Convergence to fair wage growth?
Evidence from European countries on the link between productivity and real compensation growth, 1970–2017

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Abstract

This paper examines two questions. First, whether and if so, to what extent real compensation growth has been systematically associated with labour productivity growth in the past five decades, once other factors determining real compensation growth have been taken into account. And secondly, whether the apparent gap between real compensation and productivity growth, which can also be considered to be a measure of 'fair' wage growth, has been growing or diminishing over time and whether the EU member states have been converging to or diverging from it.

The first question has been the subject of recently renewed policy and academic interest, especially in the United States, but also in Europe. Answering this question has important implications regarding the policies that are necessary (but not necessarily sufficient) to support stronger real wage growth, which could help to reduce income inequality and support currently globally disappointing output growth rates.

The particular contribution of this paper is that it builds on the existing empirical literature to provide country-specific evidence on 25 EU member states on the first question and examines this evidence from the perspective of the European Pillar of Social Rights. It highlights the diversity in the degrees to which various EU member states have been experiencing 'fair' wage growth and thus provides some insights towards understanding what needs to be done in order to pursue this aim.

The analysis in this paper suggests that the linkage between productivity and real compensation growth is still present in most of the countries examined, but that in most of them workers have not been reaping the full gains from productivity growth. The second question is pertinent to the implementation of the 'fair wages' principle of the European Pillar of Social Rights. This paper provides evidence suggesting that following the period of 1970-1994 when the gap between productivity and real compensation growth widened on average, there has been convergence towards a 'fair' wage growth pattern since the mid-1990s, which nevertheless did not reverse the earlier losses.

1. Introduction

Does productivity growth matter for real wage growth? Driven by an apparent decoupling of labour productivity from real wage growth – dubbed 'the Great Decoupling' (Brynjolfsson and McAfee 2014) – this question has been the subject of a growing academic and policy debate in the United States, where the majority of American workers have been experiencing wage stagnation (Bivens and Mishel 2015; Bernstein 2017; Stansbury and Summers 2018). This paper extends the empirical investigation of this question to Europe and examines whether and, if so, to what extent increases in real hourly labour productivity were *systematically* associated with increases in real hourly employee compensation in European countries between 1970 and 2017. In other words, with how much of an increase in average real hourly compensation was a 1 per cent increase in average real labour productivity associated during this period? Does any gap between the two vary across member states and, if so, has there been convergence or divergence in this gap?

Answering these questions could provide insights that enable us to better understand three currently salient economic and political issues. First, what drives income inequality. Secondly, how the currently long-drawn-out and fragile recovery from the Great Recession in Europe could be strengthened. And third, how far from the principle of 'fair wages' proposed by the European Pillar of Social Rights different member states are.

In order to address this question, this working paper analyses the covariation of average real hourly labour productivity and average real hourly employee compensation in 25 European countries using annual data from 1970 to 2017 (and for shorter periods for several of them, depending on availability). I document the differences in the extent to which real hourly productivity gains have been systematically associated with real hourly compensation gains and I examine whether, over time, there has been convergence or divergence in the gap between the two variables across member states. Overall, in most member states the evidence does not support the hypothesis that, on average, productivity and real compensation growth have been decoupled, although I also find that, in most cases, productivity gains do not fully translate into real compensation gains.

The existence of a gap between productivity and real compensation growth also marks the departure from a benchmark of 'fair' wage growth, whereby real wages/compensation grow in line with labour productivity. 'Fair wages' is one of the twenty principles of the European Pillar of Social Rights. Using the data developed for the analysis of the previous question, this paper also looks whether 'fair' wage growth has been, on average, the norm and EU member states have been converging to or diverging from it.

This paper is structured as follows. Section 2 explains why the questions examined in this paper are important. Section 3 illustrates what we already know from existing empirical research on the subject. Section 4 provides essential information and clarifications for the data used in the analysis and

explains and justifies the empirical approach adopted. Section 5 presents and interprets the results. Section 6 concludes by stating some policy implications and open questions for future research. An online appendix, for the more technically minded reader, provides full details on the steps of and options chosen taken for the empirical analysis.

2. The importance of the 'Great Decoupling' between productivity and real compensation growth

Figures A.1–A.25 in the annex show how real hourly labour productivity and real hourly compensation per employee have evolved in the 25 countries, taking as the base year (equal to 100) the first year for which data were available. For the EU15 member states the base year is 1970, with the exception of Austria (1995), Germany (1991) and Greece (1983). For most 'new' member states the base year was 1995, except for Czechia and Poland (for which it was 1993).

The development of real hourly productivity and real hourly compensation has varied widely across the 25 countries shown here. In most of the Eurozone member states examined here, real hourly compensation started growing more slowly than productivity upon joining the EMU and in some formerly high inflation countries, such as Portugal, Spain, and Ireland, a few years earlier in the 1990s, presumably when they were trying to meet the entry criteria. Prominent examples are Austria, Belgium, Cyprus, Finland, Germany until the crisis, Spain, Portugal, Slovakia (although not in the past few years) and Slovenia. Exceptions have been France (where the two kept growing in line with each other), Italy (where both started stagnating from the mid-1990s, with real compensation growing faster for a few year prior to the crisis), the Netherlands (where the two kept growing in line with each other), Greece (where up until the crisis real compensation was growing faster than productivity), Estonia and Latvia (where real hourly compensation grew faster than productivity since joining EMU). In several member states, the gap in favour of productivity widened substantially during the crisis years.

Labour productivity growth provides the material basis for real wage growth. This does not mean that real wages are only set by productivity growth developments, as social norms, especially concerning fairness, also enter the picture. Thus, a starting point for understanding the causes behind real wage stagnation is to ask whether gains in labour productivity – that is, labour productivity growth – have been systematically associated with higher real wage growth. At first glance and looking into the averages of advanced economies and not just the United States, there appears to have been a 'decoupling' of aggregate average hourly labour productivity from average real hourly compensation growth (Bivens and Mishel 2015 all provide graphs illustrating the decoupling for the US, the EU12 and Japan.; Stansbury and Summers 2018; Pasimeni 2018). Declining trends in the labour share – that is, the ratio of real compensation over output – also support this observation. The divergent growth in the two series, however, does not necessarily mean that the *link* between the two has been severed (cf. Schneemelcher and Ständer 2018). It is also possible that other factors, for example redistribution policies, are in play and mask the real extent of the association between productivity and real wage growth.

Real wage stagnation is a potentially important driver of the rise in income inequality (Atkinson 2015). The salience of the causes and the implications of income inequality have been rising even among economists (see for example Piketty 2013), who, until recently and with very few exceptions (for example, the late Tony Atkinson and Branko Milanovic), have traditionally and largely avoided the issue. In the course of the recent Great Recession, for example, the IMF's research department and the OECD's economics department produced a series of papers that examined and provided some empirical evidence on the question of whether income inequality and redistributive policies, on one hand, and output and productivity growth, on the other, rather *than* being in a trade-off relationship may be mutually conducive (Berg and Ostry 2011; Ostry *et al.* 2014; OECD 2016).

