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Determinants of Household Earnings Inequality: The Role of Labour Market Trends and Changing Household Structure

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DETERMINANTS OF HOUSEHOLD EARNINGS INEQUALITY: THE ROLE OF LABOUR MARKET TRENDS AND CHANGING HOUSEHOLD STRUCTURE

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This article assesses various underlying driving factors for the evolution of household earnings inequality for 23 OECD countries from the mid-1980s to the mid-2000s. There are a number of factors at play. Some are related to labour market trends – increasing dispersion of individual wages and changes in men's and women's employment rates. Others relate to shifts in household structures and family formation – more single-headed households and increased earnings correlation among partners in couples. The contribution of each of these factors is estimated using a semi parametric decomposition technique. The results reveal that marital sorting and household structure changes contributed, albeit moderately, to increasing household earnings inequality, while rising women's employment exerted a sizable equalising effect. However, changes in labour market factors, in particular increases in men's earnings disparities, were identified as the main driver of household earnings inequality, contributing between one-third and one-half to the overall increase in most countries. Sensitivity analysis applying a reversed-order decomposition suggests that these results are robust.

JEL classification: D31, J12, J22, I30

Keywords: Earnings inequality, assortative mating, female labour supply, decomposition

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Introduction

Rising wage disparities are often seen as the main culprit behind the growth of household earnings inequality observed in most OECD countries over the past decades. However, the links between individual and household earnings distributions are rather complex (Gottschalk and Danziger 2005). Individuals usually pool and share their earnings (and other income sources) with other household members, and the distribution of household earnings therefore depends on a number of other factors such as household composition, how earners are clustered within households, and how jobs are distributed among family members. While some of these factors partly offset each other, existing evidence shows that level of trends of household earnings inequality do not necessarily mirror those of individual wage inequality (*e.g.* Parker 1995 for the United Kingdom; Saunders 2005 for Australia; OECD 2008 for a sample of 19 OECD countries; OECD 2011 for 23 OECD countries).

There are a number of reasons why the trend in household earnings inequality may differ from that of individual earnings (see McCall and Percheski, 2010; and Burtless, 2011 for a review of the literature). For instance, demographic shifts and societal changes, in particular changes in household structure and family formation, are likely to influence household earnings. The steady increase in the share of single-parent families combined with a tendency for individuals to choose their spouses in groups of similar earnings or educational levels (so-called marital sorting or "assortative mating") may have driven inequality up. Conversely, the substantial increase in women's employment rates may have helped reduce household earnings inequality.

This paper provides a comparative analysis of the importance of both labour market-related and demographic/societal shifts for the evolution of household earnings in 23 OECD countries. Of particular interest are the effects of changing family formation practices. The latter effects have been identified in some case studies as a main factor for increased household earnings and income inequality (*e.g.* Myles 2010 for Canada), while other studies either attribute marginal explanatory power to this phenomenon (*e.g.* Worner 2006 for Australia) or a sizeable but modest effect (Schwartz 2010 for the United States).

In the analytical framework used in this paper, inequality of household earnings is determined by two broad sets of factors, referred to as "labour market" factors (earnings dispersion and employment rates) and "family formation" factors (assortative mating and household structure). The aim is to assess their relative influences on changes in household earnings inequality.

Our results below yield the following key findings:

- Between the mid-1980s and mid-2000s, household earnings inequality increased in 21 of the 23 OECD countries studied.

- There was a trend towards more single-headed households, higher female employment, and greater earnings correlation among partners in couples.

- Marital sorting and household structure changes contributed, albeit moderately, to increasing inequality.

- By contrast, rising women's employment exerted a sizable equalising effect.

- Changes in labour market factors, in particular increases in men's earnings disparities, remain the main driver of household earnings inequality, contributing between one-third and one-half to the overall increase in most countries

The article is organised as follows. Section 1 discusses the trend in the distribution of household earnings and its potential determinants, *i.e.* the polarisation of men's earnings, changes in the employment rates, and shifts in family formation practices. Section 2 presents an empirical model to quantify the inequality impact of labour market and demographic developments. This applies a decomposition method which relies on the calculation of specific counterfactuals such as "what level of earnings inequality would prevail in the most recent year if all factors but family formation (or other factors) were held constant over time?" The difference between this counterfactual inequality and actual inequality represents the starting point for understanding the role of family formation (and the other factors). Section 3 provides a sensitivity analysis applying a reversed-order decomposition and the final section summarises and concludes.

