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Wen-Hao Chen, Michael Förster and Ana Llena-Nozal

For additional information please contact:

Name: Wen-Hao Chen

Affiliation: OECD

Email Address: Wen-Hao.CHEN@oecd.org

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The Impact of Globalisation on Rising Earnings Inequality: Empirical Evidence from OECD Countries

Wen-Hao Chen[*], Michael Förster[**] and Ana Llena-Nozal[***]

OECD Social Policy Division

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Abstract

This paper examines the distributive consequences of economic globalisation in 23 OECD countries over the past quarter century, taking into account the multi-faceted dimensions of globalisation and controlling for influence from other concurrent trends, in particular technological progress and changes in labour market institutions. The paper also identifies the relevant pathways between globalisation and earning inequality among the whole working-age population by accounting for both rising wage dispersion among workers and widening earnings gaps between employed and non-employed. The results show that financial deepening (through increased foreign investment) is a key driver behind the upward trend of income inequality; it transmitted inequality through both raising wage dispersion and reducing employment rates. Trade integration in general exerted little distributional effect. Technical advancement also contributed to widening the earnings distribution among the whole working-age population, while the growth in the supply of skilled workers provided a sizable counterweight to increasing inequality. Moreover, the declining strength of labour market institutions tended to be distributional neutral overall, as the (increasing) employment effect largely offset the (increasing) wage inequality effect.

Keywords: globalisation, innovation, labour market institutions, inequality
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[*] Wen-Hao.CHEN@oecd.org; voice: +33 01 45 24 89 59.
[**] Michael.FORSTER@oecd.org; voice: +33 01 45 24 92 80.
[***] Ana.LLENANOZAL@oecd.org; voice: +33 01 45 24 85 27.
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1. Introduction

The OECD publication "Growing Unequal?" (2008a) documented a widespread, moderate but significant increase in household income inequality in the OECD area over the past 20 to 30 years. The report analysed the impact of immediate, direct drivers of income inequality and put forward three key drivers: i) changes in market income dispersion; ii) trends in household structure, and iii) changes in tax/transfer effectiveness. Among these. market income inequality trends were the most important (Table 1). In particular, wage dispersion and employment/unemployment patterns were identified as significant drivers. While the report described and analysed these different direct drivers in depth, what are the underlying "causes" of these changes remained an open question to be addressed.

In that context, "globalisation" has been much debated as a main cause for widening inequality in OECD countries. From a political point of view, protectionist sentiments have been fuelled by the observation that the benefits of productivity gains in the past two decades accrued mainly – in some cases exclusively – to high-skilled high-educated employed persons, leaving people with lower skills behind. This view is often based on an overly simplistic interpretation of trade theories which predicts that increased trade integration would compress the income distribution in poorer countries while, at the same time, making it more unequal in richer countries.[1]

However, public debate on the channels through which globalisation affects inequality has been frustratingly confused. In part, this is due to the inconsistency between empirical evidence and the theory. A number of studies actually find trade globalisation to have increased income inequality in low-income countries but evidence on the impact in high-income countries remains mixed;[2] in advanced countries, the shift in the relative demand towards skilled labour did not occur between sectors as predicted by trade theory, but rather occurred mostly within sectors. In any event, research on the causal link between trade globalisation and wage inequality, if any, has been modest or inconclusive.[3] This leads to a quest for alternative explanations for rising inequality, and a broad consensus in the literature is that other factors, in particular skill-biased technological change (SBTC) and institutional forces, seem to be more important in explaining the evolution of inequality.[4]

The confusion about the distributional effect of globalisation is further exacerbated by a lack of precision in definitions and concepts used. First, "globalisation" entails various aspects and they are likely to impact on trends in inequalities in different ways and in possibly opposing directions: trade integration (goods mobility); financial integration (capital mobility); technology transfers (information mobility); or production relocation (firm mobility). There are also aspects which go beyond the pure economic notion of globalisation, such as political, cultural and social globalisation, or migration (labour mobility). Second "inequality" is often meant to describe disposable income per capita inequality. But, different income aggregates and population sub-groups will be affected differently by macro-economic forces. Too often jumps are made to link between globalisation and disposable income inequality, ignoring the fact that the former may impact on labour market inequality and thus earnings in the first place, while the latter can be shaped by many other factors such as changes in tax/transfer systems.

[1] This is often associated with the so-called Heckscher-Ohlin-Samuelson model, or variants of it (for a review, see Freeman 2009).
[2] For a review, see Milanovic and Squire (2005).
[3] See for example, Bound and Johnson (1992), Berman *et al.* (1994), Krugman (1995 and 2007).
[4] See for instance, Berman *et al.* (1998), Krueger (1993), Autor *et al.* (1998), Machin and Van Reenen (1998), IMF (2007), and OECD (2007) for the relatively role of SBTC; and DiNardo *et al.* (1996) for influence of institutions.

In this paper we examine the most direct and relevant pathway between economic globalisation and labour earnings inequality among the whole working-age population.[5] Specifically, we investigate whether and how trends in globalisation have translated into inequalities in wages and earnings. This is done by undertaking a dual approach taking into account both the wage and the employment consequences of globalisation. The results, combined with findings from literature that addresses the contribution of labour earnings (and other income sources) to inequality dynamics, therefore shed light on the distributional effect of globalisation.

The current study goes beyond the existing international cross-country studies on globalisation and inequality in several ways. First, the analysis incorporates several recent global developments in OECD countries that may be seen as potential drivers of rising inequalities. Existing empirical studies are limited in time to the period up to the late 1990s/early 2000s. However, many macro-economic global trends really took off in the most rent period of the 2000s. These include a marked shift in the import share from advanced economies to developing world, a fast-growing foreign direct investment (FDI) that underlines the rise in the numbers of multinational corporations, and an unprecedented growth of innovative activities. The last two encompass non-trade dimensions of globalisation. Second, the paper also examines the impact of globalisation *net* of the influence of labour market institutions. The disequalizing effect of an exogenous macro shock in favour of skilled workers may be greatly offset by a concurrent increase in the strictness of employment protection legislation, while it may be reinforced if wage-setting mechanisms have become less strict and more flexible over time. Third, a novelty of this paper is the identification of the relevant pathways between globalisation and inequality among the whole working-age population. Previous studies on the impact of globalisation on earnings inequality often focus on workers only, while this paper takes into account the fact that globalisation may affect inequality of the entire working-age population not only through raising wage dispersion among the employed, but also through increasing earnings gap between the employed and the non-employed. Moreover, this study is confined to the region of OECD countries, as well as to the population of working age.[6] This allows a much higher degree of comparability of indicators and will strengthen the significance of any links being found. This also permits us to shed light on some specific transmission mechanisms of inequality which had not been analysed in depth so far.

The paper is organised as follows. In section 2 we document recent trends in wage inequality and macro-economic developments concerning trade, financial globalisation and technological advancement. Section 3 presents the empirical model and results on the relationship between globalisation and wage inequality. Section 4 discusses the distributional impact of globalisation in the presence of institutional variables. Section 5 presents a theoretical and empirical work that links between globalisation and earnings inequality among the whole working-age population by accounting for both the wage effect and the employment effect. The final section summarises and concludes.

2. Overview of recent trends in wage inequality and globalisation in OECD countries

Earlier empirical studies on inequality that used data from the 1980s and 1990s were unable to find clear evidence on the causal link between global developments (trade in particular) and inequality. While searching for alternative explanations for growing inequality, there have been quite some later developments since the 1990s. For instance, a great share of import has shifted from advanced countries to from developing countries lately, and the rise in the number of multinationals was seen a widespread phenomenon across the OECD area. As more information and time-series data become

[5] That is, political and cultural aspects as well as migration trends are not considered here.
[6] Defined here as the population of age 25 to 64.

available, there is a renewed interest in examining whether the processes of new global movements alters the contextual labour market, and thus wage structures. In this section, we first offer an overview of recent trends on wage inequality and several notable global movements including foreign direct investments and innovative activities.

2.1 Trends in wage dispersion

We begin our analysis by looking at changes in wage distribution *within* countries. This chapter uses earnings data from the OECD earnings database for 23 OECD nations.[7] This dataset provides comparable and consistent measures of wages through time for each country.[8] Our measure of wage dispersion is estimated by the decile ratio of the top 10 percent to the bottom 10 percent of full-time or equivalent workers. Figures 1-3 show the evolution of earnings dispersion for selected OECD countries over the period of 1980-2008.

Looking at these trends, overall we find a widespread and significant increase in wage dispersion in the OECD area over the past 25 years, with a few notable exceptions such as France, Japan, and Finland. The increase is more salient in countries where the employment protection legislations were less regulated. These include the U.S., U.K. as well as some transition economies such as Hungary and Poland. In the U.S., for instance, the earnings gap between the richest and poorest 10% of full-time workers has widened from 3.8 times in 1980 to nearly 5 times in 2008. The comparable figures are 3.6 (1992) and 4.6 (2006) for Hungary and 2.9 (1992) and 4.2 (2004) for Poland. The extent of rising inequality was especially stark during the late 1990s. This can be seen in Germany, New Zealand, Netherlands and Demark, where the decile ratios remained stagnant throughout the 1980s, but started to progress in the mid-1990s.

Korea stands out as its inequality trend was characterised by a unique U-shaped pattern, decreasing during the 1980s and the early 1990s, while increasing since the mid-1990s. Kang and Yun (2008) in particular investigated this particular pattern and concluded that factors related to human capital played an important role in molding the U-shaped changes in wage inequality in Korea. They speculate that the rapid growth in wage inequality since the 1990s may be related to skilled-biased technological change since the Korean economy was transformed into more knowledge intensive, high-tech industry centred economy around the mid-1990s. They also speculate that an increase in outsourcing to China or other low-wage countries may explain the surge in wage inequality in recent years.

It is worth noting that the trend towards greater wage inequality, although more moderate, was also seen in some Nordic countries—a region that traditionally had a very low level of wage inequality, likely due to relatively stricter employment protection legislations (EPL) and stronger unions as compared with those in other OECD nations. The D9/D1 ratio in Denmark, for instance, has increased from 2.1 in 1980 to 2.7 in 2007. This finding does not seem to support the conventional view of downward nominal wage rigidity, which is predicted in this region (Holden and Wulfsberg 2007).

To show whether there is a general tendency towards greater wage dispersion across 23 OECD countries under study, we present a summary statistics in Figure 4. This is done by running country-specific regressions where D9/D1 ratios are regressed against time. A positive and significant coefficient therefore indicates an upward trend in wage inequality. Overall, using available time-series data, we found that wage dispersion increased in a majority (15 out of 23) of the OECD

[7] See appendix A for data description.

[8] The comparability of earnings series across countries, however, is less compelling due to differences in both population coverage and definitions.

countries over this period, at 5% level of significance. Only three countries (Japan, France and Switzerland) registered a moderate decline in wage inequality, and the results for the other five countries (Korea, Spain, Belgium, Finland and Ireland) appeared to be less precisely estimated, with the 95% confidence intervals cross zero.

2.2 Globalisation: some recent trends in global economic developments

As mentioned, the term "globalisation" needs to be clearly specified when evaluating the possible causes of increased inequality. There are different aspects of economic globalisation, and both trade and non-trade dimensions need to be considered. In this section, we look at trends in various global developments. In particular, we are able to disaggregate several developments into finer levels, and this provides further insights regarding possible transmission mechanisms through which global developments affect wage inequality.

2.2.1 Trade Integration

The extent of trade integration increased substantially since the 1980s. Statistics reveal that the share of trade to GDP rose in practically all OECD countries, and most of the increase occurred during the last 10-15 years.[9] An important driver behind the fast expansion in merchandise imports among the OECD nations over this period, arguably, can be related to rapid export growth of the emerging trade giants, in particular developing Asia. To address this issue, we analyse data from the United Nations Conference on Trade and Development (UNCTAD), which dataset contains detailed information regarding trade flows by region of origin and destination (i.e., advanced and developing countries). The trade partners can be further disaggregated according to national income levels.

Figure 5 reveals that on average growth in import intensity from developing countries contributed to less than half of the total increase in merchandise imports in most countries. The extent of OECD-developing world integration was much stronger in non-EU areas: strikingly nearly all the increase in merchandise imports in Canada, Australia, New Zealand, Korea and Japan over this period can be attributed to a rise in trade with developing countries. Similar developments were also seen in the U.S. and some EU member countries such as Netherlands, Italy, and UK. Only France and Ireland registered a modest yet insignificant decline in imports from developing countries over this period.

To investigate how much of the increase in imports among the OECD nations over this period can be accounted for by enhancing trade with the emerging market economies such as China and India, we further disaggregate the developing countries by two income levels (i.e. high-income and mid/low-income groups) in Figure 6.[10] It reveals an across-the-board increase in imports from mid/low-income developing countries in all 23 OECD under study—a pattern that is hidden when looking at broad levels of aggregation. Interestingly, countries like France and Ireland, which registered declines in overall imports from the developing economies now also show enhanced trade with mid/low-income countries. In most cases, the enhanced ties with mid/low-income trading partners dominated the entire import growth with developing countries, and most of the developments took place during the past 10-15 years. The trade relationship with high-income developing countries, on the other hand, has become less important in many OECD countries. Indeed, more than a dozen countries registered a decline in imports from this region of origin over this period.

[9] OECD trade indicators (http://dotstat.oecd.org/wbos/index.aspx).

[10] The distribution of developing countries by income group is defined according the United Nation Conference on Trade and Development's (UNCTAD) classification. That is, high-income groups are defined as countries where per capita current GDP is above US$4,500; mid-income countries, between US$1,000 and US$4,500; and low-income countries, below US$1,000 (http://www.unctad.org/Templates/Page.asp?intItemID=2166&lang=1).

We redo the same exercise for exports (not shown), but do not find any general and consensus pattern of changes in exports across countries. Developments of exports to mid/low-income developing countries were in fact quite modest: exports to mid/low-income region as a percentage of GDP, on average, increased only by about 1.6 percentage points between 1980 and 2008 in most countries. In sum, the portraits of trade globalisation presented in this subsection helps us to take precise aim at a few recent global developments—in particular imports from mid- and low-wage developing countries—as possible channels through which trade affects domestic labour markets in OECD countries.

2.2.2 Financial globalisation

Another trend of the recent stage of economic globalisation is the development of flows and stocks of Foreign Direct Investment (FDI), which involves international investment of multinational corporations in both home and host states. Since the second half of the 1980s, foreign direct investment has played a fundamental role in furthering international integration and has been the most dynamic factor in industrial restructuring at the global level (OECD 2005). Again, using data from the UNCTAD, we illustrate in Figure 7 that FDI inward stock as a percentage of GDP has increased in all countries: on average from less than 7 percent in 1980 to over 45 percent in 2008. The increase was more than 40 percentage points in 11 out of 23 countries, and most of the increase has been experienced in the last decade. Benelux countries, Switzerland and Ireland had the highest ratio for inward FDI stock, while foreign investment only accounted for about 2% in Japan, which has the lowest ratio amongst all OECD countries. The rapid expansion of FDI inward investment may well reflect a tremendous growth of foreign affiliates in the OECD area. If the utilization of capital and the technology it embodies require the use of skilled workers, financial globalisation would propel changes in domestic wage distribution.

Figure 8 also reveals a similar development for outflow investment. Outward FDI stock as a percentage of GDP increased in all 23 countries between 1980 and 2008: on average from less than 5 percent in 1980 to nearly 50 percent at the end of the 2000s. Again, most of the increase occurred during the last 15 years. The growth towards more outward investment suggests that OECD countries have substantially increased multinational corporations as well as their overseas operation over the years. This may also reflect an increase in offshore outsourcing activities in many OECD nations. Overall, the relative share of outward FDI stock in most OECD countries is higher as compared to their inward investments. This suggests that OECD countries are net exporters of FDI. Transition economies, such as Czech Republic, Hungary and Poland, however, are exceptions from the general trend. These economies are mostly recipients of FDI.

It is noteworthy that financial globalisation is likely to be interdependent with other global developments. For instance, trade liberalization is very often accompanied by the removal of restrictions on capital flows; and financial deepening may in turn facilitate more trade since multinationals often export goods from the host state. Furthermore, the growing direct investment by foreigners implies that more capital, as well as embodied foreign technologies, is transferred to the host countries. The transfers of technology may increase productivity and indeed lead to more trade or investment. The real distributional impact of financial globalisation may not be disentangled easily when the interplay between these aspects of economic integration is considered.

2.2.3 Technological progress

Another notable trend in the last 20-30 years that may be considered a different strand of global integration (i.e., information mobility), is the tremendous advancement in science and technology activities. The challenge, similar to globalisation, is the lack of consensus in measurement and definition. In general, the stock of knowledge, as measured either by innovative investments (e.g., R&D expenditure) or by output of knowledge production (e.g., patents), all increased considerably over time. In this paper we focus on patent indicators, which have been used intensively in the literature to measure inventive performance. The patent data are drawn from the OECD patent database.

Figure 9 show an obvious upward trend in patents across the OECD zones. In the U.S., for instance, the number of total patent applications to both the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO) has increased four-fold from 70,000 in 1981 to nearly 280,000 in 2007. The speed of growth accelerated particularly after the mid-1990s. When factoring out population size, Figure 10 presents evidence that technological progress is indeed a widespread phenomenon. Inventive activities increased in all countries under study. There are a few notable increases such as Korea and Denmark where the number of patent applications per million population had gone up from virtually nothing in the beginning of the 1980s to a considerable amount (i.e. around 500) in 2007.