The rise in income inequality and, in particular, the notion that the gains from growth may not have been widely distributed, as a result of which large parts of the population and in particular the middle classes have been 'left behind', have been linked in some cases to the rise of 'anti-systemic' parties and their increasing electoral success in advanced economies. Given that these parties often have a clearly Eurosceptic agenda, calling into question the value added of the EU in improving the living standards of its citizens and ultimately the participation of their countries in it, it has become an existential question for the EU to address the issue of rising income inequality. This is also reflected in the policy agenda of the Juncker Commission.

To implement this agenda and promote upwards convergence of social standards, the European Commission proposed the establishment of the European Pillar of Social Rights, which was announced by the EU institutions in November 2017. One of its twenty principles is that workers are entitled to a 'fair' wage. Reaping the gains of labour productivity to the full is a definition of fair wage growth that is hard to dispute. Knowing the extent to which real wage growth is fair in this sense and whether member states' real wage growth patterns are converging to or diverging from it is an important first step for understanding where policy efforts should be focused to implement the principle.

A second reason why this is an important question is that, given the relatively large share that private consumption typically represents in aggregate demand (cf. Romer 1997) and the importance of labour income in determining it, weak real wage growth has meant that recovery in Europe has not been as strong as policymakers would have hoped in the aftermath of the deepest recession since the Second World War. This weakness has been of concern even for major central banks in advanced economies, such as the ECB and the US Federal Reserve (Yellen 2015; Draghi 2017).

3. What do we already know about the decoupling between productivity and real compensation growth?

Stansbury and Summers (2018) summarise three possible broad explanations of the apparent decoupling of wages from productivity. First, there has been a 'de-linkage' of wage growth from productivity; that is, productivity growth no longer leads to wage growth. Second, there is still a linkage between the two, but other structural factors, such as the decline in trade union and labour power, have weakened this linkage by reducing the extent to which productivity gains are translated into higher wages. Third, the linkage between productivity and wages still exists but other factors, such as technological change, have exerted downward pressure on wage growth.

Depending on which of these explanations is correct, one can draw appropriate policy implications. For example, are policies associated with stimulating productivity growth relevant for raising real wages or not? And if so, should they be prioritised over policies that increase redistribution? Getting a clearer picture of whether the link between labour productivity growth and real wage growth is still strong and significant would thus allow us to evaluate whether certain policy prescriptions are likely to bear fruit. For example, in its 2017 Annual Growth Survey the European Commission stated that '[g]rowth in real wages, as a result of increased productivity, is crucial to reduce inequalities and ensure high standards of living' (European Commission 2017a: 10), while in its autumn economic forecasts for 2017 it suggested that 'significant and structurally higher wage growth would require a trend reversal in low labour productivity growth' (European Commission 2017b: 64) . The assumption here is that, if successful, policies that promote faster labour productivity growth, for example by fostering technological progress, should 'trickle down' to produce real wage gains across the workforce.

More broadly, on both sides of the Atlantic, economic policy priorities focusing on achieving high growth first and foremost, while assuming that their benefits will 'trickle down' to large parts of the population, have been called into question. From the perspective of real wage convergence, understanding whether the extent to which any labour productivity gains are associated with real wage gains differs across member states and, if possible, why, would facilitate the pursuit of policies to stimulate convergence beyond those aimed at convergence in productivity.

Studies to date of the linkage/de-linkage of wages from productivity have focused on the United States (Bivens and Mishel 2015; Lawrence 2016; Stansbury and Summers 2018), and the United Kingdom (Pessoa and Van Reenen 2012). Pasimeni (2018) examined this question for 34 advanced economies, including the EU, by using macro-panel data analysis. As the author himself admits in his conclusions, however, his aggregate panel approach is likely to be concealing significant heterogeneity across countries. The wide diversity of wage-setting institutions across the EU is one of several

factors that suggest that such heterogeneity is likely to be sufficiently important to warrant a country-by-country investigation. Stansbury and Summers (2018) extended their country-by-country analysis to individual G7 member states, including EU member states France, Germany and Italy. This paper departs from these two contributions and aspires to contribute to this growing body of empirical literature by extending the analysis to 25 individual EU member states not covered so far.

4. Empirical approach

4.1 The data

The data for the analysis presented in this paper come from the European Commission's AMECO database (see Table 1 for more details on the definitions, codes and measurement units of the variables used). The countries examined are the EU28 except for Hungary,[1] Luxembourg and Malta. The available data in AMECO are subject to certain limitations, especially by comparison with the data used in analyses of the United States by Bivens and Mishel (2015) and by Stansbury and Summers (2018). In the rest of this section the choice of variables to be used for the analysis and their limitations are discussed.

To answer the question of whether labour productivity gains translate into gains for workers several choices that need to be made concerning measures of the two variables. A first choice is between compensation and wages as an indicator of gains for workers. Following previous literature, compensation is preferred over wages, as over the years non-wage elements of compensation (for example, contributions to complementary pensions or health-care schemes) have gained importance as part of the rewards that workers/employees receive (Feldstein 2008; Stansbury and Summers 2018; Pasimeni 2018).

A second choice is between nominal and real variables. I have opted for real measures of productivity growth and compensation. This then begs the question of which price deflators should be used to transform the nominal variables of interest into real ones. Because I am interested in whether productivity gains translate into gains for workers, I have opted for a measure of real compensation that has been calculated using the private consumption deflator so as to reflect the gains for workers in terms of purchasing power.

The real output measure, available from AMECO, from which productivity can be calculated is deflated using the GDP deflator, which reflects changes in prices driven by changes in demand for domestically produced output. Consequently, there is an inconsistency between the deflators used for calculating real productivity and real compensation, which could alter the results in undesirable ways. For example, any divergence between real productivity and compensation growth may be due at least partly to divergence of the two deflators (see, for example, Feldstein 2008 and Lawrence 2016).

AMECO provides data on real compensation per employee using both the private consumption and the GDP deflators (using the latter would eliminate the inconsistency with the deflator of the real productivity measure). I have calculated the correlation between the two series for each country and it is reassuringly high, with correlation ρ's equalling 0.97–0.99. To further check

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1. Hungary was excluded because the period for which data on average hours worked are available is too short.

the robustness of my results using the above variables, I have also run the analysis using both measures of real compensation and the results have been very similar (results available upon request).