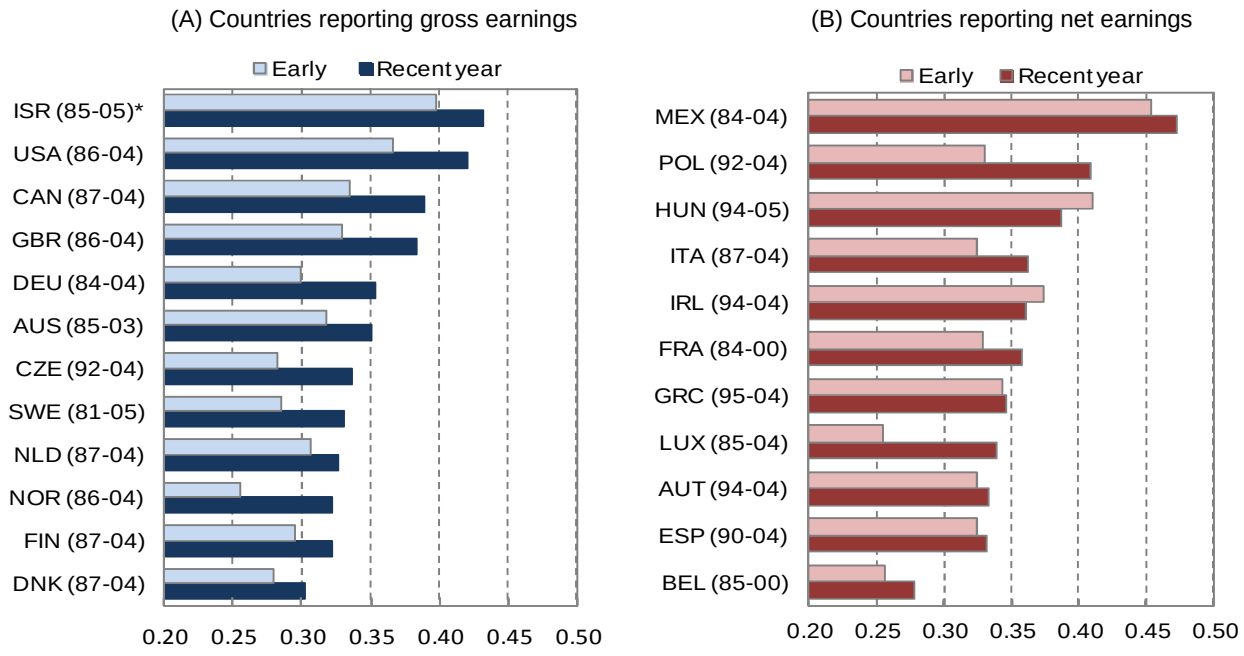
1. Trends in household earnings inequality and its determinants

The analysis in this paper draws on household micro data from the Luxembourg Income Study (LIS) for a period between the mid-1980s and the mid-2000s, covering 23 OECD countries. Samples are restricted to adults aged 25-64 living in a household with a working-age head.[1] Household earnings are calculated as the sum of annual wages and self-employment income from all household members, and are equivalised to account for the economies of scale associated with larger households.[2] For 11 of the 23 countries included in the analysis, only net (of taxes and social contributions) rather than gross earnings were available. It means that in these countries, the changes in any state redistribution mechanisms would also be captured here. The paper does not, however, analyse the role and contribution of tax/transfer policies explicitly. As levels and trends in the distribution of earnings, as well as the contributions of driving factors, will be different for gross than for net earnings, the two groups of countries are discussed separately below.

It is also important to note that this paper focuses on the developments of *annual* earnings rather than *hourly* earnings as in most standard analysis of earnings dispersion literature. One implication of the adoption of the annual accounting period is that it captures both dispersion in wage rates (i.e. price effects) and labour force participation (i.e. employment effects). In other words, the observed upward trends in individual earnings inequality can reflect either the widening wage dispersion or fluctuations in the proportion of earners with earnings for part of the year, or both. The extent to which component contributed a larger portion to annual earnings inequality however varies greatly across nations. A simple decomposition analysis in Annex Table A1 reveals that in most OECD countries wage rates account for the largest portion of earnings inequality, explaining 55-63% of earnings variance on average across the countries, while variation in annual working hours contributed to about 28-40% on average. We will return to this issue in section 2.2 when interpreting the main results of the study.

