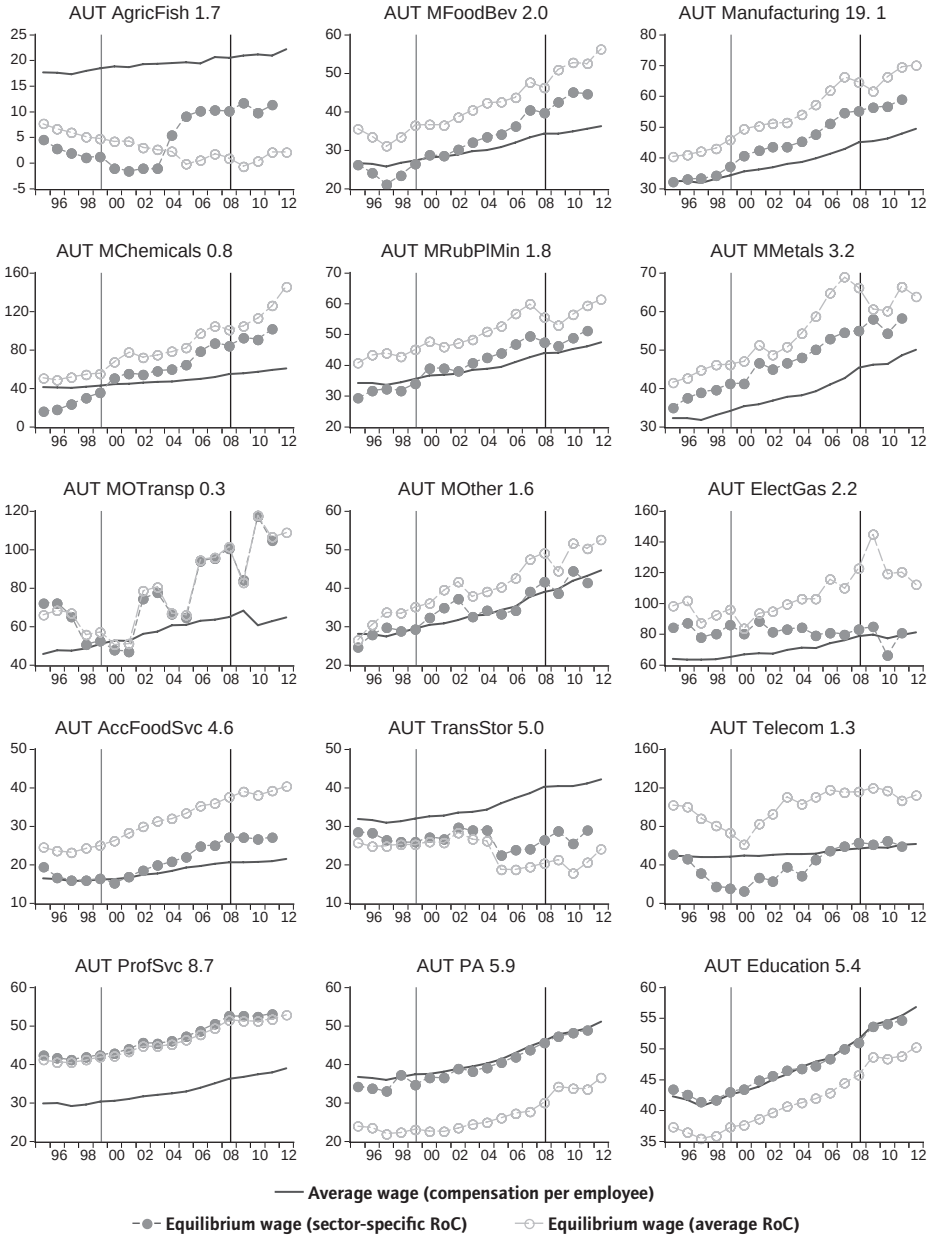
All links were checked on 14.11.2016.

# Appendix

# Appendix 1
# Sectoral evolution of actual and equilibrium wages

Figure A1.1 **Austria**

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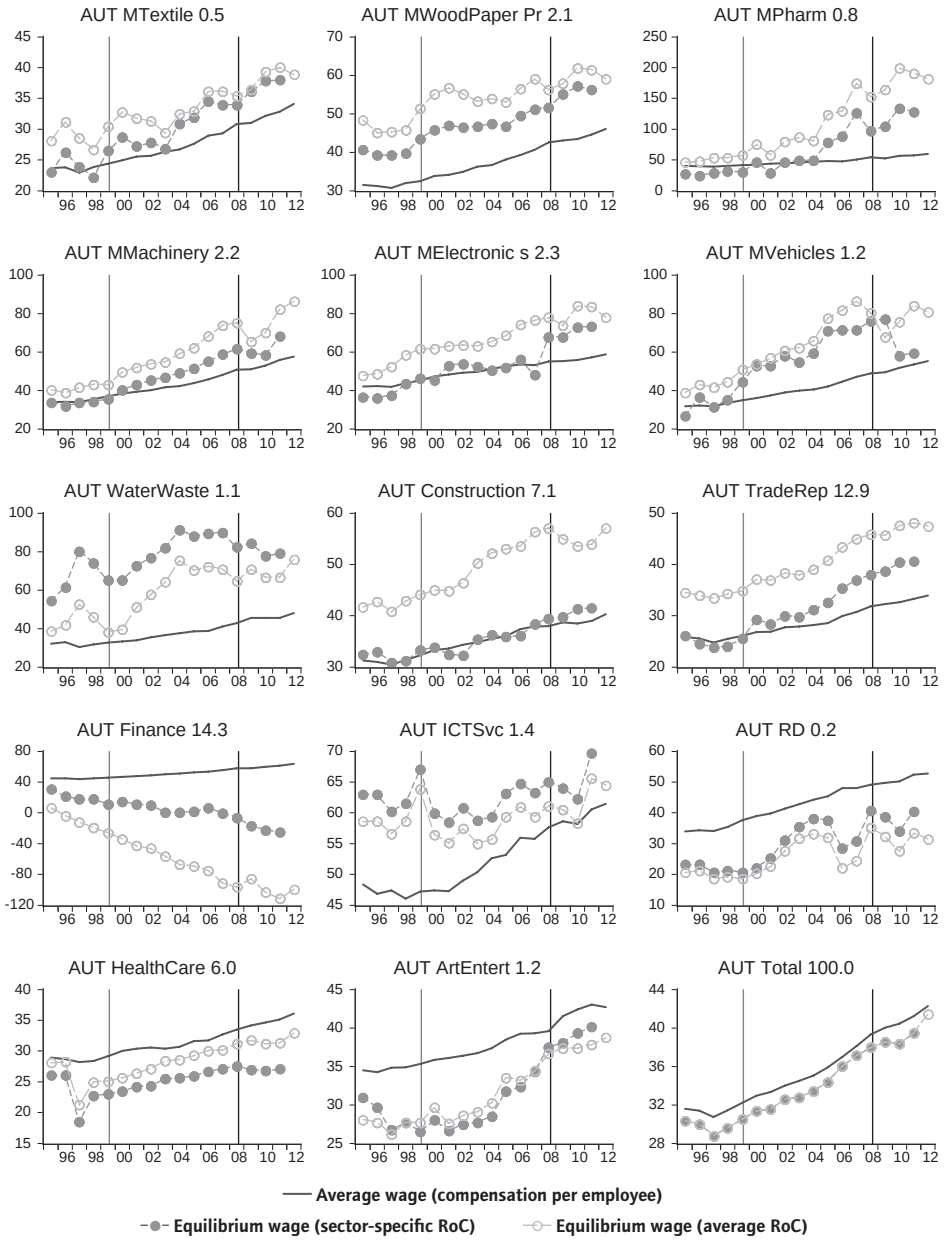
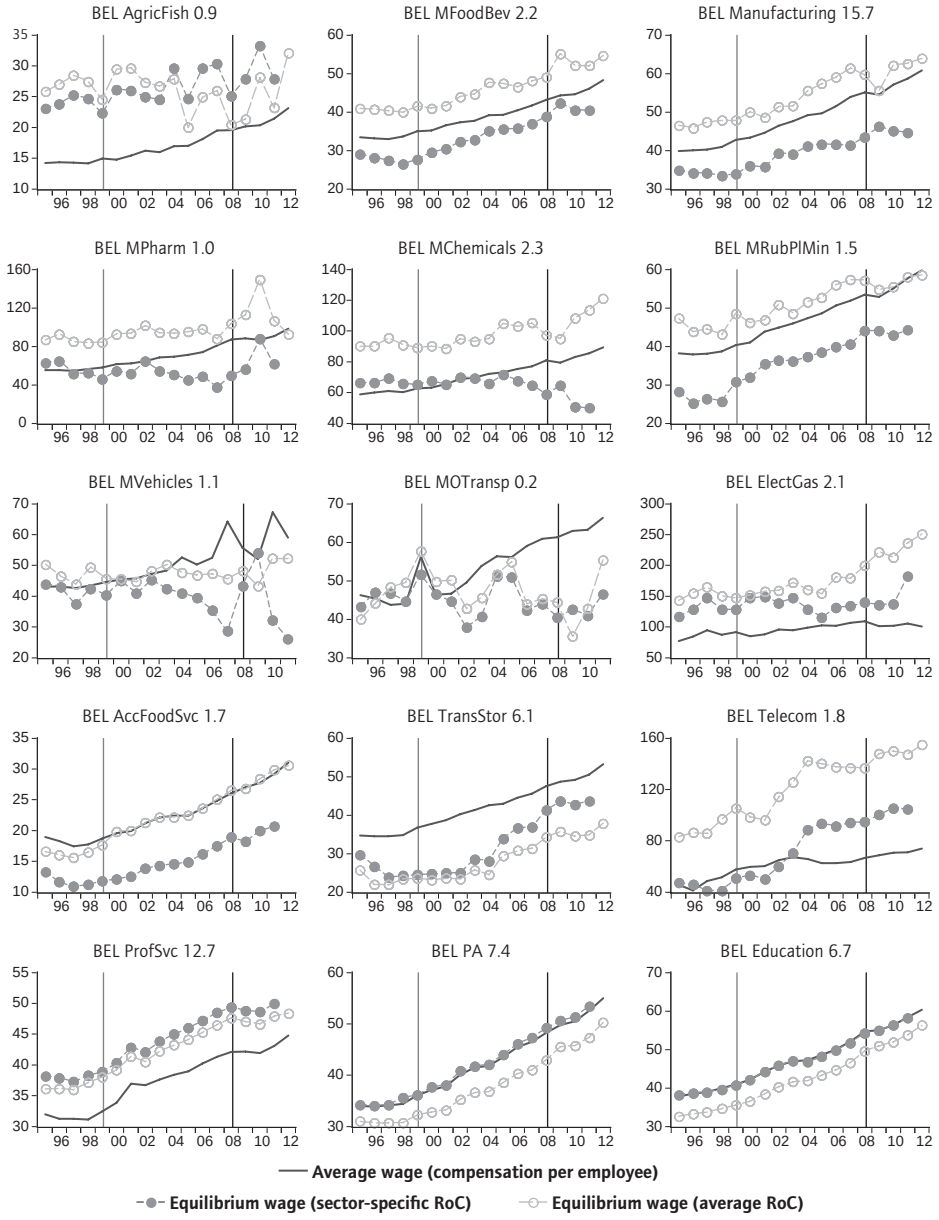



Source: Authors' elaboration of Eurostat and OECD data.

Figure A1.2 **Belgium**

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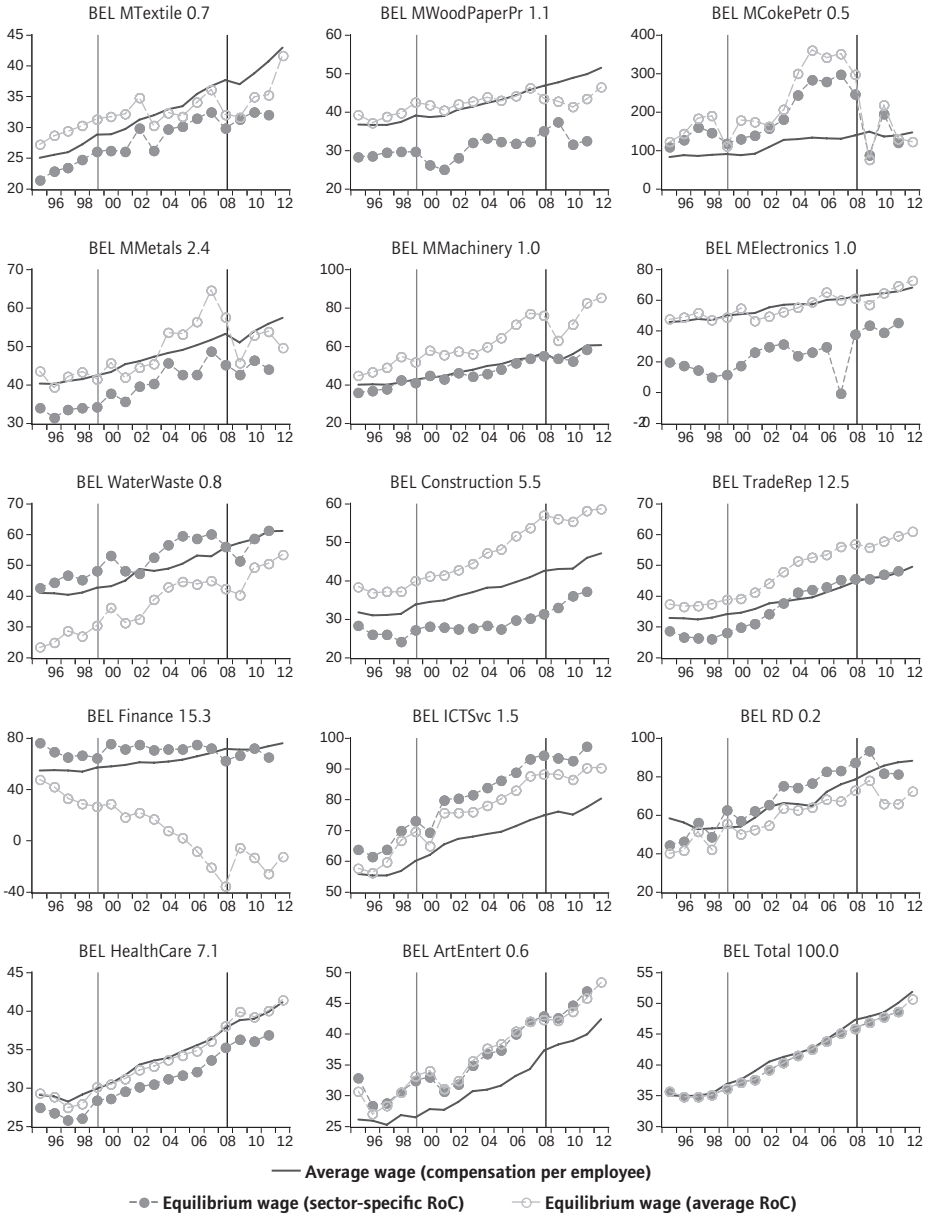


Source: Authors' elaboration of Eurostat and OECD data.

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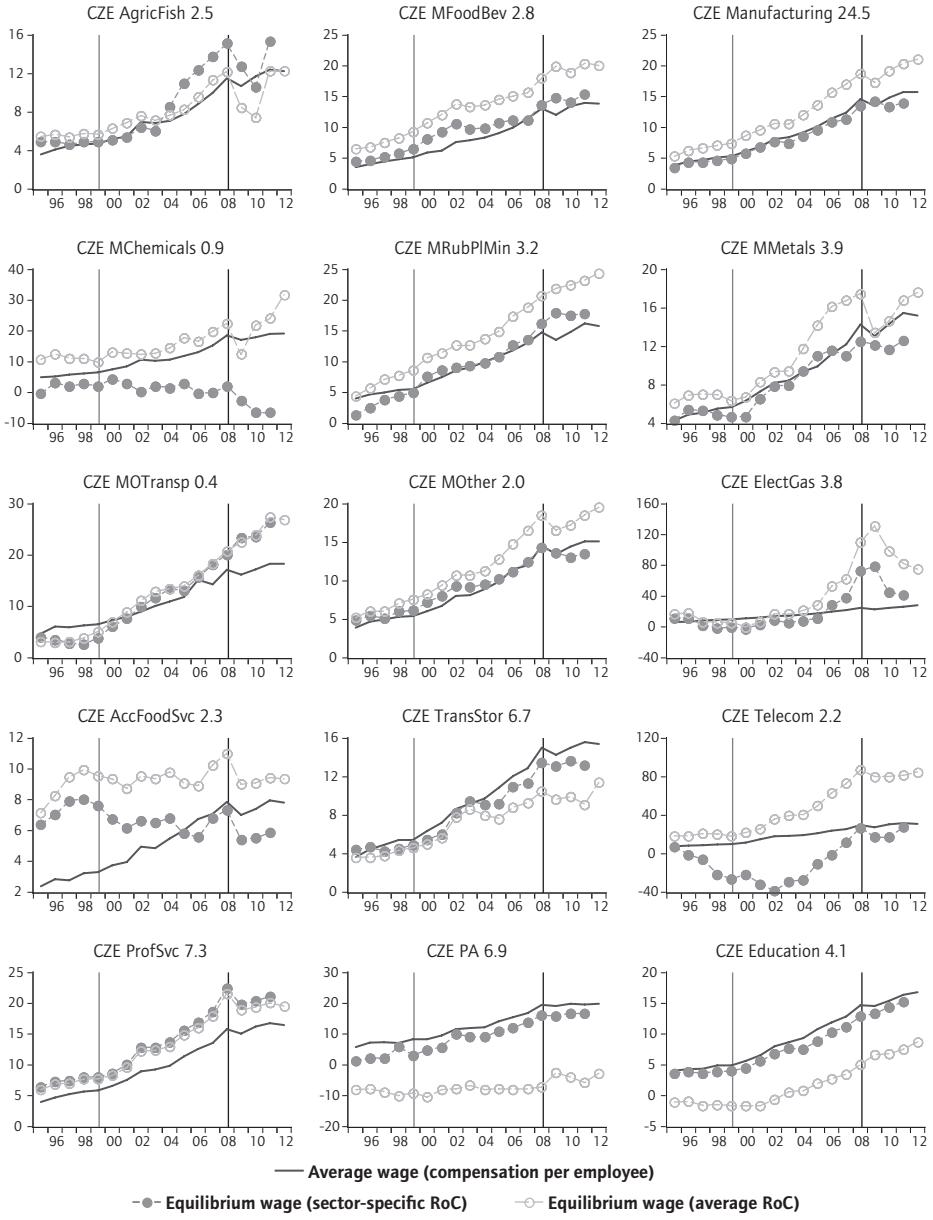


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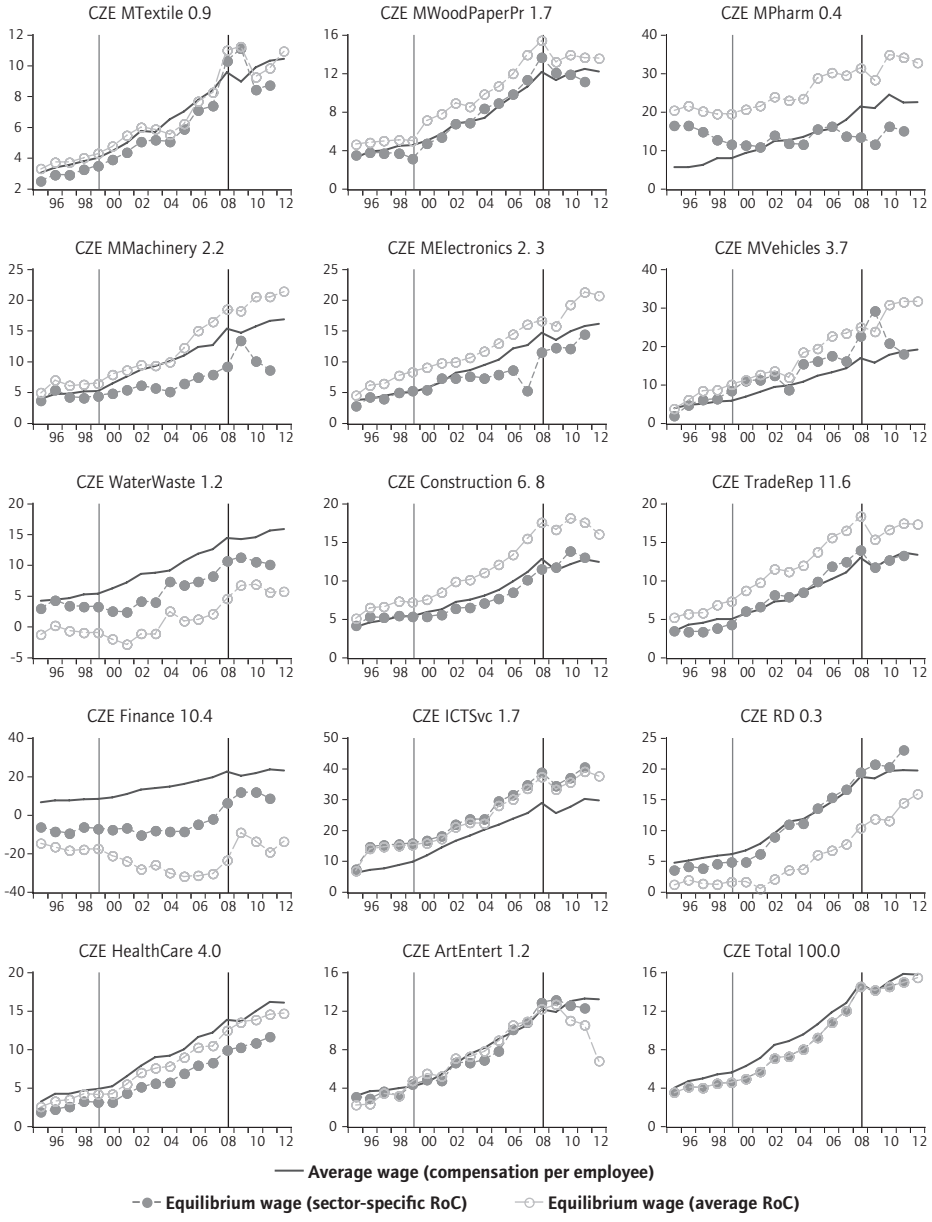


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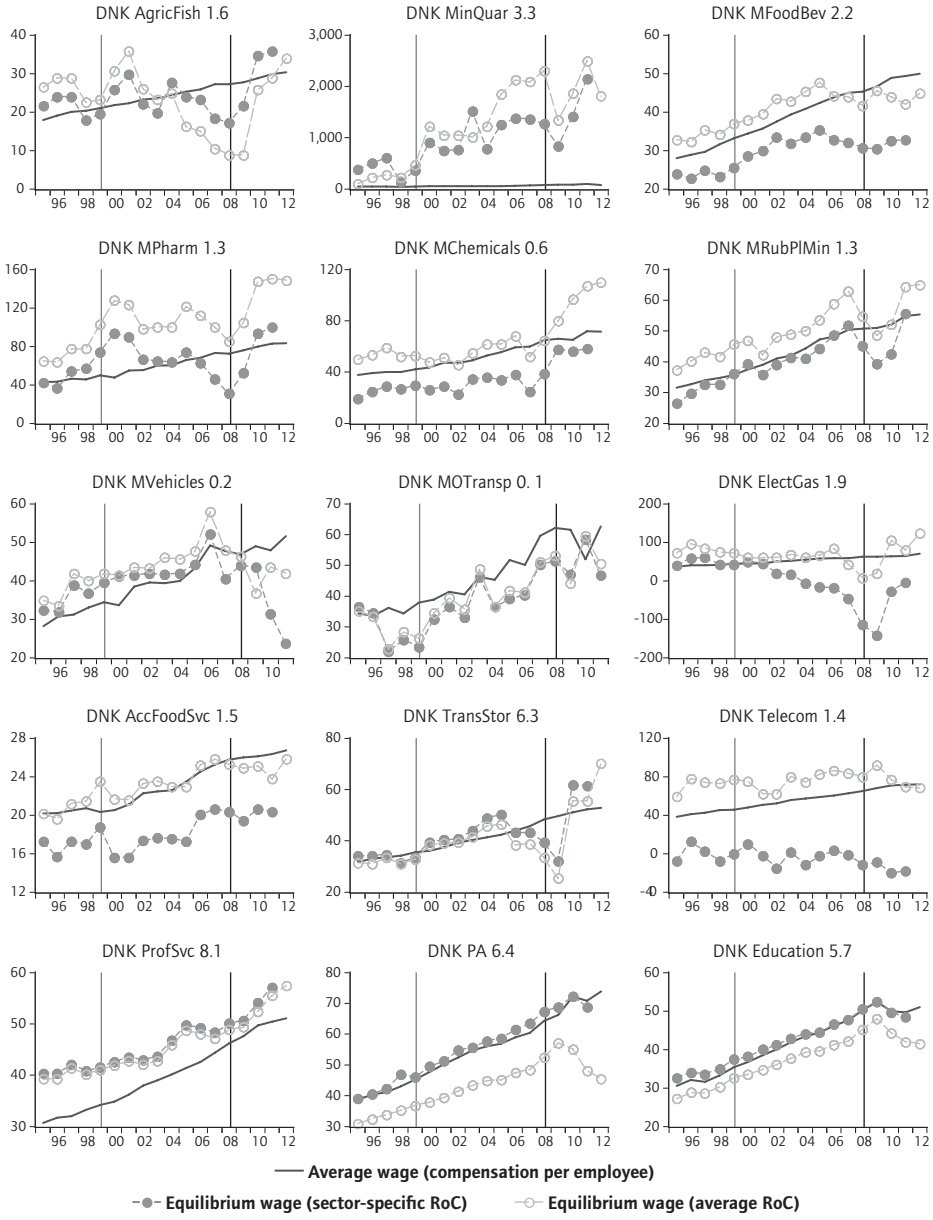


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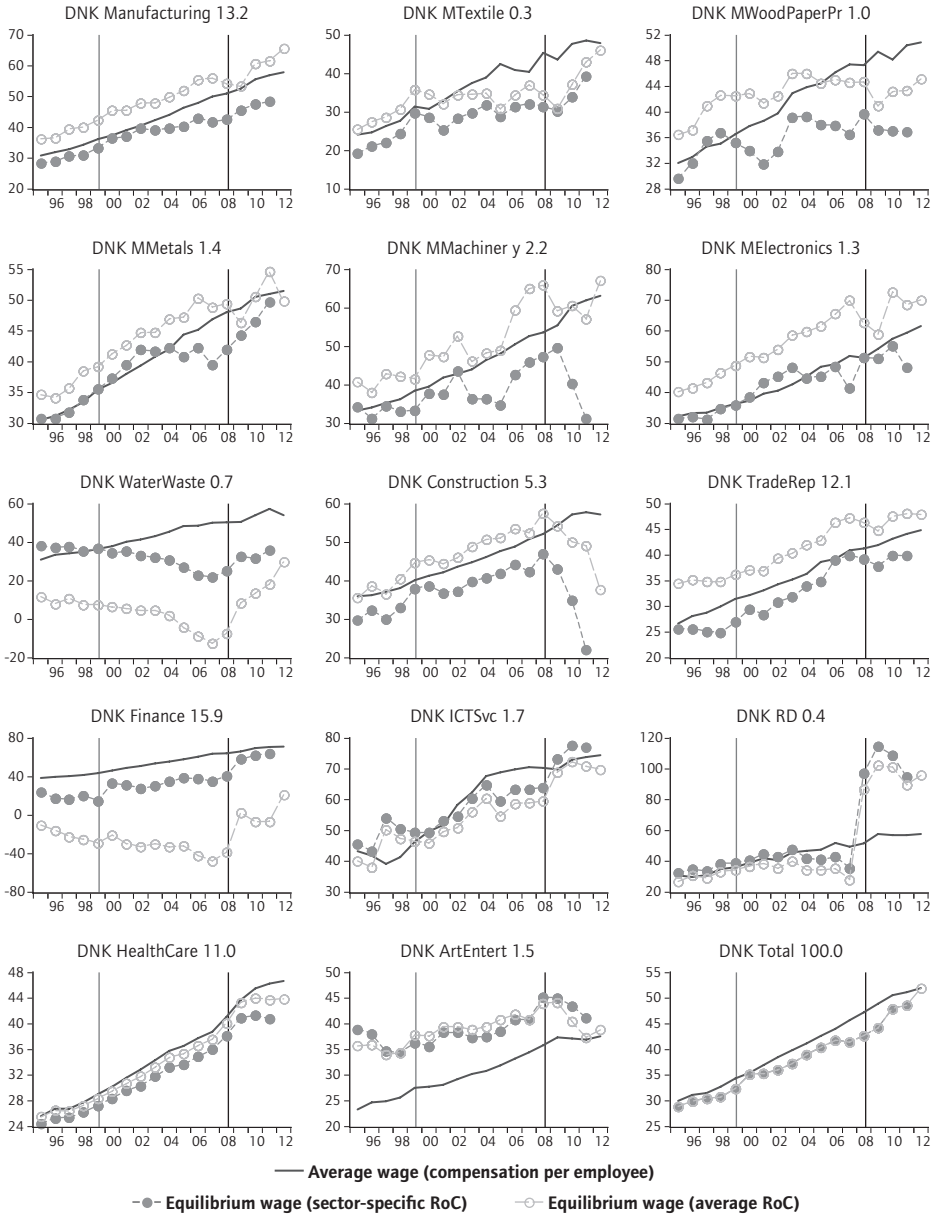


Source: Authors' elaboration of Eurostat and OECD data.