Last but not least, there is the question of whether productivity and compensation should be examined per person employed/employee or per hour. Real productivity/compensation per hour are more appropriate measures than real productivity per person employed and compensation per employee because changes in the composition of the workforce (for example, due to an increase in the share of part-time jobs) can alter the pattern according to which productivity growth translates into real compensation growth due to composition rather than distribution of gains. It should also be noted that all variables used for calculating real hourly productivity and real hourly compensation are measured in national currency units.

In contrast to the US analysis, no comparable data are available on median compensation for European member states in AMECO, which would represent the compensation of the 'typical' worker, that is, the worker right in the middle of the compensation distribution. Given that there is inequality in compensation, with the distribution being skewed towards the lower end, average compensation will be higher than median compensation. Thus, using data on average compensation, as is done in this paper, will overestimate the extent to which gains in labour productivity translate into gains in compensation for the 'typical' worker and underestimate any divergence between the two.

On the other hand, there are no comparable European data on Europe concerning the non-farming business sector (cf. Stansbury and Summers 2018. Given that in the public and non-profit sectors the measurement of productivity growth closely tracks developments in compensation (as the price of inputs, including labour, is assumed to be equal to the value of output), using data for the whole economy as opposed to using data for the non-farming business sector is likely to overestimate the extent to which productivity gains result in compensation gains. Last but not least, I use data on gross as opposed to net productivity, which would exclude the value of capital depreciation in the calculation of GDP. This is also likely to overestimate any divergence between productivity and compensation growth because the measurement of GDP that is used for calculating productivity includes expenditure earmarked for replacing depreciated capital rather than for distributing returns to factors of production.

4.2   Methods of analysis

I am interested in whether there is a systematic association between average labour productivity and average real compensation growth. In its simplest form, this relationship could be written as

$$\Delta lncompensation = constant + \beta \Delta \ln productivity + u$$

The coefficient β shows how much (in percentage terms) of a 1 per cent increase in productivity can be associated with an increase in real compensation. If the productivity gains were fully passed on to real compensation growth, then the coefficient β should be equal to 1. If real compensation has been completely decoupled from productivity growth, then β should be equal to 0. If β is somewhere between 0 and 1, then the de-linkage has only been partial and, depending on whether β is closer to 1 or to 0, productivity growth is still important (or not) for real compensation growth. Therefore, the analysis below will try to estimate the value of β for each different country over the period 1970–2017 for most EU15 member states (or 1995–2017 for most newer member states).

The gains for wages/compensation from labour productivity growth may take some time to materialise, depending on how fast bargainers become aware of productivity gains, whether they anticipate them or not, and so on. This time span may depend on various factors, for example the institutions and practices of wage-setting and collective bargaining in each country, the balance of considerations of wage- and price-setters and, more generally, workers' bargaining power. Given this peculiarity of the relationship between productivity and compensation growth, and following Stansbury and Summers (2018), I have filtered the data using moving averages (3 years as the baseline but 5 years to check the robustness of the results), that is, examining the association between productivity and compensation growth using their average values over 3 (and 5) years.[2,3] I also use the annual change of each variable of interest instead of its level[4]. Thus, the generic 3-year moving-averages model to be estimated is

$$\frac{1}{3} \sum_{-1}^{1} \Delta lncompensation = constant + \frac{1}{3} \sum_{-1}^{1} \beta lnproductivity_t$$

$$+ \frac{1}{3} \sum_{-1}^{1} \gamma unemployment_t + \frac{1}{3} \sum_{-1}^{1} \delta \Delta unemployment_t + u_t$$

To account for other factors that may be affecting the extent to which any productivity gains may be associated with compensation gains, I have also included the unemployment rate in level and its first-difference, that is, its (absolute) annual change. In general, and depending on the labour market institutions in place, the higher the unemployment rate (or when it increases), the weaker the bargaining power of wage-setters is and therefore, other things

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2. The construction of data through this filtering procedure is bound to introduce serial correlation in the regression residuals, which I have corrected for using Newey-West robust standard errors.

3. I have also run the analysis using distributed-lags models. The results (available upon request) are, in the vast majority of cases, in line with those of the models using 3-year moving averages.

4. This is done in order to avoid spurious results, given that (the logarithms of) both real hourly productivity and real hourly compensation present unit roots in levels. I therefore use their first-differences (that is, the change from one year to the next), which were found to be stationary.

being equal, the smaller the extent to which gains from productivity are likely to be passed on to compensation.

To keep the presentation of the results tractable for non-technical readers, I have put all the technical details in an online annex.

5. Discussion of the results

5.1 Is there a decoupling of real compensation growth from average labour productivity?

Table 2 reports the results of the analysis on whether there is a de-linkage between average productivity and real compensation growth. The coefficients ($\beta's$) of the labour productivity growth term show what percentage increase in real hourly compensation a 1% increase in labour productivity growth is associated with. Several points are worth noting.

First, the results of our analysis suggest that, for most of the countries examined, the linkage between productivity and real compensation growth is alive and well. In 16 out of the 25 countries examined (Belgium, Czechia, Denmark Estonia, Spain, Finland, Greece, Croatia, Italy, Lithuania, the Netherlands, Poland, Romania, Sweden, Slovakia and the United Kingdom), a 1 per cent increase in labour productivity growth has been associated with an increase in real hourly compensation growth of at least 0.5 per cent, that is, with at least 50 per cent of the productivity gains passing on to real compensation gains and the estimated coefficient has been statistically different from zero. Moreover, in nine out of these 15 cases (Belgium, Estonia, Greece, Croatia, Italy, Lithuania, the Netherlands, Poland and Romania), the hypothesis that the estimate of the coefficient was equal to 1 could not be rejected. In the cases of Czechia and Slovakia, the hypothesis that the estimate was statistically different from 1 was rejected, but the estimates were well above 1, suggesting that a 1 per cent increase in productivity growth was associated with more than full pass on of gains to real compensation growth (1.31 per cent in Czechia and 1.41 per cent in Slovakia).

In another three of the 25 countries – namely, Latvia, Portugal and Slovenia – a 1 per cent increase in productivity growth has been associated with real compensation growth acceleration of between 0.39 and 0.46 per cent, with all estimated coefficients statistically different from 0. Finally, in six countries – namely, Austria, Bulgaria, Cyprus, France, Germany (after 1991) and Ireland – the estimated coefficients of productivity growth have been found not to be statistically different from zero and in all cases except Bulgaria, they were fairly small.

Broadly speaking, the results of this paper are in line with the general conclusion of Pasimeni (2018) for the EU as a whole, namely that the link between productivity and compensation growth exists, although it is not a one-for-one. My results for France and Italy are broadly in line with those of Stansbury and Summers (2018), whereas the estimated coefficients for Germany and the United Kingdom are smaller, albeit over different samples (1993–2015 for Germany and 1996–2015 for the United Kingdom).