Figure 1 reveals that household earnings inequality, in terms of the Gini coefficient, has increased noticeably in most OECD countries over time. There is a more consistent trend among those countries which report gross rather than net earnings (Panel A). Norway and Sweden initially had low inequality levels but experienced a considerable increase over the years, while Canada, the United Kingdom and the United States started with relatively high levels of inequality which further increased by the end of the period. Trends are more diverse among countries which report net earnings only (Panel B). In Luxembourg and Poland, the Gini of household earnings rose more than 7 percentage points over the past decades, while in some countries, such as Greece, Ireland and Hungary, earnings inequality was stable or even fell. For the latter countries, it can however be not disentangled with the data at hand to which extent such a modest change (or decline) in household earnings inequality reflects the impact of labour market and demographic developments or was a combined result of changing market/family trends and tax systems.

Figure 1. Evolution of equivalent household earnings inequality (Gini coefficient)



Note: Samples are restricted to the working-age population (25-64 years) living in a household with a working-age head and positive earnings. Equivalent household earnings are calculated as the sum of earnings from all household members (including elderly and young adults if they lived in a household with a working-age head), adjusted for differences in household size with an equivalence scale (square root of household size). ***** Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

1.1. The determinants of rising household earnings inequality

What drives changes in household earnings inequality? Previous research (Box 1) suggests that inequality of household earnings is affected by two broad types of determinants: labour market factors and household formation factors. The former is often captured by changes in wage dispersion as well as employment rates, while the latter may be modelled by two additional influences: assortative mating, *i.e.* the degree to which individuals marry within their own income group; and household structure.[3] This subsection examines changes in both labour market and demographic factors from the mid-1980s to the mid-2000s.

Box 1. The role of demographic change for household earnings and income inequality: a review

The demographic-related factors behind the growth in household earnings and income inequality have been investigated extensively in the literature. For instance, Karoly and Burtless (1995), Burtless (1999), and Daly and Valletta (2006) suggest that the increase in single-headed families is responsible for a sizeable proportion (more than one fifth) of the spread in overall income inequality in the United States. Peichl *et al.* (2010) find that the changing household composition in Germany between 1991 and 2007 was associated with increasing inequality but the effect was stronger for pre-tax household income inequality than after accounting for taxes. Focusing on family earnings in Canada, Lu *et al*. (2011) show that about 20% (30%) of the growth in inequality between 1980 and 1995 (1995 and 2005) can be explained by changing family composition. By contrast, Jäntti (1996) finds that demographic shifts cannot be assigned any major role in the increase in inequality in five OECD countries (including Canada) over the 1980s.

There is also a literature that discusses the increasing role of wives' earnings in family income growth. Shorrocks (1983), Lerman and Yitzhaki (1985), and Karoly and Burtess (1995) decompose the change in inequality indices (e.g., Gini coefficient) by family income components and find that wives' earnings magnify family income inequality. Esping-Andersen (2009) observes, for five OECD countries, that women's employment

participation increased to a much larger extent at the top end of the income distribution, contributing to increased household income inequality. In contrast, Cancian *et al.* (1993) and Cancian and Reed (1998) suggest that wives' earnings equalize the distribution of family income and Harkness (2010) finds an inverse relationship between female employment and income inequality for a sample of 17 OECD countries.