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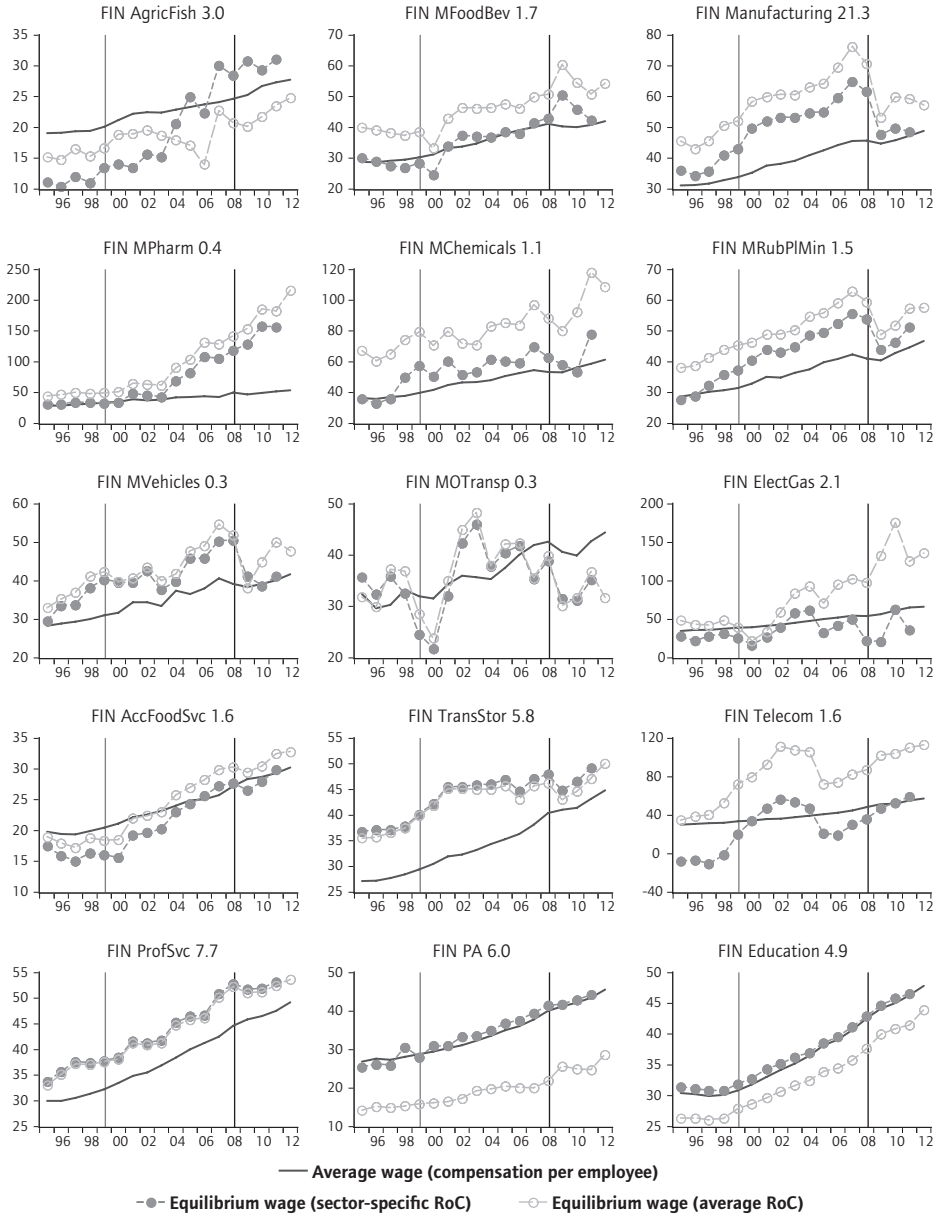


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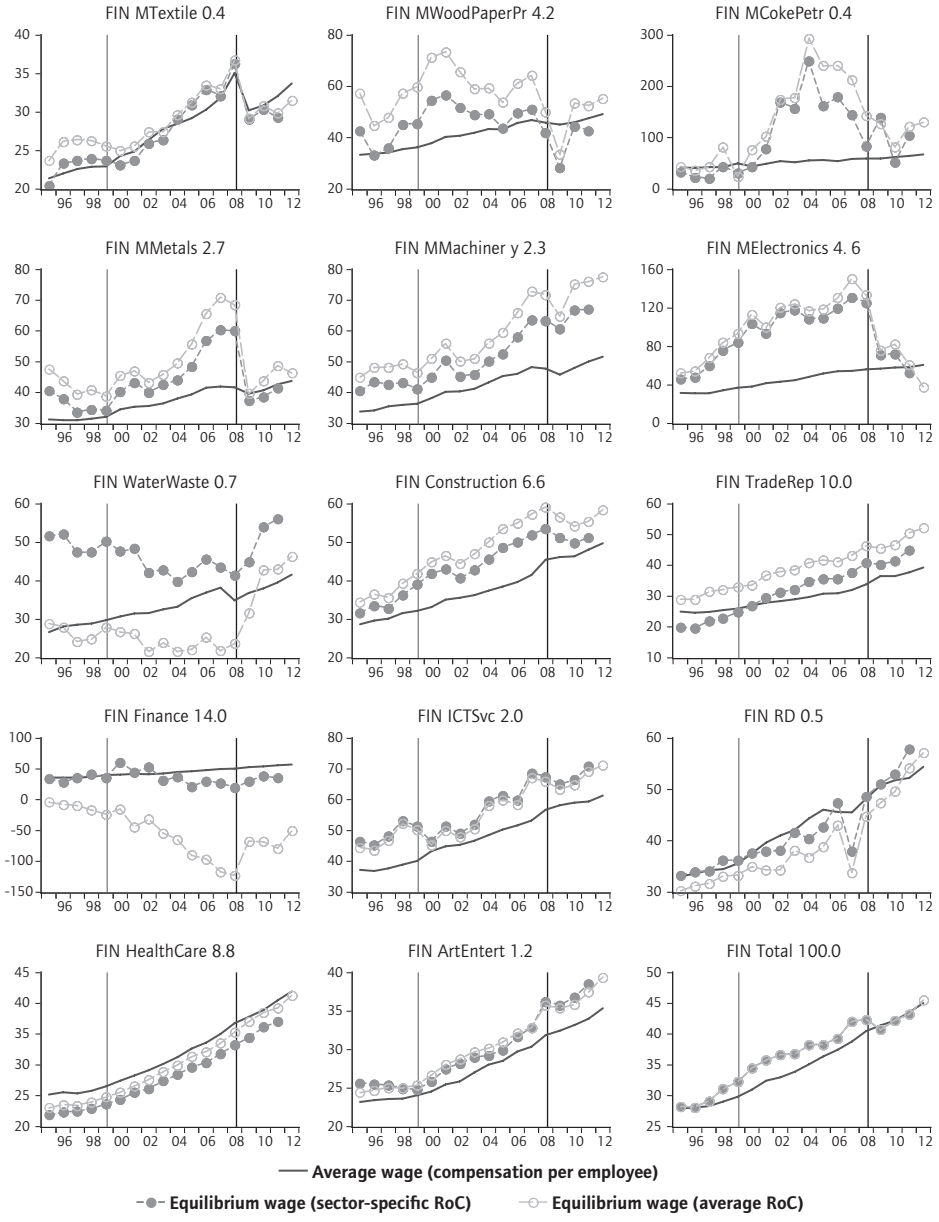


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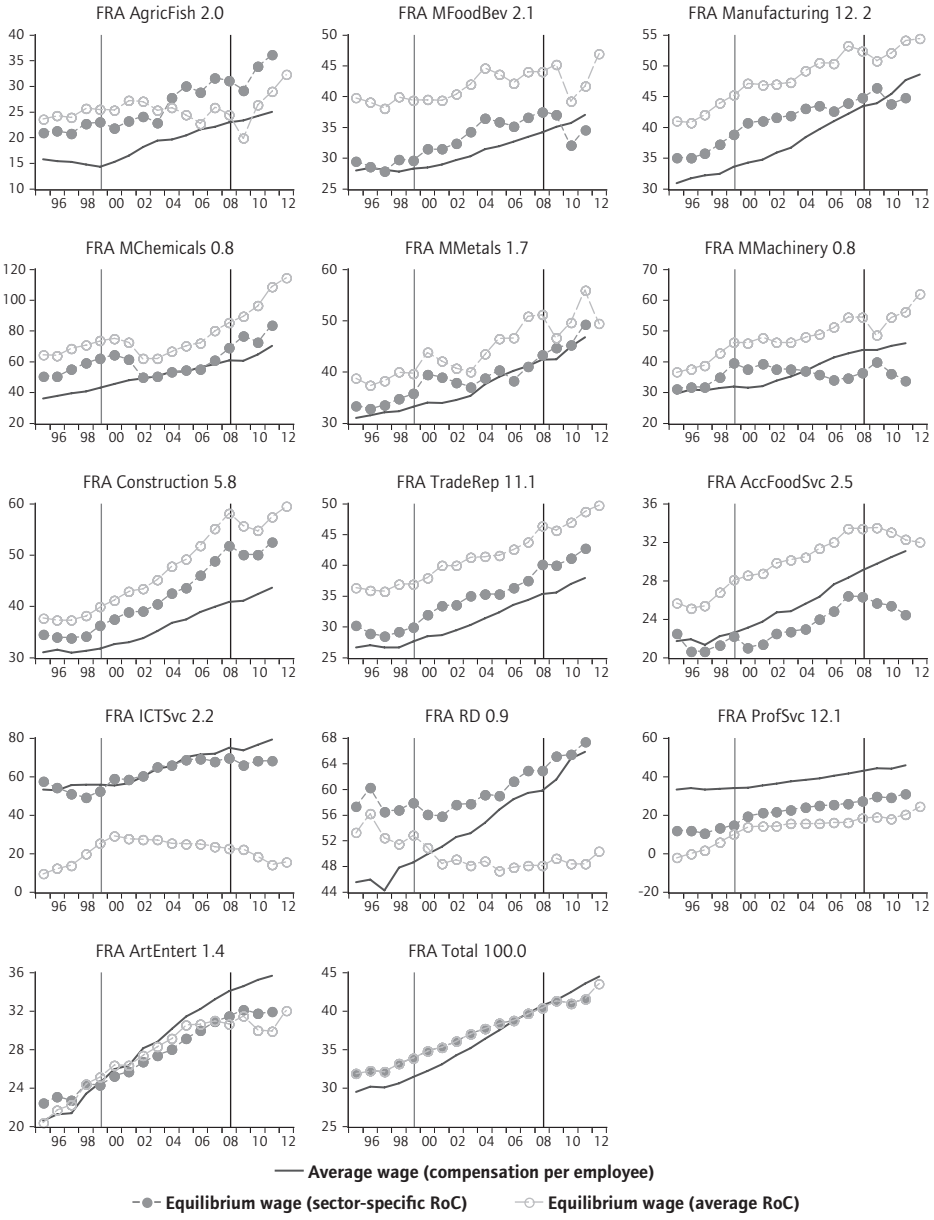


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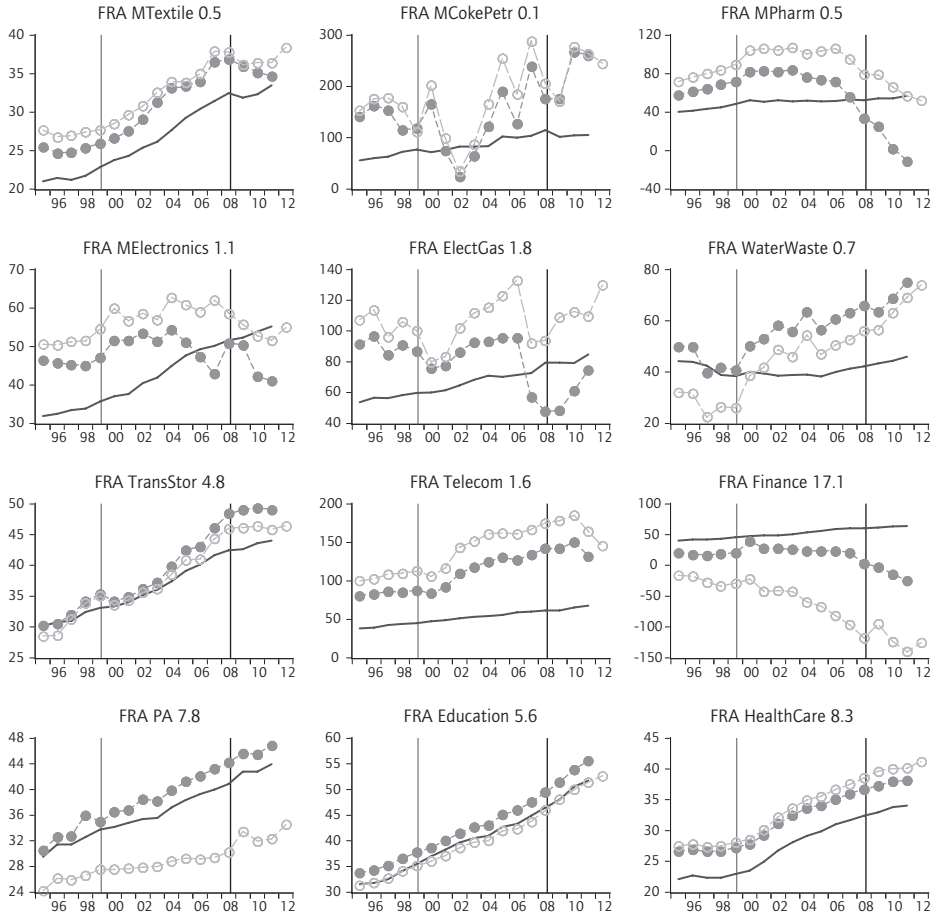


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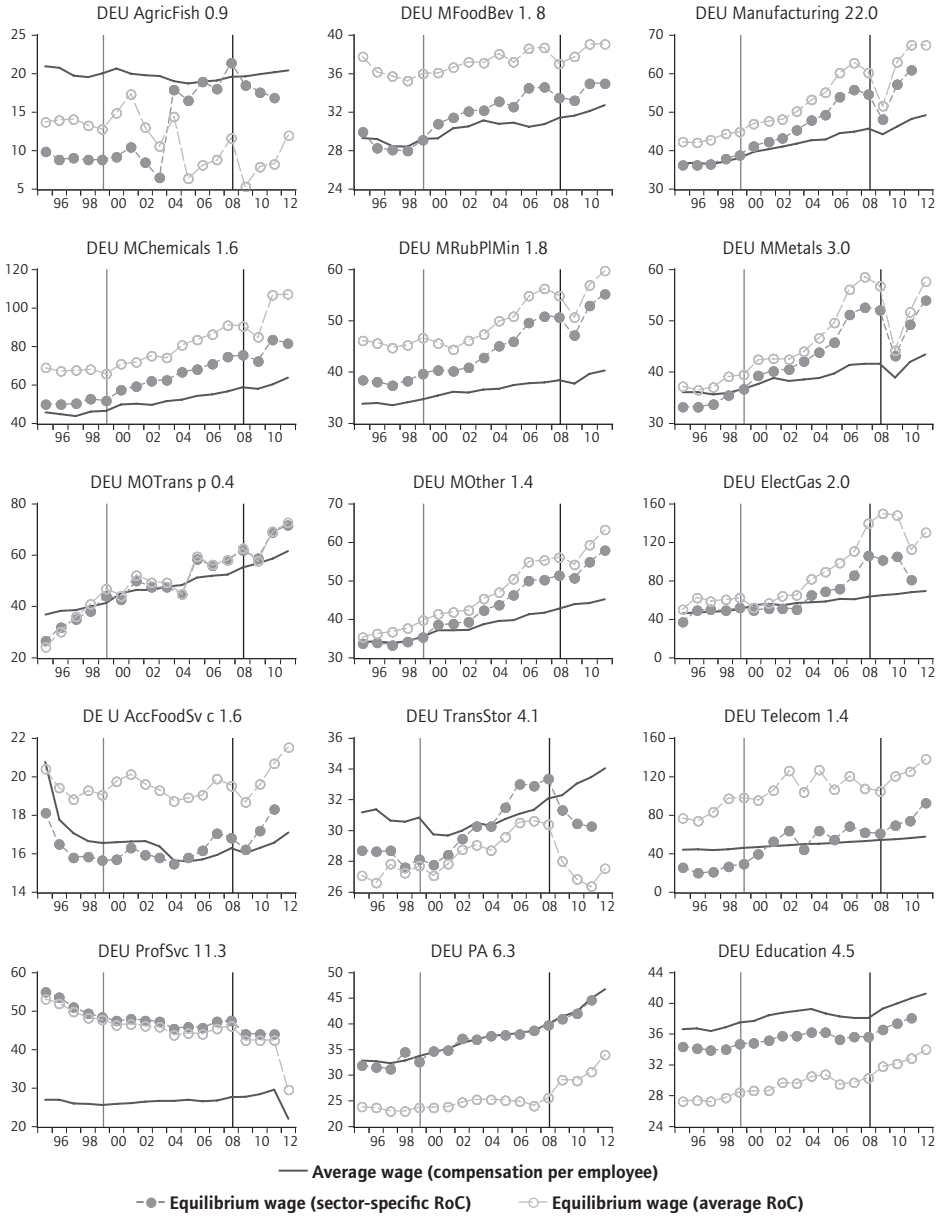


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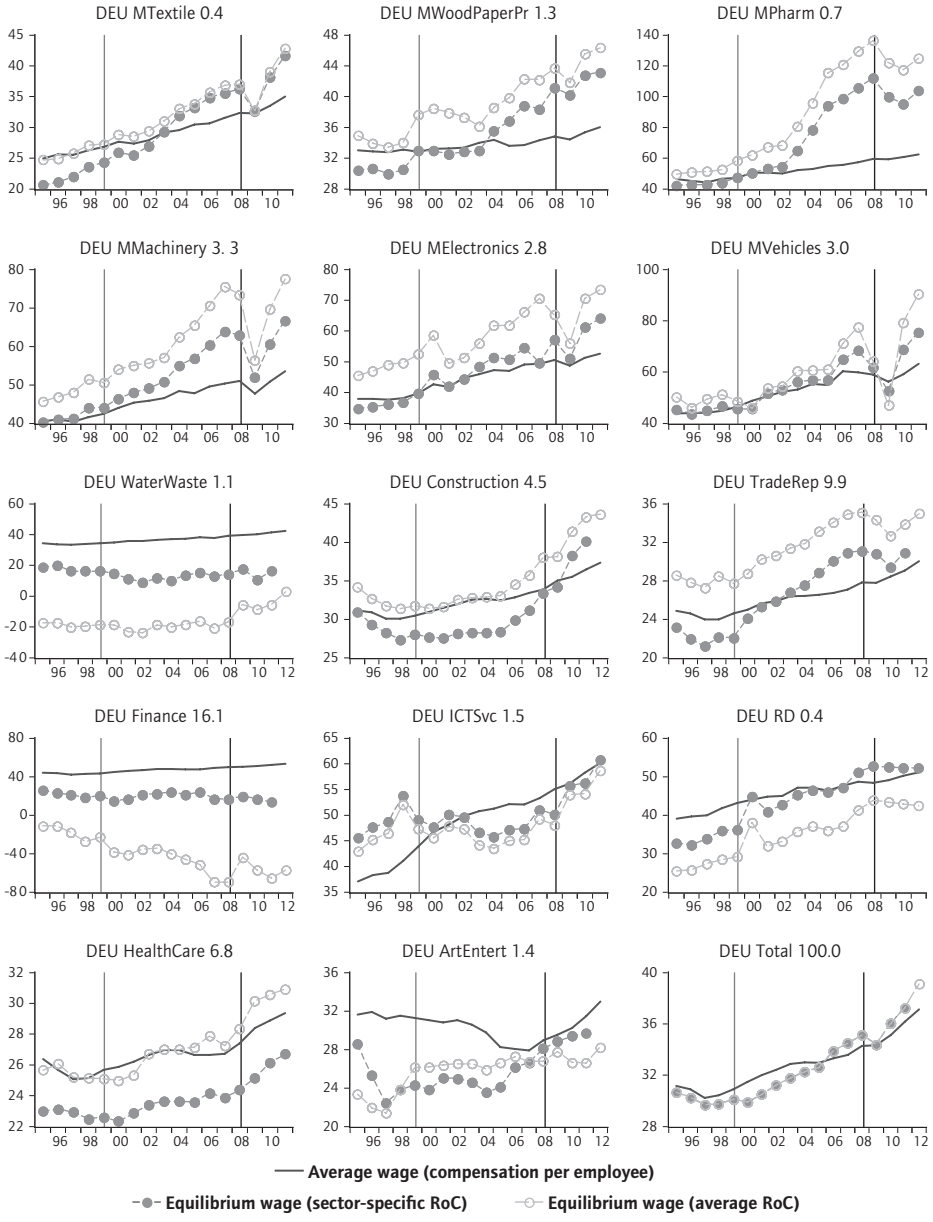


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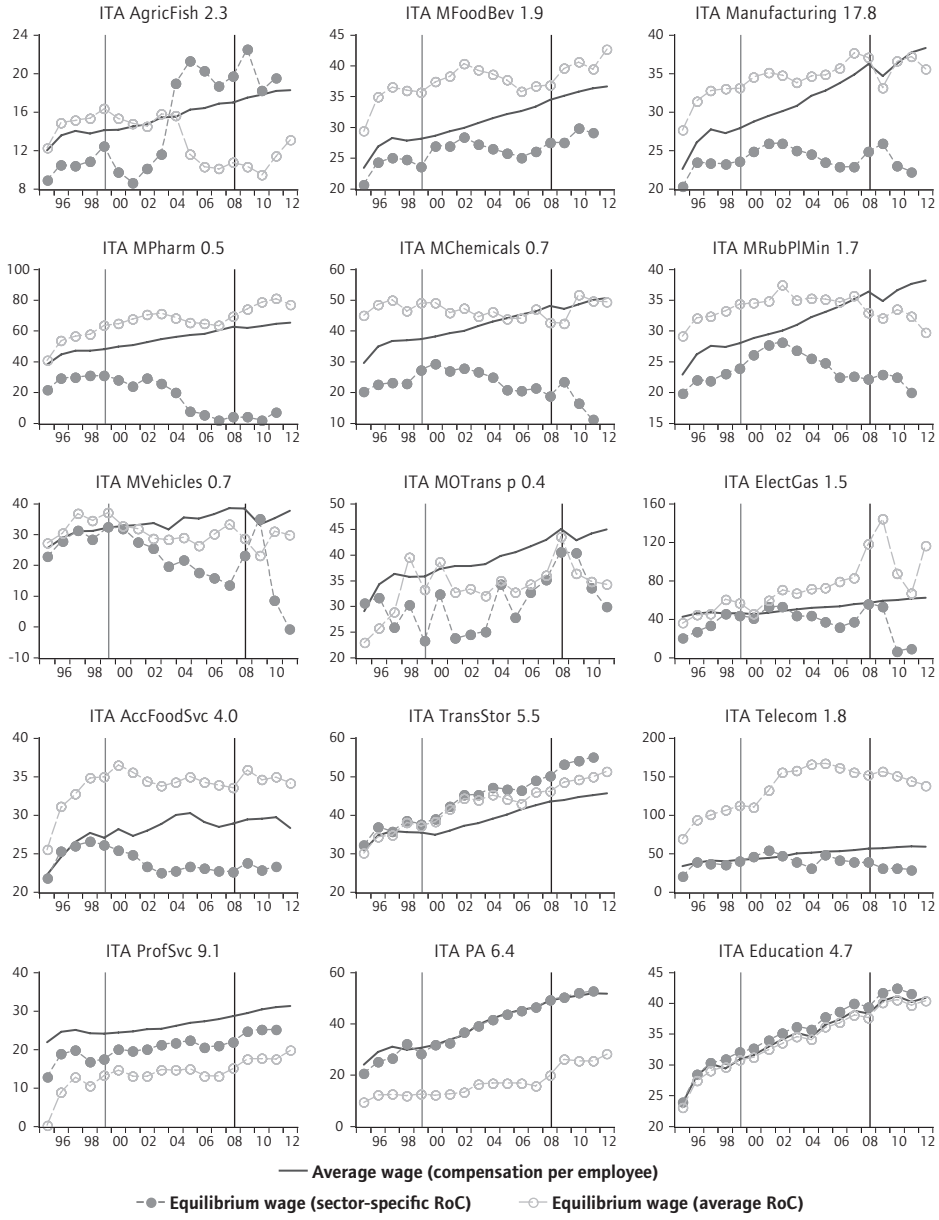