3. Globalisation and wage inequality

We now turn to examine the distributional consequences of globalisation in OECD countries over the past quarter century. The analysis focuses on the *within*-country variation in inequality, relating changes in wage dispersion to various channels through which globalisation would operate, and to technology factors that are considered a crucial driver of inequality trend in countries over recent decades. Our analysis uses a cross-country time-series dataset, which covers 23 OECD countries from the early 1980s to 2008.

To focus on within-country changes of inequality, we follow a fixed effects specification as follows.

$$Wage\ dispersion_{it} = \alpha + \beta' GLOB_{it} + \lambda\ Tech_{it} + \gamma' X_{it} + C_i + \eta_t + \varepsilon_{it} \quad (1)$$

where the dependent variable, wage dispersion, is measured by the decile ratio (D9/D1) of weekly earnings among full-time workers.[11] For explanatory variables, *GLOB* are a set of globalisation indicators, including measures for both trade and financial integration. *T* is an indicator of technological progress, principally measured by patent counts in the study.[12] *X* is a vector of control variables, including the sectoral share of employment, education (% of population with post-secondary education), and the share of female employment; C_i and η_t denote country- and year specific effect, respectively, and ε_{it} is random disturbance. All variables are expressed in natural logarithms.[13] We restrict our sample to those in which information on all variables used in the

[11] In most cases, wage refers to gross weekly or monthly earnings of full-time workers (see data in appendix A).

[12] We also use alternative science and technology measures, including per capita R&D expenditure, and trade performance of R&D-intensive industries, to assess different technology effects.

[13] Since both dependent and independent variables used in the analysis tended to be skewed by their very nature (i.e. ratios), the use of logarithmic transformations will make the distribution more symmetric. In addition, there is a considerably amount of heteroskedasticity in our cross-country data that could make some of our tests and confidence intervals invalid. For instance, trade volumes as a percentage of GDP range from as

regression are available. The resulting dataset is an unbalanced panel including 414 country-year observations covering 23 OECD countries over the period 1979-2008. The sample thus covers 18 observations per country, on average, which compares favourably to recent comparative studies on this issue (see Appendix table A3).

3.1 Identifying the channel through which trade affect wage dispersion

Before fitting the data to equation (1), we first perform a simple exercise to identify key channel(s) through which trade affects wage inequality. This is done by disaggregating the overall trade volume into subcomponents. In particular, by exports and imports, but also by the region of origin and destination. This is relevant because trade may influence wage distribution through various ways. For instance, the labour market may respond differently when there is an increase in import competition or an increase in export opportunities. Furthermore, theoretical models and various hypotheses also predict different distributional impacts between trade with advanced countries (North-North) and trade with the developing world (North-South). Analysis based on an overall trade indicator may therefore overlook the importance of underlying transmission mechanisms.

The results are presented in Table 2.[14] Column (1) indicates that an increase in overall trade volume had a strong and significant disequalizing effect. However, by disaggregating total trade flows (columns 2-4) we show that the channel by which trade affects wage distribution is primarily through imports, and indeed through imports from developing countries (DC). When we further disaggregate developing countries by income levels, we found that actually it is the import from mid/low-income developing countries that contributed to rising wage dispersion. This finding remains robust when other trade variables are in the control (columns 5-6). Exports in general had little impact on wages inequality once imports are held constant. Similarly, imports from advanced nations have no role for wage dispersion as long as imports from the developing world are also controlled for.

The results give us the very reason to restrict our further analysis of trade globalisation to a rather narrow dimension—imports from middle- and low-wage developing countries. Although this definition does not reflect the full complexity of trade globalisation, it does offer a very straightforward interpretation and policy implication. This focus also appears to be quite pertinent as there have been vigorous debates in the EU and the U.S. about potentially imposing or even to increasing restrictions on certain categories of goods imported from developing countries.

3.2 Empirical results

Having identifying the trade variable, we estimate equation (1) by successively adding key variables of globalisation in the model. Column (1) of Table 3 shows that both trade and inward FDI stock have a significant impact on wage dispersion, controlling for education, female participation, and sectoral employment shares. These coefficients indicate that a ten-percent increase in trade (or inward FDI stock) increases D9/D1 ratio by 0.5%. For a baseline D9/D1 of 3.0, this amounts to an increase of 0.015 point (i.e., 3*1.005=3.015) for each factor.

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little as 25% in one country to exceed 150% in the other. A logarithmic transformation will reduce unequal variability and therefore make the within-group variability more similar across groups.

[14] This is done by estimating equality (1) without controlling for financial globalisation and technology variables.

The inequality-enhancing effect of FDI liabilities has been suggested in several cross-national studies (IMF 2007, Baccaro 2008, and Reuveny and Li 2003).[15] However, the effect is in general shown to be at work in developing countries since inward investment is expected to be relatively skill-intensive for these countries; and an increase in foreign investment would lead to higher inequality through more demand for skilled labour.[16] Nevertheless, our findings suggest such patterns also hold up in the context of skill-abundant OECD countries. There may be a couple of reasons for this. First, there is evidence that inward investment by multinational enterprises is more concentrated in the skill-intensive sectors in advanced economies (see, for example, IMF 2007), and therefore increase relative demand for skilled workers.[17] Second, it is probable that foreign multinationals entering domestic markets will pay above-average wages for the industry, causing wages to rise in those sectors (OECD 2008b). Third, FDI could affect wage distribution through technology spillover if foreign technologies are embodied in capital flown into the country.

In column (2), we further control for outward FDI stock. This indicator shows the relative interdependence of domestic investors and the direct investment enterprise in another country. If a great deal of outflow investment over this period went from OECD areas to developing countries due to a growing importance of international production sharing (outsourcing), we may expect an additional disequalizing effect from outward FDI, as predicted by the outsourcing literature (e.g. Feenstra and Hanson 1996, 1997, 2003, Hijzen 2007). In fact, the results show that there is no distributional effect of this factor. If anything, it has an equalizing effect. This finding, nevertheless, is not inconsistent with previous studies.[18] One possible explanation is that capital related to outsourcing activities to developing countries in general only accounted for a smaller portion of total outward FDI stock in many OECD countries. Indeed, intra-OECD investment still accounted for the largest share of total outward investment in OECD countries.[19]

The other reason why the outward FDI stock showed little, or even a negative, impact on wage distribution may be related to the industry sector from which investment originated. If a firm in tradable sectors expanded by moving their activities abroad to produce tradable goods, we would expect a substitution between the foreign and the home labour market, as the firm could either export goods produced at home or produce it in its foreign affiliates.[20] In Figure 11, we find that in most countries the majority of direct investors were actually located in the non-tradable service sector. In 2007, the share of outward investment in service sector on average represented about 66% of total outward FDI stock, with a few exceptions such as Norway and Korea. Given that, it is reasonable to infer that many goods produced in the foreign affiliates are non-tradable and cannot substitute for home country exports. This may partially explain why the outward FDI has little distributional impact in our findings.

Next we examine the impact of science and technological activities controlling for both trade and financial determinants. Inventive performance is primarily measured by patent counts (column 3) or

[15] For country-specific studies, see Taylor and Driffield (2005) for UK, and Bruno *et al.* (2004) for Czech Republic, Hungary and Poland.

[16] Figini and Gorg (2006), nevertheless, show that inward FDI stock tends to decrease wage inequality for OECD countries, but still increase wage inequality for developing countries.

[17] See Figure 4.12 in IMF (2007).

[18] Slaughter (2000), for instance, shows that outsourcing activities of US multinational enterprises tend to have small, imprecisely estimated effects on US relative labour demand. Similarly, OECD (2007) also concludes that outsourcing in general only has a rather moderate effect on shifting relative demand away from low-skill workers within the same industry. Lorentowicz *et al.* (2005) even discover that outsourcing actually has lowered the skill premium in Austria, the skilled-abundant country, while it has increased the wage gap in Poland, the relative labour-abundant country.

[19] See OECD Economics Globalisation indicators (2005).

[20] See, for instance, Braconier and Ekholm (2000) for Sweden.

its normalized indicators (column 4). We prefer patent to other technological measures because it conveys information on output and processes of inventive activities, and may better capture the overall picture of technological change.[21] The results suggest that technical progress has a significant disequalizing impact: a 10 percent increase in patent counts is associated with a 0.68% increase in D9/D1 ratio. The story is much the same when patents per capita indicator is used.[22] The finding is consistent with the common view in the literature that technological progress tends to widen wage distribution by raising the demand for skilled labour.

The other interesting finding here is that the distributional impacts of trade and of inward FDI stock declined notably when technology variable is taken into account, suggesting a positive correlation between technology and these two globalisation factors. This echoes a growing number of literature concerning the interplays between globalisation and technological activities.[23] If scientific activities were induced in response to a more integrated global economy, then the interactions between globalisation and technology may just create an important mechanism leading to a rise in wage differentials in OECD countries. In such a case, we may argue that the distributional impacts of technology observed in Table 3 are likely overstated, while the real impacts of globalisation may be overlooked.

3.3 Globalisation or global shocks?

In fixed effects model, it is often a common practice to add year dummies if one estimates the time-specific unobservable might be important. The unobserved global shocks, such as recession, may be correlated with other explanatory variables and results in biased estimates of the coefficients. The inclusion of time-fixed effects is needed in order to remove the common unobservable across countries. However, we argue that this exercise is less practical in our context because by doing so we also remove global demand shocks that were originated from globalisation and technological change which we attempt to identify in the study. For instance, it is reasonable to perceive China's entry into the World Trade Organization (and thus the elimination of most quotas) may stimulate trade, to a similar extent, across OECD countries. By including time-fixed effects, we also wipe out this important development of globalisation. Indeed, we show in the last column of Table 3 that the inequality-enhancing effect of trade disappears completely, and the effects of inward FDI and technology reduce notably when time-fixed effects are controlled.

The question here is whether we overestimate the impact of globalisation and technologic change if we do not control for time-fixed effects. We argue that this is unlikely the case for the following reasons. If a common unobservable was driven by a negative shock, such as an economic crisis, then

[21] Empirical research has shown that patents are frequently a good predictor of economic performance (see, for instance, Keller and Holland 1982, Hagedoorn and Clood 2003, and Rassenfosse and Pottelsberghe 2008).

[22] A few other proxies for technical progress were also tested. These include ICT investment, total researchers, the technology balance of payments (TBP) and trade in R&D intensive industries. The results are robust when these proxies were used. However, we did not include them because it further limits our sample size as such information is not available for early years and for many countries under studies. We also used the Gross domestic expenditure on R&D (as well as Business enterprise expenditure on R&D) for technical progress. However, we found that the coefficients of these proxies were not statistically significant in general, suggesting that they may not be a good proxy for the stock of technology.

[23] For hypotheses relate to trade-induced skill-biased technological change, see, for instance, Wood (1994, 1995), De Santis (2002), Thoenig and Verdier (2003), Stojanovska and Cuyvers, (2010), Bloom *et al.* (2008); For endogenous technological change relate to capital deepening, see Coe and Helpman (1995), Schiff and Wang (2006). Also Goldberg and Pavcnik (2007) for a review of literature on mechanisms through which globalisation induces technical change in developing countries.

we expect such global recession would in general reduce trade volumes as well as investments in R&D. In that case, we actually understate the distributional impact of globalisation and technology by not controlling for time-fixed effects. If, on the other hand, an unobserved global factor mainly refers to a positive supply (or demand) shock, such as falling prices of goods, then arguably such shock is actually a result of globalisation due to an advance in trade or technology, which makes production more efficient, thus increasing output. For these reasons, we focus on results without time-fixed effects in the estimation.

3.4 Quantifying the contribution of changes in wage inequality

Since the estimated coefficients in Table 3 represent the elasticity (i.e., percent increase in *y* in response to a 1 percent rise in *x*), we can actually calculate the average annual change in each of the explanatory variable, and then multiplying by the coefficients from regression result to obtain a simulated change in wage inequality arising from changing globalisation factors or other forces.[24] The results are displayed in Figure 12. It reveals that the D9/D1 ratio on average grew 0.57 percent annually over the period 1980-2008. For a baseline D9/D1 of 3.0, this translates to a rise of 0.017 point per year.

With respect to factors that contribute to the annual change in wage inequality, technological progress, measured by patent innovations, alone contribute 0.45 percent annual increase in this ratio. Inward FDI stock also exerted a marked disequalizing effect, contributing another 0.37 percent average increase per year. The effect of trade is rather moderate, if any, it further added 0.13 percent a year to raising the D9/D1 ratio. On the other hand, outward FDI stock exerted an moderate equalizing effect by contributing 0.16 percent annually to reducing the D9/D1 ratio. It is worth noting that the rise in the supply of educated workers provided a sizeable counterweight (0.43 percent a year) to offset an increase in wage dispersion. In fact, if we simply overlook the impact of globalisation, it seems to suggest that the evolution of wage dispersion can be viewed as a race between education and technology (Goldin and Katz 2008).

Other factors also contributed to a moderate annual increase in the D9/D1 ratio. A detailed breakdown of this category (not shown) reveals that a rise in female employment share further contributes a 0.13 percent annual increase in inequality. This is consistent with the view that female employment gains have been largest for high-wage women (Juhn and Murphy, 1997). Moreover, a shift of employment away for industry and a rise of employment in service had exerted two opposing effects on wage inequality, but the magnitudes are generally trivial.

3.5 Robustness tests

To which extent are our findings robust? It is known that in a macro regression with limited observations and time-series data, the results may be heavily influenced by outliers if changes in variables in a country have been large enough. To see whether the inclusion of a given country significantly alters regression results, we re-estimate our preferred specification (Table 3, column 3) by successively dropping one country at a time from the sample. We do this for each country and obtain 23 separate estimates of coefficients, which are plotted in Figure 13 panels A-C for trade, inward FDI and technology variables respectively.

[24] The contributions of the variables of interest to the change in the D9/D1 ratio are computed as the average annual change in the respective variable multiplied by the corresponding coefficient in Table 2 (3). Following IMF (2007), the average across country groups are weighted by the number of years covered for each country in order to give more weights to countries with a longer period of observation.

Generally, for these three variables of interest, the results are always within 95% confidence intervals (dotted lines) of the preferred estimates in row 3 of Table 3 based on the full sample. This suggests that our general findings are robust and will not be affected by any particularly influential country data. This exercise, however, highlights that Hungary has a noticeable impact on the point estimate: that is, removing Hungary from the sample will significantly reduced the disequalizing effect of trade globalisation. The opposite is true when Australia, Denmark, Japan or Sweden was removed from the estimation. It is also interesting to note that the distributional impact of technological change would be even stronger if samples from Germany, Hungary and Poland were excluded.

4. Globalisation, labour market institutions and wage inequality

At the same time as wage inequality has been rising since the 1980s, the role and strength of labour market institutions declined in most OECD countries. According to a simple framework which assumes unions bargain with employers over the wage, most labour market institutions would improve the relative position of unskilled workers when an adverse demand shock hits. Thus stronger institutions will strengthen the bargaining power of unskilled and compress the distribution of wages. This suggests that the declining role of labour market institutions observed in the last decades would tend to raise wage inequality.

In fact, the impact of economic globalisation on wage inequality could be reduced or even off-set if wage-setting mechanisms remained very strong over time, but it could also be exacerbated with a concurrent decline in collective bargaining or in the strictness of employment protection legislation. Similarly, inequality may be quite path-dependent due to no change or very slow changes of the institutional context. The assessment of globalisation without taking into account the developments of institutions, therefore, may be subject to an omitted variable bias.

Table 4 lists five institutional variables used in this paper and the average values across OECD countries over the 1980s and 2000s (columns 1-2).[25] These variables encompass various dimensions of labour market institutions including wage bargaining mechanisms (union density and union coordination), strictness of employment protection legislation (EPL), generosity of unemployment benefits, labour taxation, and government spending on active labour market programs.[26] Overall, there was a general declining role in all institutions since the 1980s. The average union density rates across countries, for instance, declined more than 15 percentage points between 1980s and 2000s. Table 4 also reveals marked cross-national differences in institutions. For instance, the average values of institutions for the U.S. (i.e., the country with the most flexible labour market regulation) are far below the cross-national averages, and two of the five institutions (EPL and union coordination) remained at the lowest level and did not evolve over time. At the other extreme, institutions in Sweden are fairly strong and many remained very strict in recent years. This suggests that the impact of globalisation on wage inequality may be stronger in the flexible U.S. labour market than in the more rigid Swedish labour market.

[25] In a separate analysis we also incorporate the minimum wage variable (relative to the median wages if full-time workers), with expected results. However, we did not report the findings as the inclusion of this variable reduces significantly the sample: only 14 out of 23 countries under study has information on the minimum wages.

[26] All institutional variables (except union coordination) are drawn from OECD sources (see Appendix A2). For coordination of wage bargaining, we use the index developed by Visser (2009).