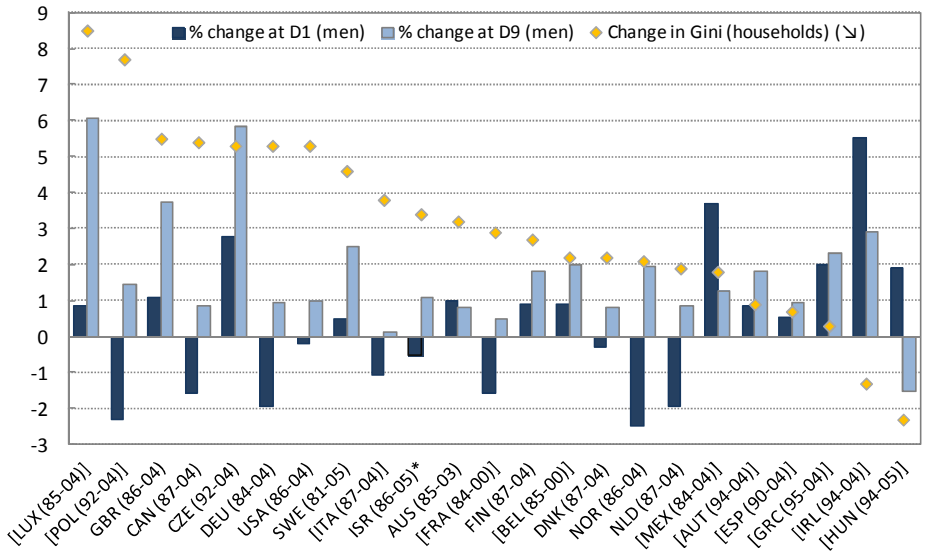
The relative role of changes to men's and women's labour market outcomes (i.e. employment rate and wages) in explaining household earnings inequality also depends on how the family is formed and the extent to which it has changed over time. There is increasing evidence that men and women with similar characteristics are more likely to be married to each other, the phenomenon described as "assortative mating". Juhn and Murphy (1997), for instance, find that the increase in female labour supply over time (either in terms of participation or hours worked) has been strongly non-uniform among all married women in the US, with wives of high-paying husbands experiencing more pronounced increases in labour market activities than wives of low-paying husbands. Morissette and Hou (2008) also report similar findings for Canada. Pencavel (1998) and Devereux (2004) stress that an increasing trend towards marital homogamy needs to be taken into account when interpreting the increased relation between wives' work decisions and husbands' earnings. Past studies have shown that the increasing resemblance of spouses' earnings across couple households contributes a nontrivial portion to widening inequality (Cancaian *et al.* 1993; Blackburn & Bloom 1995; Cancian & Reed 1999; Hyslop 2001; Schwartz 2010). On the other hand, Callan *et al.* find that despite an increased correlation in the earnings of spouses increases in female labour force participation and female wage rates account for between one quarter to half of the fall in income inequality in Ireland between the mid-1980s and mid-1990s.

1.1.1. Trends in men's earnings distribution

Figure 2 presents the annual percentage change of real earnings[4] among men in the bottom and the top deciles. The distribution of male earnings has become more dispersed in a large majority of the countries studied. In ten countries (such as Poland, Canada and Germany), rising male earnings inequality was a result of growth in real earnings in the top decile combined with a decrease for the bottom decile (see also Table A1 in the Annex).

Figure 2. Dispersion of men's earnings

Annual percentage changes in men's real earnings at the bottom and top decile and percentage point changes in Gini coefficients of household earnings



Note: Earnings refer to net earnings for countries in brackets and to gross earnings for other countries. Men's earnings refer to working-age men (25-64) with positive annual earnings. Sample refers to working-age persons in households with positive earnings. ***** Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

Changes in household earnings inequality are smaller in countries where the growth in men's earnings dispersion is less pronounced. The Gini coefficient of household earnings changed very little in Austria, Spain and Greece where the growth of earnings in the top and bottom deciles was either modest or increased at a similar rate. In Ireland, men's earnings increased at both ends of the earnings distribution, but more so in the bottom decile resulting in a drop in household earnings inequality. Such a pattern is also observed in Mexico, though this did not move in hand with decreased overall household earnings inequality, suggesting other important factors at play. In Hungary, which experienced a notable drop in household net earnings inequality, earnings inequality actually decreased among men as real earnings declined in the top decile and rose in the bottom (for interpretation of the results for Hungary, see Box 2 below).