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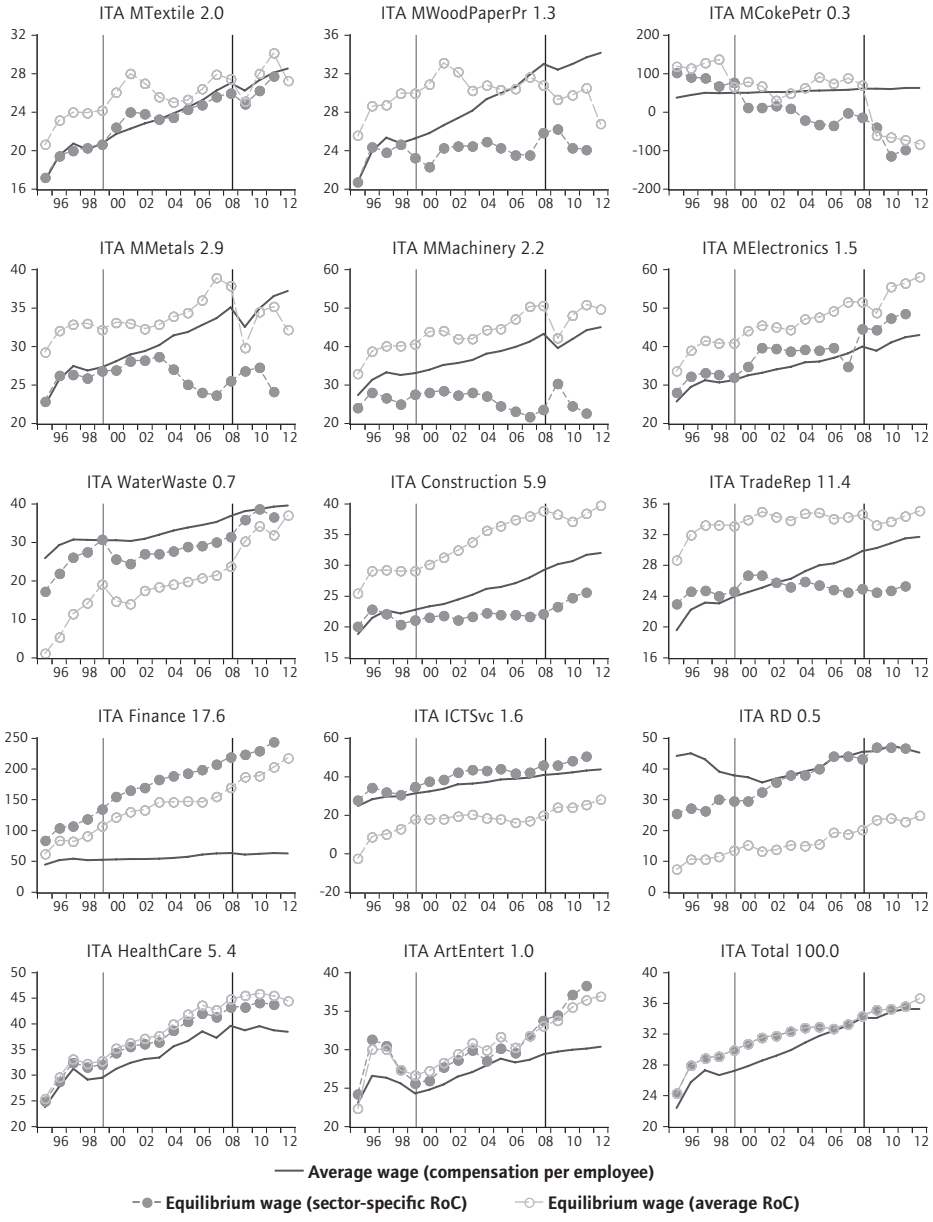


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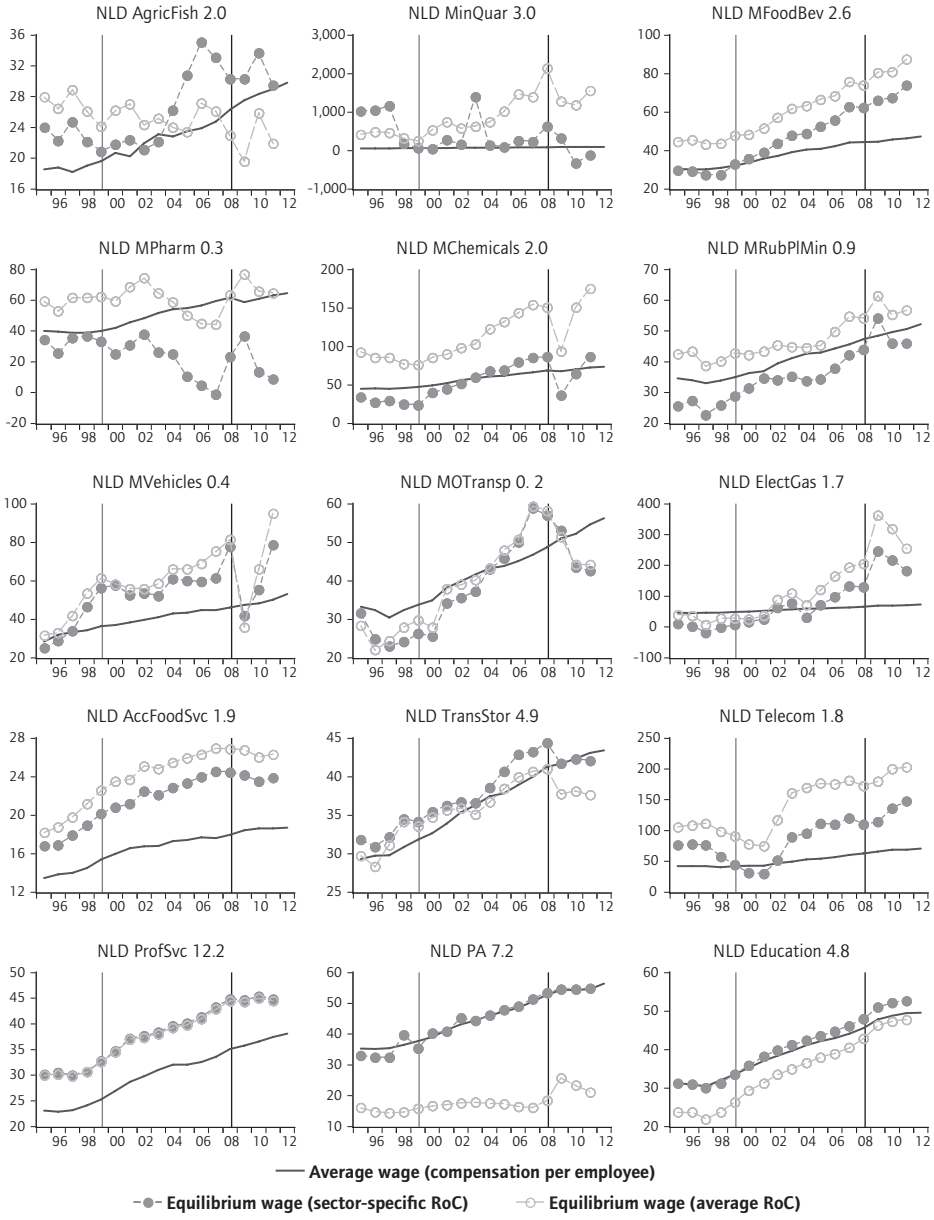


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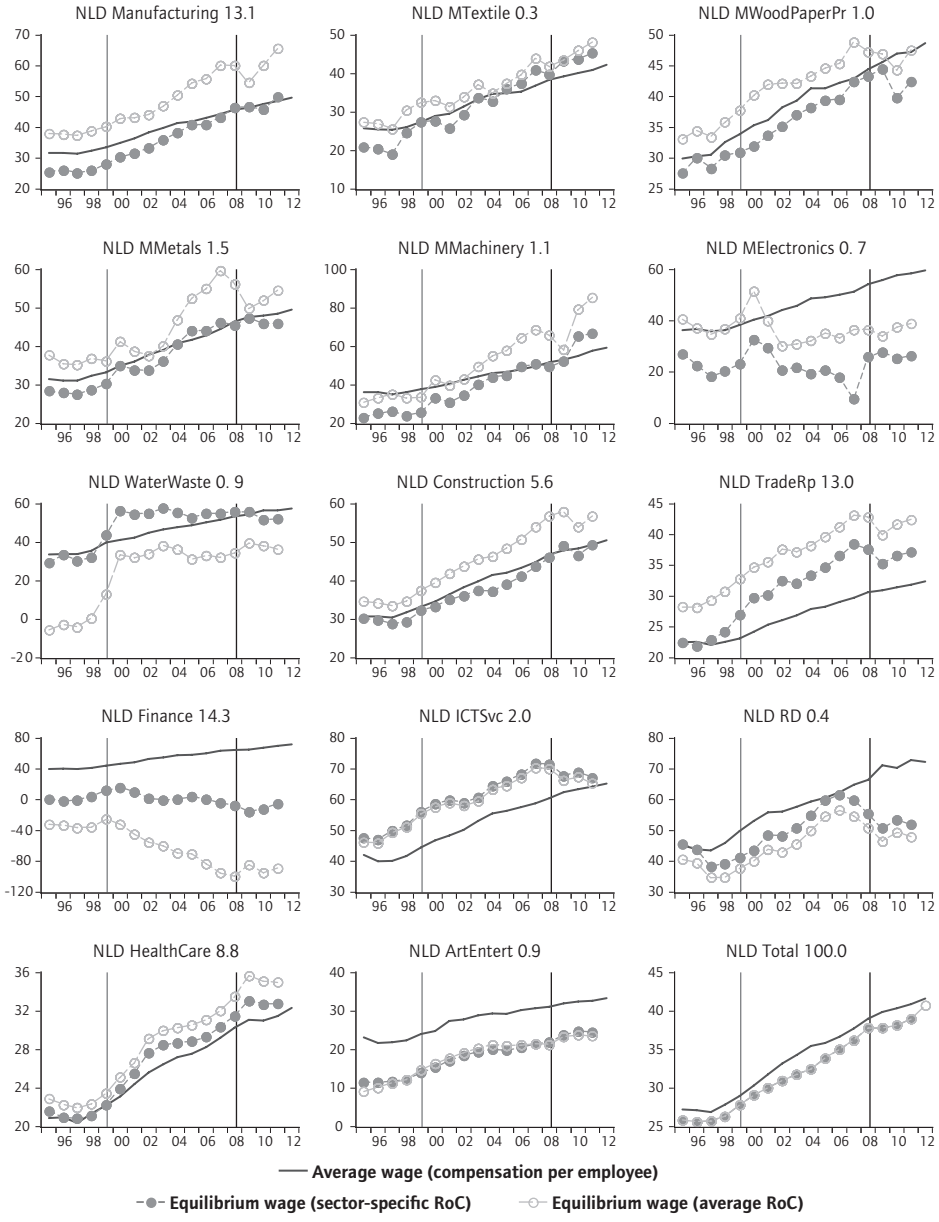


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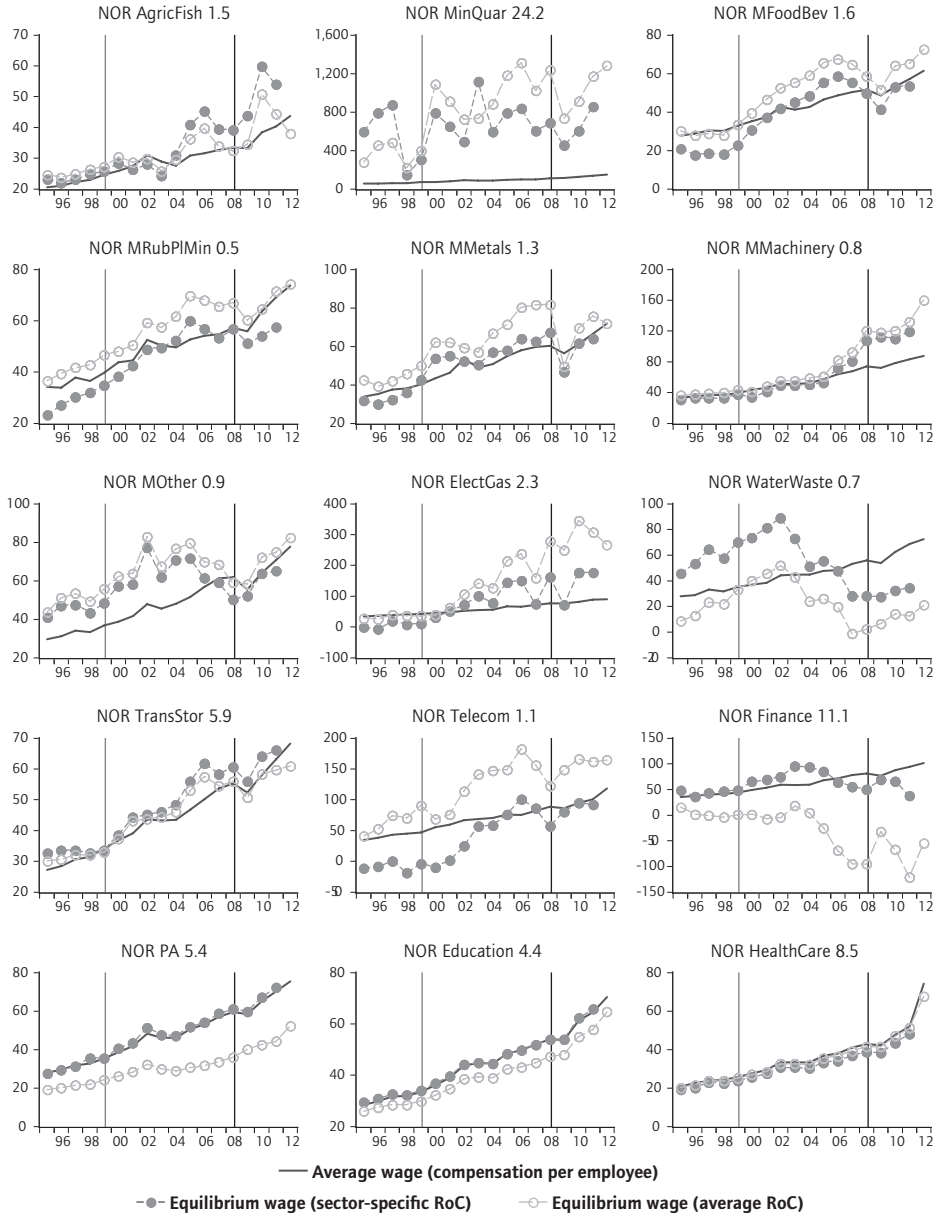


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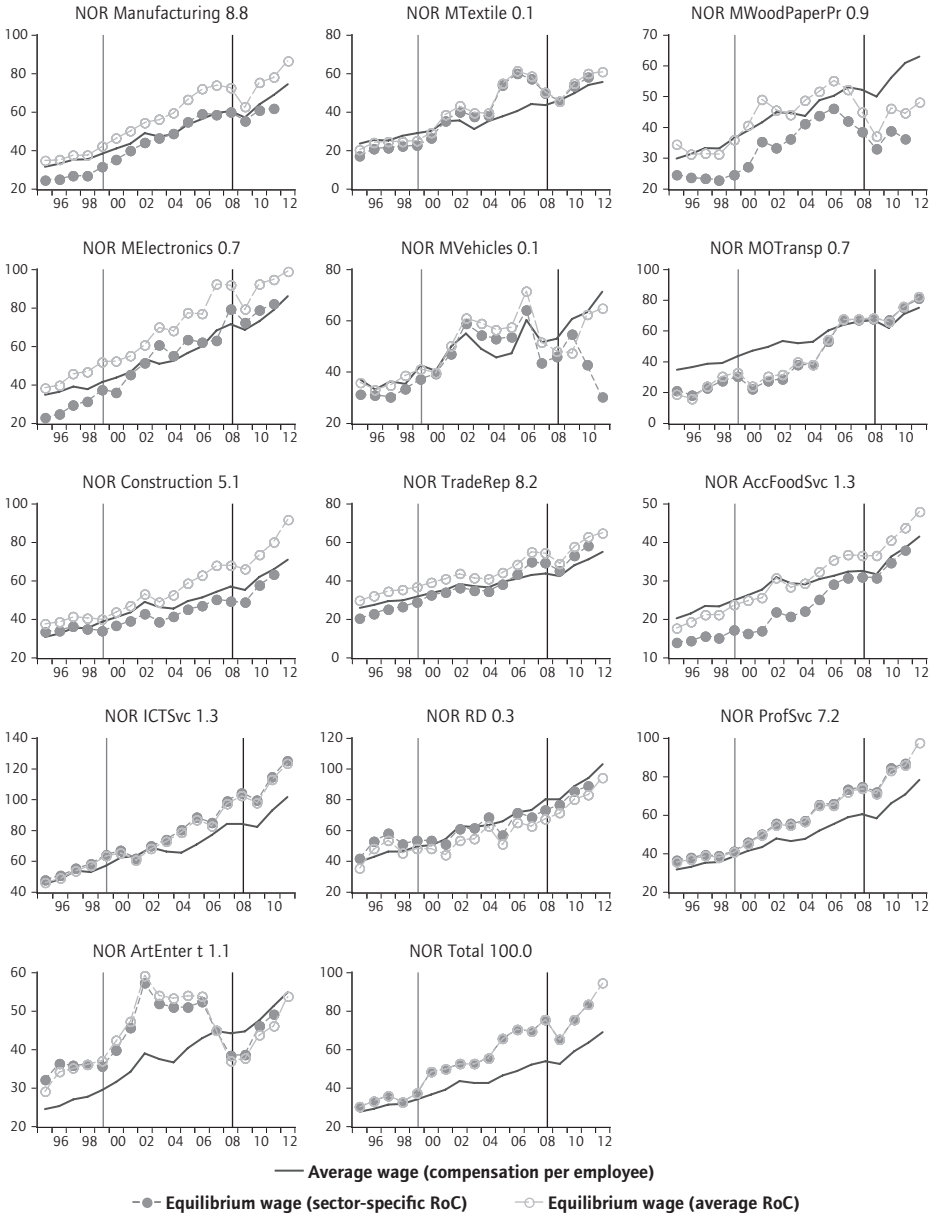


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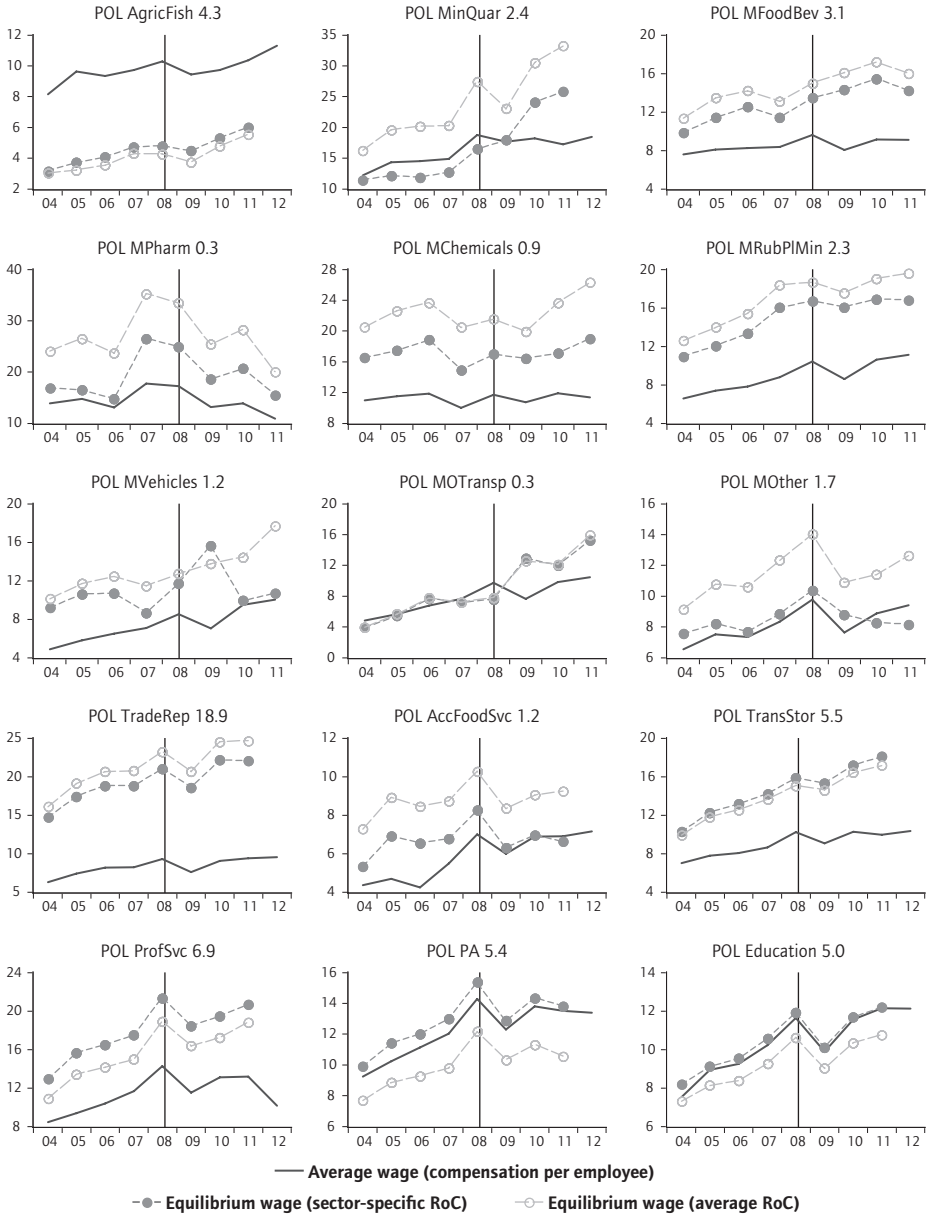


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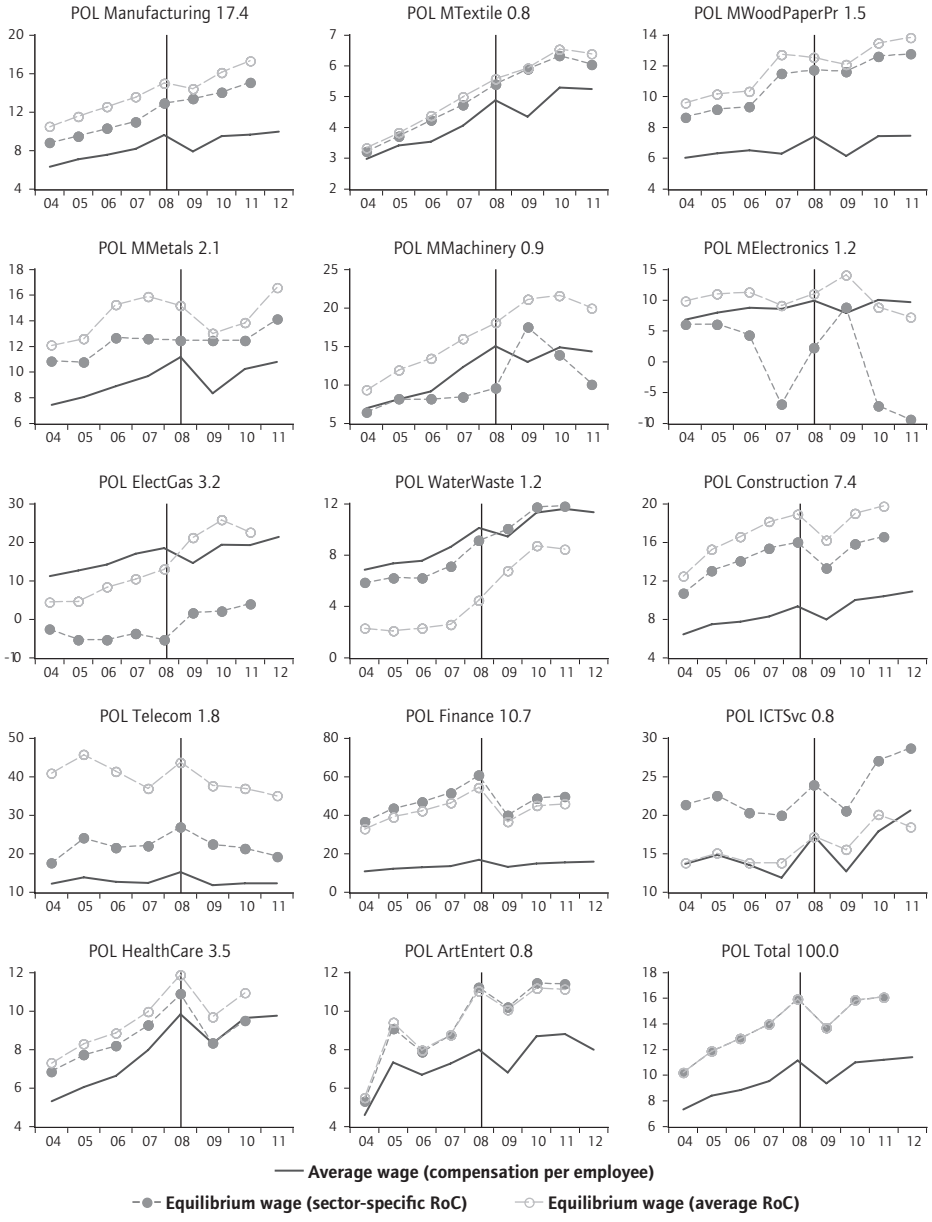
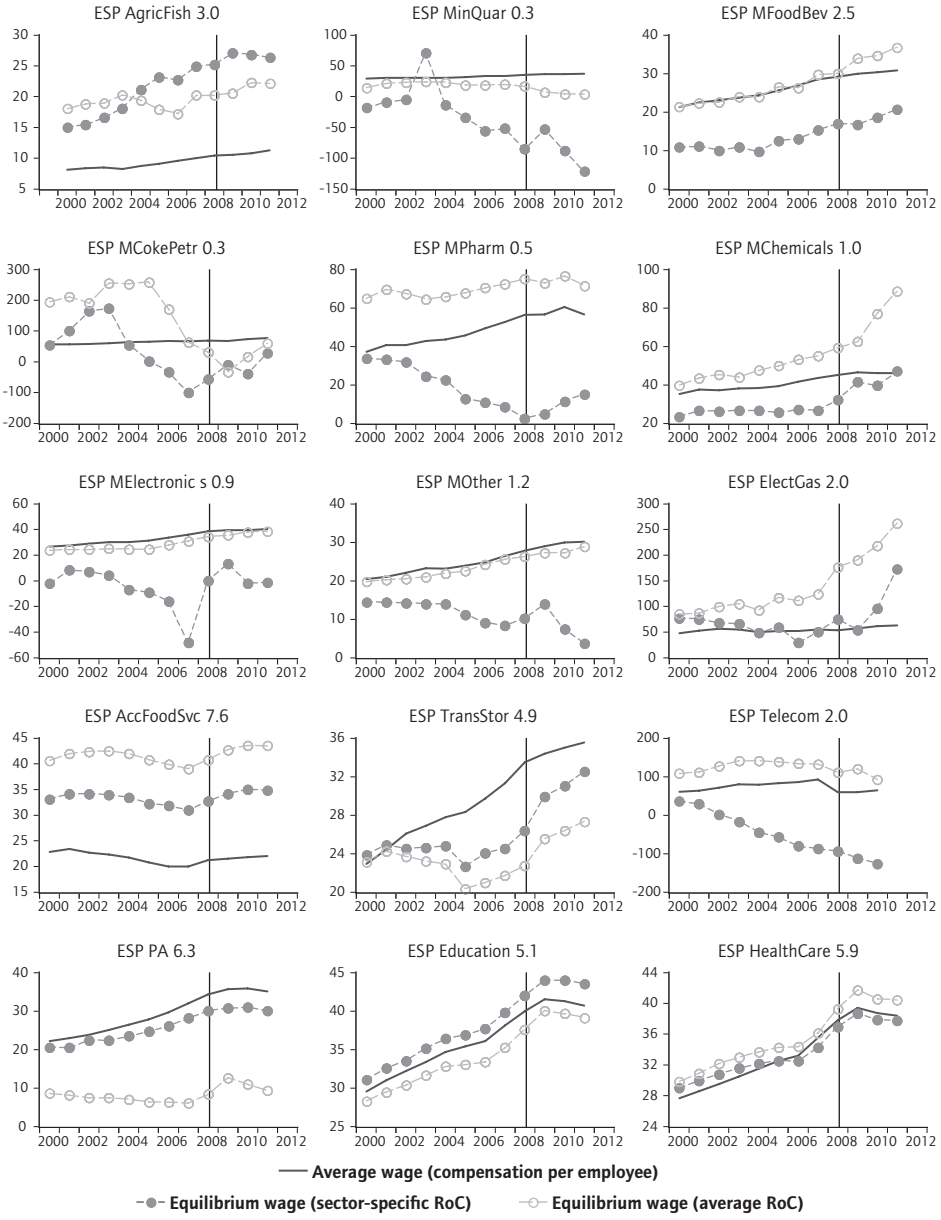



Source: Authors' elaboration of Eurostat and OECD data.