Table 1   Compensation and productivity: Results from regression analysis
(3-year moving average model specification; dependent variable: 3-year
moving average of average real hourly compensation (deflated by private
consumption deflator))

	Coefficient (β) of 3-year moving average of productivity	Coefficient (γ) of 3-year moving average of unemployment rate	Coefficient (δ) of 3-year moving average of change in unemployment rate	Coefficient of productivity (β) statistically different from 1? (Ho rejected?)
AT	0.49	0.006	−0.01	No***
BE	0.98***	−0.006***	0.002	No***
BG	4.74	−0.007	0.001	No***
CY	0.45	−0.002***	−0.003	No*
CZ	1.56***	−0.01*	0.01	Yes***
DE	0.48	−0.005**	0.007	No***
DK	0.54***	−0.005**	0.002	Yes***
EE	0.74**	−0.008	0.002	No***
ES	0.61***	−0.002***	0.0005	Yes**
FI	0.66***	−0.003***	−0.004	Yes**
FR	0.28	−0.004***	−0.0003	Yes***
GR	1.31***	0.0003	−0.003**	No***
HR	1.051**	−0.003***	−0.002	No***
IE	0.05	−0.002*	0.005	Yes***
IT	0.50***	−0.005**	−0.002	No***
LT	1.15***	−0.007**	−0.005	No***
LV	0.39*	−0.011***	−0.002	Yes***
NL	0.94***	−0.005***	0.005***	No***
PL	0.94***	−0.003***	−0.002	No***
PT	0.46**	−0.005**	−0.008*	Yes***
RO	1.00**	−0.026***	0.021	No***
SE	0.53*	0	−0.01***	Yes**
SI	0.44***	−0.005***	−0.006	Yes***
SK	1.41***	−0.006***	0.004	Yes*
UK	0.54**	−0.003**	−0.002	Yes**

Note: ***p<0.001, **p<0.05, *p<0.1: level at which Ho=0 or Ho=1 was rejected/not rejected.

5.2 Has there been convergence or divergence in the productivity-compensation gap?

A growing gap between productivity and compensation growth indicates the distancing from a principle of 'fair' wage growth: on average, workers' real compensation does not reap the full gains from labour productivity growth. As the previous section indicated, the extent to which this has been happening has varied across member states. A further question to examine is therefore whether member states have been converging or diverging in their distance from fair wage growth.

To assess whether there has been convergence of member states to fair wage growth, I follow Mascherini *et al.*'s (2018) approach to characterising upwards (or downwards) convergence and examine the (unweighted) average of the gap between real compensation and productivity annual growth rates over the years and the evolution of the dispersion of member states' gaps from this average using the population standard deviation. To make the visualisation more intuitive I have used the negative of this gap, that is, the difference between compensation and productivity growth: an increase in this average would imply that real compensation has been growing faster than productivity. The ideal development from European workers' perspective would be that the average gap between real compensation and productivity growth increased to at least zero (that is, average real hourly compensation grew in line with hourly labour productivity) and that the EU countries converged to the fairer wage growth that an increasing average gap would signify, that is, the standard deviation measure declined as well. Given that for most new member states data have been available only since 1995, I have constructed two figures that show the evolution of the average gap and the dispersion of individual country gaps from this average, one for the period 1971–1994 and another for the period 1995–2017.

Figure 1 shows that between 1970 and 1994 the average gap between real compensation growth and productivity growth fluctuated around a downward trend for most of the EU15 member states[5]. This gap turned negative in the 1980s, that is, real compensation growth was, on average and over time, not fair. There was neither convergence towards nor divergence from this average (the standard deviation fluctuated around a steady mean).

The picture is different for the period 1995–2017 (figure 2). The average gap between real compensation and productivity growth fluctuated around a steady zero mean during this period; in other words, *on average* and over time within the group of 25 countries examined[6], labour productivity and real compensation grew in line with each other. The countries within the group examined here appear to have been converging to this zero gap between productivity and compensation growth. In other words, on average the period 1995–2017 can be characterised as one of convergence to 'fair' real compensation growth.

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5. Germany, Greece, Austria and Luxembourg were not included in this group.
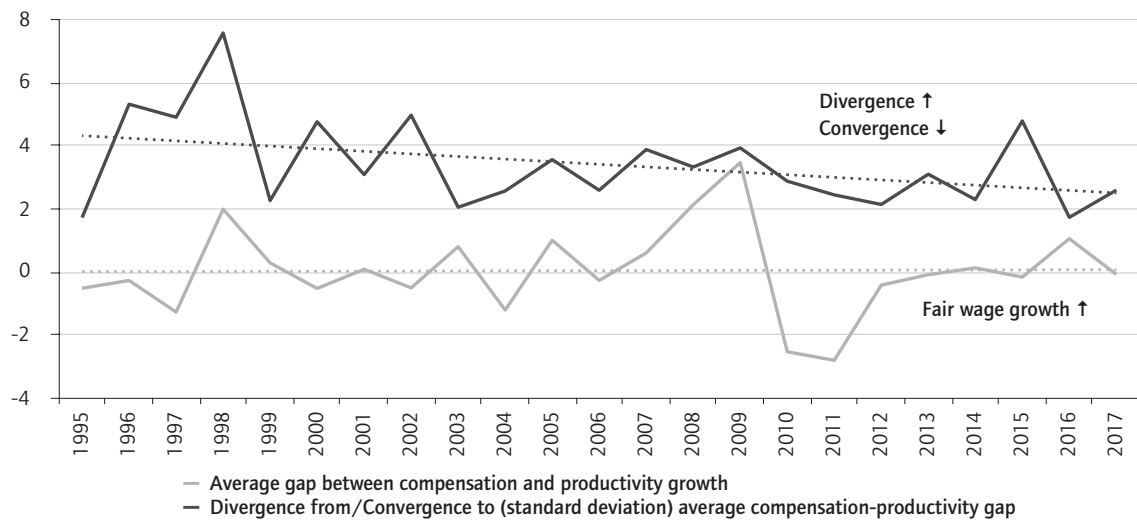6. The group is the EU28 except Luxembourg, Malta and Hungary.