4.1 Empirical results

To investigate the effect of globalisation net of the influence of labour market institutions, we again fit a fixed effects model (equation 1) by incorporating the five institutional variables mentioned above. Since the use of institutional variables results in fewer observations (and also country coverage) compared with our previous sample, this may cause incomparability between two results. For comparison, we display previous findings in column 1 of Table 5, and repeat the previous specification using the current sample (column 2). We found that the exclusion of two countries (Italy and Korea) in the analysis does not change the general story on the wage inequality impact of globalisation and technology. However, we do see a reduced role for inward FDI stock, which now exerted a moderate but still disequalizing effect and the estimate was only marginally significant.

In column (3) we add one institutional variable—union density—in the control. As a result, the inequality-enhancing role of trade globalisation (measured by imports from mid/low-income developing countries) disappears completely.[27] The results suggest that trade globalisation plays no role when labour market flexibility is fixed. In other words, the declining role of institutions towards more flexible labour market regulation facilitated trade globalisation, and the wage inequality impact of trade observed in the previous section is likely to reflect changes in institutions.[28]

In column (4) we include all other institutional variables to offer an overall picture on the relationship between globalisation, policies/institutions and within-countries inequality. Generally, the findings indicate that labour market institutions and technological innovation are the main determinants of the increase in wage inequality between 1985 and 2007. Most institutional variables have a strong and negative correlation with wage dispersion. The is consistent with previous studies that a decline in union density as well as more relaxed employment-protection legislation tend to associate with higher wage dispersion (Koeninger *et al.* 2007, Visser and Cecchi 2009, Wallerstein 1999). An interesting exception is that wage inequality tended to increase when the level of coordination is higher. This is somehow counterintuitive as we expect to see a more compressed wage distribution when unions' bargaining power over the wage can be extended to industry- or economy-wide level.[29] One explanation for this finding is that more coordinated unions (e.g. the central organisations of unions), unlike local unions, often need to take economy-wide impacts into account because their decisions are likely to affect the entire economy or sectors. As a result, unions may be less demanding in wage bargaining as they are aware of the adverse employment consequences of excessive wages. In sum, the results in table 5 suggest that apart from technology and institutions, trade and financial globalisation exert little distributional impact, while the increase in the supply of skilled workers help reduce wage differentials.

4.2 Quantifying the contributions to wage inequality

Using estimated coefficients from column (4) in Table 5 together with information on annual variations in each explanatory variable, we can quantify the relative contributions of globalisation, institutions and other factors on rising wage inequality over the past decades in Figure 14. For ease

[27] It should be noted that the disappearance of the trade effect is unlikely to be a result of sample coverage issue since we only lost two observations when moving from specification (2) to (3).

[28] Of course, one can argue the relationship is inverse. Indeed, endogenous institutional change has been discussed in the literature. For instance, Acemoglu *et al.* (2001) argued that skill-biased technological change may increase the outside option of skilled workers, and weakens their incentives to join the unionized sectors. Standing (1997) and Dreher and Gaston (2005) also argued that international competition (globalisation) may reduce the market power of unions by raising the elasticity of labour demand.

[29] However, such finding is not uncommon. Koeniger *et al.* (2007), for example, also find a positive correlation between union coordination and wage inequality.

of presentation, we grouped all institutional effects together. In general, the D9/D1 ratio on average increased 0.47 percent annually between 1985 and 2007.[30] It becomes clear that both institutions and technological progress are the two main forces that contribute to the annual increase in the D9/D1 wage differential: institutions together contribute to a 0.38 percent annual increase in this ratio, and technical progress further contribute to another 0.3 percent average increase in inequality annually. With respect to globalisation, trade no longer contributes to changing wage dispersion, while financial globalisation (combined inward and outward FDI) still plays a moderate role by further contributing to 0.12 percent average increase a year.[31] Other factors, which mixed effects of changes in education, sectoral and female employment shares as well as the residuals, account for the rest of 0.29 percent annual increase in inequality.

5. The distributional impact of globalisation accounting for inequality between the employed and the non-employed

So far, our discussion of determinants of changes in inequality focused on wage inequality among the employed population because the wages or earnings data, by definition, cover only the employed. However, the impact of globalisation and other macro-economic shocks affects labour markets not only through changes in wage rates but also through unemployment or inactivity, and may result in widening disparity between the employed and the non-employed. This implies that the earnings distribution among the *whole* working-age population can widen even if wage inequality among the employed remains unchanged, simply because unemployment or inactivity are increasing. This is especially the case in labour markets where wages and labour flows are constrained by institutional rigidities. Analyses that only look at changes in wage dispersion therefore only tell a partial story of the effect of globalisation.

There is also another strand of literature that examines the employment impact of globalisation. Unfortunately, these studies often fail to put inequality into perspective. In particular, they do not explain to what extent does the rise in unemployment—due to globalisation—transmits inequality to the whole working-age population. Empirically, little has been done to assess the distributional impact of globalisation by combining the discussions of both the wage effect and the employment effect in the same context.

In this section, we aim to fill this knowledge gap in the literature. In particular, we ask the following questions: to what extent does globalisation or other contextual changes affect inequality of the working-age population as a whole (rather than just the employed), and through which channel (wage or employment) inequality was transmitted?

In the following we first describe a theoretical framework that can be used to link the change in inequality of the population to two transmission mechanisms: the wage effect and the employment effect. Then we fit the model with data from the Luxembourg Income Study to quantify the impact of both the *within-group* inequality (due to changes in wage dispersion among the employed) and the *between-group* inequality (due to changes in inequality between the employed and the non-

[30] The annual increase in D9/D1 (0.47) is smaller compared with that (0.57) in Figure 12. The discrepancy is due to different samples and years used. We expect a smaller increase in current sample because it covered a relatively shorter period (i.e., between 1985-2007 rather than 1979-2008 used previously).

[31] Note that although the coefficient of the outward FDI stock was modest and not precisely estimated in the regression, we still obtain an appreciable contribution of outward FDI stock to inequality because the annual increase of this variable is substantial.

employed) on the overall inequality of population.[32] Two approaches are then used to relate inequality dynamics of population to globalisation and other macro-economic developments.

5.1 Framework

We begin by outlining a theoretical framework to connect the change in earnings dispersion among the employed to earnings inequality among the whole working-age population (25-64 years old), by assigning zero earnings to the non-employed for the latter. Suppose there are two types of working-age groups: (1) the employed and (2) the non-employed. [33] The former receive wages or salaries and the latter receive none. Let *u* be the share of the non-employed and *e = (1-u)* the share of the employed. The Lorenz curve of the entire population can be depicted as a dashed line in Panel (A) of Figure 15. Also let B denote the area of the inner triangle (i.e. distribution of the employed only) and A+B be the area of the large triangle (i.e. distribution of the entire working-age population). Given this, inequality (as measured by the Gini coefficient) of the employed and of the whole working-age population can be expressed, respectively, as $gini_{emp} = a/B$ and $Gini_{all} = (A+a)/(A+B)$.[34]

Now suppose globalisation or changes in institutions in the subsequent year not only widen wage dispersion among the employed (from *a* to *a'*), but also increase unemployment or inactivity rates (from *u* to *u'*) as shown in Panel (B) of Figure 15. As a result, $gini'_{emp} = a'/B'$ and $Gini'_{all} = (A'+a')/(A'+B')$. Changes in inequality among the employed and among the whole population can be expressed, respectively as

$$\Delta gini_{emp} = a'/B' - a/B \quad (2)$$

$$\Delta Gini_{all} = (A'+a')/(A'+B') - (A+a)/(A+B). \quad (3)$$

Since areas A and B (also A' and B') can be expressed in terms of the unemployment share, *u* (and *u'*)[35], we rewrite (2) and (3) as

$$\Delta gini_{emp} = 2a'/(1-u') - 2a/(1-u) \quad (4)$$

$$\Delta Gini_{all} = (u' + 2a') - (u + 2a). \quad (5)$$

Using equation (4) to substitute 2a (and 2a') in (5) gives

$$\begin{aligned} \Delta Gini_{all} &= u' + gini'_{emp}\,(1-u') - u - gini_{emp}\,(1-u) \\ &= (1-u) \cdot (gini'_{emp} - gini_{emp}) + (1-gini'_{emp}) \cdot (u'-u) \\ &= e\,\Delta gini_{emp} - (1-gini'_{emp})\,\Delta e. \end{aligned} \quad (6)$$

Equation (6) implies that changes in inequality among the whole working-age population can be decomposed into the two major components: those due to changes in wage dispersion and those due to changes in the non-employment rate. This framework is based on the model proposed in Atkinson and Brandolini (2006), which offers a simple way to measure the overall impact on inequality accounting for both the wage effect and the employment effect.

[32] For more information about the LIS data, see (http://www.lisproject.org/).
[33] The data which will be used in the following do not allow to distinguish unemployed from inactive people.
[34] Note that Gini coefficient is computed as the area between the Lorenz curve and the line of perfect equality (i.e. the 45 degree line).
[35] Note that B=(1-u)/2 and A=u/2; similarly, B'=(1-u')/2 and A= u'/2.

Empirical exercise

For the empirical exercise, we can no longer use the OECD earnings database from the previous analyses because it covers only the employed. The challenge for estimating equation (6) is that the three variables—Gini of the working-age population, Gini of the employed and the employment share—need to obtained from the same data source to avoid discrepancies due to different sample coverage or variable definitions. For this reason, we derive these factors directly from the micro data using the Luxembourg Income Study (LIS) for 25 OECD countries for a period between mid-1980s and mid-2000s.[36]

The quality of the data can be assessed in Figure 16, which displays a scatter plot for the simulated change in the Gini coefficient among the working-age population (on the x-axis) and the actual change in Gini (on the y-axis) based on two data points (first and last available years) for each country. If the Gini of the employed and the employment share are estimated precisely from the data, we should expect both the simulated change and the actual change to be the same, and all countries should lie along the 45 degree line.

In general, Figure 16 reveals that the majority of countries under study hover around the 45 degree line, suggesting the overall fit of our theoretical framework to the empirical data. There are, however, a few deviations. In particular, the data points for Hungary, Austria, Australia, and Denmark all lie some notable distance from the 45 line, suggesting possible measurement issues of the data for these countries.

Contribution of the wage and employment effects to overall earnings inequality

To provide a crude measure of the average impact of the wage effect and the employment effect on the change in overall inequality across the OECD area, we estimate equation (6) by fitting a fixed-effects model using pooled observations from all countries.[37] The results are presented in Table 6. It shows that both wage dispersion and employment rate contributed to changes in earnings inequality among the whole working-age population. On average a 10 percent increase in the Gini coefficient of earnings among the employed raised the Gini of the entire working-age population by 4 percent in the OECD zone, holding the employment share constant. Also, a 10 percent increase in the employment share reduced the Gini of population by 5.6 percent, other things being equal. These estimates are statistically significant at the 1% level.

Using estimated coefficients, we compute a crude decomposition to quantify for how much of the annual change in population inequality can be attributed to the wage and the employment effects, respectively (Figure 17). Overall, it indicates that the Gini coefficient of earnings among the whole working-age population on average increased 0.03 percent annually over the mid-1980s to mid-2000s. This is a result of the two opposing forces where increasing wage dispersion among the employed has exerted an marked disequalizing impact, contributing 0.18 percent a year to raising the population inequality; whereas the growing employment rate has contributed to offset rising inequality by an almost equivalent reduction (0.14 percent annually) over the period examined.

[36] The period of analysis differs notably across nations due to the availability of data.

[37] This is done by working with an unbalanced panel of about 25 OECD countries with on average 5 time-series observations per country (see detailed country-year lists in appendix B).

5.2 Linking Globalisation and other macro-economic developments to changes in inequality among the working-age population

Having identified the contribution of the wage effect and the employment effect to overall inequality, the next question is to what extent can inequality dynamics among the working-age population be explained by globalisation and other contextual changes, and through which channel (wages, employment or both) inequality was transmitted? Two approaches are used to answer these questions. A counterfactual approach is proposed to *quantitatively* identify the distributional impact of globalisation, which involves the construction of a series of counterfactual outcomes of both earnings and employment. This approach offers a direct linkage between globalisation and overall inequality, but the results may be subject to the influence of errors (associated with the predictions) as it requires the use of coefficient estimates from multiple-stages of regressions. To validate the results, an alternative approach is also proposed. This is done by first examining the employment impact of globalisation, and subsequently assessing the distributional impact of globalisation among the working-age population by synthesizing—in qualitative term—findings from its influence on both the wage dispersion (sections 3 & 4) and the employment outcome (discussed below). The alternative approach also permits us to identify channel(s) (wages, employment or both) by which globalisation transmitted inequality.

5.2.1 Counterfactual approach

The basic idea here is to formulate the following question: what the Gini coefficient of earnings among the population would have been in the hypothetical case of no changes in globalisation index over time? The distributional impact of globalisation can then be assessed by comparing the actual and the simulated values of inequality. We briefly describe this approach as follows.

Recall equation (6) that $\Delta Gini_{all} = e\ \Delta gini_{emp} - (1\text{-}gini'_{emp})\ \Delta e$, the conditional change in overall inequality, holding one contextual development (trade globalisation, for example) in each country at its initial year's level can be written as

$$\Delta Gini_{all}\,|\Delta \text{ trade glob}=0$$
$$= e \cdot (gini'_{emp}\,|\Delta \text{ trade glob}=0 - gini_{emp}) - (1 - gini'_{emp}\,|\Delta \text{ trade glob}=0) \cdot (e'|\Delta \text{ trade glob}=0 - e). \quad (7)$$

On the right-hand side, the two counterfactual components—the Gini of the employed ($gini'_{emp}\,|\Delta$ trade glob=0) as well as the employment share ($e'|\Delta$ trade glob=0), holding trade globalisation constant at the early year's level—are obtained by estimating, separately, the following two auxiliary macro regressions using pooled LIS data from 23 countries.

$$Gini_{emp,it} = \alpha_1 + \gamma_1 Trade_{it} + \gamma_2 Financial_{it} + \gamma_3 Technology_{it} + \delta_1 Instit_{it} + \beta_1 X_{it} + \varepsilon_{it} \quad (8)$$

$$e_{it} = a_1 + \zeta_1 Trade_{it} + \zeta_2 Financial_{it} + \zeta_3 Technology_{it} + \lambda_1 Instit_{it} + b_1 X_{it} + \varepsilon_{it} \quad (9)$$

(i = country; t = year)

Both dependent variables ($Gini_{emp,it}$ and e_{it}) are derived from the LIS micro data, and all explanatory variables are drawn from the macro dataset we developed in the previous chapters.[38] Using estimated coefficients from (8) and (9), we retrieve the two counterfactual components in (7) for

[38] Trade globalisation is measured by merchandise imports from mid/low-income developing countries; Inward and outward FDI stocks are used for financial globalisation; Technological progress is assessed by patent counts; The institutional variable refers to union density only, and all other controls include education (% with post-secondary education), country-fixed effects and year-fixed effects.

each country in subsequent years by fixing macro development(s) in question at their initial year's levels, but keep all other controls at their contemporary values. In the example of holding trade globalisation constant, we have

$$\text{Gini'}_{emp,i} \,|\Delta \text{ trade glob}=0$$
$$= \hat{\alpha}_1 + \hat{\gamma}_1 \text{Trade}_i \,|\text{trade\_t}=\text{trade\_1} + \hat{\gamma}_2 \text{Financial}_i + \hat{\gamma}_3 \text{Technology}_i + \hat{\delta}_1 \text{Instit}_i + \hat{\beta}_1 X_i \quad (10)$$

$$\text{e'}_{emp,i} \,|\Delta \text{ trade glob}=0$$
$$= \hat{\alpha}_1 + \hat{\zeta}_1 \text{Trade}_i \,|\text{trade\_t}=\text{trade\_1} + \hat{\zeta}_2 \text{Financial}_i + \hat{\zeta}_3 \text{Technology}_i + \hat{\lambda}_1 \text{Instit}_i + \hat{b}_1 X_i. \quad (11)$$

We then plug these predicted values back into equation (7) to obtain the counterfactual inequality of the working-age population that would have prevailed if there had been no change in trade globalisation (i.e., $\text{Gini'}_{all,i} \,|\Delta$ trade glob=0). Note that the counterfactuals are computed for each country in all subsequent years in which data are available.[39] Finally, at aggregate level, we calculate counterfactual average annual (percentage) change in overall inequality in OECD countries over the study period. The impact of trade globalisation can then be assessed by the differences between the counterfactual change and actual change.[40]

1) Impact of trade globalisation = Ave. ΔGini all − Ave. ΔGini all |Δ trade glob=0

To assess the distributional impacts of other contextual changes, we obtain different counterfactuals by adding other macro variables successively in following order (trade, financial, technology, institution, and education). Therefore, the impact of other macro developments can be expressed, respectively, as:

2) Impact of financial globalisation
= Ave. ΔGini all |Δ trade glob=0 − Ave. ΔGini all |Δ trade, financial glob=0

3) Impact of technological change
= Ave. ΔGini all |Δ trade, financial=0 − Ave. ΔGini all |Δ trade, financial, technology=0

4) Impact of institutional (union density) change
= Ave. ΔGini all |Δ trade, financial, technology=0 − Ave. ΔGini all |Δ trade, financial, technology, institution=0

5) Impact of changes in education (supply of skilled workers)
= Ave. ΔGini all |Δ trade, financial, technology, institution=0
− Ave. ΔGini all |Δ trade, financial, technology, institution, education=0

6) Residuals
= Ave. ΔGini all |Δ trade, financial, technology, institution, education=0 − Ave. ΔGini all

Since the impacts of factors may be quite sensitive to the decomposition order, we also calculate counterfactuals using the reverse-order decomposition to evaluate the robustness of the results.