Figure A1.12 **Spain**

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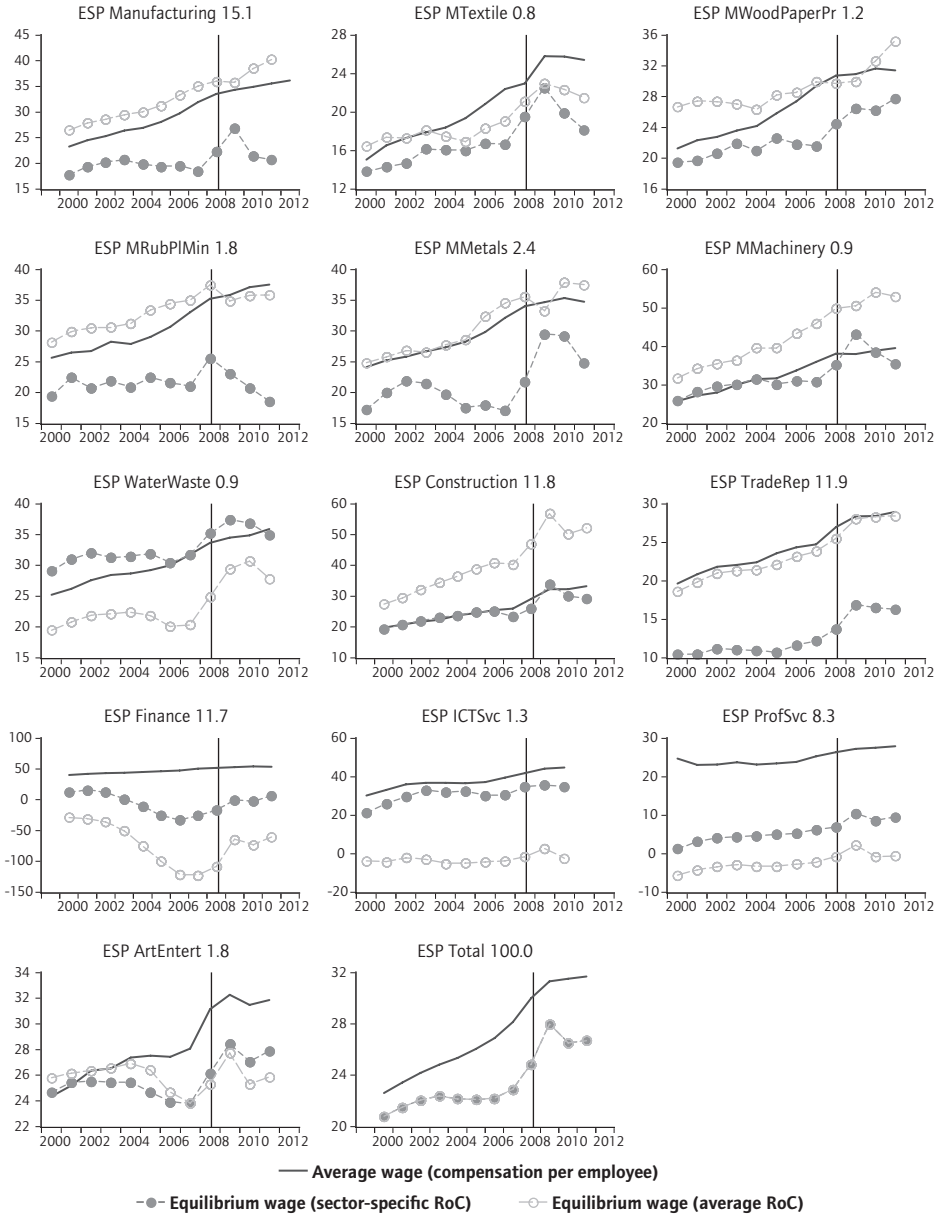


Source: Authors' elaboration of Eurostat and OECD data.

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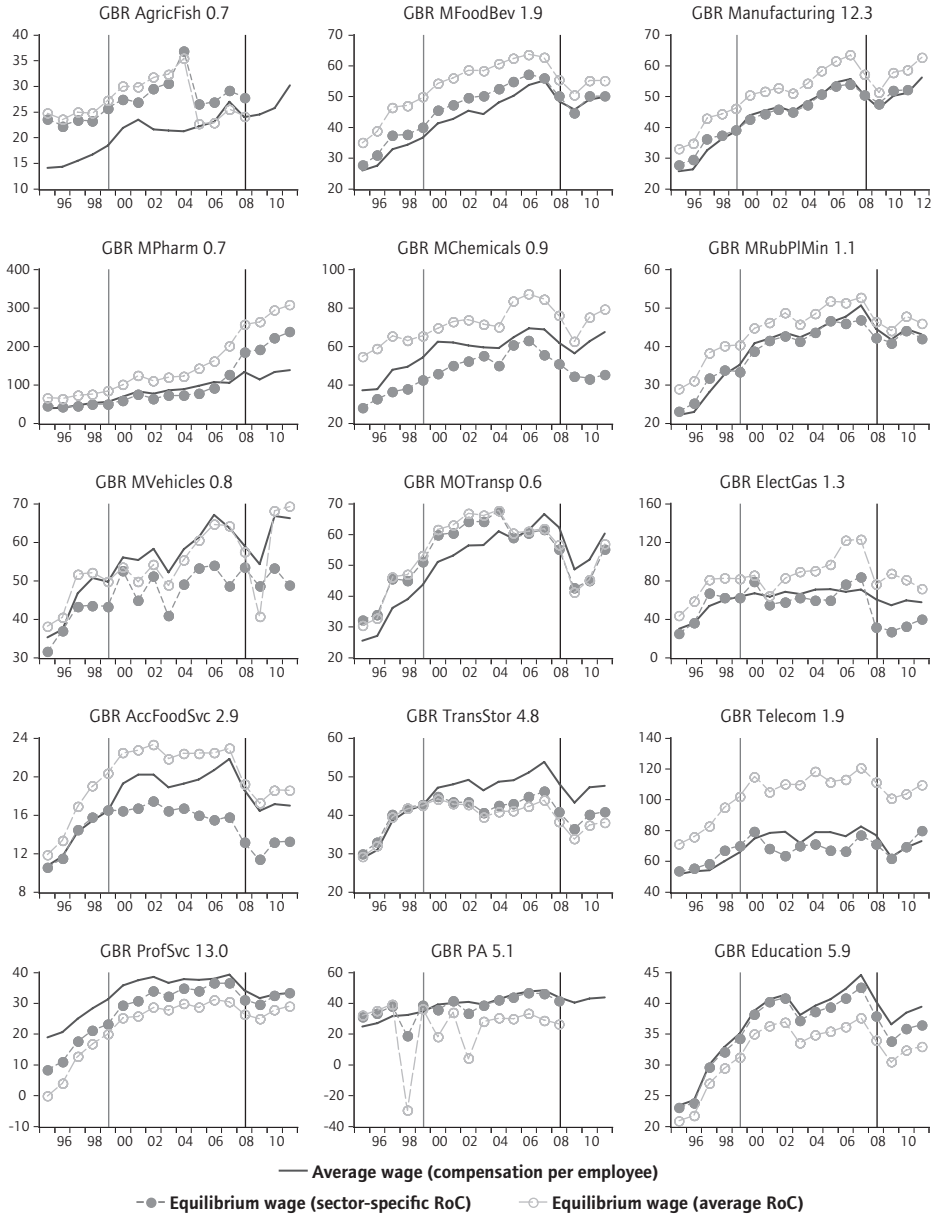


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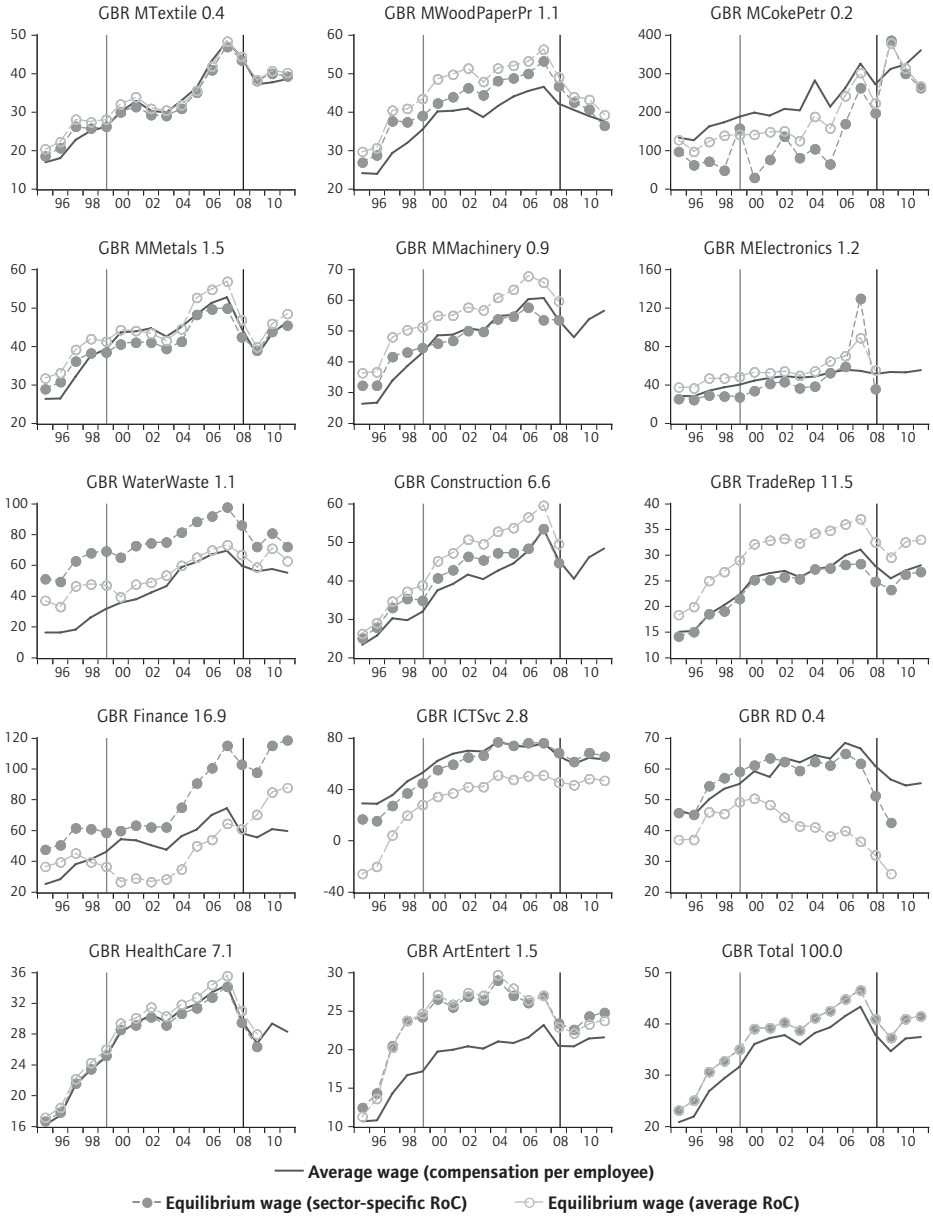
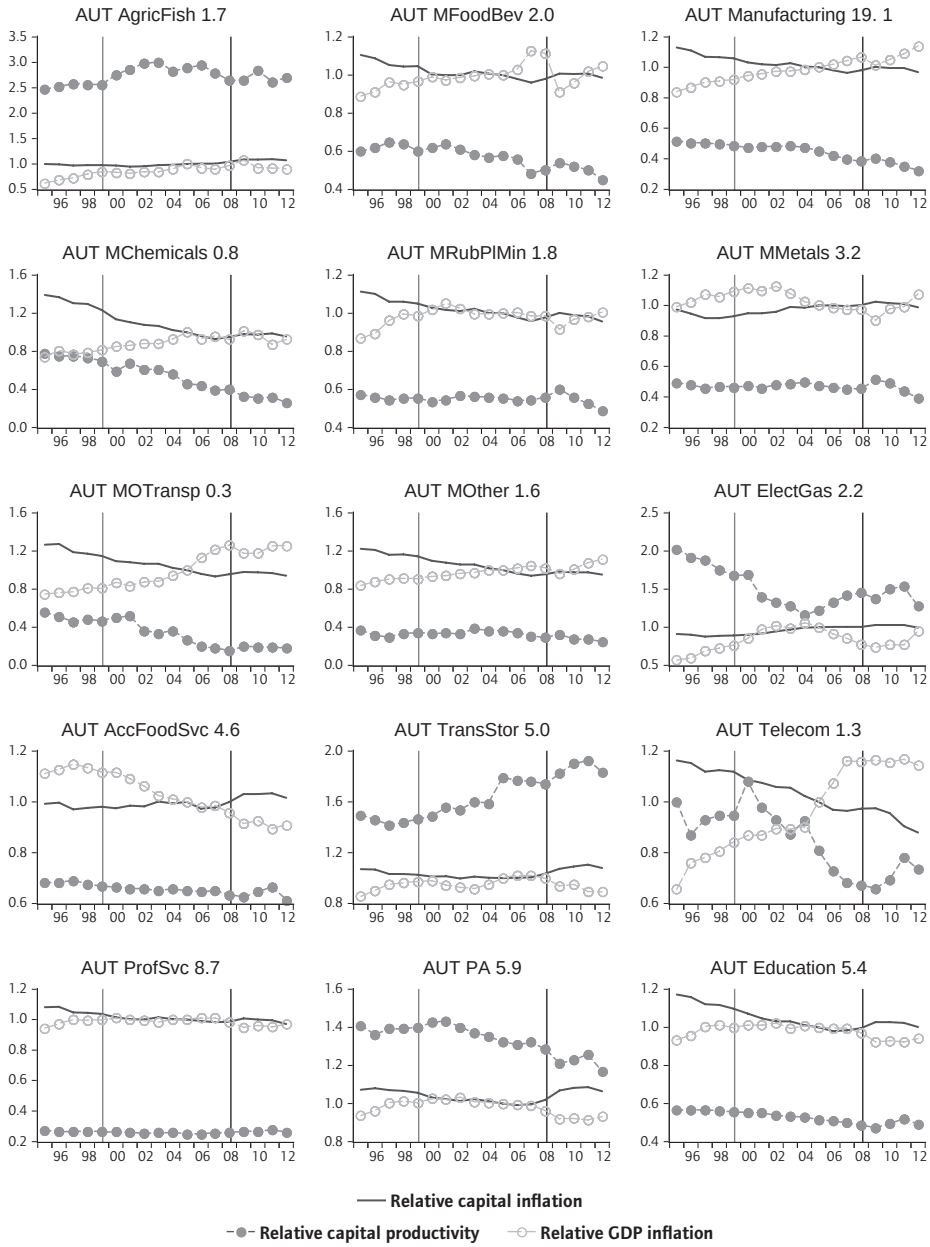


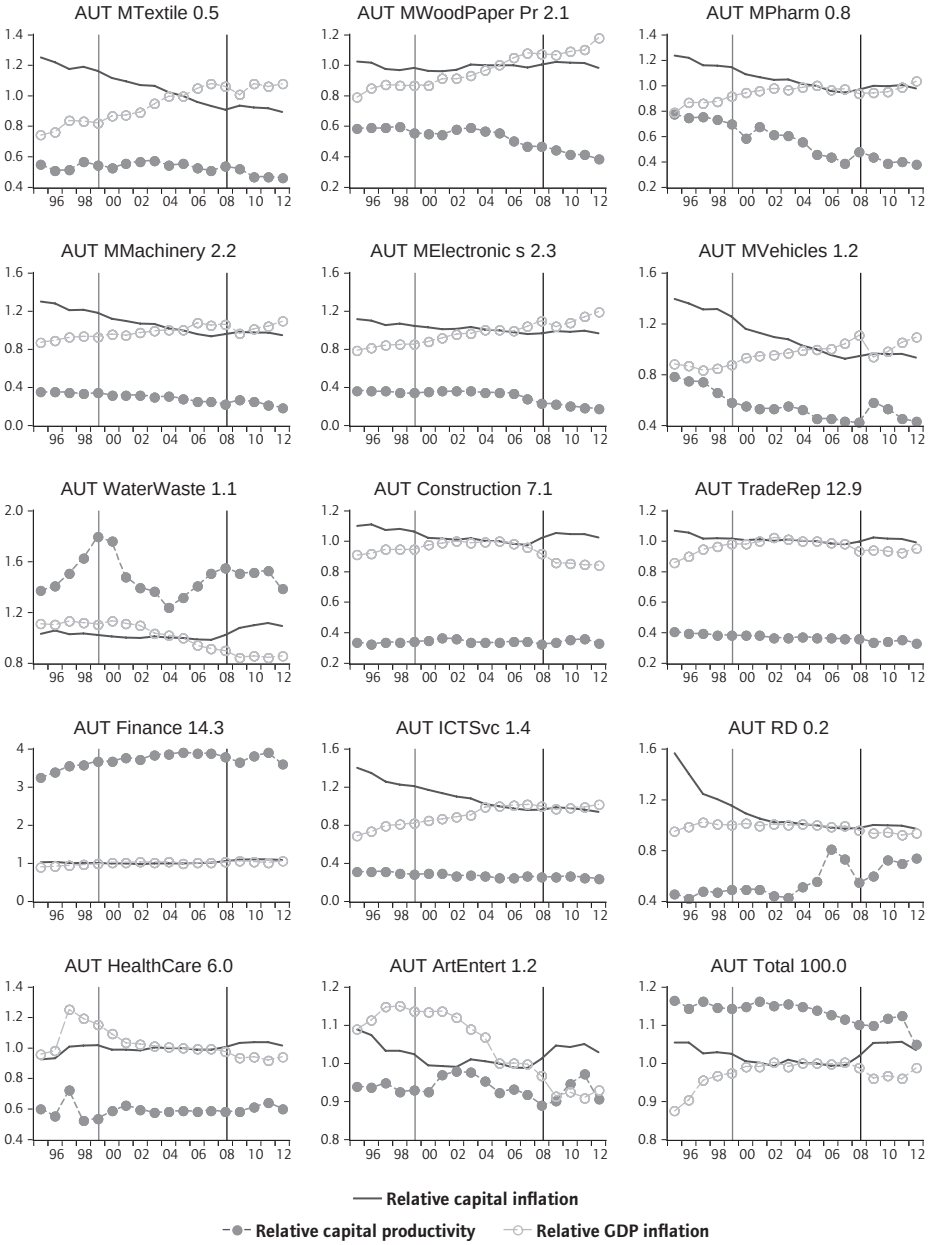

Source: Authors' elaboration of Eurostat and OECD data.