Figure 1   **Evolution of fair wage growth and convergence to/divergence from it, 1970–1994**
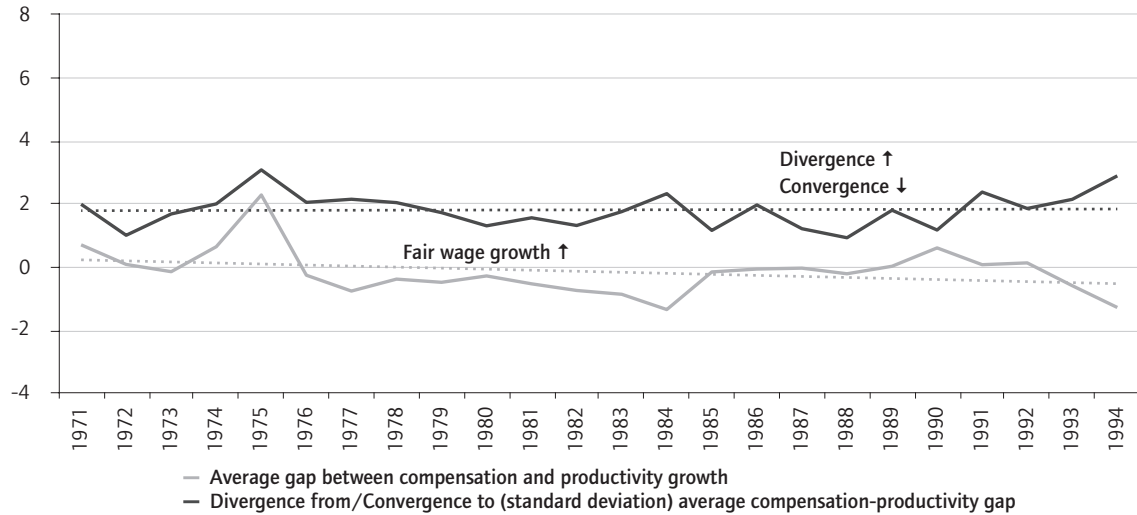
Source: Author's calculations using AMECO data.

Figure 2   **Evolution of fair wage growth and convergence to/divergence from it, 1995–2017**

Source: Author's calculations using AMECO data.

6. Conclusions, limitations and questions for further research

The empirical analysis presented in the previous sections suggests that real hourly productivity growth and real hourly compensation growth remain linked in many, but not all EU member states examined, although the extent to which growth in the former is associated with growth in the latter varies and can be considerably less than full. It should also be restated here that the results presented are likely to understate any de-linkage between productivity and real compensation growth for the typical worker as average real wage/compensation growth tends to be higher than the median. This limitation notwithstanding, the results suggest that, for many member states, labour productivity growth remains important for real compensation growth and, in this respect, policies aimed at stimulating labour productivity growth should be part of the toolkit for promoting real compensation growth. At the same time, our understanding of which policies are effective in stimulating productivity growth should not be overstated. As evidence is growing that some of these policies may have negative side-effects in terms of equality in the distribution of gains from growth (see, for example, Ciminelli *et al.* 2018; Archanskaia *et al.* 2019), more innovative approaches will have to be implemented to mitigate any productivity–equality trade-offs.

The second important insight of the analysis is that there is variation in the extent to which wage earners in various EU member states reap the gains from labour productivity growth, which could also be called 'real wages growing at a fair rate'. The third finding of this paper is that while the period 1970-1994, and particularly the 1980s, was marked by an increase in the *average* gap between productivity and real compensation growth of 13 out of the EU15 member states for which there were available data, the period 1995-2017 was characterised by convergence of member states to an *on average* aligned growth between productivity and real compensation. Although the aligned growth between productivity and real compensation suggests that real compensation growth has been on average evolving along a 'fair' path in 1995-2017, this 'fair' growth path followed a period (1970-1994) of losses in labour share which on average were not reversed. A plausible explanation for the increasing gap that emerged in the 1980s is the shift in the orientation of macroeconomic policies in many advanced economies in favour of price stability and in the aftermath of the productivity slowdown that had occurred since the 1970s. One of the explanations for the relative stability of the gap especially in the early 2000s could be the launch of the euro, which stripped the member states that adopted it from the capacity to devalue their nominal exchange rate vis-à-vis other members. The loss of the nominal exchange rate instrument meant that a pattern of average real compensation growth in line with average labour productivity growth was the only one compatible with stability, albeit not one that all member states could, would, could and did pursue.

Finally, it should be stressed that the analysis of this paper provides only one step in figuring out how to increase real wages, namely with regard to whether

productivity growth is relevant or not. They suggest that it is, but they do not provide any indication of *why* productivity gains are not passed on to compensation growth to a greater extent or why it does so in some countries but not in others. This will be the subject of future work. Moreover, although the analysis of this paper covers fairly long periods of time, it is possible that fundamental changes in the institutions framing the distribution of productivity gains may have taken place after 2010 in several countries in ways that may have altered the extent to which productivity gains pass on to compensation. The period is still too short to perform a reliable analysis of whether this is the case with regard to annual data.

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Annex: Tables, figures and some technical details

Table A1 **Variables used for analysis**

Variable	Variable code in database	Measurement unit
Gross domestic product at current prices per hour worked	HVGDH	National currency
Gross domestic product at 2010 reference levels	OVGD	Euro-national currency, 2010=100
Total annual hours worked: total economy	NLHT	Millions of hours
Average annual hours worked per person employed	NLHA	Hours
Real compensation per employee, deflator private consumption: total economy	RWCDC	National currency, 2010=100
Real compensation per employee, deflator GDP: total economy	RWCDV	National currency, 2010=100
Unemployment rate: total (definition Eurostat)	ZUTN	Percentage of active population

Source: AMECO database.

Constructing the real hourly compensation and real hourly labour productivity variables

To obtain real compensation per hour, I divided real compensation per employee, deflated by the private consumption deflator and by the GDP deflator, by the average annual hours worked and created two variables of real hourly compensation.

To obtain real hourly productivity, I used two alternative methods, following Pasimeni (2018). First, I divided the real GDP (at 2010 constant prices) by the total annual hours worked. Second, I deflated the nominal GDP per hour using the GDP deflator. The variables used in the baseline models are the real hourly compensation calculated using the private consumption deflator and the real hourly productivity calculated using the nominal hourly GDP, calculated by deflating nominal hourly GDP by the GDP deflator. The alternative measures of real hourly compensation and real hourly productivity described above have been used in order to check the robustness of the results obtained.

It should be noted that I have used the natural logarithm of all productivity and compensation variables for the analysis.

The presence of unit roots

Visual inspection of the series of real hourly productivity and real hourly compensation suggests that they are not stationary and appear to present a drift for the largest part of the periods examined. Consequently, I tested each series (in natural logarithms) for unit roots using an augmented Dickey-Fuller test. Once it was confirmed that the null hypothesis of unit root could not be rejected for each of the time-series (in ln) I also tested for the existence of unit roots in the first-difference of each. In most cases, the null hypothesis of unit root could be rejected at 1% and in a few cases at 5%, confirming that the first-differences could be used for OLS analysis. The results of the test are presented in the online annex.

Testing for the assumptions of the linear regression model

Every specification has been tested for serial correlation. In many of the specifications, especially in the models using moving averages, the null hypothesis of no serial correlation could not be rejected. This is not surprising for two reasons. First, I used fairly simple models, which suggests that the likelihood of omitted variables, one of the possible causes of serially correlated residuals, is not negligible. Second, in the specifications using moving averages, serial correlation is effectively introduced in the construction of these averages. To correct for the consequences of serial correlation for inference, namely the larger than minimum variances, the models have been re-run using the Newey-West corrected standard errors[7].