[39] For instance, suppose 5 years of Australia data (1985, 1989, 1995, 2000 and 2003) are included in the pooled-country regression in equations (10) and (11). Counterfactual gini of earnings among the employed (and the employment rate) for Australia in all subsequent years (i.e., 1989, 1995, 2000 and 2003), holding trade globalisation at 1985 level, will be computed.

[40] Note that Ave. ΔGini $_{all}$ = $\frac{1}{ns}\sum_i^n \sum_t^s \Delta Gini_{\text{ all, it}}$, where i denotes country (n=23 countries) and t denotes years (s=number of years available for a country).

Results

Table 7 displays results of the counterfactual exercise. For reference purpose, column (1) reports the average annual percentage change in the Gini of earnings among the working-age population over the period examined. Focusing on the primary-order decomposition (top panel), column (2) reveals that the Gini coefficient would have increased by 0.089 percent annually (instead of 0.027), if trade globalisation in each country had not evolved since their initial year of data. Nevertheless, the impact of trade globalisation is said to be insignificant as the corresponding coefficients that used to predict the counterfactuals were not precisely estimated at the 10% level.

Columns (3)-(6) report other counterfactual findings when more macro developments were held constant. In general, financial deepening and technological progress are two key drivers of rising inequality of the population. Holding both developments, together with trade globalisation, at initial year levels for each country would have resulted in a decline in the average Gini by 0.33% a year (column 4).

With respect to the impact of institutions, we only focus on union density rate since the inclusion of other institutional variables would further reduce our already small sample size in the analysis. Column (5) shows that the average change in Gini coefficient shrunk to -0.23% a year (from -0.37%) when union density together with the aforementioned controls were held constant. This implies that declining union density has a small equalizing effect overall. Given the strong effect of declining union density on widening wage dispersion found in the previous section, the result here seems to suggest that there was a sizable employment effect, and the latter slightly outweighed the former. The impact of education is assessed in the last column. Not surprisingly, holding the supply of skilled workers unchanged would have greatly increased inequality among the working-age population. The counterfactual change in the Gini turned positive (0.073%), compared with -0.23% of the previous specification.

The robustness of these impacts is tested by redoing the same exercise based on the reverse-order decomposition (bottom panel of Table 7). In general, we found our results are robust as the distributional impacts of factors changed little when different orders of decomposition were used. This can also be seen in Table 8 in which we summarize the contribution of each macro development to average annual percentage change in inequality among the population.

Overall, we found that a small annual change (0.027%) in the Gini coefficient observed in the data disguised great influences of different components of macro developments. Financial globalisation and innovative activities are two major forces behind the rise of inequality in OECD countries since the 1980s, contributing to 0.22 percent and 0.16-0.2 percent annual increase, respectively, in the Gini coefficient of earnings among the working-age population. These sizable disequalizing effects were greatly mitigated by the increase in the supply of skilled workers, which contributed to 0.27-0.31 percent annually to reducing inequality. Moreover, both an increase in imports from mid/low-income countries as well as a decline in union density had exerted some effects in equalizing the earnings distribution of population, even though the change is not large enough to warrant a significant impact.

5.2.2 Alternative approach

This approach is proceeded as follows. First, we estimate a macro-regression to examine the effects of globalisation, technological progress and institutional change on employment dynamics. Then we take the results of the employment impact together with findings from the wage impact (sections 3

& 4) to offer an assessment on the overall distributional impact of globalisation among the working-age population.

Globalisation, other contextual changes and employment

The effects of globalisation, technological progress and institutional change on employment dynamics can be modelled as follows

$$Emp_{it} = \delta\, Glob_{it} + \rho\, Tech_{it} + \gamma\, Instit_{it} + \sum \beta_j X^j_{it} + \alpha_i + \lambda_t + \varepsilon_{it}. \quad (12)$$

The dependent variable, employment rates (emp), is obtained from the OECD employment database.[41] The explanatory variables are defined the same way as in sections 3 and 4.[42] The model is fitted the fixed-effects procedure, which permits us to focus on the average employment impact of the *within*-country variation. The final sample consists of an unbalanced country-year panel of 23 OECD countries for a period between 1981 and 2007, with on average 21 time-series observations per country. The regression results for the whole working-age population are presented in Table 9.

Trade globalisation

Growing trade integration with developing economies may both create opportunities and threats to employment in OECD countries. Conventional trade theory that is based on a comparative cost advantage between countries did not offer a clear view on this since it assumes full employment of all factors of production. Recent trade model that emphasizes heterogeneity on both sides of the labour markets (i.e., firms and workers), however, argue that increased trade integration may generate unemployment (Davidson *et al*, 1999, Davidson *et al*, 2008, Helpman *et al*, 2008).

Focusing on the import aspect of trade globalisation, we find that rising foreign competition, in particular growing merchandise imports from mid/low-income developing countries, has little effect on changes in employment in OECD economies over time. The coefficient (elasticity) was negligible and was imprecisely estimated at the 10% level in all specifications examined.[43] The result is in line with the general result of empirical studies, which find the net employment effects of changes in trade have not been significant in OECD countries (OECD 1985, 1992, 2007).[44]

Foreign direct investment

Financial deepening that was characterized by a rapid growth in foreign direct investment (FDI), inward or outward, may also affect job creation and destruction. Multinational corporations are widely seen as the main forces behind this strand of globalisation, responsible for the majority of FDI. Foreign corporations that establish new local plants or affiliates (i.e., Greenfield investment) may potentially stimulate economic growth and create jobs linked to their activities in the host country. On the other hand, multinationals that increased subcontracting across national boundaries

[41] http://www.oecd.org/document/34/0,3343,en_2649_33927_40917154_1_1_1_1,00.html.

[42] *Glob* denotes two globalisation factors, namely trade and financial integration, *Tech* is patent counts that capture technological change, *Instit* includes a set of institutional and policy variables (union density, tax wedge, and UI replacement rate), *X* refers to other controls including education and GDP (deflated), and α_i and λ_t refer to country-specific and time-specific fixed effects respectively.

[43] The estimate remains insignificant even without controlling for year fixed-effects (not shown).

[44] Although the overall employment effect of trade has not been significant, these studies also revealed that, at industrial level, the increased import competition had adverse employment effects in certain industries (OECD 1992), and imports from emerging economies tended to reduce sectoral labour demand (OECD 2007).

(in particular, outsourcing to a developing country) may lead to job displacement in the home country.[45]

Overall, we find that financial deepening appears to have a negative and appreciable impact on employment in OECD countries. With respect to inward investment, our finding indicates that a 10% increase in inward FDI stock/GDP ratio reduces the employment rate by over 2.1 percent. For a baseline employment rate of 65 percent, this amounts to a decline of 1.4 percentage points to 63.6 percent. One possible explanation is that multinationals tend to provide better pay than their domestic counterparts (OECD 2008), so the entry of multinationals may skim the domestic labour market and cause the labour supply to fall by crowding out local entrepreneurs at least in the short-run.[46] The other possibility is that not all inward foreign investment creates new establishments. More and more foreign investment comes in the form of cross-border mergers and acquisitions. In such cases, it may lead to job losses through post acquisition rationalization.

A very similar negative impact on employment was also found in outward FDI stock. The result seems to support the outsourcing story for which outward FDI from the developed countries serves as an instrument for exporting jobs to developing or low-wage countries. Despite a plausible explanation, it should be noted that FDI activities in OECD countries are still dominated by flows between the developed economies and the fact that net outflows to emerging market countries are rather small.[47] It seems the outsourcing story alone is not responsible for all the displacement effect of outward FDI.

Technological progress

There is no doubt that technological progress will result in changes in the demand for labour. Process innovation that introduces automated assembly line may increase productivity, but may result in a decline in the demand for (likely unskilled) workers. On the other hand, product innovation that leads to an increase in total consumption may stimulate employment due to stronger sales or exports. Empirical evidence on the employment consequences of technological change is mixed, and depends largely on the forms of innovation and the levels of unit (firms, sectors or the whole economy) analyzed (see for example the survey by Vivarelli 2007).

Our results in columns (1)-(4) of table 9 reveal that on average technological advancement—through more innovative outputs (i.e., patents)—has very little impact on employment in OECD countries over the years. If any, it seems to suggest that labour-saving innovations slightly outweighed labour-augmenting innovations and resulted in a moderate decrease in the employment rate.

Labour market institutions

The relation between labour market institutions and employment are examined in columns (3) and (4) of table 9. Basically, the inclusion of institutional variables does not alter the results for

[45] There is mixed evidence on whether outsourcing affects employment in advanced countries. For instance, Falk and Wolfmayr (2005), Harrison and MccMillan (2006), Anderton and Brenton (2006), and Hijen *et al.* (2005) find that international outsourcing has had a strong negative impact on the demand for unskilled labour. However, Slaughter (2000) shows that outsourcing activities of US multinational enterprises tend to have small, imprecisely estimated effects on US relative labour demand. Similarly, using industrial data for a group of OECD countries, OECD (2007) also concludes that outsourcing in general only has a rather moderate effect on shifting relative demand away from low-skill workers within the same industry.

[46] See De Backer and Sleuwaegen (2003) for discussion of Belgium. Misun and Tomsik (2002) also find that FDI tends to crowd out domestic investment in Poland.

[47] See OECD (2005) for FDI outward stock in OECD and non-OECD countries.

globalisation and technology with respect to their impact on employment. This is different from the analysis of wage inequality in the previous section where we show that the wage inequality impact of globalisation greatly reduced when institutional variables were included in the model.

For the employment impact of institutions, it is often put forward that higher union density (or coverage) strengthened workers' bargaining power over wages, and thus would lower employers' demand for labour. Hence, the declining trend of union density in OECD countries over recent decades should result in higher employment. However, this does not seem to reconcile with our results which find no impact of union density on employment. If any, it exerted a positive but fairly modest employment effect when all other institutional variables were not included (column 3).

The estimated coefficients for other institutional variables in column (4) in general have the expected signs. Higher UI replacement rates are negatively associated with the employment rate. This is consistent with the view that more generous unemployment insurance benefits tend to increase unemployment because the costs of being unemployed is reduced (e.g., Layard *et al*. 1991, OECD 1994). We also find that a higher degree of coordination in wage bargaining tends to improve employment. Moreover, the employment protection legislation (EPL) has a strong and negative impact on employment, which is in line with the view that a stricter EPL makes firing and probably also hiring more difficult and costly, and therefore may discourage job creation. One exception is tax wedges which estimate is not significant at the 10% level. The finding does not seem to support a common view that higher tax wedges tend to raise the tax burden and thus reduce employment. This also suggests that governments' objective to raise employment through changes in policy instruments embedded in tax wedges in response to adverse economic shocks or aging populations may only receive a very limited impact.

In columns (1)-(4) of table 9 we followed a standard practice to include GDP in the employment regression for the purpose of controlling for the aggregate demand fluctuations over the cycles. However, the inclusion of GDP may also understate the role of some determinants if these variables affect employment mainly through their influence on output. In order to estimate the full effects of the variables of interest by allowing for the "scale effect", we remove GDP from the regression in column (5).

In general, the results of many variables remained robust but there are also some interesting deviations. First, technological progress now exerted a positive impact on employment with an estimate at the 5% level. This is possible if the diffusion of new innovative products effectively stimulated consumption and resulted in greater GDP, and thus higher employment. By allowing the effect of technology through higher overall growth, the finding offers important evidence of the labour-augmenting effect of technological change. Second, both union density and tax wedges now have the expected (negative) sign and were significantly estimated at the 10% and 1% level respectively when GDP is not controlled for. Third, the effect of EPL has become insignificant in column (5). It remains unclear why EPL is imprecisely estimated in the absence of GDP. However, given no evidence that EPL would affect employment through its influence on overall output, the specification in column (5) may not improve its coefficient estimate but rather introduce other biases (e.g., omitted variable bias).

Globalisation and changes in overall inequality: bring together evidence

What are the distributional impacts of globalisation and other contextual changes? Having examined their respective impacts on the employment (above), the impacts on wage dispersion (sections 3 and 4) together with findings from the first part of section 5, we evaluate the final impact of globalisation

on earnings inequality of the working-age population in Table 10 by synthesizing together all the evidence.

In columns 1 and 2 we report the contribution (share) of variables of interest to the average annual percentage change in wage dispersion and the employment rate respectively (see also Figures B1 & B2 in Appendix B).[48] In columns 3 and 4 we report findings from the first part of section 5 (i.e., from Figure 17) that changes in wage dispersion and changes in the employment rate contributed a 0.177 percent annual increase and a 0.143 percent annual decline, respectively, to earnings inequality of the whole working-age population. Based on columns (1) to (4), we then evaluate the overall impact of each contextual change on earnings inequality of the population in column (5). This is done in a rather suggestive way by simply calculating a weighted average of the wage and the employment effect from columns 1-4 (i.e., (1)*(3)+(2)*(4)).[49]

In general, we find very similar results compared with those of the counterfactual approach above. Financial deepening and technological progress are the two main culprits behind the rise in earnings inequality of the working-age population, contributing a combined 0.31 (0.165 and 0.145 respectively) percent a year to increasing the Gini coefficient of earnings. An advantage of this approach is that it further offers insight regarding mechanisms through which these factors transmitted inequality. For instance, FDI tended to raise inequality through both the wage inequality and the employment channels, with a stronger influence through the latter. Similarly, technological progress exerted a disequalizing impact through both channels, but with a stronger importance of the wage inequality channel (the within-group inequality). Trade globalisation appears to have no impact on final earnings inequality among the working-age population, and it exerted no effect on both channels of transmissions.

The sizable disequalizing effect of financial globalisation and technical change was entirely offset by equivalent reduction in inequality (-0.312) from the growth in the supply of skilled workers. It affects the final earnings distribution among the working-age population through altering both the distribution of wages among the employed and inequality between the employed and the non-employed.

The other factor that contributed an appreciable effect to raising earnings inequality of the population is union density. This is, however, in contrast to the previous counterfactual finding that union density had exerted a moderate equalizing effect. The discrepancy might be due to the fact that the term “wage” is defined differently in both analyses. We may understate the disequalizing effect of union density (through raising wage dispersion) in the previous analysis because the wage refers to earnings among all workers (including part-time and self-employed), and the use of earnings may not reflect well the role of union bargaining with employers over the wage. In addition, the discrepancy might also be due to the fact that we understate the equalizing effect of union density (through improving employment) in the current approach by not allowing for the scale effect discussed previously. When taking both understated effects into account, the results from both approaches can be reconciled. That is, union density trends tended to be overall distribution neutral.

[48] Specifically, the figures in column (1) are derived using the specification in Table 5 (4); the figures in column (2) are derived based on the specification in Table 9 (4).

[49] This assumes that the wage (the employment) effect in column 3 (column 4) is simply an aggregation of the sum of total changes in wage dispersion (the employment rate) in column 1 (column 2), ignoring the fact that these results were drawn based on different variable definitions and data sources. In particular, contributions to wage dispersion in column (1) refer to full-time equivalent workers and were derived from the OECD data sources, while the wage effects in column (3) refer to earnings dispersions among all workers, and were from the Luxembourg Income Study (LIS) data.

With a larger sample size, we are able to assess the distributional impact of other institutional changes in this approach. Generally, their impact on earnings inequality among the working-age population tends to be quite modest because of their relatively small contributions to either wage inequality or employment. Some institutions had exerted opposing effects. One interesting case is the employment protection legislation (EPL), which contributed a moderate effect to increasing wage dispersion and a moderate effect to improving job creation. Its impact on final inequality of population, therefore, is negligible.

6. Summary and conclusions

The aim of this paper has been to assess the distributive consequences of economic globalisation within OECD countries. Our analysis contributes to previous literature on this issue in three aspects. First, the paper presents new empirical evidence based on a dataset including 23 OECD countries over the 1980-2008 period. The restricted sample of OECD member countries and the availability of a standardised earnings and inequality measures allow a higher degree of comparability and thus strengthen the significance of any links being found; and the use of data over the 2000s further captures the latest macro-economic developments. Several aspects of globalisation such as trade and financial integration indeed accelerated during the most recent decade and these trends could not be captured by earlier studies. Second, the paper disentangles the effect of globalisation from other concurrent trends, in particular technological progress and labour market institutions. The latter are likely to have a major impact on the distribution of earnings. Third, the paper identifies the relevant pathways between globalisation and inequality of the whole working-age population—not just the employed—by accounting for inequality which arises from widening earnings gap among workers on the one hand and inequality between the employed and the non-employed on the other. The results can be summarised as follows.

First, financial globalisation (measured by stock of FDI) is positively and strongly related to within-country earnings inequality in OECD countries. This pattern is generally robust to the use of various model specifications. The finding is in line with previous cross-national studies (e.g., IMF 2007, Baccaro 2008). We also find that FDI tended to raise earnings inequality through both the wage inequality and the employment channels, with a stronger influence of the latter.

Second, by disentangling trade volumes to their origin areas and also to income level of origin countries, we show that rapid growth in imports from mid/low-income countries has been the main channel through which trade affects wage inequality. We show that this factor contributes to an appreciable rise in within-country wage inequality among workers in OECD countries. However, this effect disappears when other concurrent trends (in particular institutions) are controlled for. Overall, the rise of import competition from emerging economies tends to be distributional neutral among the working-age population.