# Appendix 2
# Decomposition of the relative ACE effect

Figure A2.1 **Austria**

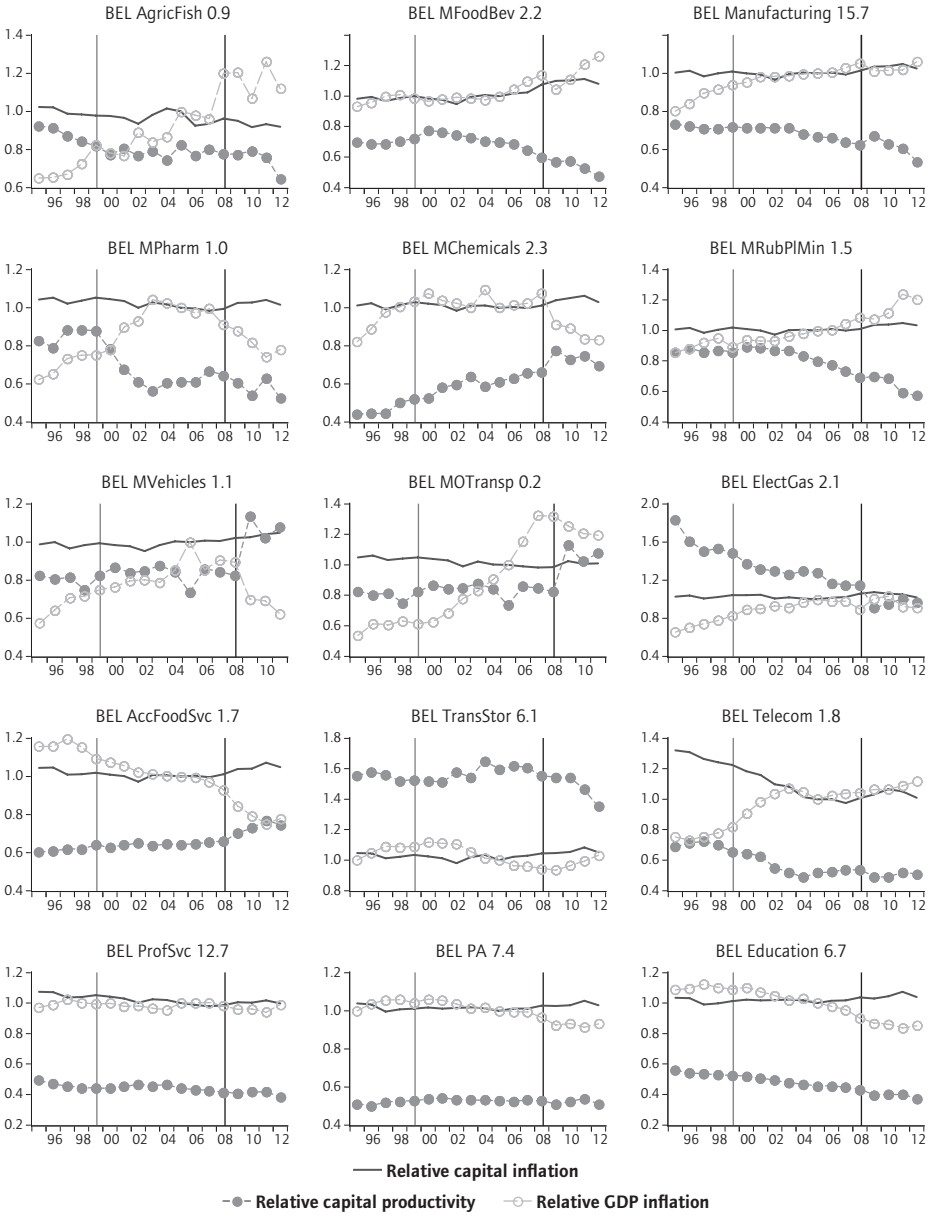



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

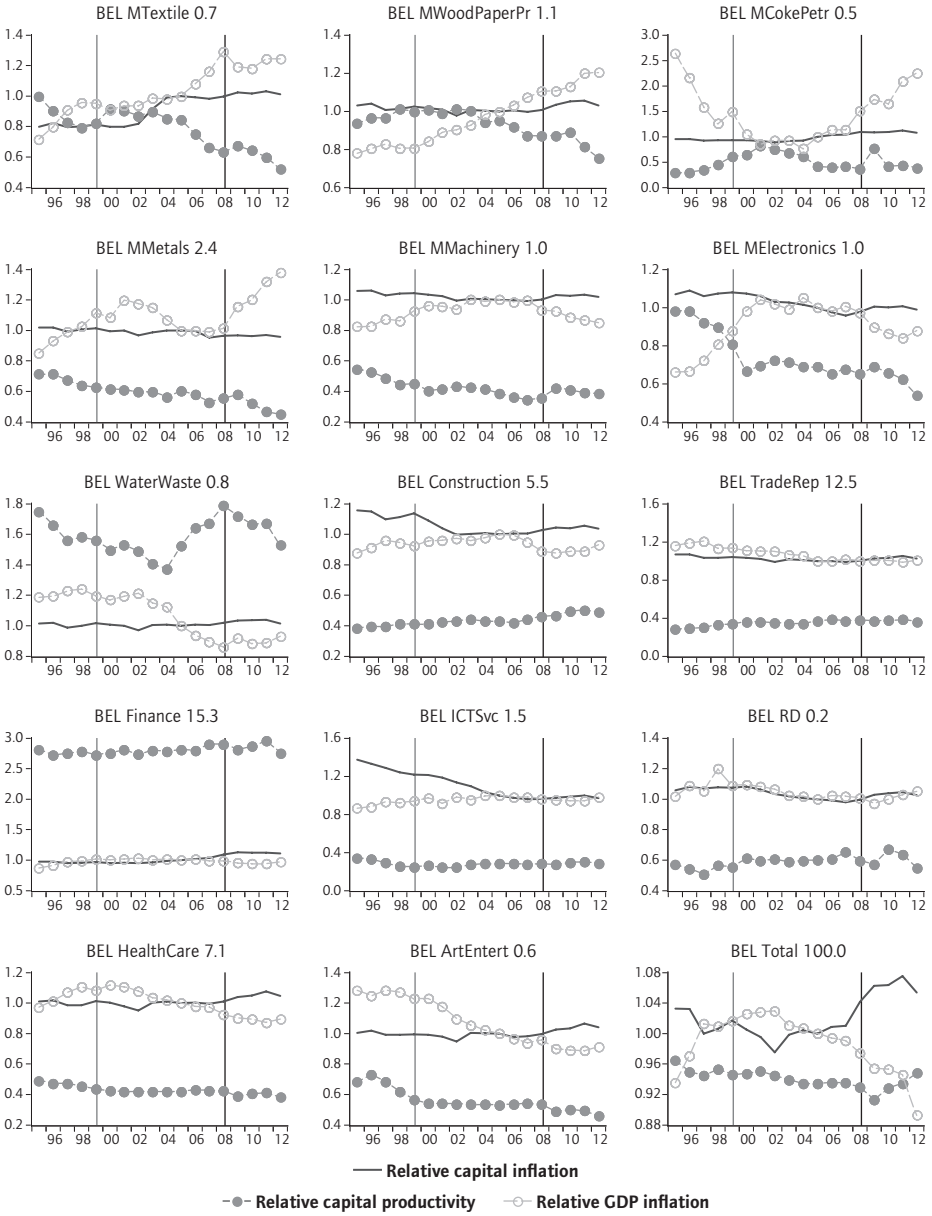



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.2 **Belgium**

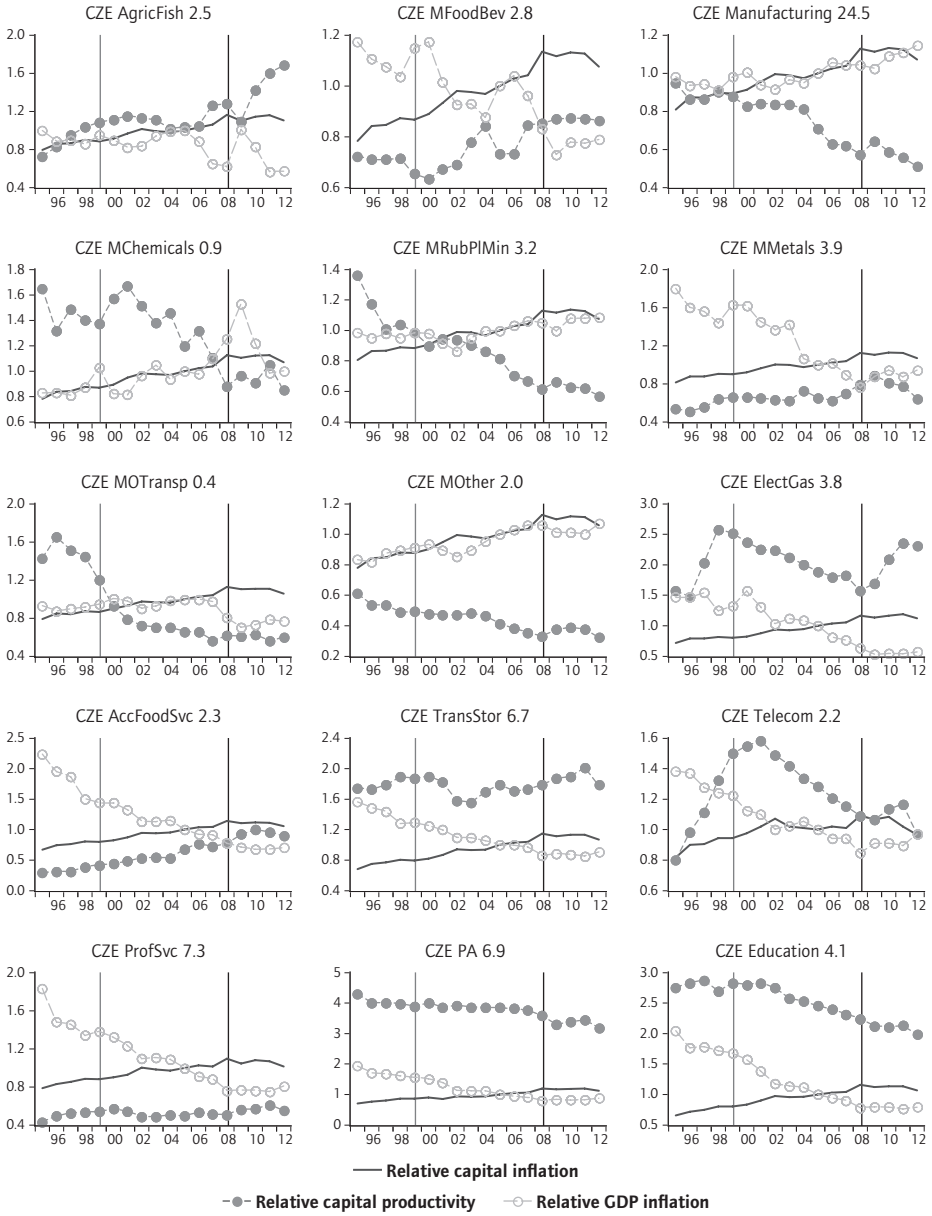



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

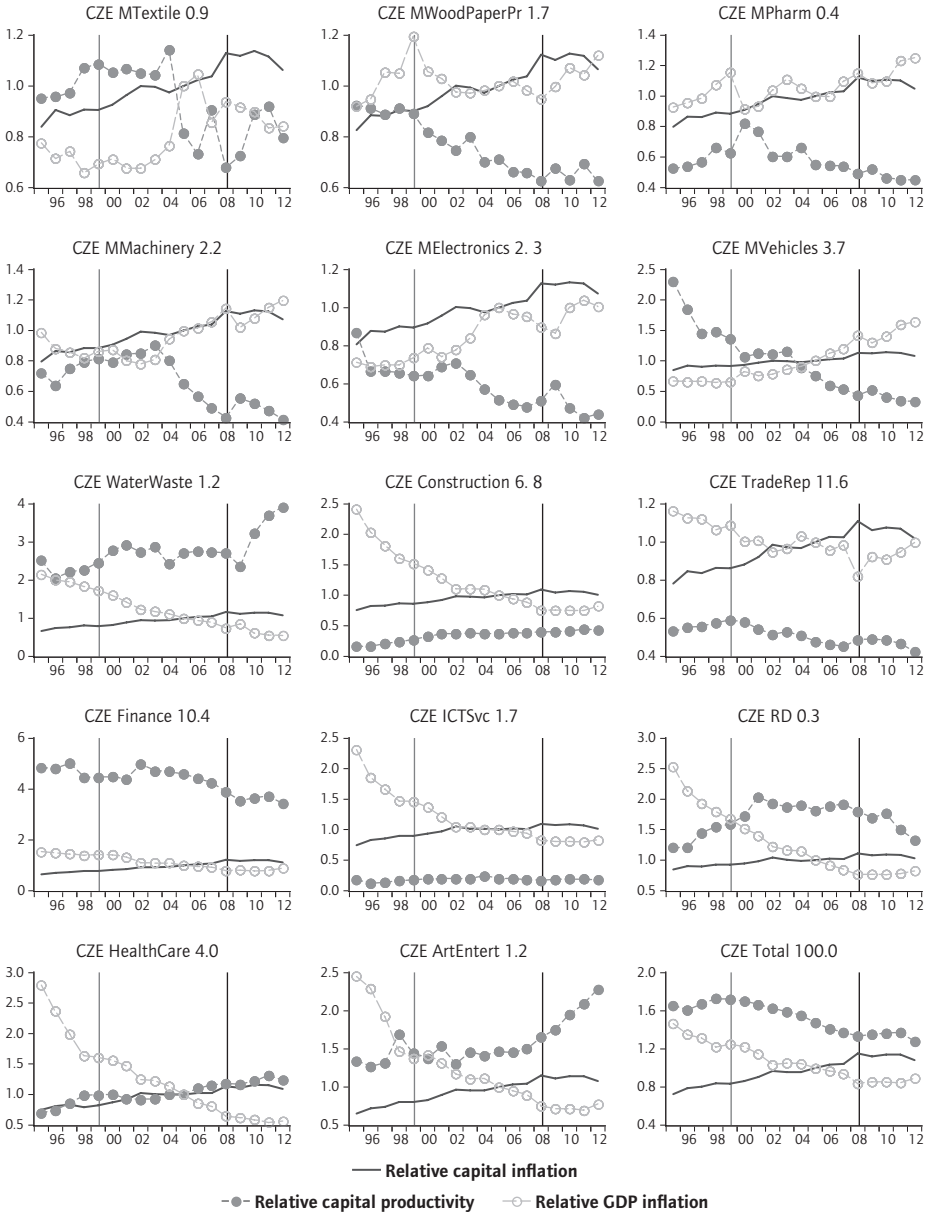



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.3 **Czech Republic**

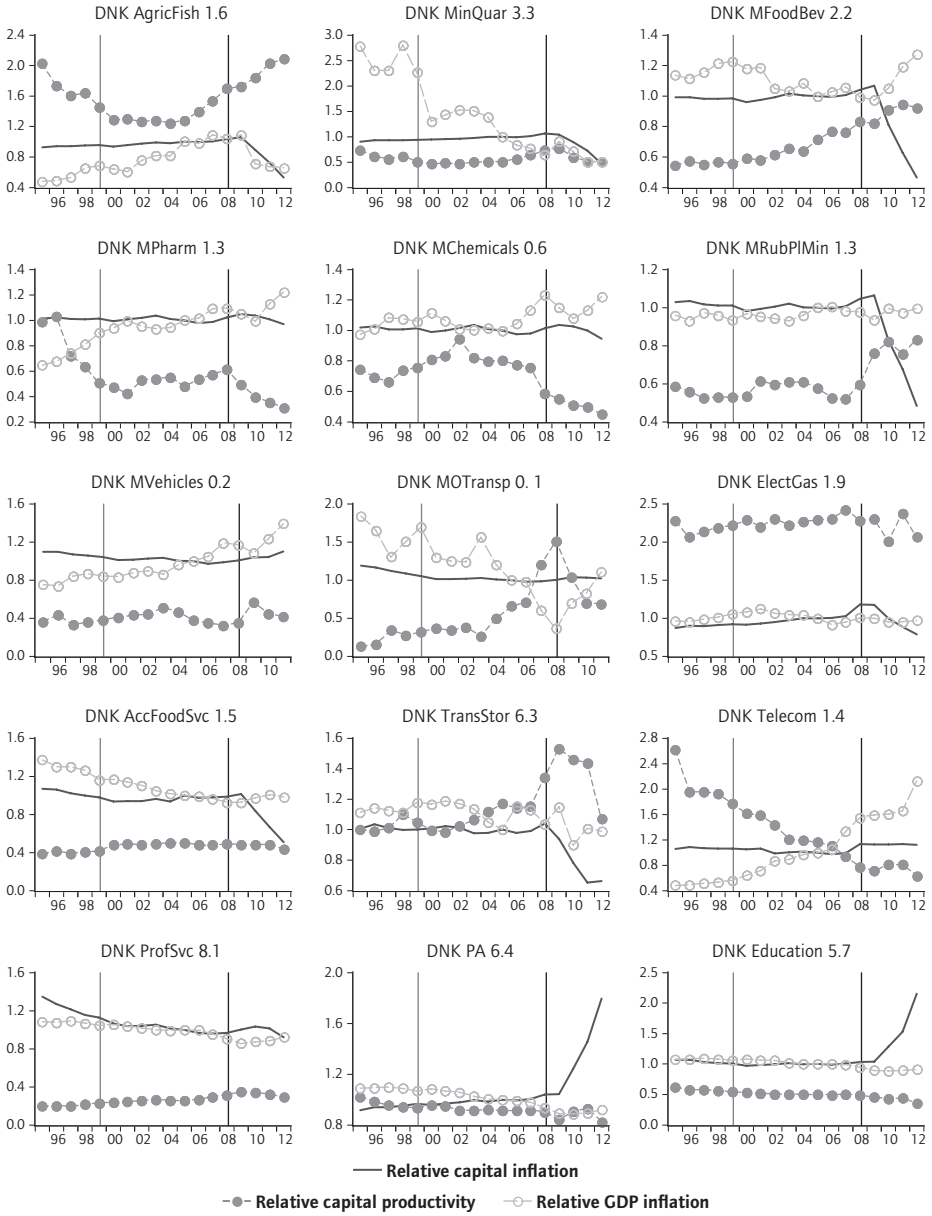



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

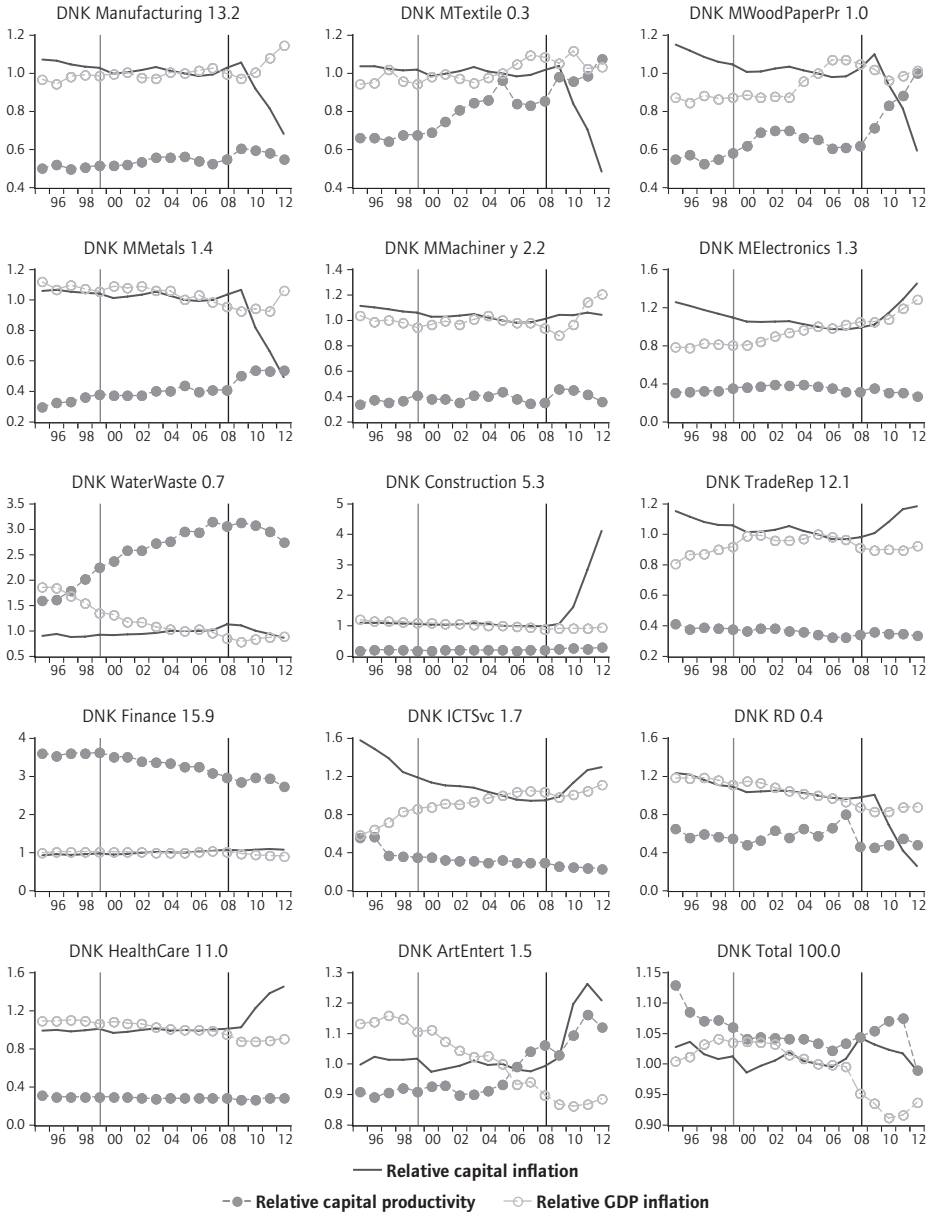



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.4 **Denmark**

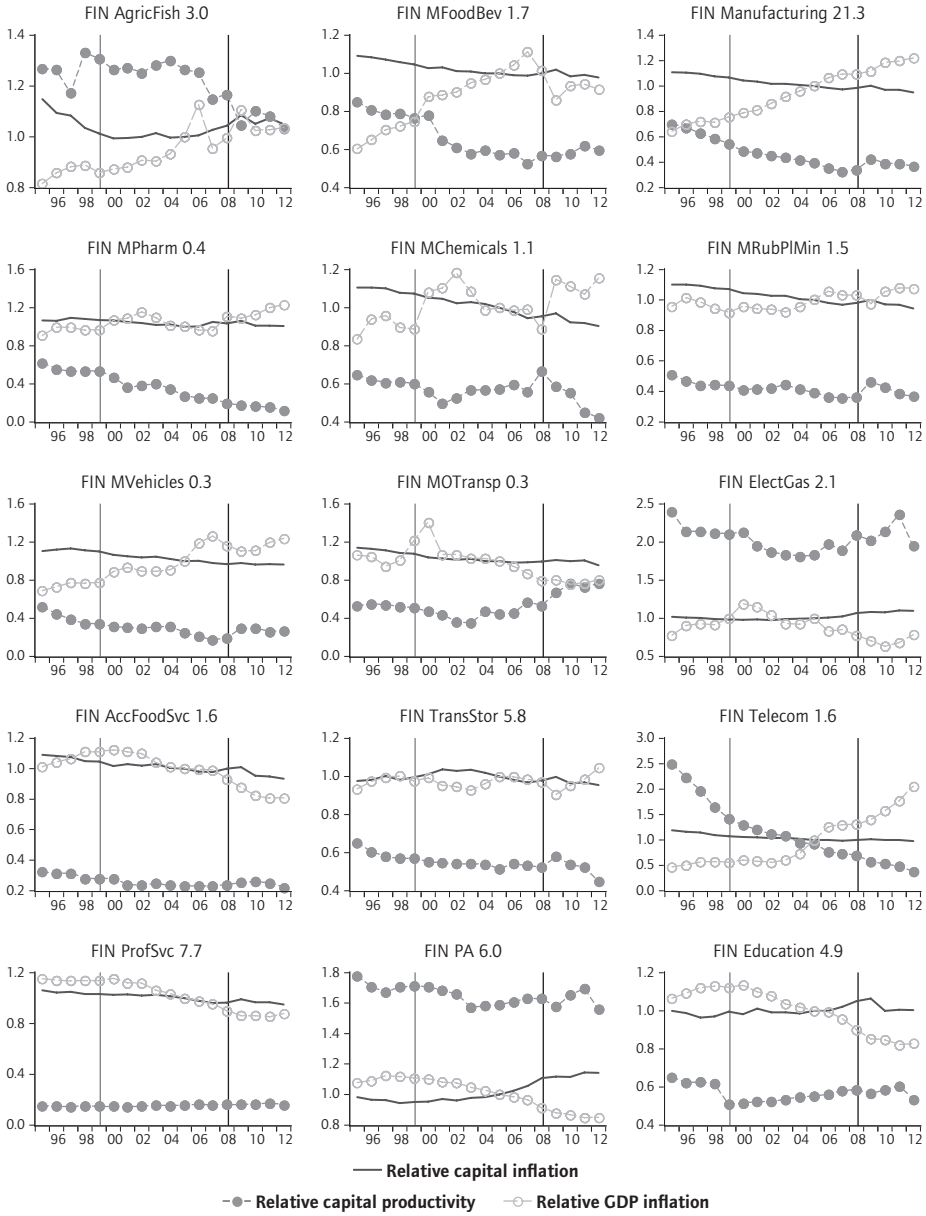



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

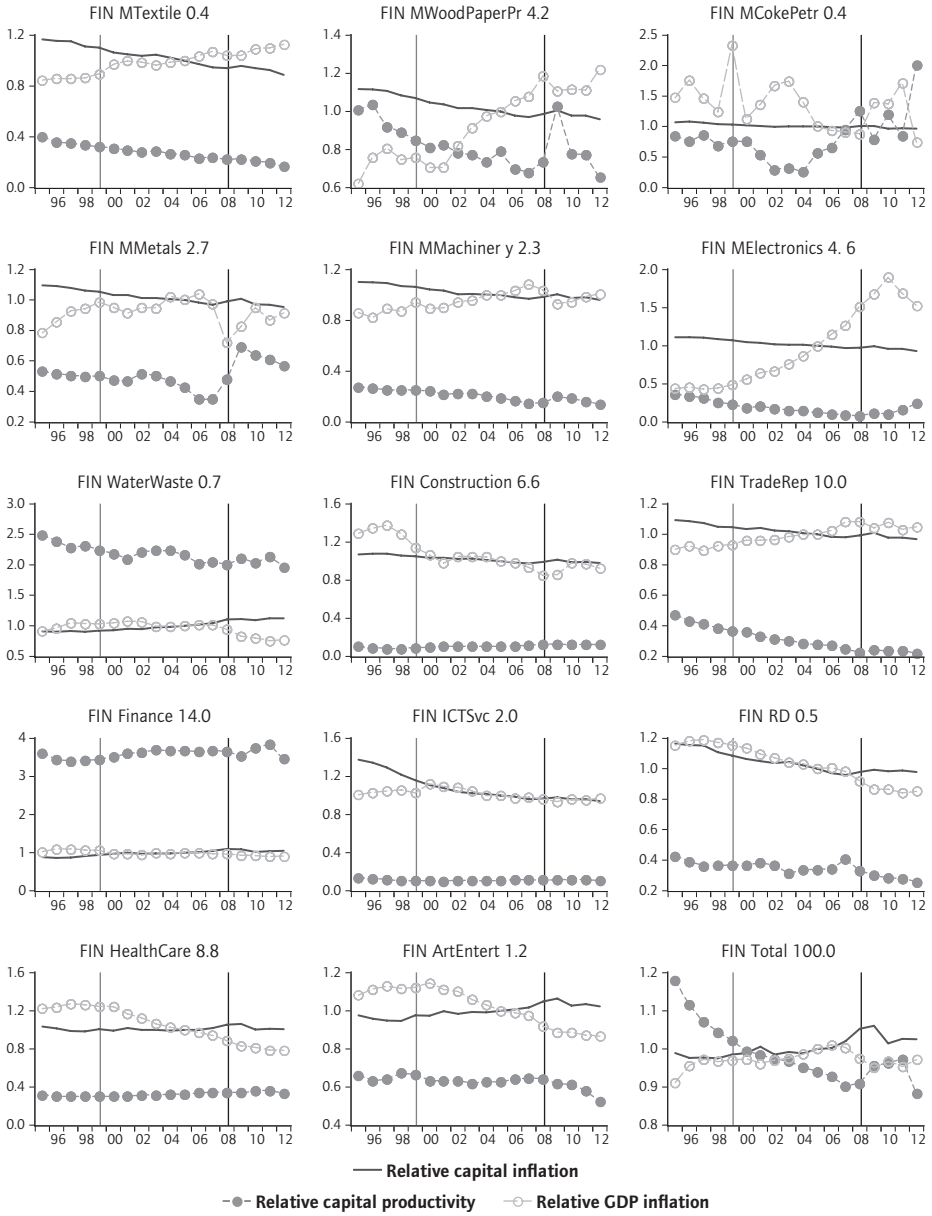



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.5 **Finland**