Figures: Average real hourly labour productivity vs. average real hourly compensation growth
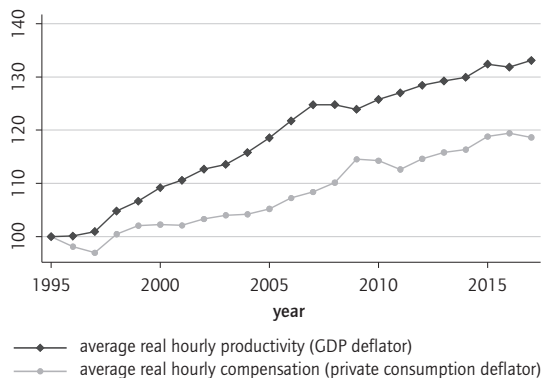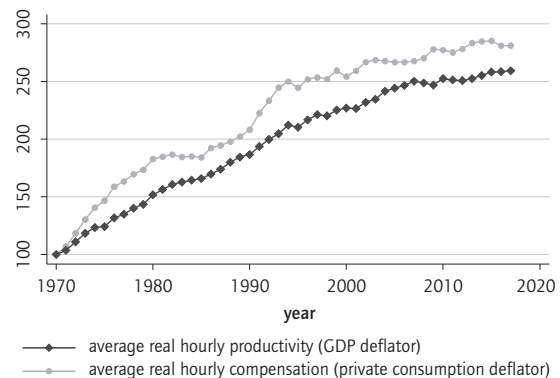
Figure A1   **Austria 1995-2017 (1995=100)**

average real hourly productivity (GDP deflator)

average real hourly compensation (private consumption deflator)

Figure A2   **Belgium 1970-2017 (1970=100)**

average real hourly productivity (GDP deflator)

average real hourly compensation (private consumption deflator)

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7. In order to specify the number of lags to use in the Newey-West standard errors, I followed the following rules: using twice as many lags as the number of years over which the moving average is calculated for the moving average specifications and the lags=$0.75 \times T^{1/3}$ for the distributed lags specifications (Stock and Watson 2007).

(Figures: Average real hourly labour productivity vs. average real hourly compensation growth, continued)
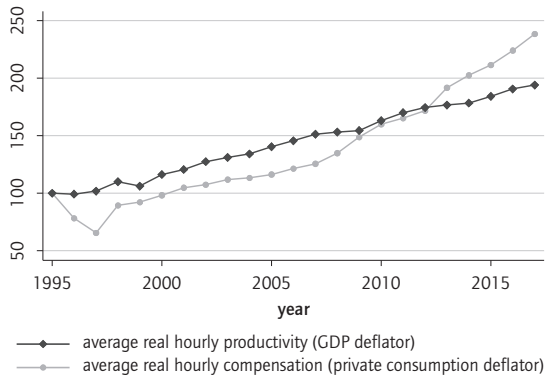
Figure A3 **Bulgaria 1995-2017 (1995=100)**

— average real hourly productivity (GDP deflator)
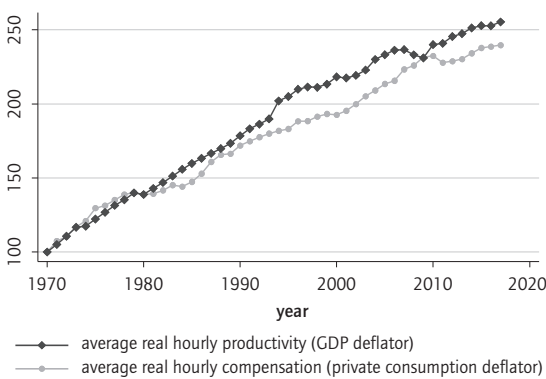— average real hourly compensation (private consumption deflator)

Figure A4 **Croatia 1995-2017 (1995=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
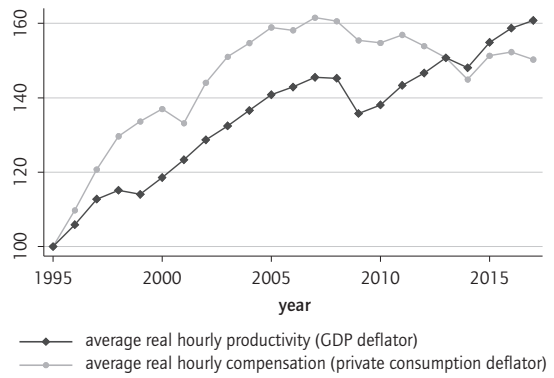
Figure A5 **Cyprus 1995-2017 (1995=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
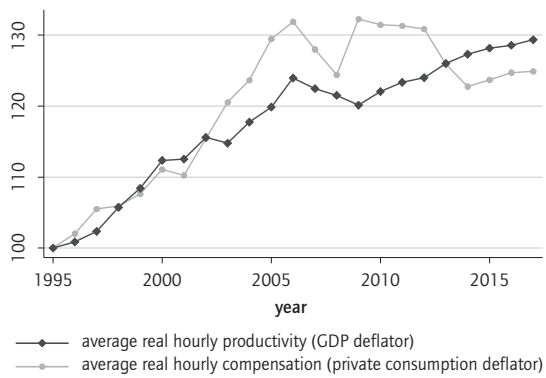
Figure A6 **Czechia 1993-2017 (1993=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
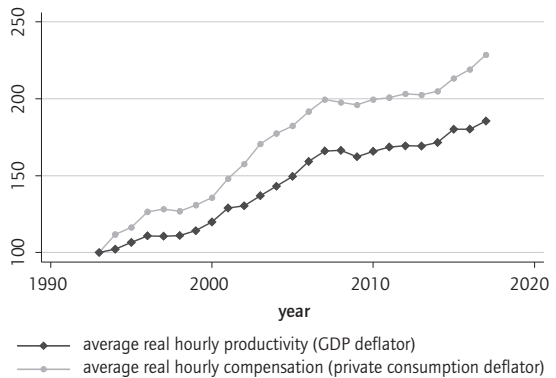
Figure A7 **Denmark 1970-2017 (1970=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)