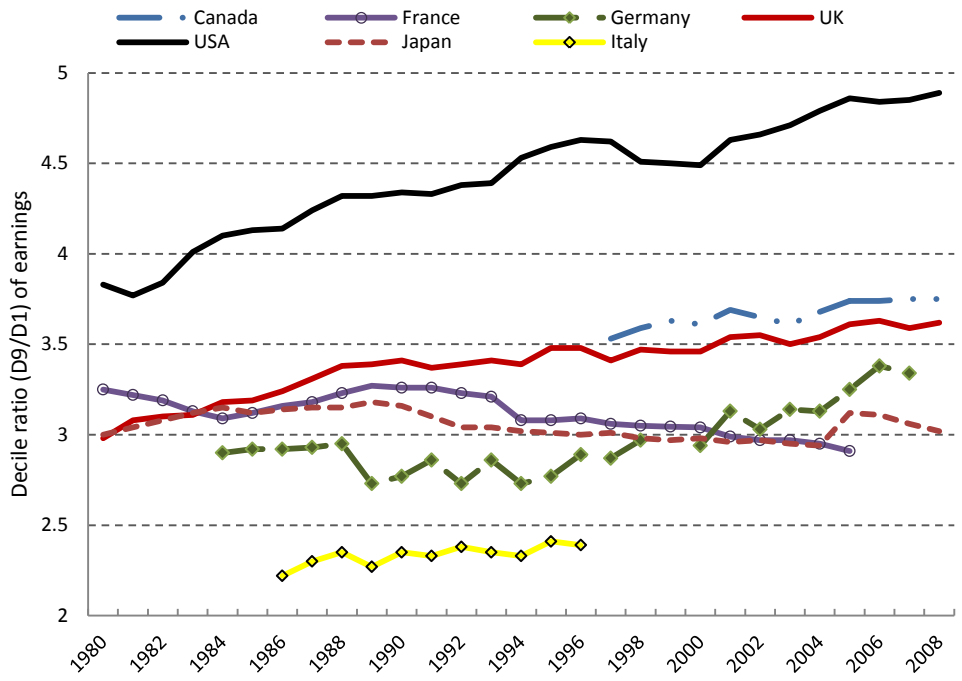
Third, with respect to other forces that underlie rising earnings inequality of the population, technical progress (measured by patents) plays an important role mainly through widening wage dispersion among the employed. Whether the extent of innovation is labour-saving or labour-augmenting is less clear and depends largely on other variables included in the specification. Fourth, the weakening of labour market institutions over the years seems to exert two opposing effects to the earnings distribution of the population: raising wage dispersion and increasing employment rates. Their impact on final inequality of population, overall, tend to be trivial. Finally, the increase in the supply of skilled workers greatly minimises the disequalizing impact due to financial globalisation and technical change.

Our results highlight several key drivers of rising earnings inequality and the role of globalisation. The discussion is all the more pertinent given the current global economic crisis as well as concerns about protectionism in today's trade debate. However, the findings should be interpreted with care and may not be viewed as conclusive because of the following limitations. An important caveat is the interplay between globalisation and other contextual changes, which may obscure the full impact of globalisation. Another potential problem is the dynamic nature of inequality. In fact, a spurious relationship between globalisation and inequality may arise when inequality itself is path-dependent.[50] Furthermore, other aspects of globalisation not addressed in the study, in particular international labour migration, are likely to impact on trends in wage as well as earnings inequalities.[51] Further investigation on these areas is required in future research.

[50] Inequality may be path-dependent if it is affected by some structural factors that are slow to change over time, such as institutions. We attempt to mitigate this problem by introducing as many controls as possible including labour market institutions. In the literature, a common solution to this problem is to include the lagged dependent variable and estimate the model by GMM (generalized method of moments). Unfortunately, GMM estimators are only efficient asymptotically and is not suitable for our case, which only 23 countries are included. An alternative approach to estimate a dynamic specification is the Least Square Dummy Variable Corrected (LSDVC) estimator (see, for example, Meschi and Vivarelli 2009).

[51] It is often put forward that labour migration is associated with wage depression or higher unemployment. Empirical studies generally find limited effect of migration on employment and wage (for a review, see Borjas 1999 and Jean and Jimenez 2007). The absence of a major aggregated effect does, however, not necessarily imply that the distributional effects are negligible. Recent contributions to the debate suggest notably that skilled labour immigration has a potentially inequality-reducing effect while the effects of unskilled immigration remain undetermined (Kahanec and Zimmermann 2009).

Figure 1. Trend in wage dispersion, OECD G7 countries, 1980-2008



Source: OECD Earnings database.
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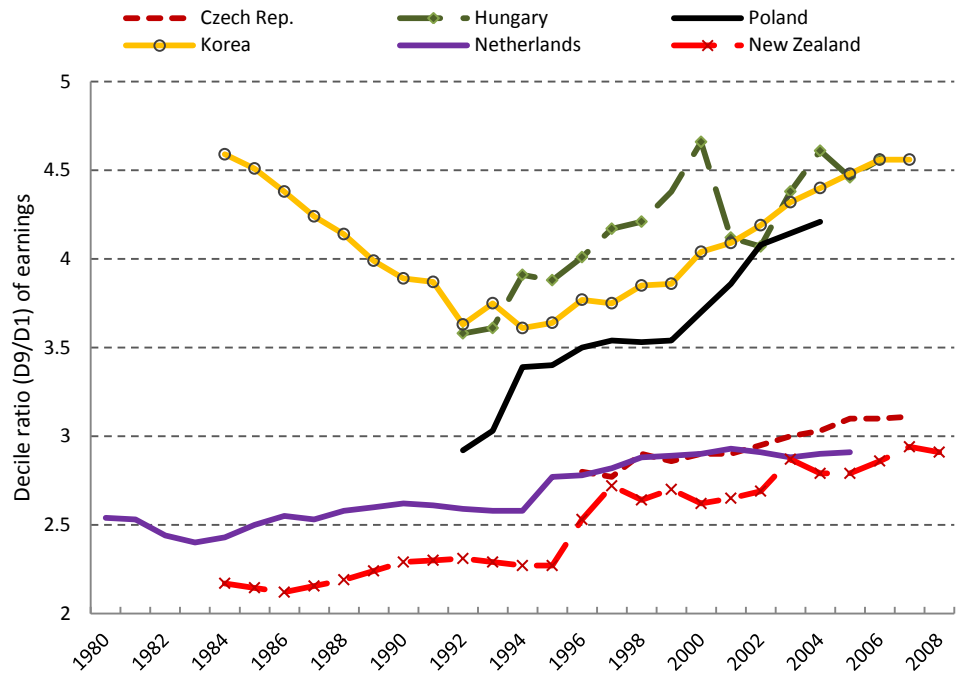
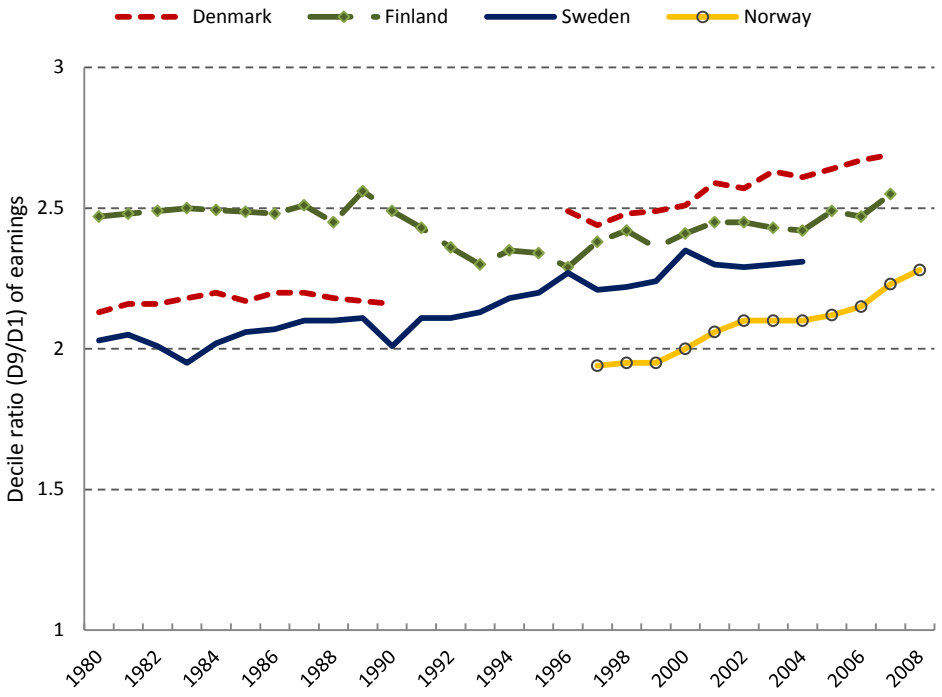
Figure 2. Trend in wage dispersion, selected OECD countries, 1980-2008



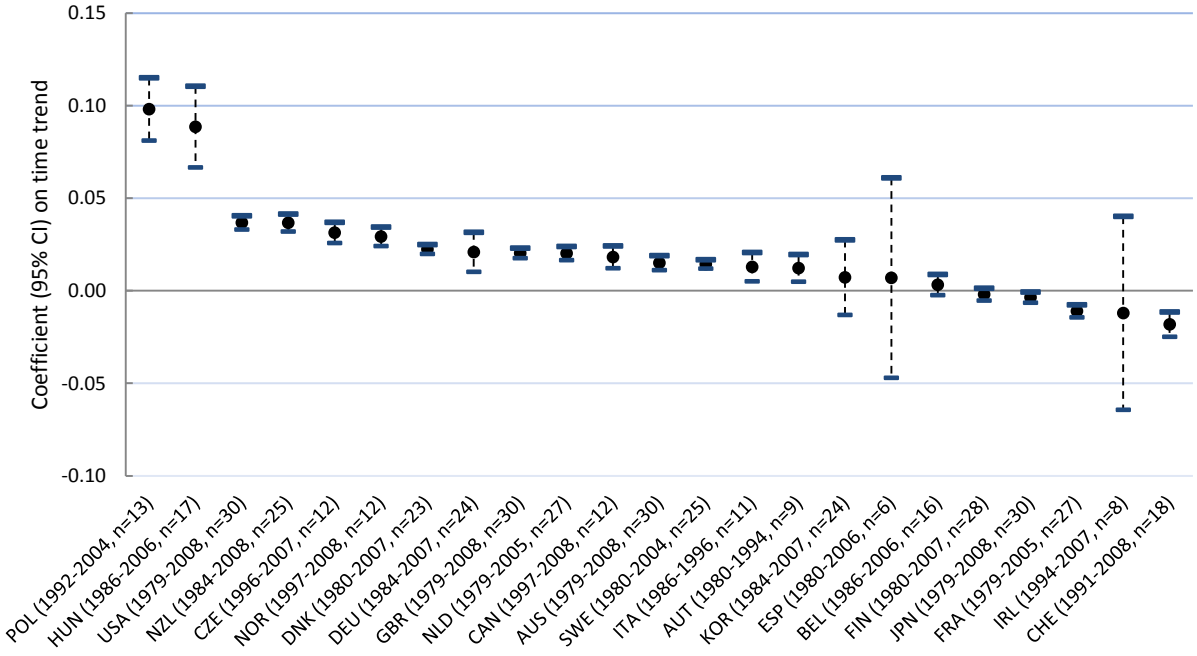
Source: OECD Earnings database.

Figure 3. Trend in wage dispersion, OECD Nordic countries, 1980-2008



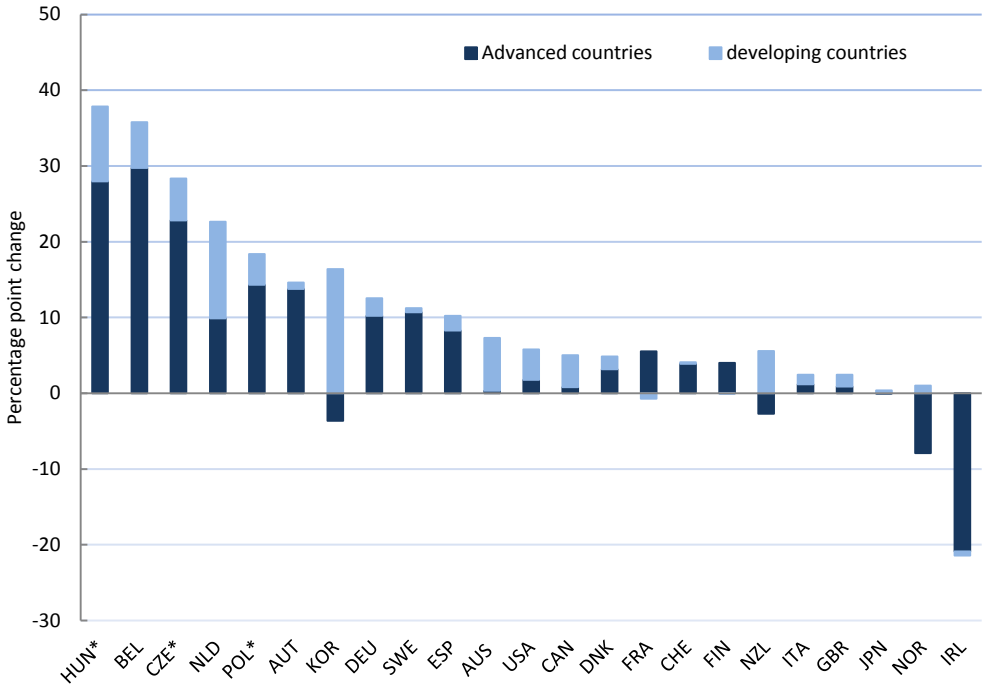
Source: OECD Earnings database.

Figure 4. Country-specific regression of wage inequality (D9/D1) on time trend, years indicated



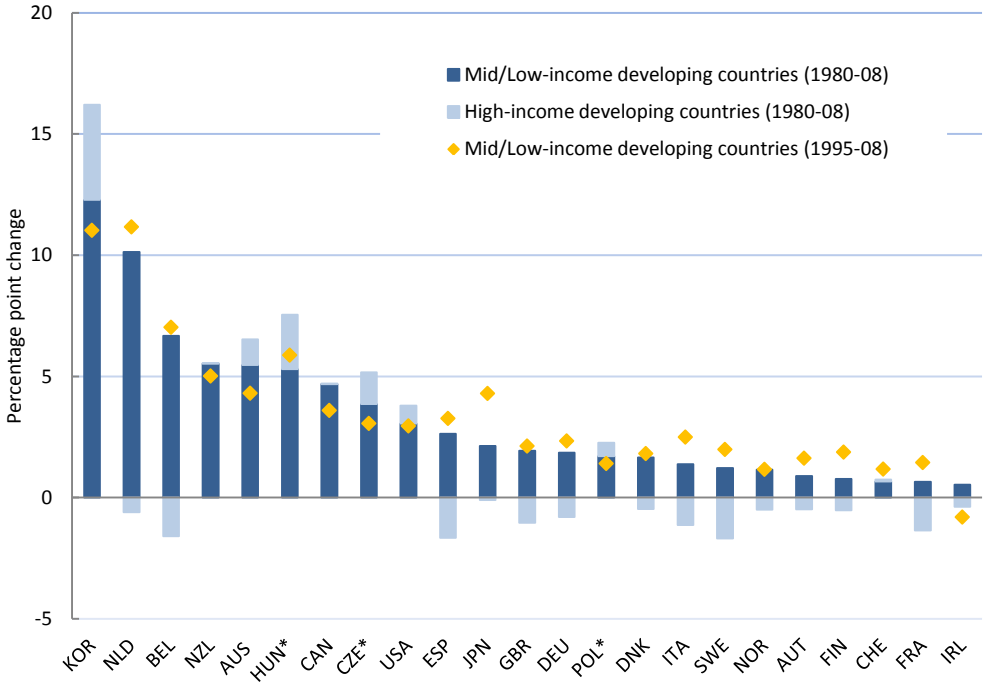
Source: OECD Earnings database.