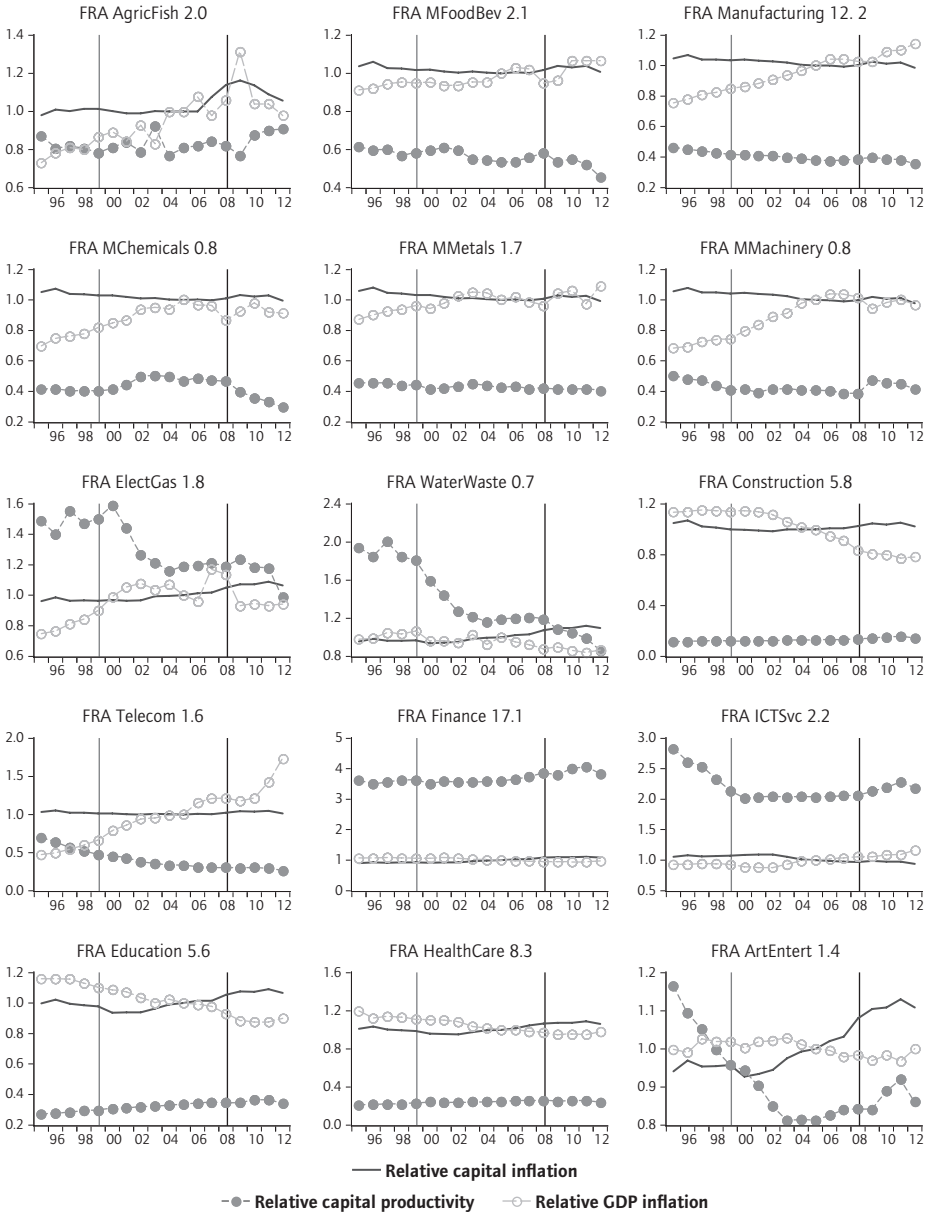



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

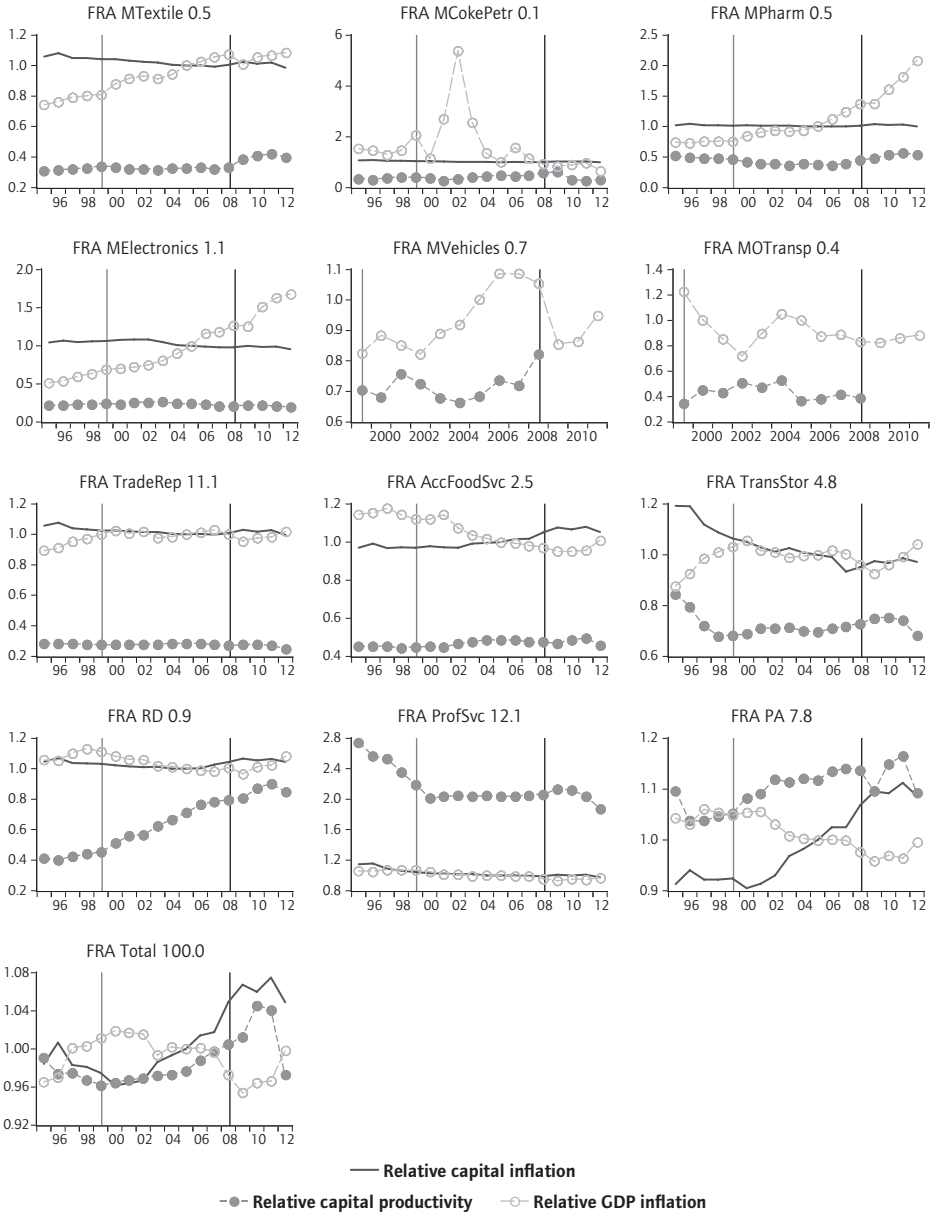



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.6 **France**

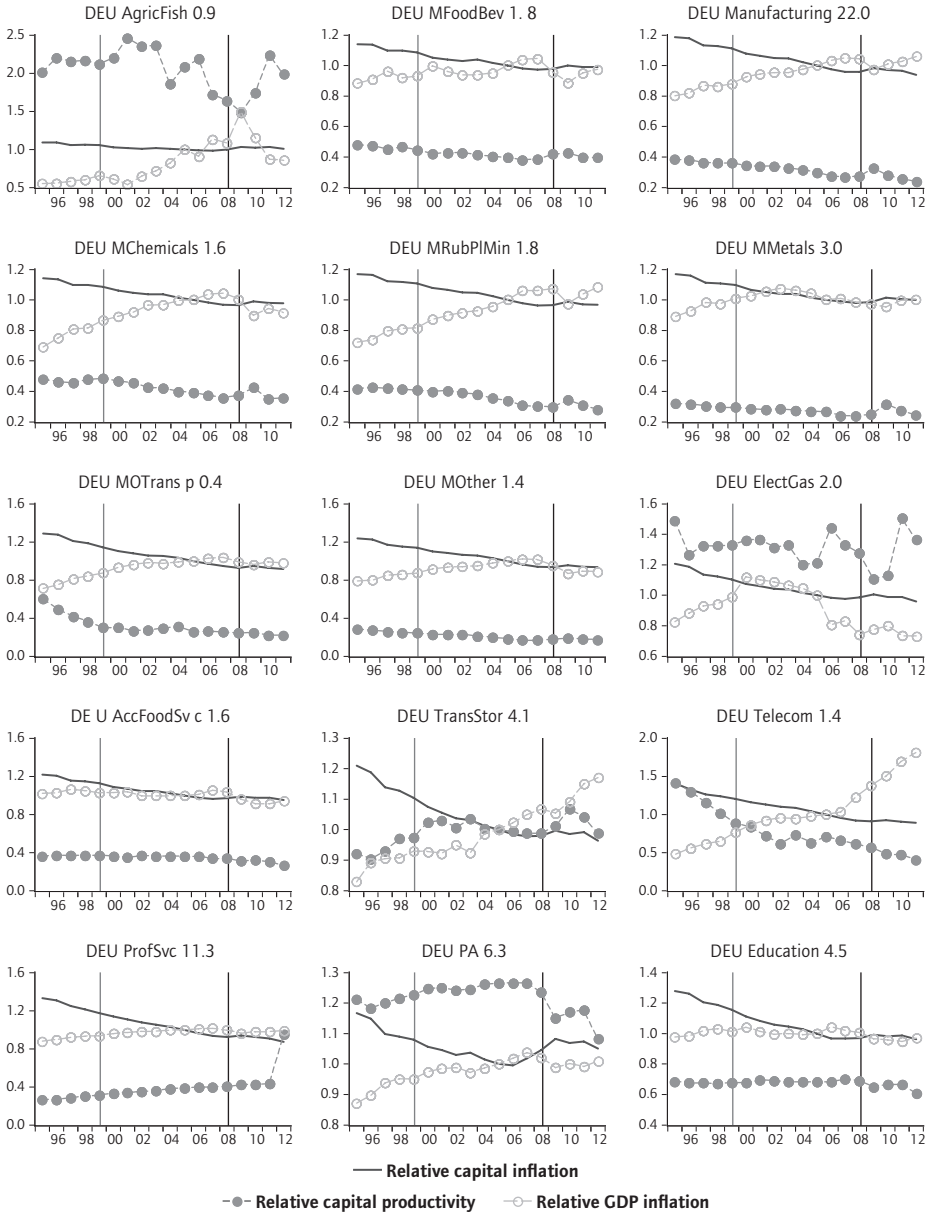



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

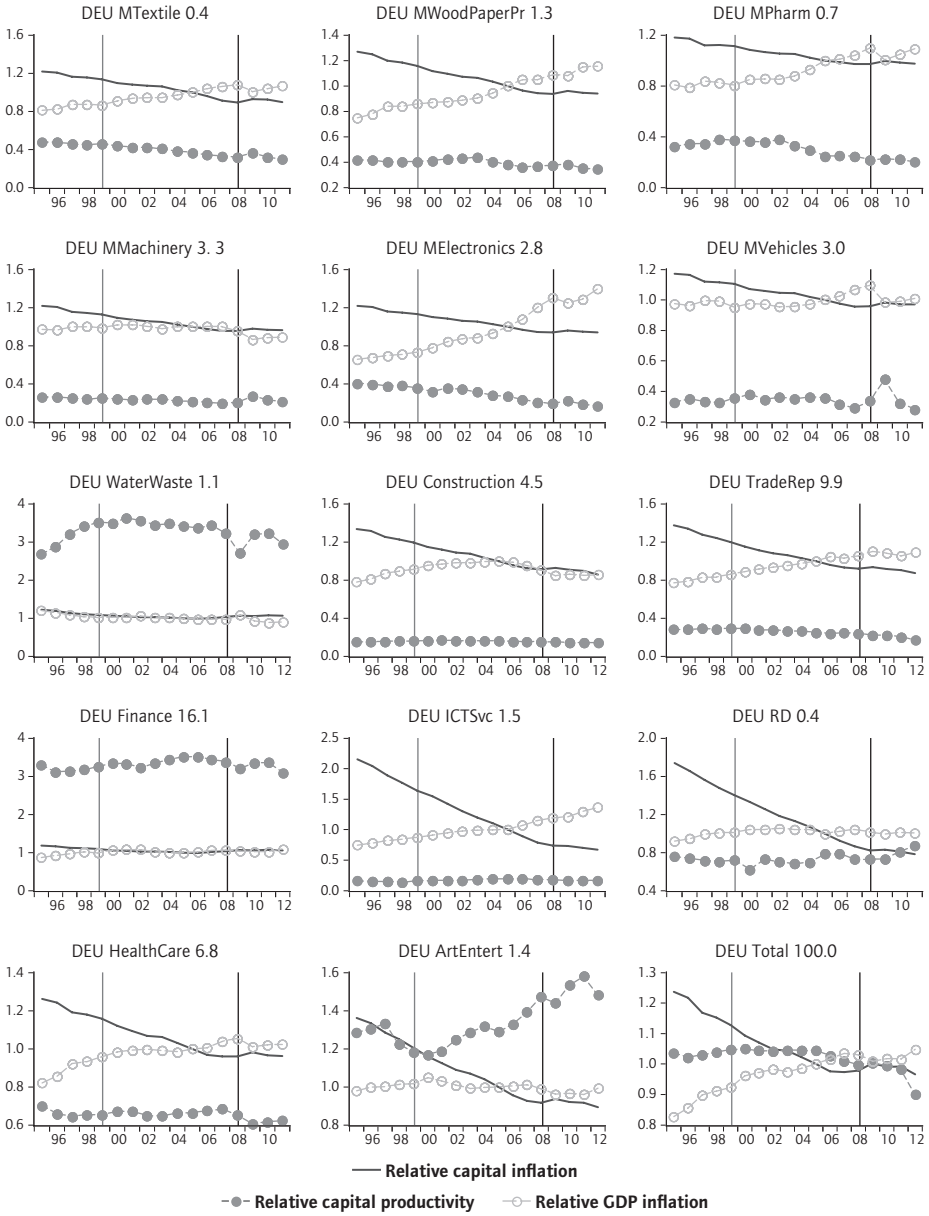



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.7 **Germany**

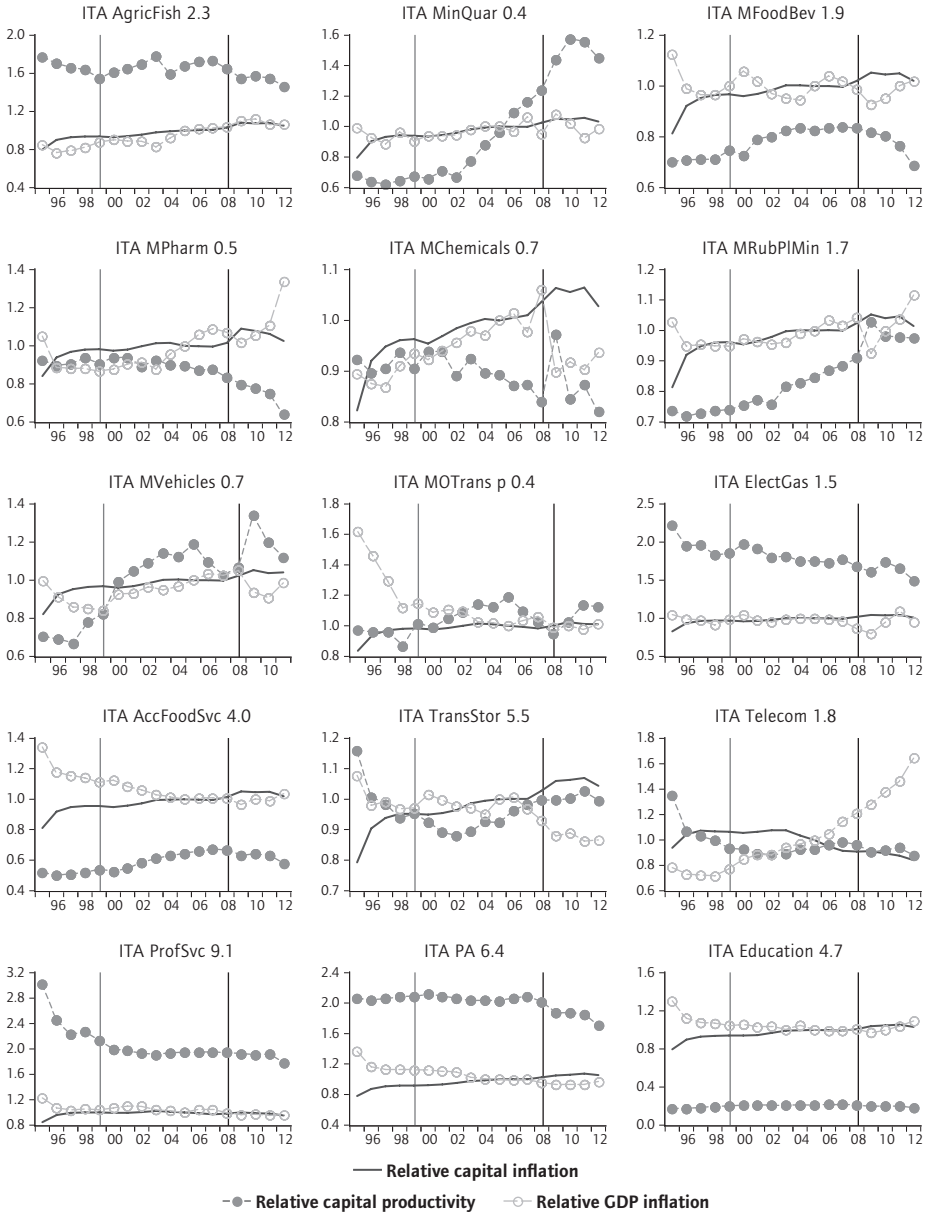



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

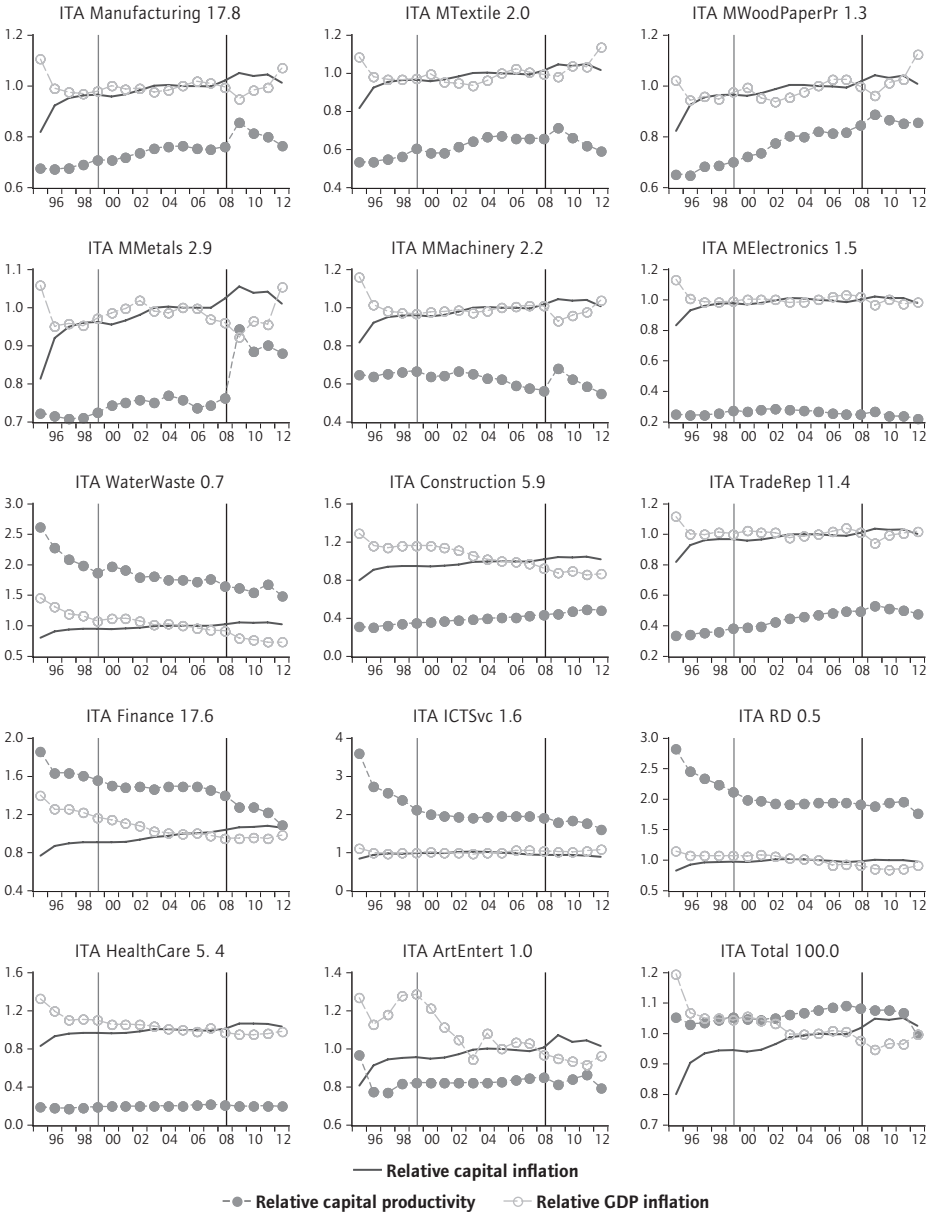



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.8 **Italy**

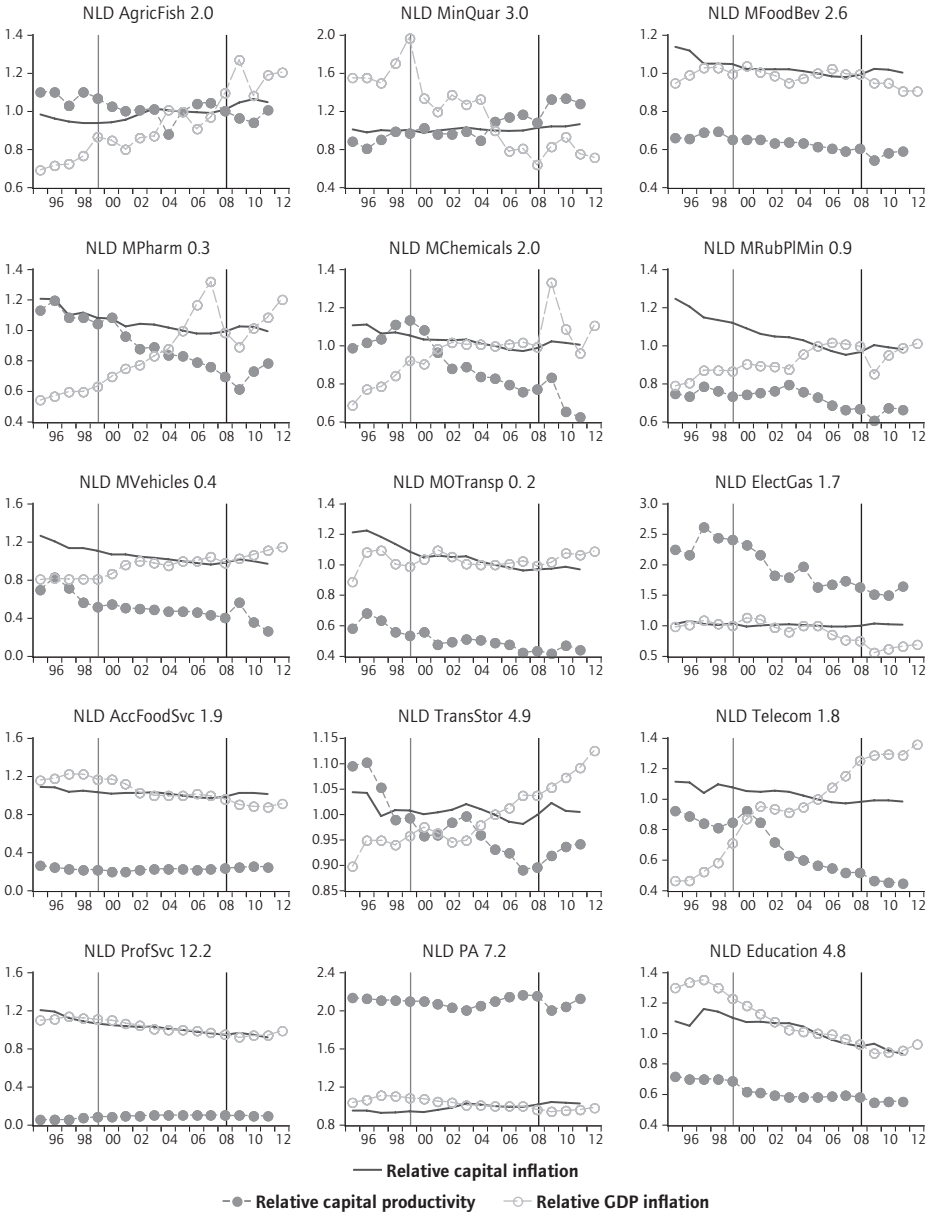



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

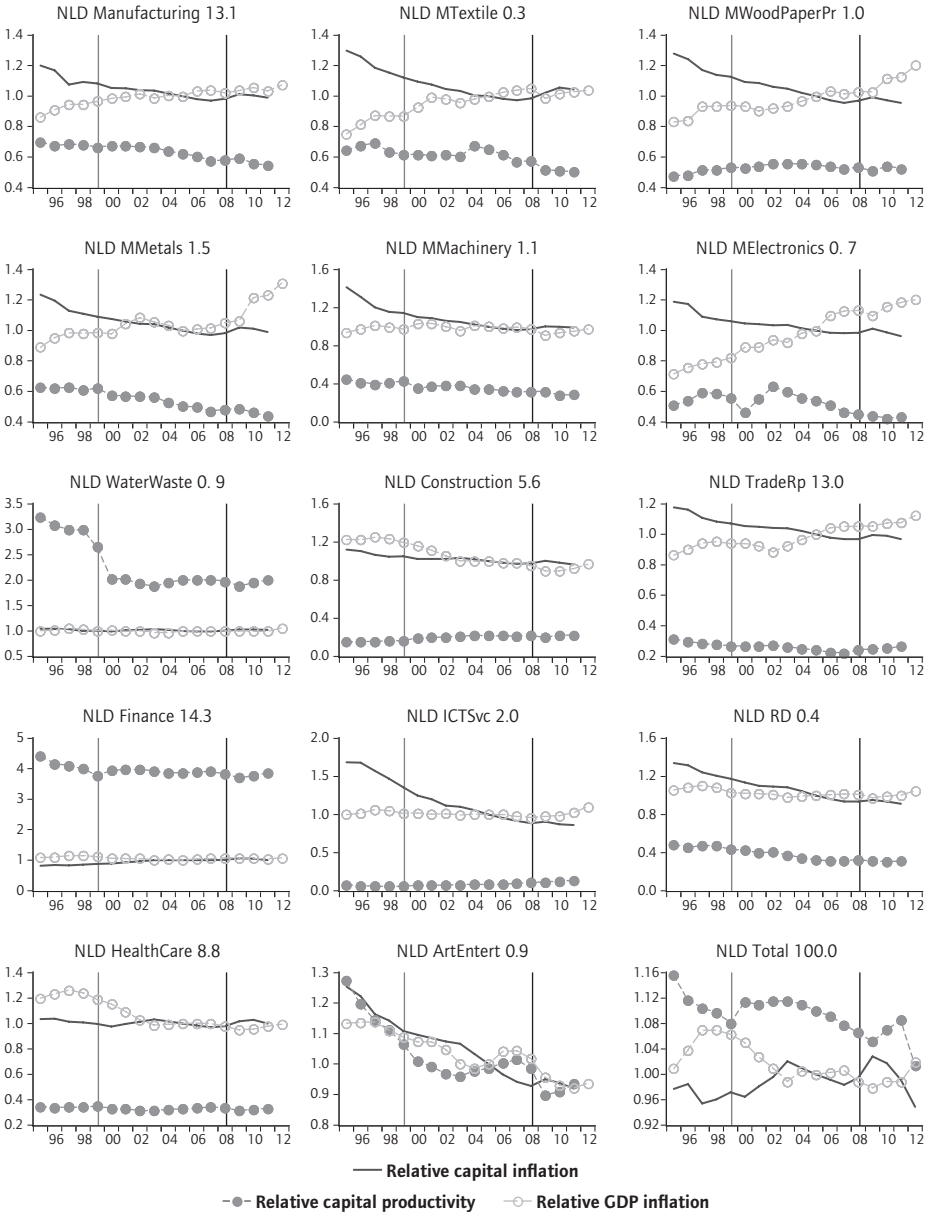



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.9 **The Netherlands**

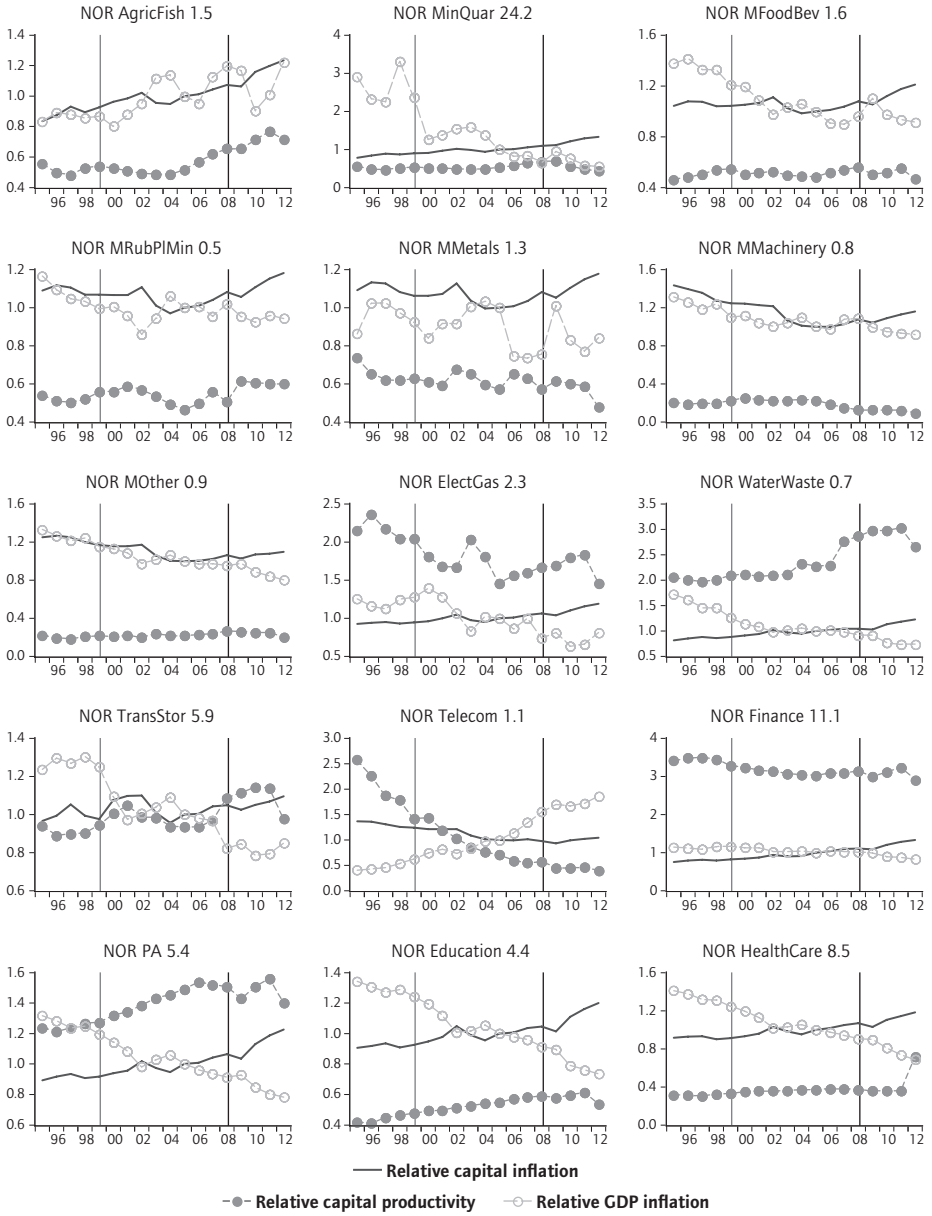



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