Figure A8 **Estonia 1995-2017 (1995=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
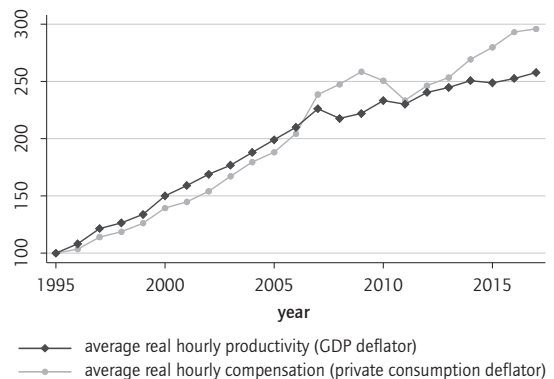
(Figures: Average real hourly labour productivity vs. average real hourly compensation growth, continued)
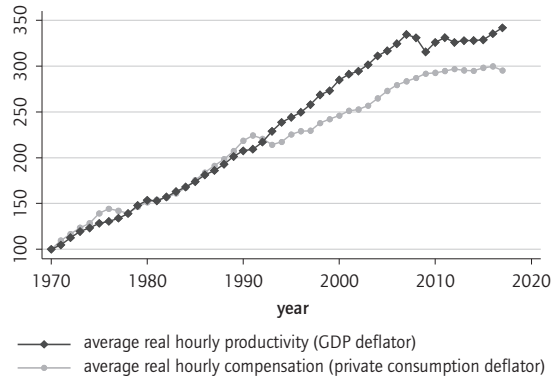
Figure A9   **Finland 1970-2017 (1970=100)**

- average real hourly productivity (GDP deflator)
- average real hourly compensation (private consumption deflator)

Figure A10   **France 1970-2017 (1970=100)**

- average real hourly productivity (GDP deflator)
- average real hourly compensation (private consumption deflator)
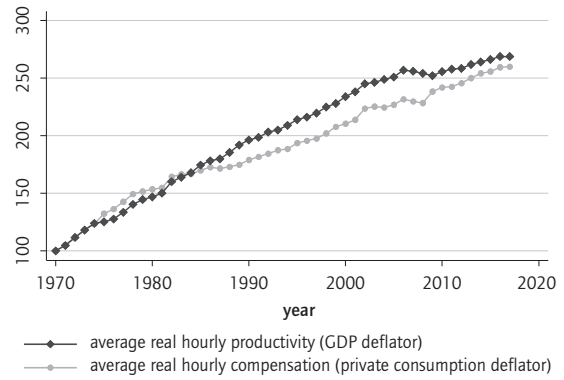
Figure A11   **Germany 1991-2017 (1991=100)**

- average real hourly productivity (GDP deflator)
- average real hourly compensation (private consumption deflator)
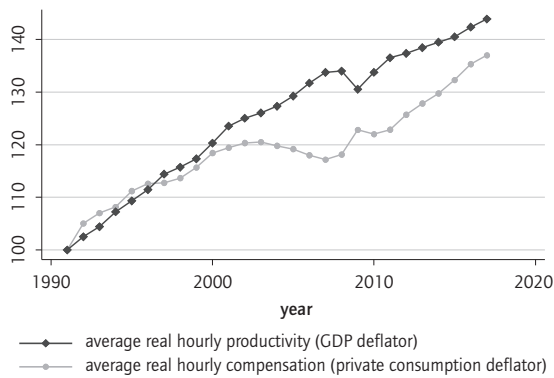
Figure A12   **Greece 1983-2017 (1983=100)**

- average real hourly productivity (GDP deflator)
- average real hourly compensation (private consumption deflator)
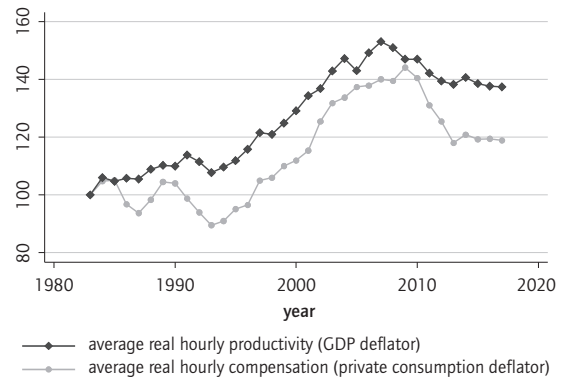
Figure A13   **Ireland 1970-2017 (1970=100)**

- average real hourly productivity (GDP deflator)
- average real hourly compensation (private consumption deflator)

Figure A14   **Italy 1970-2017 (1970=100)**

- average real hourly productivity (GDP deflator)
- average real hourly compensation (private consumption deflator)
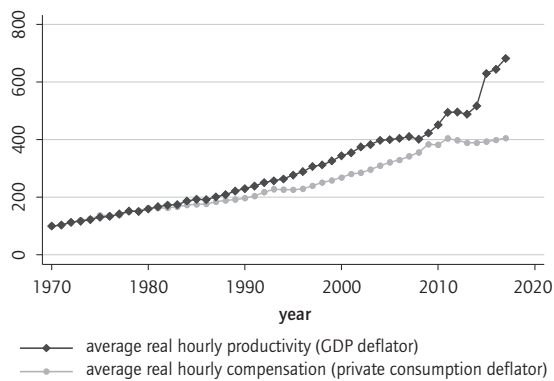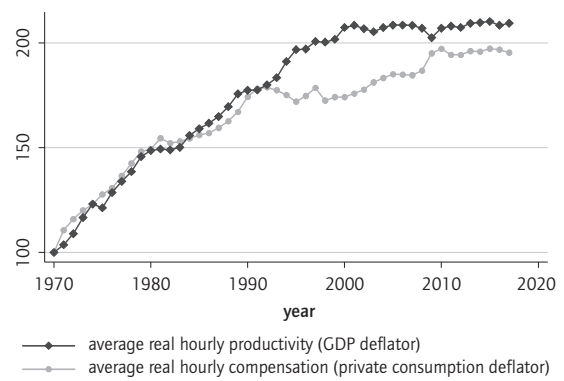
(Figures: Average real hourly labour productivity vs. average real hourly compensation growth, continued)
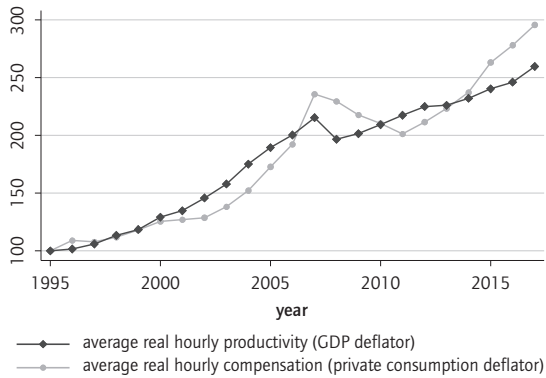
Figure A15 **Latvia 1995-2017 (1995=100)**

—◆— average real hourly productivity (GDP deflator)
—●— average real hourly compensation (private consumption deflator)