Figure 5. Change in import intensity (imports/GDP) by region of origin, 1980-2008



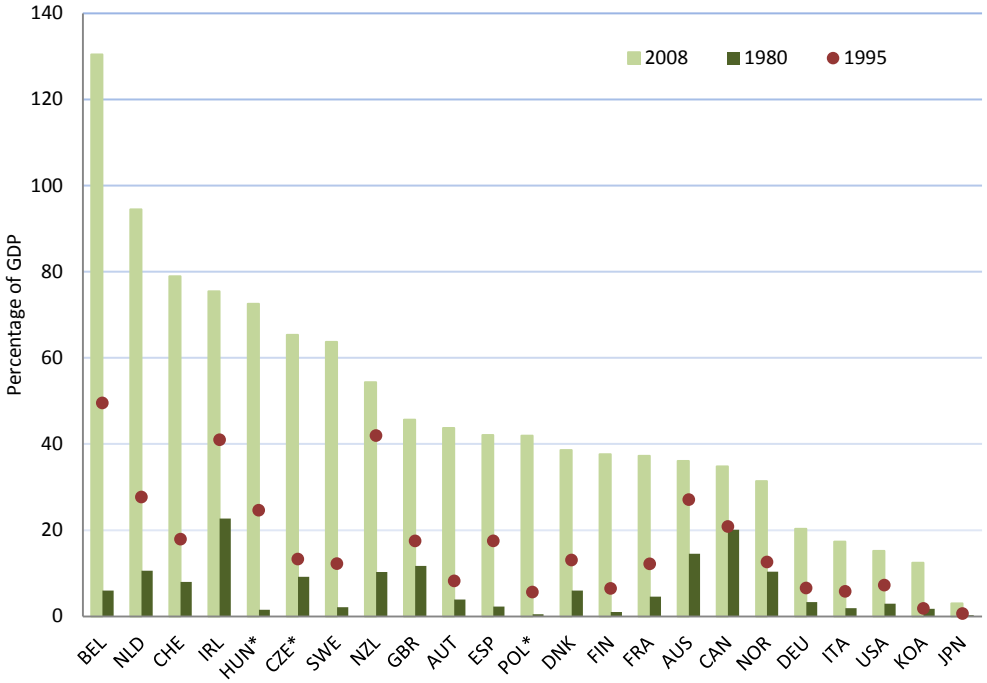
Source: United Nation Conference on Trade and Development (UNCTAD), Handbook of Statistics.
Note: Trade in service is not included. * Data series begin in early 1990s.

Figure 6. Change in import intensity (imports/GDP) with developing countries, by income levels



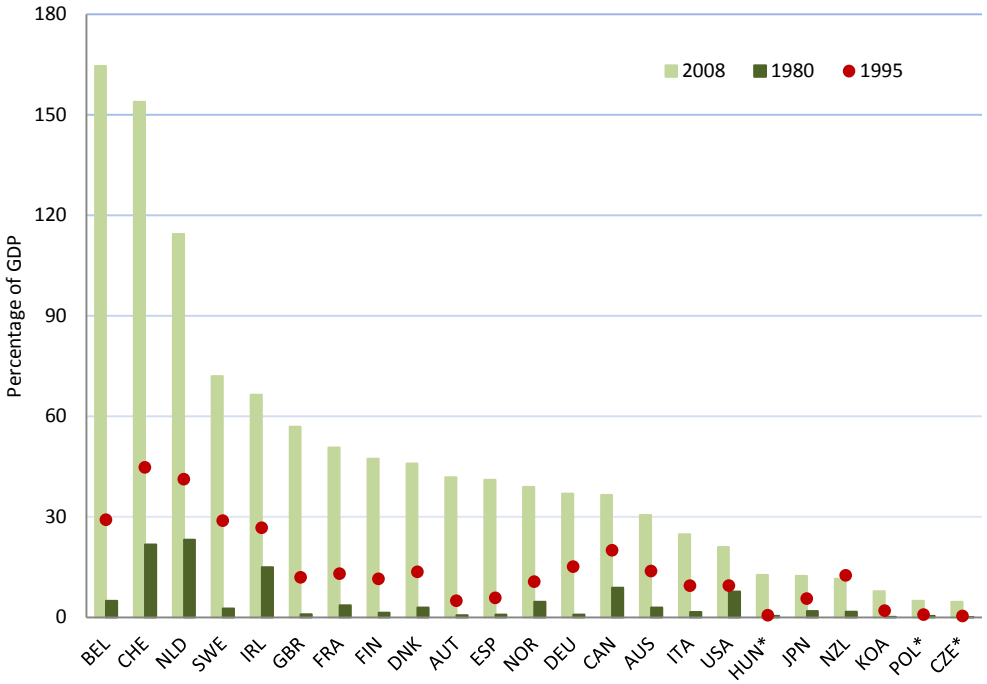
Source: United Nation Conference on Trade and Development (UNCTAD), Handbook of Statistics.
Note: Trade in service is not included. * Data series begin in early 1990s.

Figure 7. Inward Foreign Direct Investment (FDI) stock



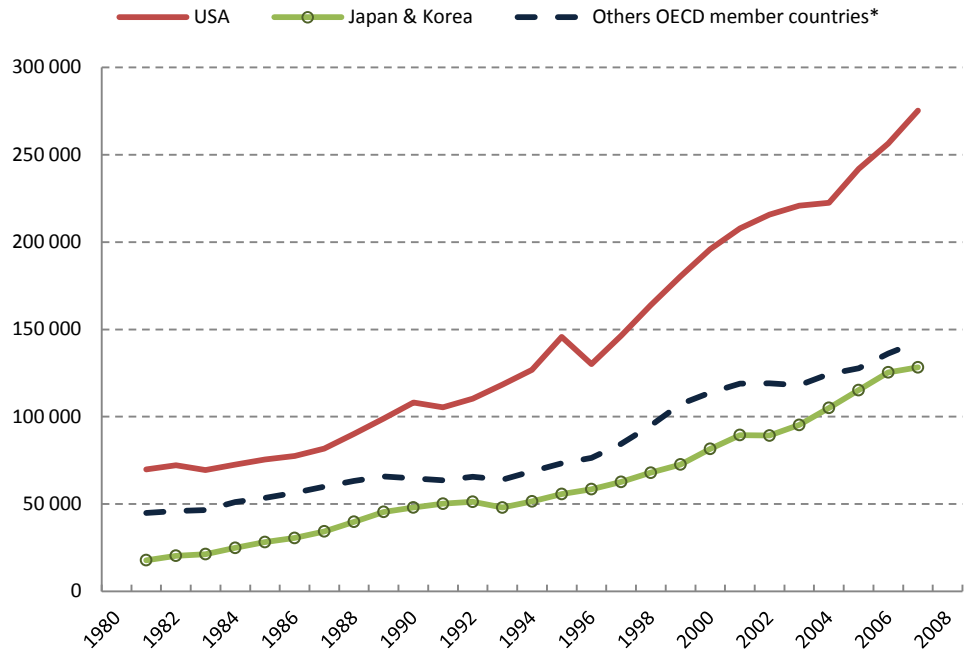
Source: United Nation Conference on Trade and Development (UNCTAD), FDI statistics online.
Note: FDI inward stock is measured as a percentage of GDP. * Data series begin in 1990s.

Figure 8. Outward Foreign Direct Investment (FDI) stock



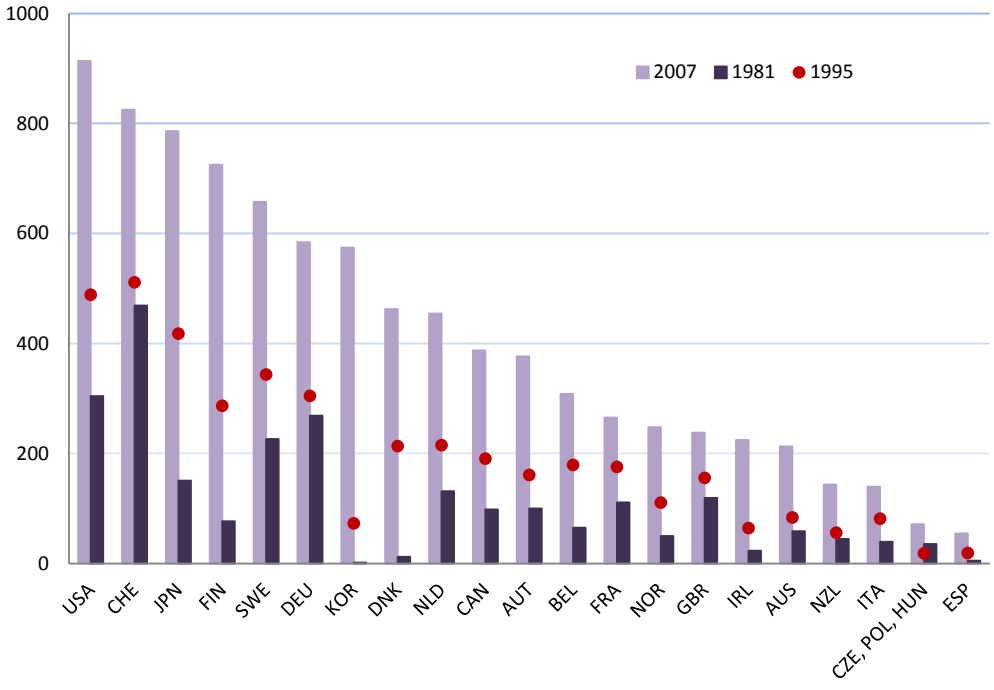
Source: United Nation Conference on Trade and Development (UNCTAD), FDI statistics online.
Note: FDI outward stock is measured as a percentage of GDP. * Data series begin in 1990s.

Figure 9. Total patent counts



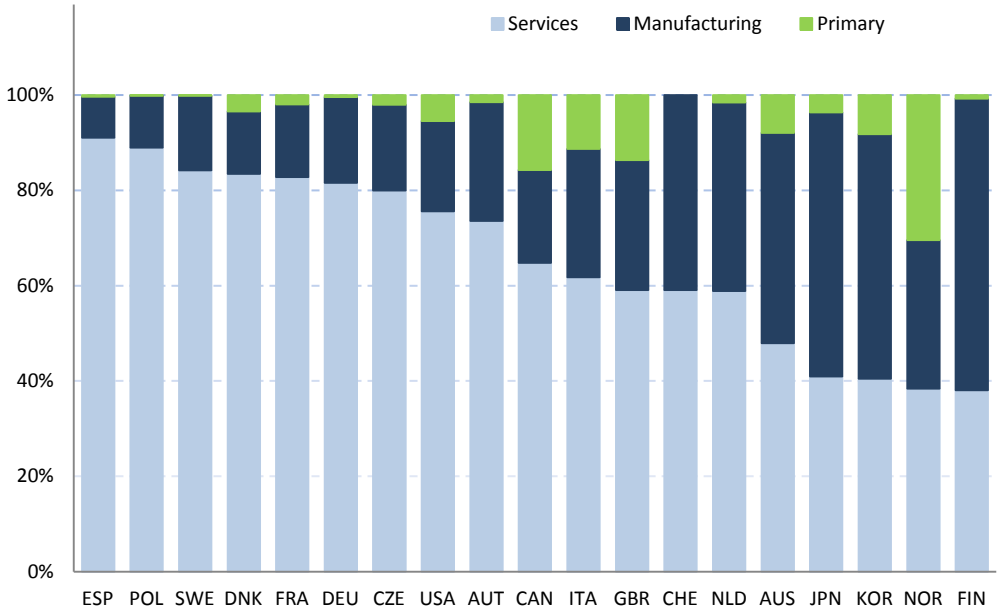
Source: OECD Patent Statistics.
Note: Total patent counts refer to the sum of patent applications to the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO).

Figure 10. Patents per capita (per million population)



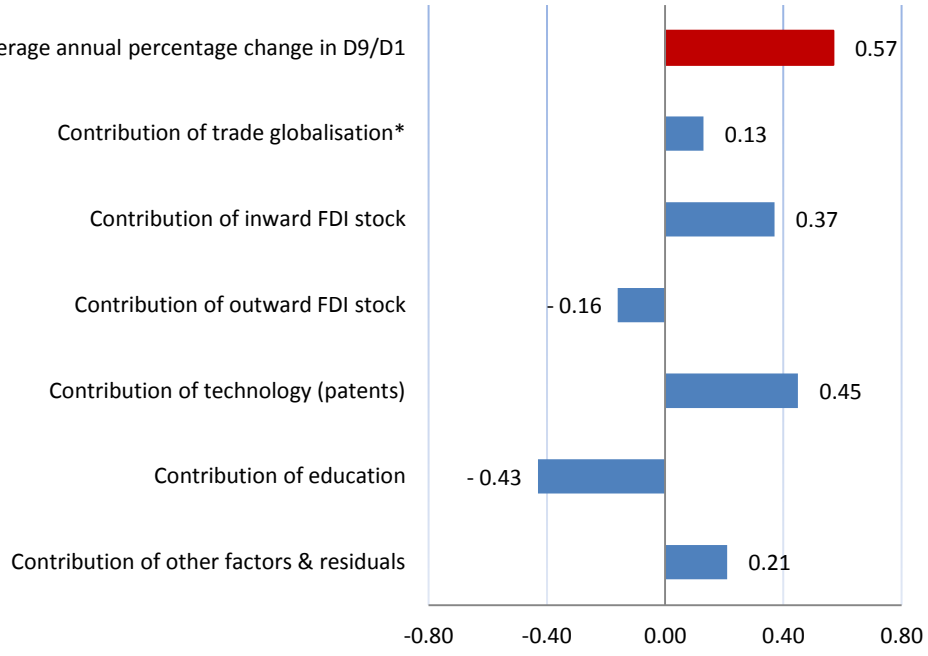
Source: OECD Patent Statistics.
Note: Total patent counts refer to the sum of patent applications to the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO).

Figure 11. Share of outward FDI stock by industry sectors, selected OECD countries, 2007



Source: OECD FDI statistics by industry

Figure 12. Explaining changes in the D9/D1 ratio (average annual percentage change)



Source: OECD Staff calculations.

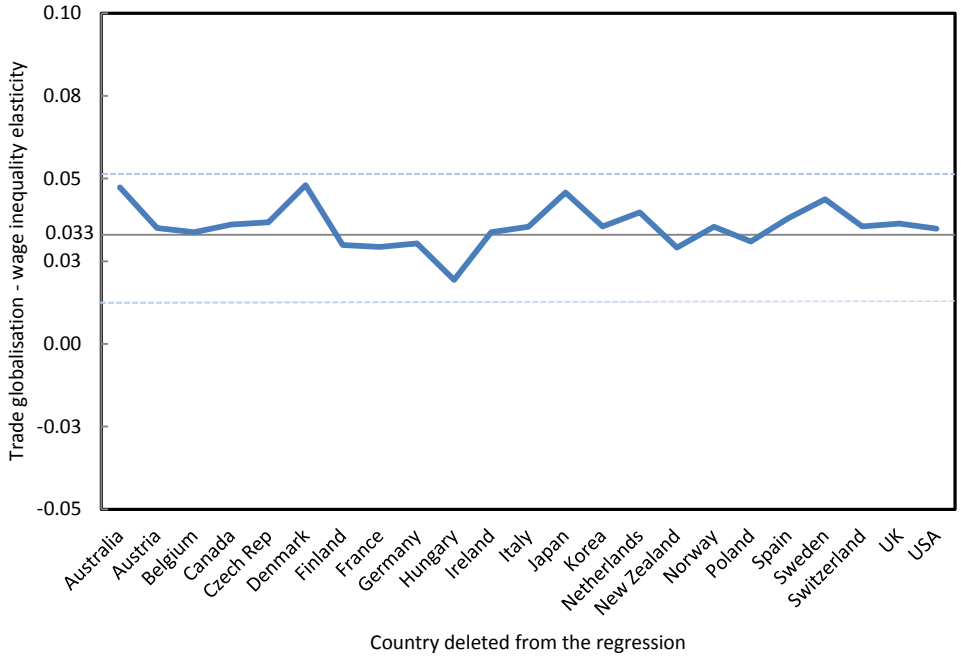
* Refers to import intensity (imports from mid/low-income developing countries/GDP).

** Other factors include female employment share and the sectoral employment shares.

Note: The contribution of each variable to the change in the D9/D1 is computed as the average annual change in the respective variable multiplied by the corresponding coefficient estimate from Table 3 (3).

Figure 13. Influential country in the regression of wage inequality

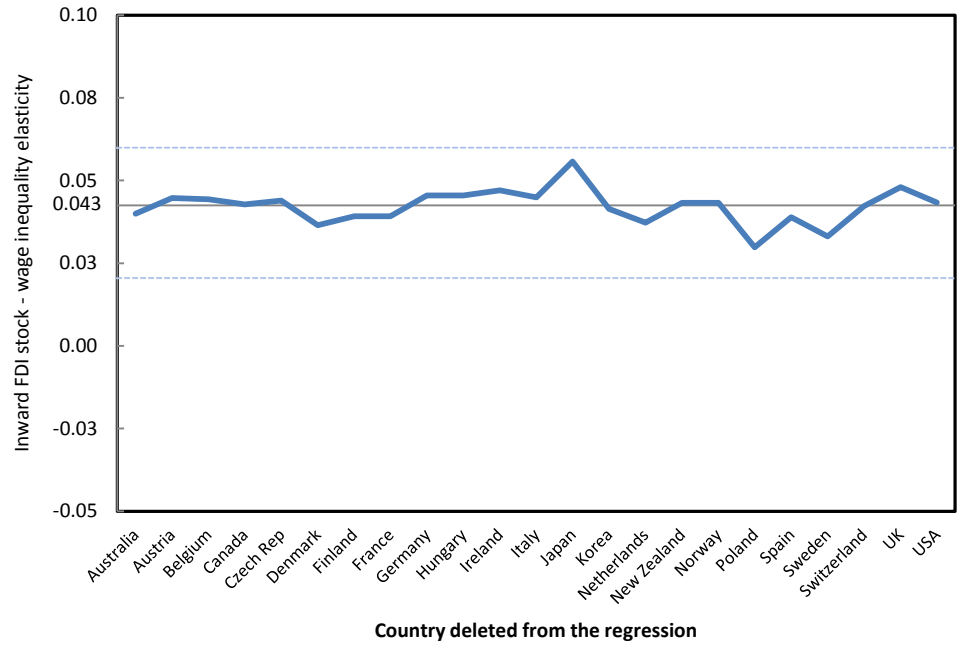
A. Trade* and wage inequality elasticity



Source: OECD Staff calculations.