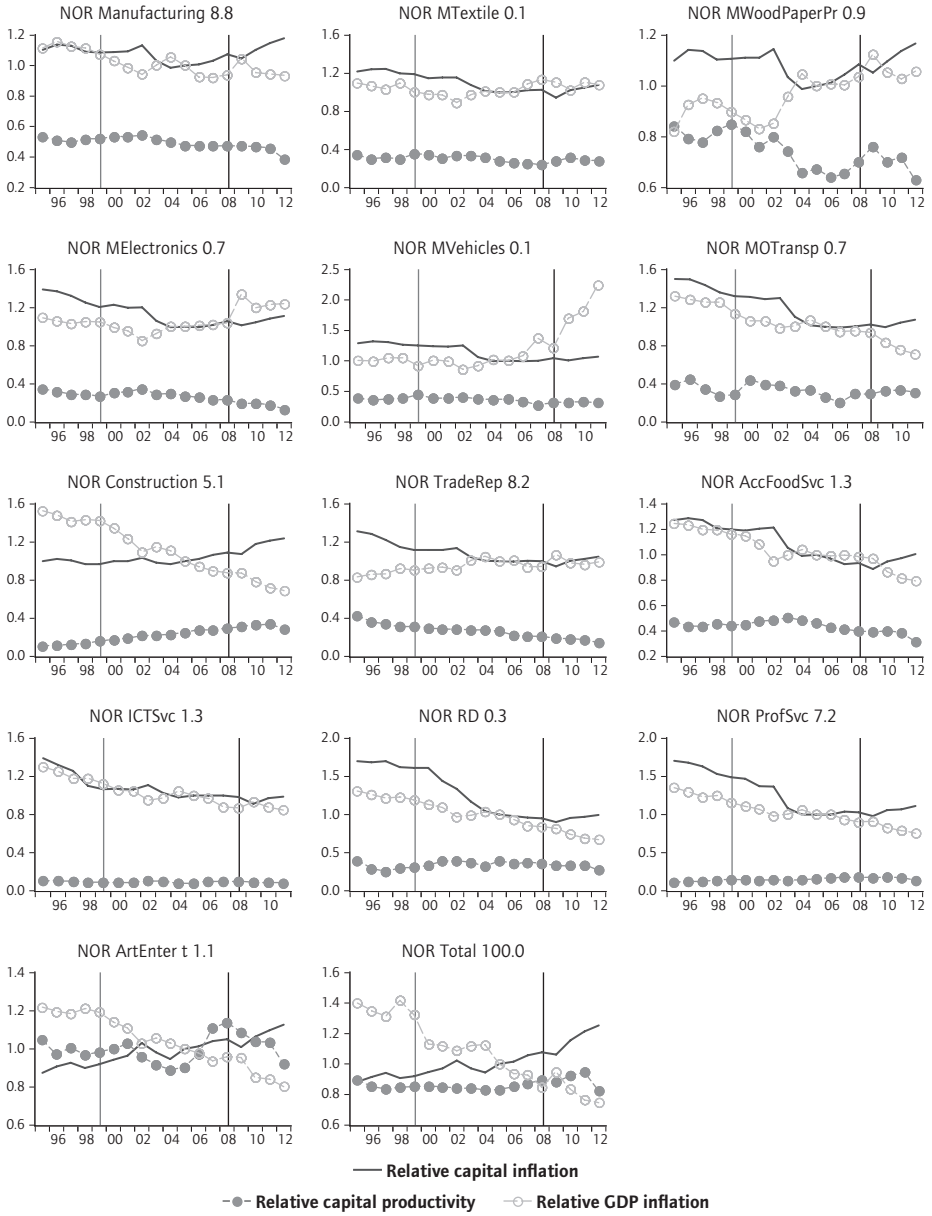



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.10 **Norway**

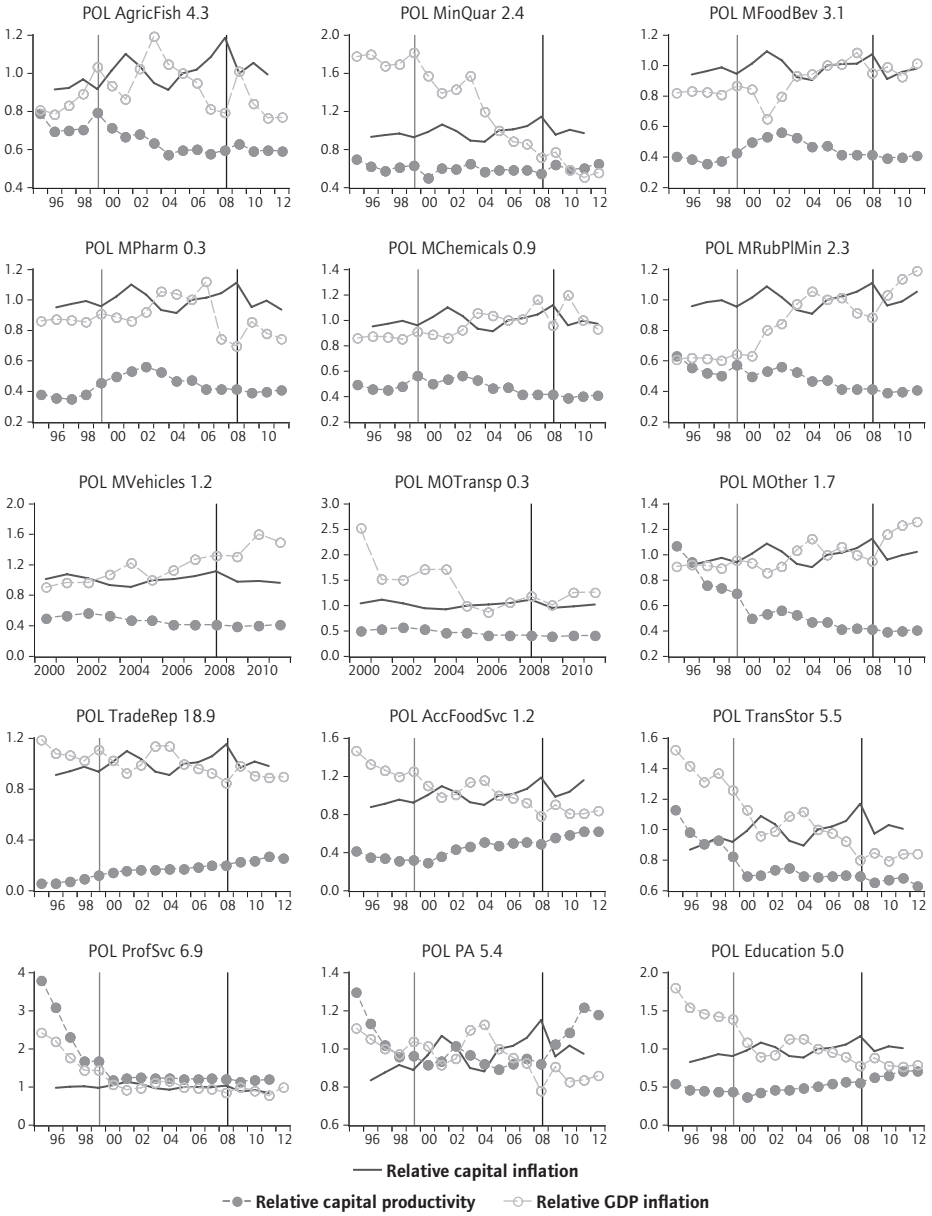



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

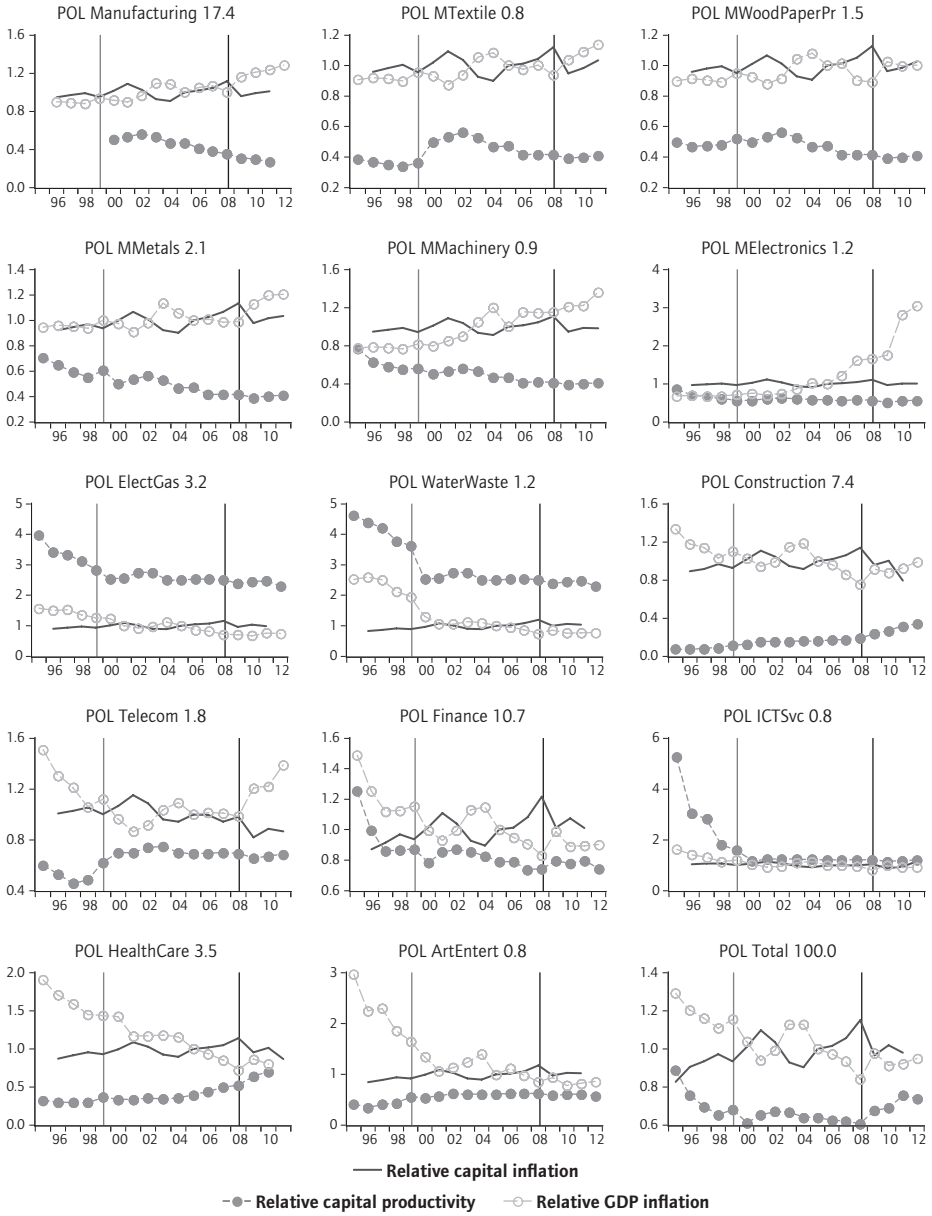



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.11 **Poland**

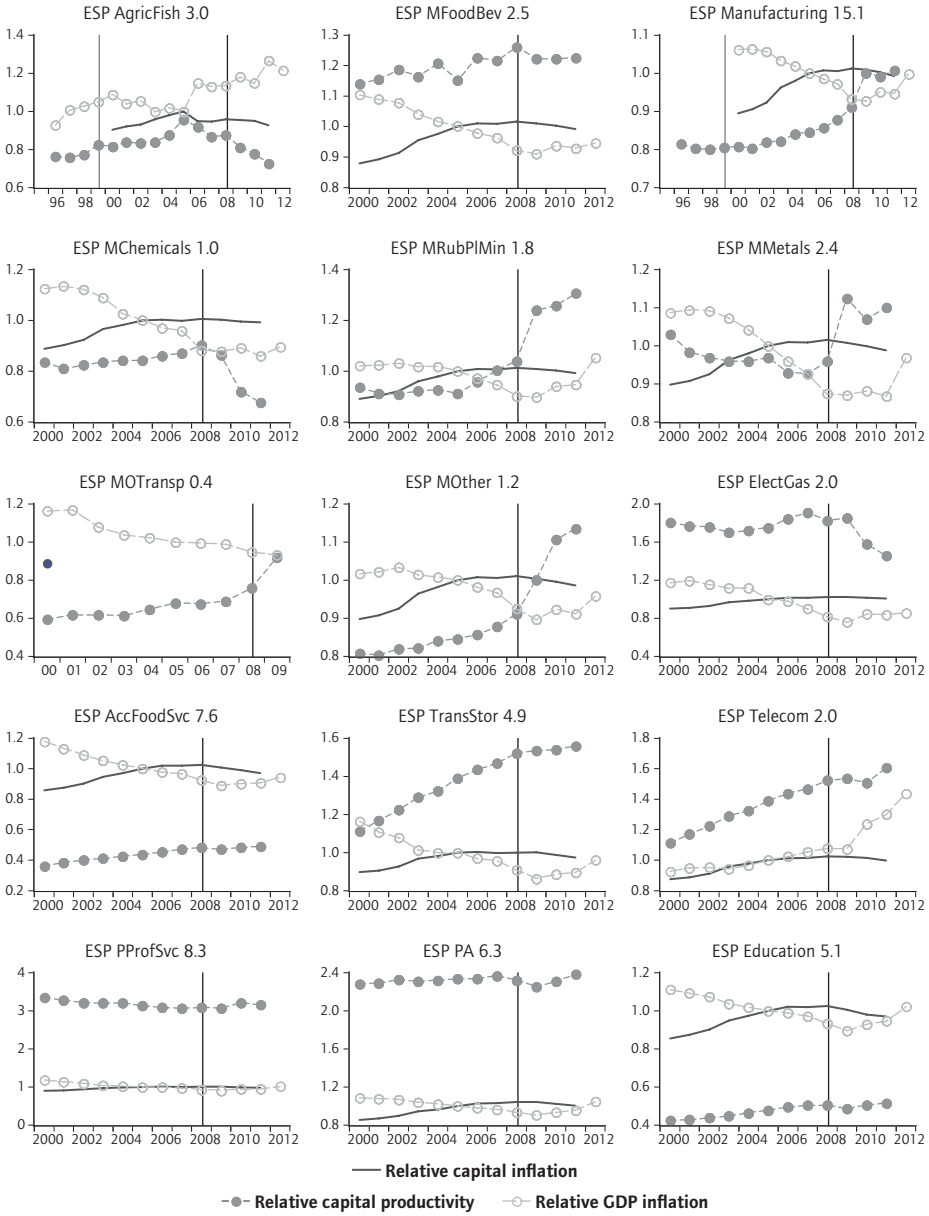



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

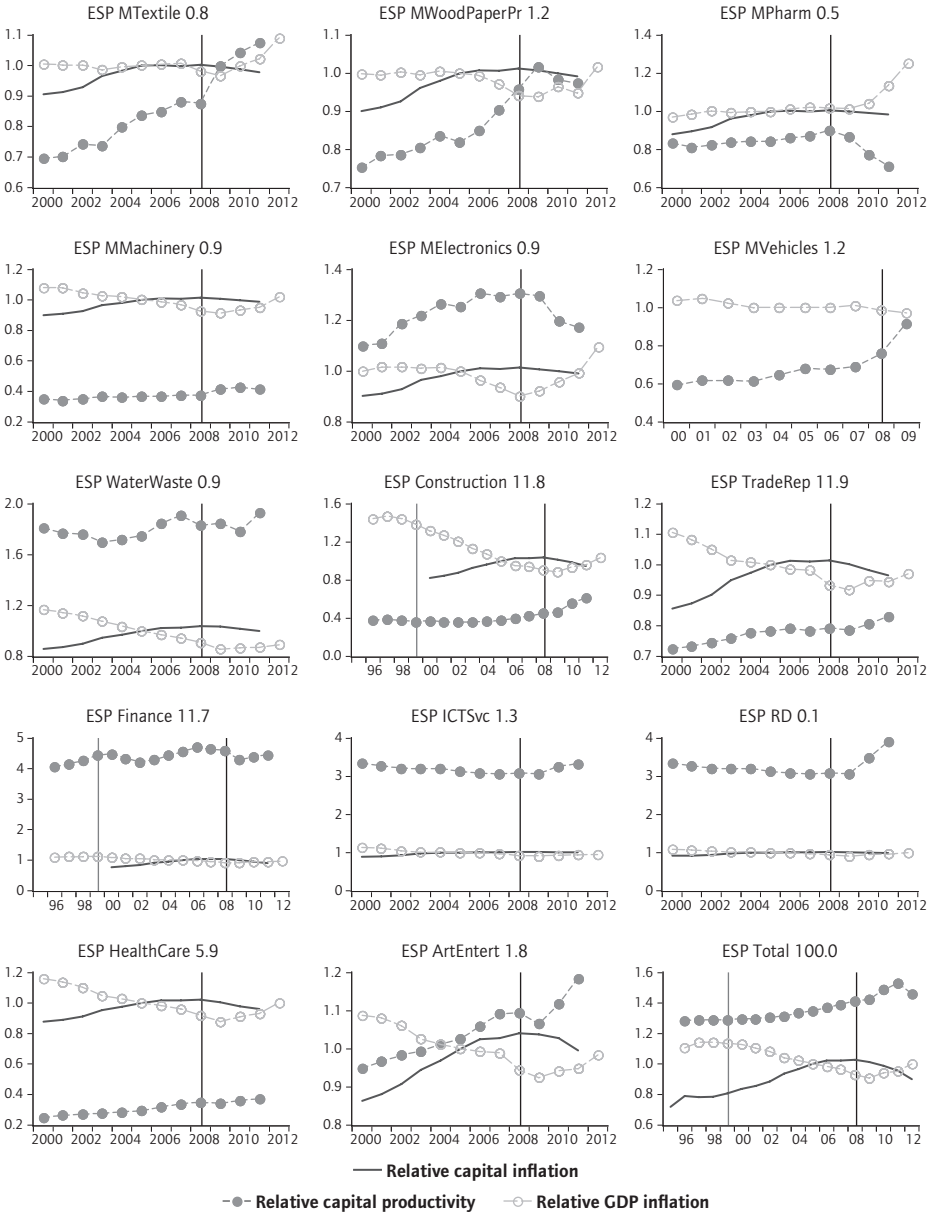



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.12 **Spain**

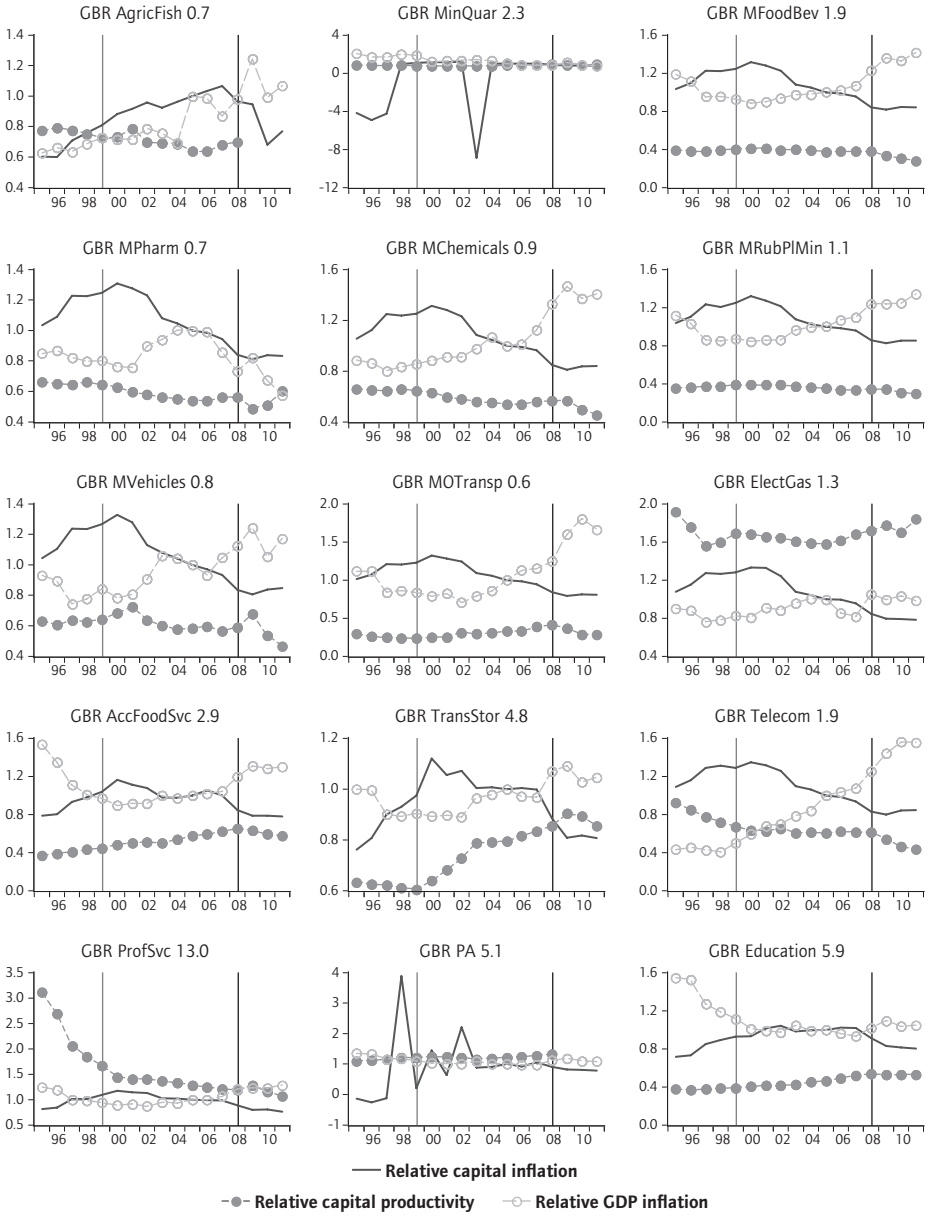



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

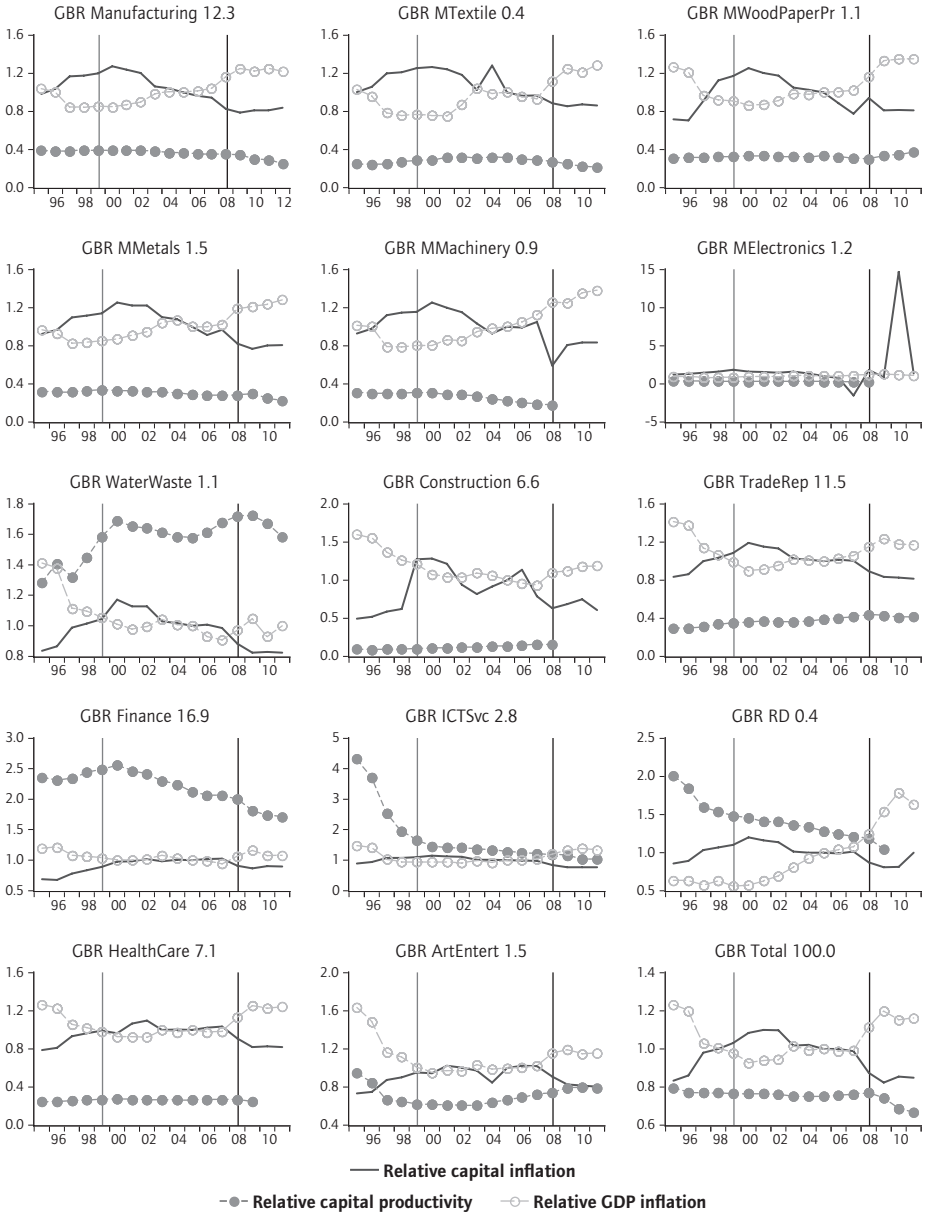



Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$).
See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

Figure A2.13 **United Kingdom**



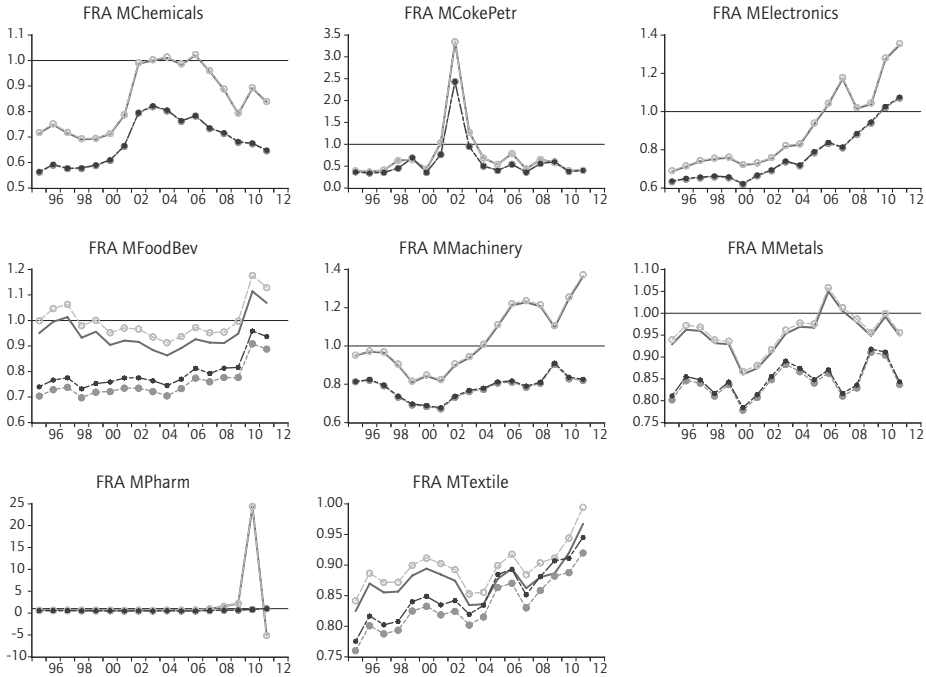

Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.