Figure A16 **Lithuania 1995-2017 (1995=100)**

—◆— average real hourly productivity (GDP deflator)
—●— average real hourly compensation (private consumption deflator)
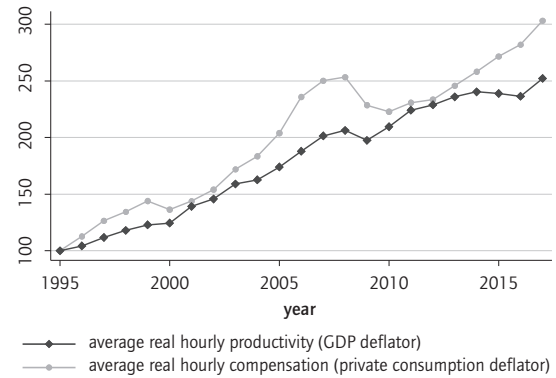
Figure A17 **Netherlands 1970-2017 (1970=100)**

—◆— average real hourly productivity (GDP deflator)
—●— average real hourly compensation (private consumption deflator)

Figure A18 **Poland 1993-2017 (1993=100)**

—◆— average real hourly productivity (GDP deflator)
—●— average real hourly compensation (private consumption deflator)
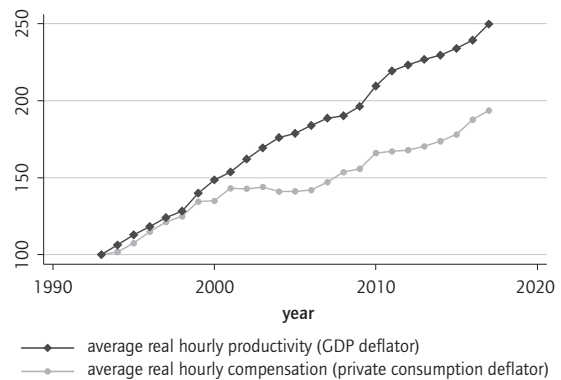
Figure A19 **Portugal 1970-2017 (1970=100)**

—◆— average real hourly productivity (GDP deflator)
—●— average real hourly compensation (private consumption deflator)
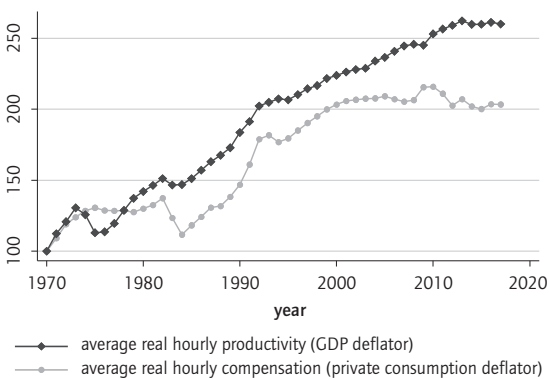
Figure A20 **Romania 1995-2017 (1995=100)**
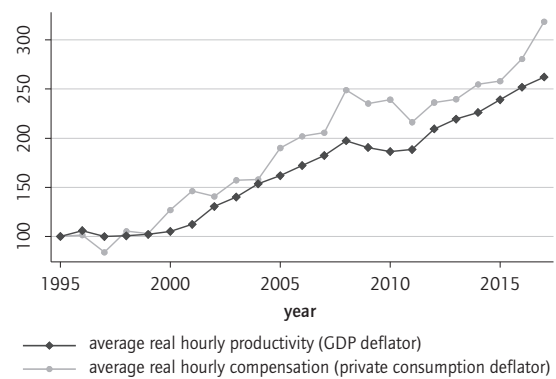
—◆— average real hourly productivity (GDP deflator)
—●— average real hourly compensation (private consumption deflator)

(Figures: Average real hourly labour productivity vs. average real hourly compensation growth, continued)

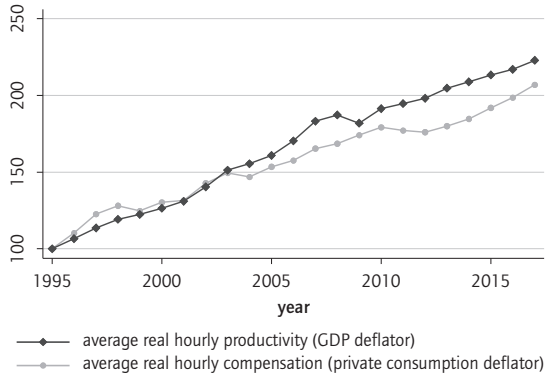Figure A21   **Slovakia 1995-2017 (1995=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)

Figure A22   **Slovenia 1995-2017 (1995=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
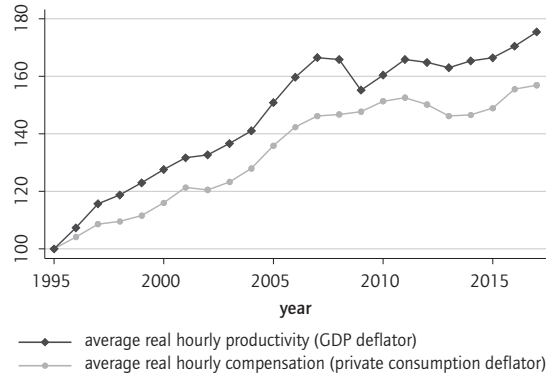
Figure A23   **Spain 1970-2017 (1970=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
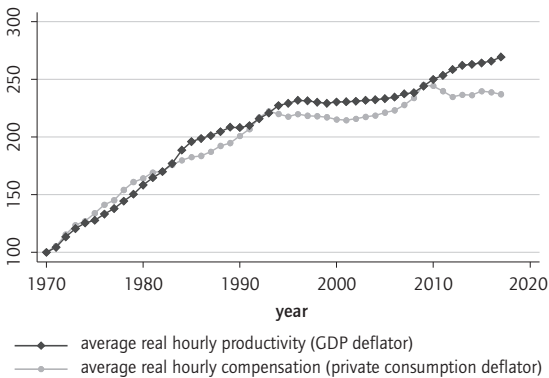
Figure A24   **Sweden 1970-2017 (1970=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)

Figure A25   **UK 1970-2017 (1970=100)**

— average real hourly productivity (GDP deflator)
— average real hourly compensation (private consumption deflator)
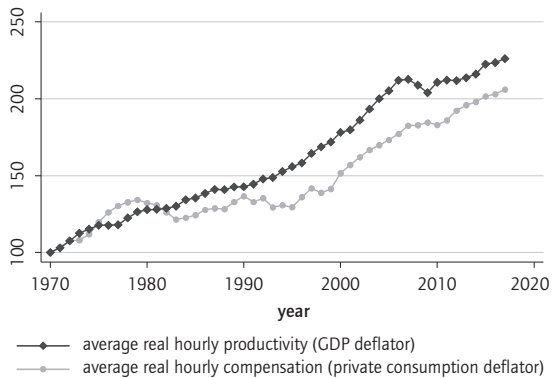
Notes: Hourly compensation deflated using the private consumption deflator. Real productivity per hour calculated by deflating nominal GDP per hour with the GDP deflator.
Source: Author's calculations using AMECO data.

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