* Refers to goods imports from mid/low-income developing countries. *Note:* Dotted lines refer to the 95% confidence intervals of the preferred estimated (of trade) in row 3 of Table 3 based on the full sample.

B. Inward FDI stock and wage inequality elasticity

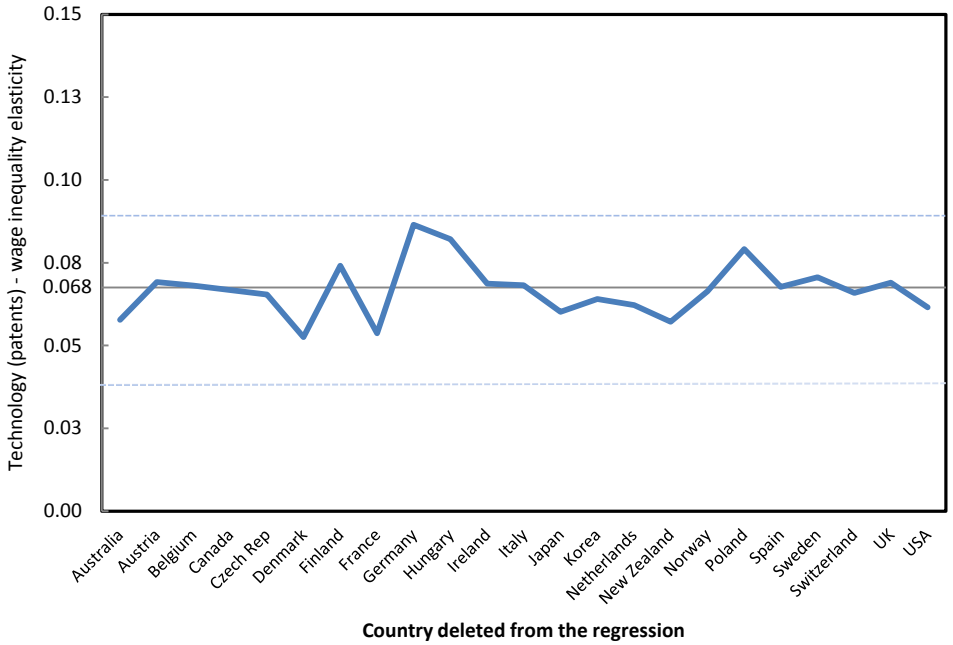


Source: OECD Staff calculations.

Note: Dotted lines refer to the 95% confidence intervals of the preferred estimated (of inward FDI) in row 3 of Table 3 based on the full sample.

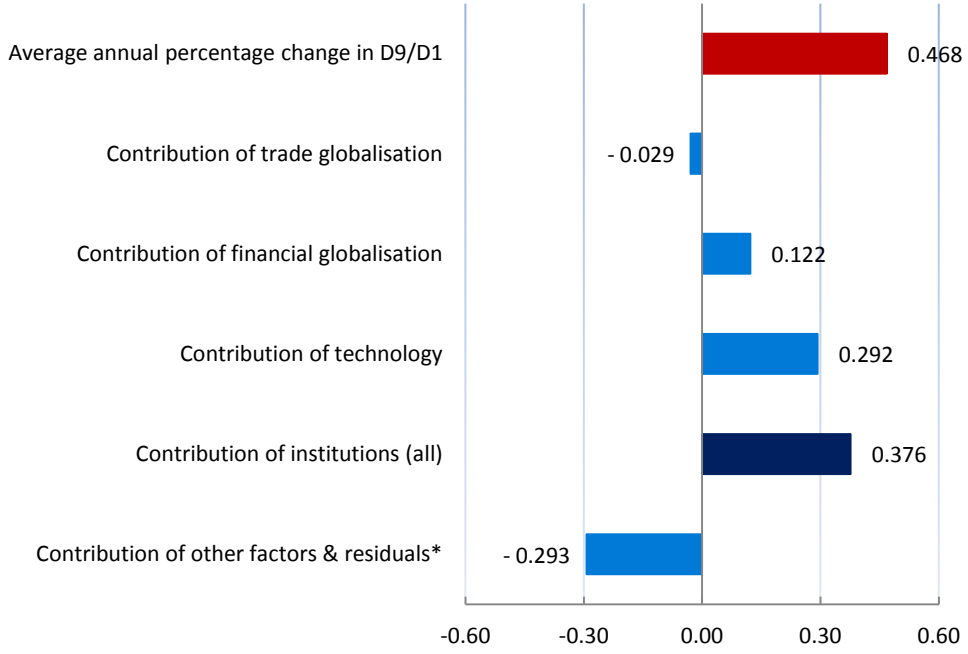
Figure 13. Influential country in the regression of wage inequality (continued)

C. Technology (patents) and wage inequality elasticity



Source: OECD Staff calculations.
Note: Dotted lines refer to the 95% confidence intervals of the preferred estimated (of patents) in row 3 of Table 3 based on the full sample

Figure 14. Explaining changes in wage dispersion



Source: OECD Staff calculations.
* Other factors include female employment share, education and the sectoral employment shares.
Note: The contribution of each variable to the change in the D9/D1 is computed as the average annual change in the respective variable multiplied by the corresponding coefficient estimate from Table 5 (4).

Figure 15. Lorenz curves and changes in inequality

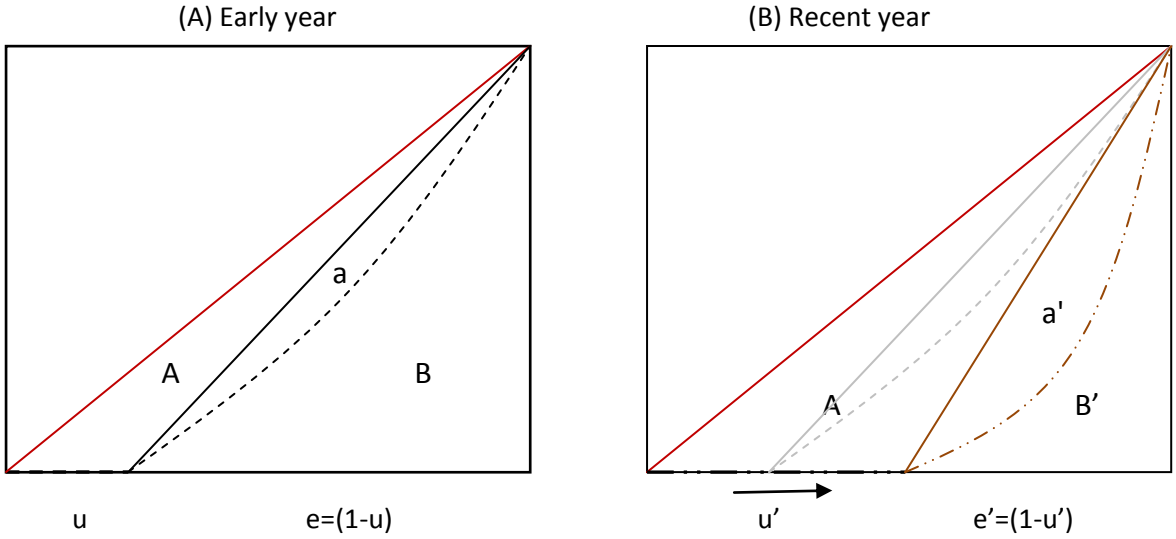
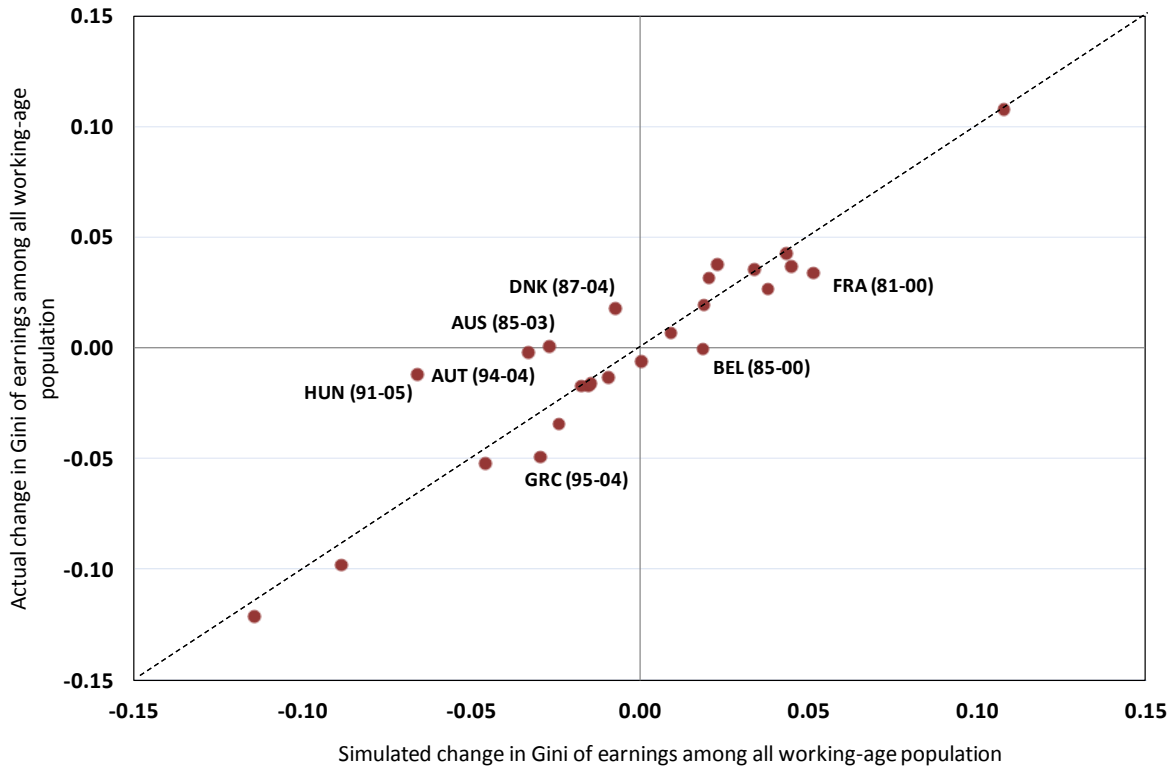
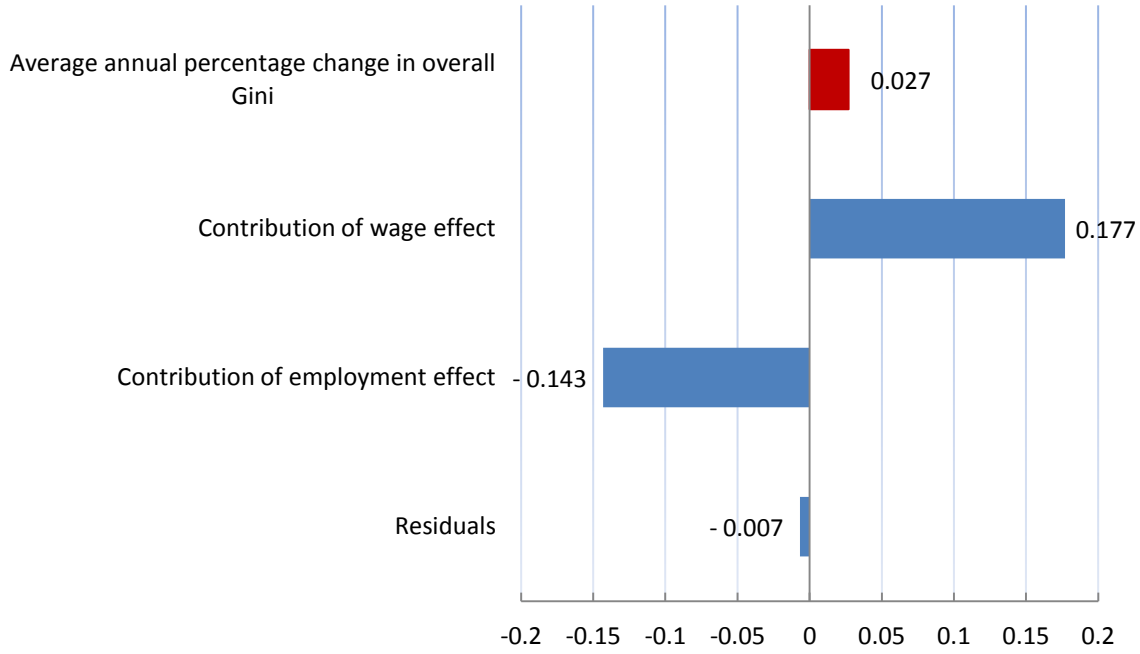


Figure 16. Actual versus simulated changes in Gini among the working-age population



Source: Luxembourg Income Study (LIS).

Figure 17. Explaining changes in Gini of earnings amongthe working-age population



Note: The contribution of each variable is computed as the average annual change in the variable multiplies the regression coefficient (Table 6) on that variable.
Source: Luxembourg Income Study micro data

Table 1. Changes in market income dispersion, in household structure, and in tax/transfer effectiveness are the key drivers for household income distribution

	Trends in market income inequality (A)	Impact of household structure changes (B)	Trends in tax/transfer effectiveness (C)
Australia	=	+++	=
Austria		=	
Belgium	+	+	---
Canada	+++	+	+++
Czech Republic	+++		+
Denmark	+++	=	+
Finland	+++	+	+++
France	-	+++	---
Germany	+++	+++	=
Italy	+++	-	---
Japan	+++		-
Luxembourg	+++	=	
Mexico		---	
Netherlands	-	+++	+++
New Zealand	+++		+
Norway	+++	+	=
Portugal	+++		-
Spain		=	
Sweden	+	-	+++
United Kingdom	+	+	=
United States	+++	=	+++

Note: Changes refer to the period from the mid-1980s to the mid-2000s.

(a) Column A refers to the percentage point change in the Gini coefficient for market incomes. "+++"/"---"denotes changes greater than 4 points; "+"/"-"denotes changes between +/- 2 points; "=" denotes changes less than 2 points.

(b) Column B refers to differences between disposable income inequality changes assuming a constant population structure and actual changes. . "+++"/"---"denotes differences greater than 30 percent; "+"/"-"denotes differences between 15 and 30 percent; "=" denotes changes less than 15 percent.

(c) Column C refers to the impact on inequality of percentage point changes in the inequality reduction rate of taxes and transfers. Positive signs signal that the redistributive impact weakened and thus raised inequality, while negative signs signal that the redistributive impact has strengthened. "+++"/"---"denotes changes greater than 4 points; "+"/"-"denotes changes between +/- 2 points; "=" denotes changes less than 2 points.

Source: OECD (2008).

Table 2. Channels through which trade affects wage dispersion

(Dependent variable: natural logarithm of P90/P10 ratio)

	(1)	(2)	(3)	(4)	(5)	(6)
Total trade of goods (import + export) /GDP	0.122*** (6.14)					
Export of goods /GDP		0.016 (0.58)				0.012 (0.42)
Import of goods /GDP		0.101*** (3.59)				
Advanced countries imports /GDP			0.028 (1.40)		0.029 (1.42)	0.021 (0.77)
Developing countries imports /GDP			0.065*** (7.08)			
High-income DC imports /GDP				0.013 (1.35)	0.012 (1.17)	0.011 (1.10)
Mid/low-Income DC imports /GDP				**0.054*** (5.39)**	**0.052*** (5.11)**	**0.051*** (4.79)**
Other explanatory variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of obs.	455	455	455	455	455	455
Number of countries	23	23	23	23	23	23
Adjusted R-squared (within)	0.31	0.31	0.35	0.35	0.35	0.35

Note: Both dependent and explanatory variables are logarithm transformed.

* Other controls include share of female in employment as well as sectoral share of employment.

** The distribution of developing countries by income group is defined according the United Nation Conference on Trade and Development's (UNCTAD) classification.
http://www.unctad.org/Templates/Page.asp?intItemID=2166&lang=1

Table 3. The impacts of trade, financial globalisation, and technology on wage dispersion

(Dependent variable: natural logarithm of P90/P10 ratio)

	(1)	(2)	(3)	(4)	(5)
Trade					
Mid/low-income developing countries imports /GDP	0.051*** (6.01)	0.053*** (6.09)	0.033*** (3.64)	0.036*** (3.97)	0.011 (0.85)
Financial					
Inward FDI stock /GDP	0.050*** (5.62)	0.053*** (5.64)	0.043*** (4.61)	0.043*** (4.63)	0.037*** (3.72)
Outward FDI stock /GDP		-0.008 (-1.03)	-0.016** (-2.13)	-0.016** (-2.17)	-0.016** (-2.01)
Technology					
Total Patent counts			0.068*** (5.81)		0.037*** (2.64)
Patents per million population				0.067*** (5.59)	
% has attained PSE	-0.112*** (-5.59)	-0.108*** (-5.28)	-0.106*** (-5.39)	-0.104*** (-5.32)	-0.153*** (-6.09)
Share of females in employment	0.282*** (2.97)	0.289*** (3.03)	0.259*** (2.83)	0.299*** (3.26)	0.264*** (2.60)
Other controls*	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	**Yes**
Number of obs.	414	414	414	414	414
Number of countries	23	23	23	23	23
Adjusted R-squared (within)	0.41	0.41	0.46	0.45	0.50

Note: Both dependent and explanatory variables are log transformed.
* Other controls include sectoral share of employment.