Note: Relative capital inflation=($P_{kx}/P_{k€}$); relative capital productivity=($Y_€/K_€$)/($Y_x/K_x$); relative GDP inflation=($P_€/P_x$). See equation (6).
Source: Authors' elaboration of Eurostat and OECD data.

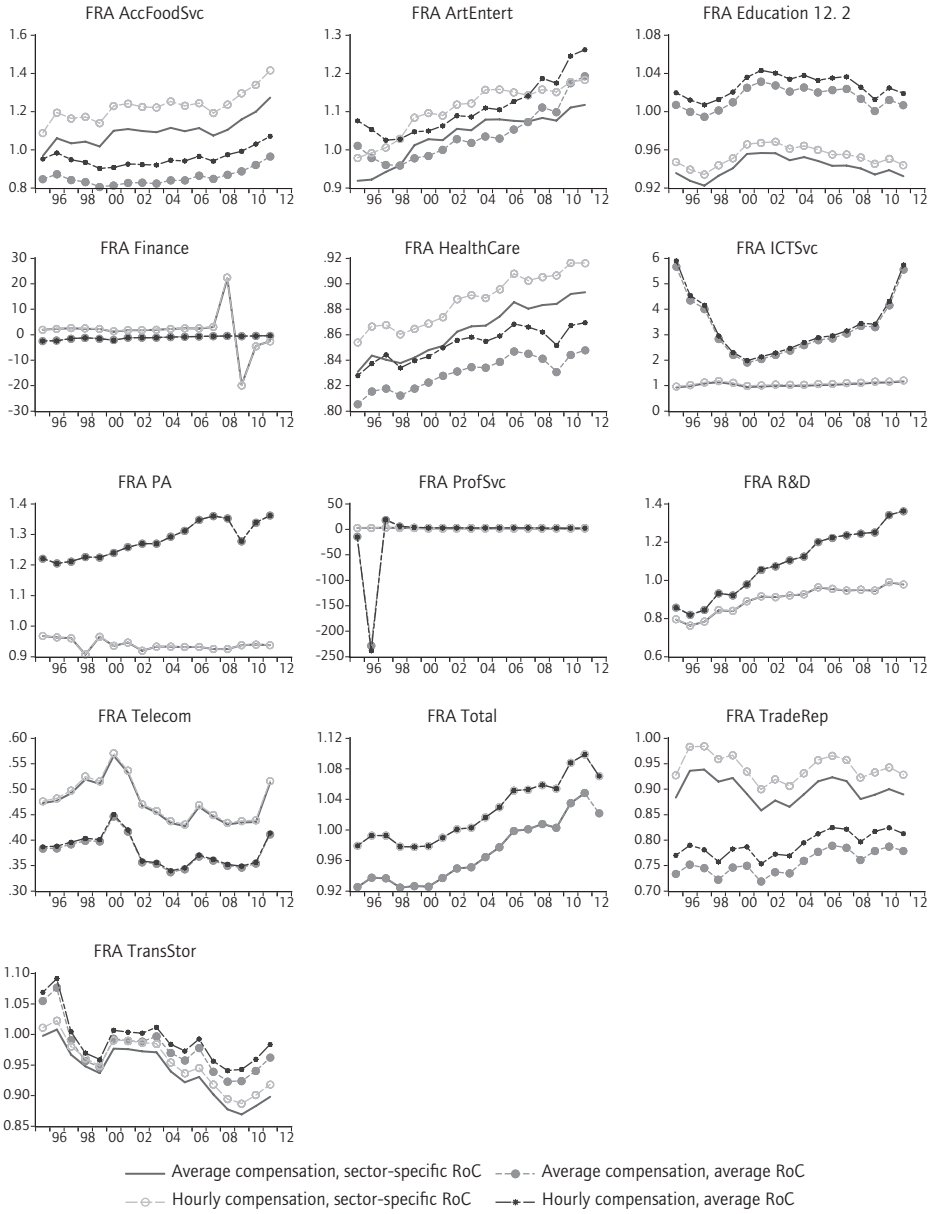
# Appendix 3
# Sectoral evolution of actual and equilibrium hourly wages in selected countries

Figure A3.1a **France, manufacturing sectors**



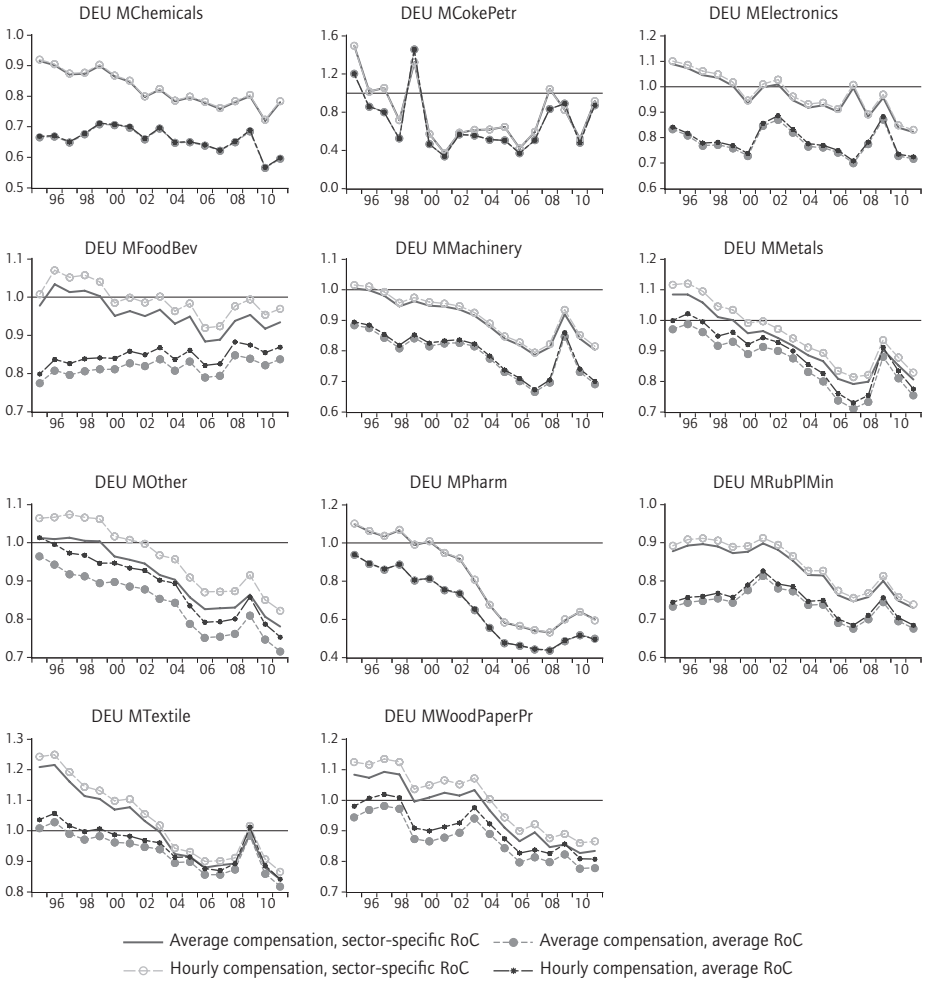

Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.1b **France, services**



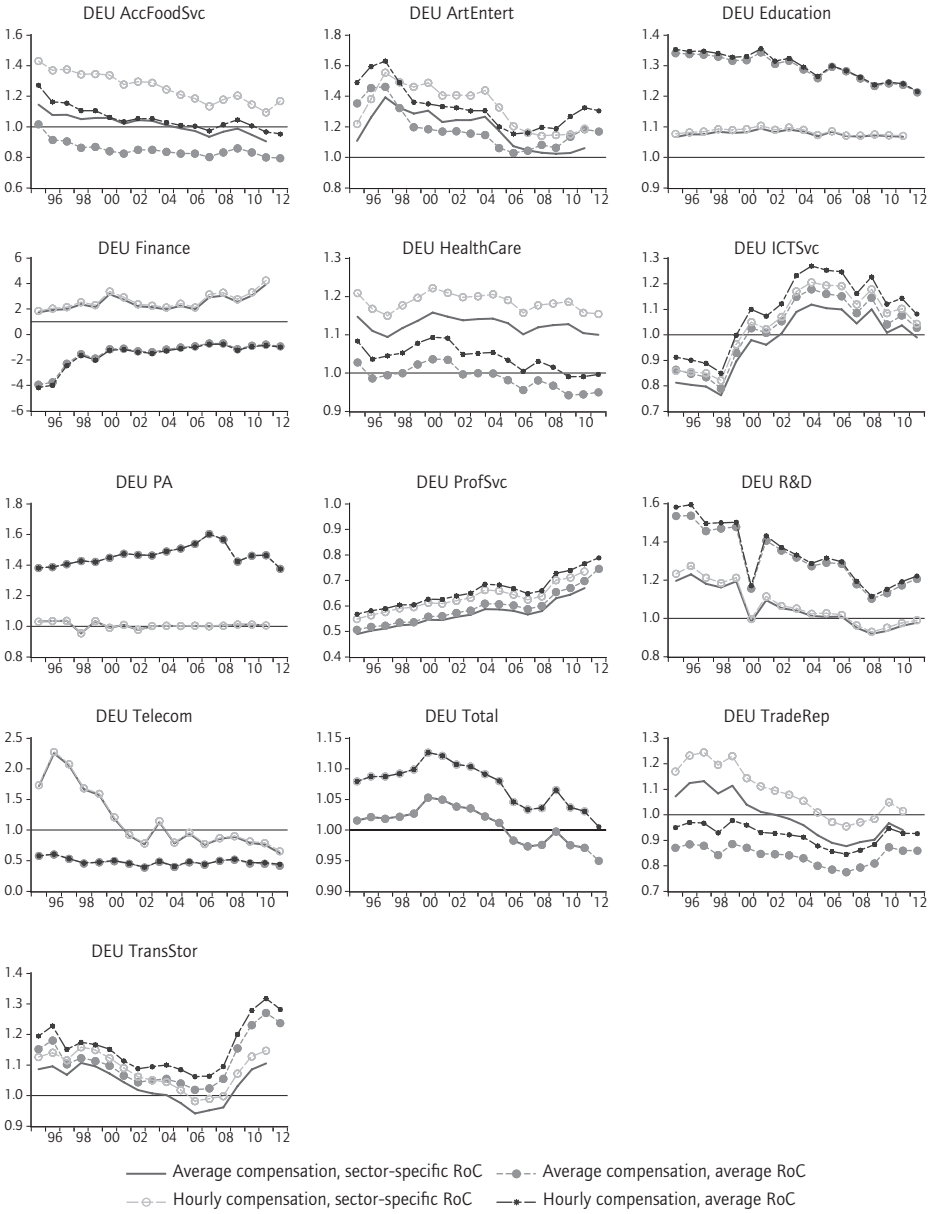

Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.2a **Germany, manufacturing**



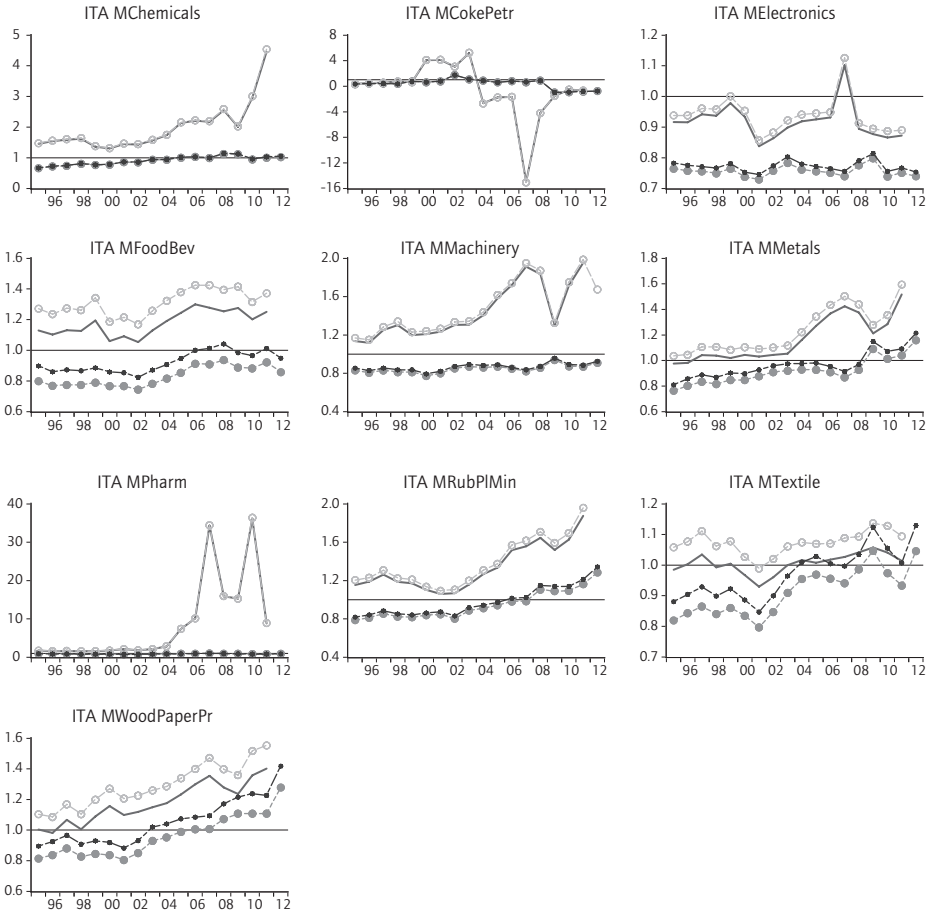

Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.2b **Germany, services**



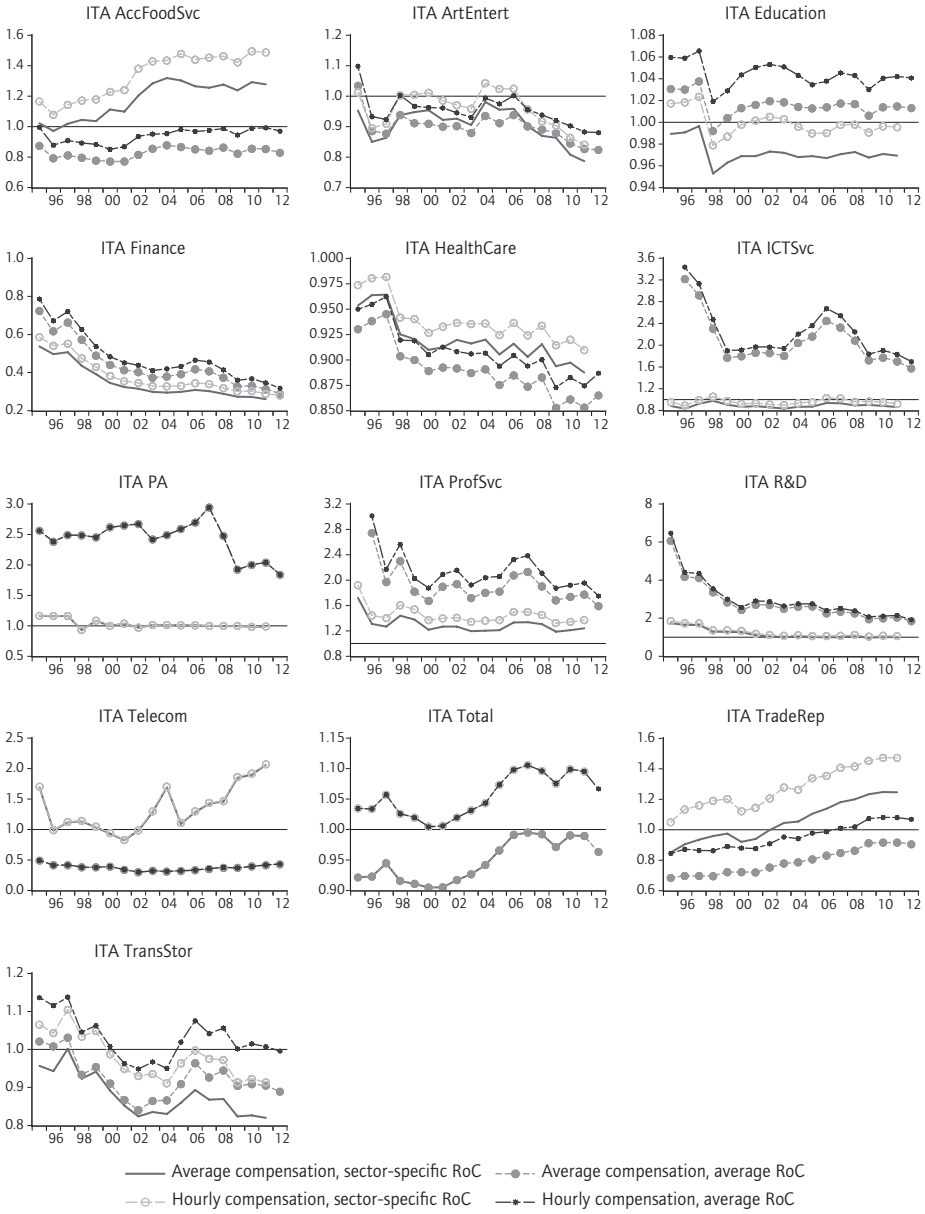

Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.3a **Italy, manufacturing**



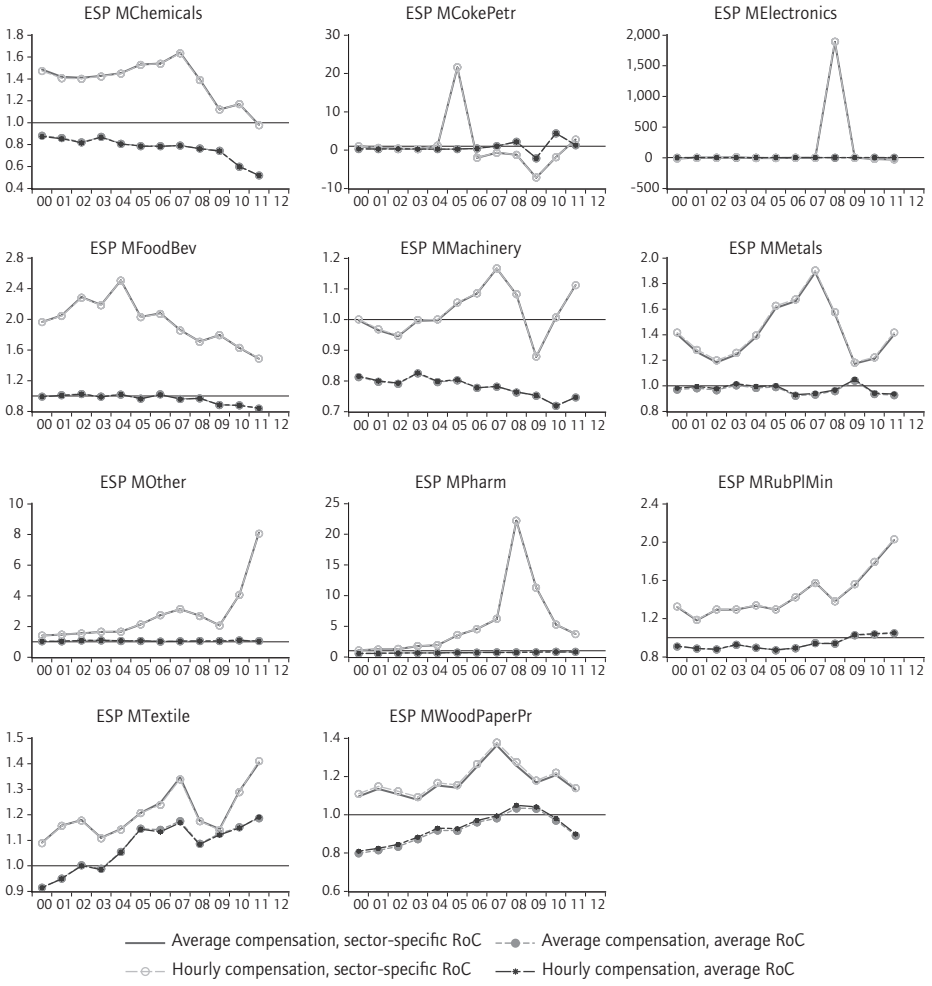

Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.3b **Italy, services**



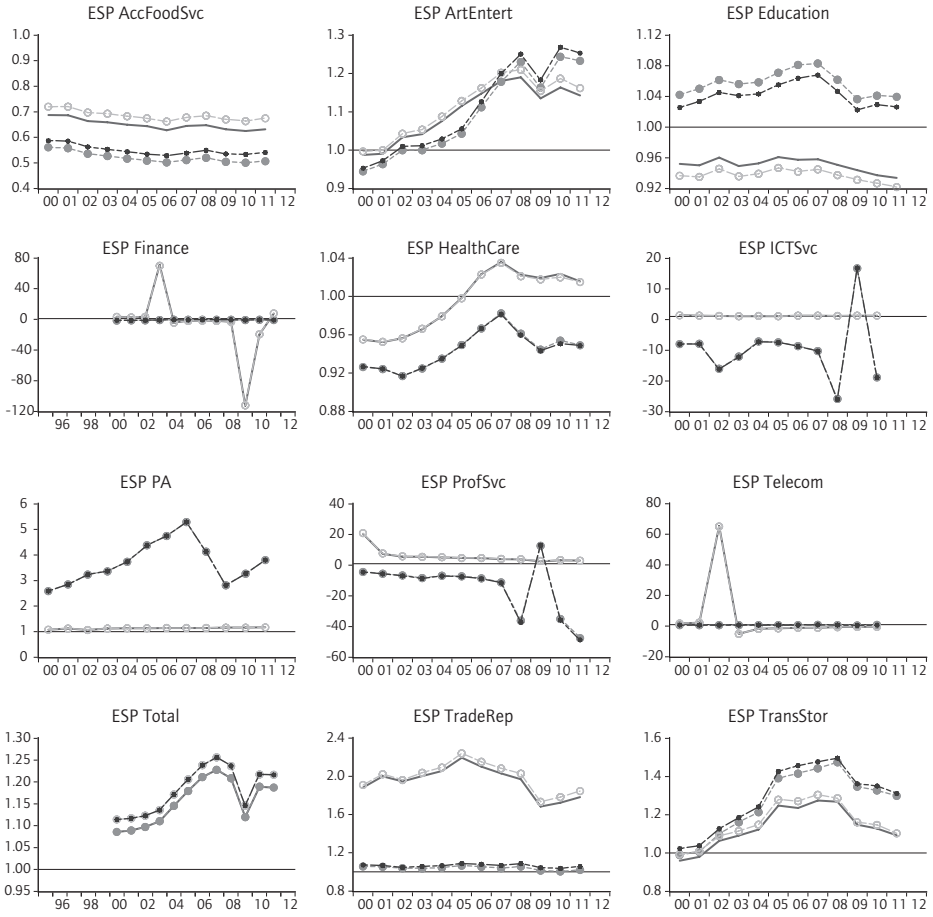

Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.4a **Spain, manufacturing**




Source: Authors' elaboration of Eurostat and OECD data.

Figure A3.4b **Spain, services**




Source: Authors' elaboration of Eurostat and OECD data.

# Appendix 4
# List of sectors

Table A4.1 **Sectors definitions, codes and abbreviations**

| Full name | NACE-3 | Short name |
|---|---|---|
| Agriculture, forestry and fishing | C01T05 | AgricFish |
| Mining and quarrying | C10T14 | MinQuar |
| Manufacture of food products; beverages and tobacco products | C15T16 | MFoodBev |
| Manufacture of textiles, wearing apparel, leather and related products | C17T19 | MTextile |
| Manufacture of wood, paper, printing and reproduction | C20T22 | MWoodPaperPr |
| Manufacture of coke and refined petroleum products | C23 | MCokePetr |
| Manufacture of basic pharmaceutical products and pharmaceutical preparations | C2423 | MPharm |
| Manufacture of chemicals and chemical products | C24X | MChemicals |
| Manufacture of rubber and plastic products and other non-metallic mineral products | C25T26 | MRubPlMin |
| Manufacture of basic metals and fabricated metal products, except machinery | C27T28 | MMetals |
| Manufacture of machinery and equipment n.e.c. | C29 | MMachinery |
| Electronics and electrical equipment | C30T33 | MElectronics |
| Motor vehicles | C34 | MVehicles |
| Other transport equipment | C35 | MOTransp |
| Manufacture of furniture; jewellery, musical instruments, toys; repair and installations | C36 | MOther |
| Electricity, gas, steam and air conditioning supply | C40 | ElectGas |
| Water supply; sewerage, waste management and remediation activities | C41 | WaterWaste |
| Construction | C45 | Construction |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | C50T52 | TradeRep |
| Accommodation and food service activities | C55 | AccFoodSvc |
| Transportation and storage | C60T63 | TransStor |
| Telecommunications | C64 | Telecom |
| Finance and real estate | C65T70 | Finance |
| Computer programming, consultancy, and information service activities | C72 | ICTSvc |
| Scientific research and development | C73 | R&D |
| Professional services | C74 | ProfSvc |
| Public administration and defence; compulsory social security | C75 | PA |
| Education | C80 | Education |
| HealthCare | C85 | HealthCare |
| Arts, entertainment and recreation | C92 | ArtEntert |
| Total - All NACE activities | CTOTAL | Total |