Table 4. Trend in labour market institutions

	Mean (std. dev.)				
	1980's	2000s	The U.S. level (average across time)	The highest country level (average across time)	Country w/ the highest rate
	(1)	(2)	(3)	(4)	(5)
Institution variables					
A) Union density rate	48.5 (21.2)	33.1 (20.8)	14.2 (1.79)	80.96 (2.04)	Sweden
B) Employment protection indicators[1] (0-6)	2.09 (1.14)	1.62 (0.73)	0.21 (0.00)	3.01 (0.04)	France
C) Tax wedges[2]	31.9 (8.62)	26.8 (9.85)	22.2 (3.61)	41.94 (2.49)	Sweden
D) Gross UI replacement rate[3]	32.0 (13.3)	26.7 (13.7)	12.8 (1.12)	53.38 (5.38)	Denmark
E) Coordination of wage bargaining[4] (1-5)	3.26 (1.27)	2.71 (1.28)	1.00 (0.00)	5.00 (0.00)	Ireland
F) Active labour market spending[5] /GDP	0.857 (0.509)	0.695 (0.459)	0.190 (0.039)	2.06 (0.53)	Sweden

Note:
[1] Employment protection (EPL) indicator: scale from 0-6 (least-most restrictions). OECD employment database.
[2] Tax wedges are calculated by expressing the sum of personal income tax, employee plus employer social security contributions and payroll tax, as a percentage of labour costs (gross wages + employer social security contributions and payroll taxes). OECD taxing wages.
[3] Gross replacement rates are calculated as gross unemployment benefit levels divided by previous gross earnings. The data refer to the average of the gross unemployment benefit replacement rates for two earnings levels, three family situations and three durations of unemployment. OECD wages and benefits.
[4] Coordination of wage bargaining indicator is a 5-point classification of wage-setting coordination scores. It ranges from 1 (no coordination or fragmented bargaining) to 5 (economy-wide bargaining). See Visser (2009) for details.
[5] OECD employment database.

Table 5. Globalisation, labour market institutions and wage inequality

(Dependent variable: natural logarithm of P90/P10 ratio)

	Table 2 (3)			
	(1)	(2)	(3)	(4)
Globalisation variables				
ln(Import intensity)[1]	0.033***	0.044***	0.012	-0.006
	(3.64)	(3.93)	(0.96)	(-0.50)
ln(Inward FDI stock/GDP)	0.043***	0.018*	0.023**	0.000
	(4.61)	(1.70)	(2.31)	(0.01)
ln(Outward FDI stock/GDP)	-0.016**	-0.005	0.003	0.014
	(-2.13)	(-0.51)	(0.31)	(1.47)
ln(Patent counts)	0.068***	0.063***	0.058***	0.056***
	(5.81)	(4.32)	(4.17)	(3.54)
Institution variables				
ln(Union density rate)			-0.107***	-0.172***
			(-5.24)	(-6.65)
Employment protection indicator[2]				-0.072***
				(-7.07)
ln(Tax wedges)[2]				-0.025**
				(-2.26)
ln(Gross UI replacement rate)[3]				-0.045**
				(-2.00)
Corrdination of wage bargaining[3]				0.014***
				(3.12)
ln(Active labour market spending/GDP)				-0.007
				(-0.79)
Other controls				
ln(% population has at least PSE)	-0.106***	-0.128***	-0.113***	-0.146***
	(-5.39)	(-5.55)	(-5.04)	(-6.87)
Sectoral and female employment shares	Yes	Yes	Yes	Yes
Number of obs.	414	341	339	309
Number of countries	23	21	21	21
Adjusted R-squared (within)	0.46	0.45	0.49	0.59

Note:
[1] Import intensity is measured by merchandise imports from mid/low-income developing countries as a percentage of GDP.
[2] Employment protection (EPL) indicator: scale from 0-6 (least-most restrictions). OECD employment database.
[3] Coordination of wage bargaining indicator is a 5-point classification of wage-setting coordination scores. It ranges from 1 (no coordination or fragmented bargaining) to 5 (economy-wide bargaining). See Visser (2009) for details.

Table 6. The wage and the employment effects on overall inequality

(Dependent variable: natural logarithm of Gini of earnings among the working-age population)

	All
	(1)
ln(Gini) of earnings among the employed	0.386***
	(6.68)
ln(Employment rate)	-0.562***
	(-9.00)
Country-fixed effects	Yes
Year-fixed effects	Yes
Number of obs.	120
Number of countries	25
Adjusted R-squared (within)	0.77

Note:
Source: Luxembourg Income Study

Table 7. Actual and counterfactual average annual change in Gini of earnings among the working-age population

(Primary-order decomposition)

	Actual change	Counterfactual change if holding the following factors at their initial year levels				
		Trade	(2) + Financial	(3) + Technology	(4) + Institutions	(5) + education
	(1)	(2)	(3)	(4)	(5)	(6)
Average annual change in Gini (%)	0.027	0.089	-0.127	-0.326	-0.234	0.073

(Reverse-order decomposition)

	Actual change	Counterfactual change if holding the following factors at their initial year levels				
		Education	(2) + Institutions	(3) + Technology	(4) + Financial	(5) + Trade
	(1)	(2)	(3)	(4)	(5)	(6)
Average annual change in Gini (%)	0.027	0.295	0.375	0.212	-0.004	0.073

Source: Authors' calculation from LIS.

Note: Trade refers to merchandise imports from mid/low-income developing countries; Financial represents both inward and outward FDI; Technology is measured by patent counts; Institutions refer to union density rate only; and education is captured by percentage of population received post-secondary education.

Table 8. Contribution of macro developments to average annual change in Gini of earnings among the working-age population

	Actual change	Contribution to average annual change in inequality of population					
		Trade	Financial	Technology	Institutions	education	Residuals
		(1)	(2)	(3)	(4)	(5)	(6)
Primary-order	0.027	-0.062	0.216	0.199	-0.092	-0.306	0.046
Reverse-order	0.027	-0.077	0.216	0.164	-0.080	-0.268	0.046

Source: Authors' calculation from LIS.

Table 9. Regression to explain changes in the employment rate, working-age population

(Dependent variable: natural logarithm of employment/population ratio)

	All working-age (25-64 years old)				
	(1)	(2)	(3)	(4)	(5)
Globalisation variables					
ln(Import competition)[1]	0.008 (0.83)	0.008 (0.84)	0.010 (1.08)	0.010 (1.06)	0.006 (0.54)
ln(Inward FDI stock/GDP)	-0.023*** (-3.44)	-0.021*** (-3.02)	-0.022*** (-3.20)	-0.024*** (-3.50)	-0.032*** (-3.94)
ln(Outward FDI stock/GDP)	-0.023** (-3.58)	-0.019*** (-2.73)	-0.021*** (-3.03)	-0.027*** (-3.97)	-0.020** (-2.49)
ln(Patent counts)		-0.019 (-1.46)	-0.024* (-1.85)	-0.022* (-1.73)	0.031** (2.21)
Institution variables					
ln(Union density rate)			0.034* (1.94)	0.007 (0.40)	-0.038** (-1.96)
ln(Gross UI replacement rate)				-0.011** (-2.29)	-0.021*** (-3.85)
ln(Tax wedges)				0.008 (0.87)	-0.050*** (-5.83)
Coordination in wage bargaining				0.012*** (3.91)	0.019*** (5.41)
Employment protection				-0.035*** (-4.98)	-0.006 (-0.74)
Other controls					
ln(% population has at least PSE)	0.094*** (6.40)	0.089*** (5.87)	0.086*** (5.69)	0.075*** (5.14)	0.100*** (5.83)
ln(GDP, $US, 2000)	Yes	Yes	Yes	Yes	No
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes
Number of obs.	423	423	423	423	423
Number of countries	22	22	22	22	22
Adjusted R-squared (within)	0.68	0.69	0.69	0.72	0.61

Note:
[1] Import competition is measured by merchandise imports from mid/low-income developing countries .

Table 10. Key drivers for changes in the earnings distribution of the whole working-age population

	[*] (share) Contribution to average annual % changes in		[**] Annual % changes in overall inequality of the working-age population due to		Contribution to annual % changes in overall inequality
	Wage dispersion	Employment rate	Wage effect	Employment effect	(1)*(3) + (2)*(4)
	(1)	(2)	(3)	(4)	(5)
Globalisation variables					
Import competition	-0.063	0.072			-0.021
FDI stock (inward & outward)	0.260	-0.837			0.165
Patent counts	0.625	-0.239			0.145
Institution variables					
Union density rate	0.643	-0.020			0.117
UI replacement rate	0.047	-0.013	0.177	-0.143	0.010
Employment protection legislation	0.127	0.103			0.008
Coordination in wage bargaining	-0.091	-0.011			-0.015
Tax wedges	0.062	-0.013			0.013
Other control					
% population has at least PSE	-1.274	0.605			-0.312

Source: Columns (1)-(2) are derived from the decomposition results from Table 5(4) and Table 9(4) respectively; and columns (3) and (4) are obtained from Figure 17 directly.

Note: The impacts on overall inequality (columns 4-5) are derived as a weighted average of the wage and the employment effects from columns 1-4.

[*] Wage inequality and employment rates are derived from the OECD sources.

[**] Wage inequality and employment rates are derived from the LIS sources.

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Appendix A. Data & Variables

A.1 Wage inequality and the OECD earnings database

The wage inequality measure used in sections 2-4 of this paper is taken from the OECD earnings database. Inequality is measured by the decile ratio of the top 10 percent to the bottom 10 percent of wage earners. In most cases, the wage refers to monthly or weekly wages among full-time (or equivalent) workers. The structure of earnings database for countries covered in this paper is detailed below.

OECD structure of earnings database

Country	Source	Years available First/latest	Earnings	Type of worker
Australia	Household survey	1979/2008	Weekly	Full-time
Austria	Social security data	1980/1996	Monthly	All workers
Belgium	Social security data	1986/2006	Weekly	Full-time
Canada	Labour force survey	1997/2008	Weekly	Full-time
Czech Republic	Enterprise survey	1996/2007	Monthly	Full-time
Denmark	Tax registers	1980/2007	Hourly	All workers
Finland	Household survey	1980/2007	Annual	Full-time
France	Salary records of enterprises	1979/2005	Annual	Full-time
Germany	Household survey	1984/2007	Monthly	Full-time
Hungary	Enterprise survey	1986/2006	Monthly	Full-time
Ireland	Household survey	1994/2007	Weekly	Full-time
Italy	Society security data	1986/1996	Monthly	Full-time
Japan	Enterprise survey	1979/2007	Monthly	Full-time
Korea	Enterprise survey	1984/2007	Monthly	Full-time
Netherlands	Enterprise survey	1979/2005	Annual	Full-time
New Zealand	Household survey	1984/2008	Hourly	Full-time
Norway	Household survey	1997/2008	Monthly	Full-time
Poland	Enterprise survey	1992/2004	Monthly	Full-time
Spain	Enterprise survey	1980/2006	Monthly	Full-time
Sweden	Household survey	1980/2004	Annual	Full-time
Switzerland	Labour force survey	1991/2008	Annual	Full-time
UK	Enterprise survey & Annual survey of hours and earnings	1979/2008	Weekly	Full-time
USA	Household survey	1979/2008	Weekly	Full-time

Note: 2010 version

A.2 Explanatory variables

For all explanatory variables used in the analyses are listed below.

Title	Definition	Sources
Globalisation & SBTC indicators		
Trade globalisation	Preferred definition Import intensity measured by imports from mid/low-income* developing countries as a % of GDP Other definitions tested in the analysis - Trade openness (trade volume /GDP) - Export (import)-to-GDP ratio - Import penetration - Exports (imports) from advanced countries /GDP - Exports (imports) from developing countries /GDP - Exports (imports) from high-income* developing countries /GDP * income level according to UNCTAD definition (see footnote 11)	United Nations Conference on Trade and Development (UNCTAD)
Financial globalisation	Foreign direct investment (FDI) - Inward FDI stock / GDP - Outward FDI stock /GDP	UNCTAD & OECD
Technological progress	Preferred definition - Patent counts (total patent applications to both the European Patent Office and the United States Patent and Trademark Office) - patents per million population	OECD Patents database
	Other definitions tested in the analysis - Gross Domestic Expenditure on R&D investment /GDP - ICT investment /GDP - Export performance in R&D intensive industries - Technology Balance of Payment /GDP	OECD science and technology indicators
Other variables in the regression		
Education	% of population has post-secondary education Note: Data for 1980, 85, 90, 95 and 2000 are drawn from Barro and Lee (2000) dataset, and for the years 2001-08 are from OECD education at a glance. For years between 1985 and 2000 are interpolated linearly.	OECD education at a glance Barro & Lee (2000)
Sectoral employment share	% of employment in industry % of employment in service % of employment in agriculture	OECD statistics
Female employment share	Female as a % of total employment	OECD statistics
Aggregate output	Gross domestic product (GDP) Other definitions tested in the analysis - GDP per capita - Output gap between actual and potential output as a % of potential output	OECD statistics

Title	Definition	Sources
Institutional variables		
Union density rate	% of employees who are members of a trade-union	OECD employment database
Employment protection legislation (EPL)	From 0 – 6 (least to most restrictions)	OECD employment database
Tax wedges	The sum of personal income tax, employee plus employer social security contributions and payroll tax, as a % of labour costs (gross wages + employer social security contributions and payroll taxes)	OECD Taxing wages
Gross UI replacement rate	Gross unemployment benefit levels divided by previous gross earnings. The data refer to the average of the gross unemployment benefit replacement rates for two earnings levels, three family situations and three durations of unemployment	OECD wages and benefits
Active labour market programs spending (AMLP)	Active labour market programs spending as a % of GDP	OECD employment database
Coordination of wage bargaining	5 = economy-wide bargaining 4 = mixed industry and economy-wide bargaining 3 = industry bargaining with no or irregular pattern setting 2 = mixed industry- and firm level bargaining, 1 = none of the above, fragmented bargaining	Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS)
Minimum wages	Minimum relative to mean and median wages of full-time workers	OECD employment database

A.3 Advantages of current sample compared with selected recent cross-national studies on inequality

	IMF (2007)	ILO (2008)[1]	Dreher and Gaston (2008)	Current study
Dependent variable	Gini of income	Gini of income	Gini of income & Gini of wages	P90/P10 of wages
No. countries analysed	51	43	100	23
No. country-year obs.	288	435	411	414
Average obs. per country	5.6	10.1	4.1	18
Years covered	1980-early 2000's	1980-early 2000's	1970-2000	1980-2008

[1] Baccaro, L. (2008)

Appendix Figures.

Figure B1. Explaining changes in wage dispersion

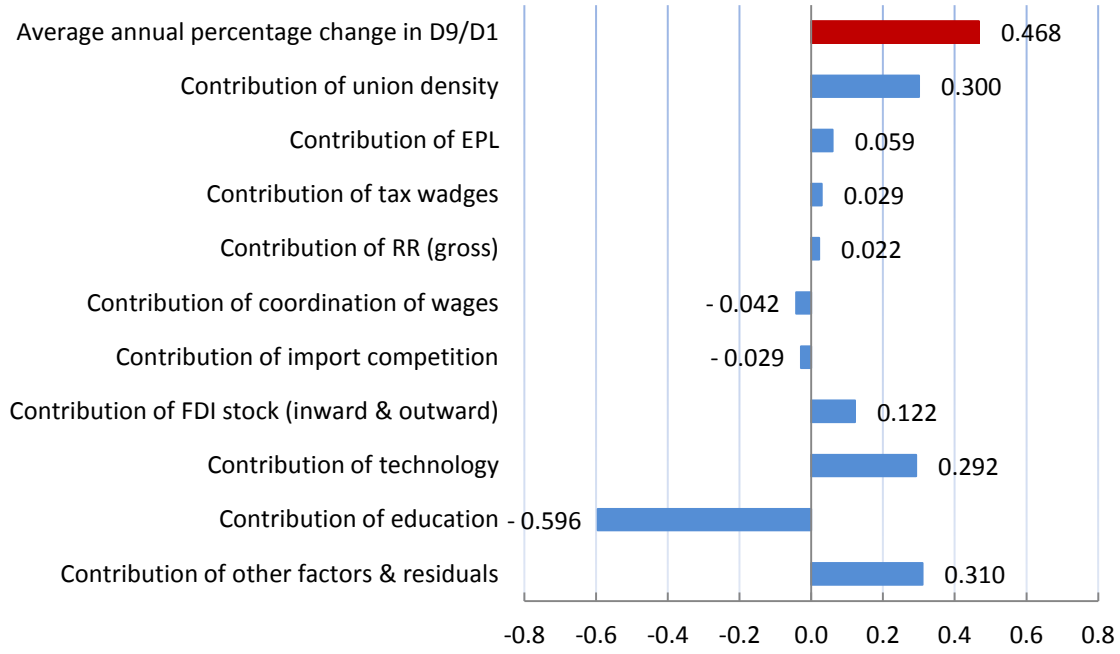

Figure B2. Explaining changes in employment rate among the working-age population