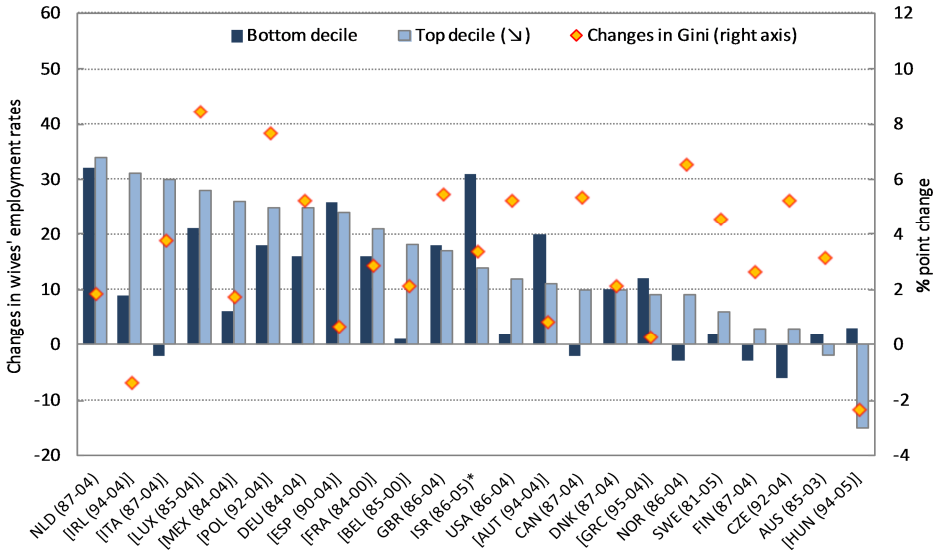
1.1.2. Trends in employment rates

The other important trend affecting household earnings inequality was the substantial increase in female employment rates. Indeed, women's employment rates rose substantially in most OECD countries, exceeding 10 percentage points in 14 of the 23 countries under study, with the largest increases seen in Luxembourg and Spain (Table A2).[5] Contrary to female employment, male employment rates reveal no obvious trend.

While changes in men's and women's labour market outcomes (*i.e.* employment rate and wages) undoubtedly reshaped the distribution of household income, their relative role in explaining household earnings inequality also depends on how the family is formed and the extent to which it has changed over time. For instance, there is increasing evidence on the relation between wives' work decisions and husbands' earnings.[6] To investigate this issue, in Figure 3 we look at changes in wives' employment rates by husbands' earnings deciles among couple households with a working husband. In most countries, employment rates increased more among wives of men in the top than in the bottom earnings decile. This was particularly the case in Italy, Mexico, Belgium, Canada and Norway. By contrast, employment rates of wives of low-wage earners increased relatively more in Austria, Hungary and Israel.

Figure 3. Female employment rates increased the most among wives of top earners

Wives' employment rates by husbands' earnings (top and bottom decile), couple households



Note: Sample for employment rates restricted to couple households with a working husband. Earnings refer to net earnings for countries in brackets and to gross earnings for other countries. * Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

Figure 3, however, also suggests no apparent link between trends in wives' employment rates and husbands' earnings on the one hand, and trends in overall household earnings inequality on the other. For instance, a growing association between wives' employment rates and husband's earnings status is not only observed in countries with a noticeable increase in earnings inequality such as Norway, Canada, Italy and the United States but also in countries with less of an inequality change such as Ireland, Mexico and Belgium. This suggests, at first sight, that the observed higher growth in participation rates of wives of top-earner husbands is not a prime candidate for explaining trends in household earnings inequality.

1.1.3. Trends in assortative mating

There is also a literature that discusses the increasing resemblance of spouses' earnings or educational background between husbands and wives, the phenomenon described as "assortative mating". Past research has found that the increased marital sorting contributed a nontrivial portion to widening household income inequality (Cancian *et al.*, 1993; Blackburn & Bloom 1995; Cancian & Reed 1999; Hyslop 2001; Schwartz 2010).[7]

A straightforward way to measure the extent of assortative mating is to look at simple linear correlation between husbands and wives earnings. This can be captured by Pearson correlation coefficients as presented in Figure A1 in the annex. The sample covers only couple households with at least one person working. Overall, the correlation coefficients have increased notably over time in 20 out of 23 countries (except Czech Republic, Finland and Hungary), suggesting that there is a general trend toward stronger marital sorting by earnings. The increase in correlation coefficients are most pronounced in Italy, Mexico, Norway and Poland.

To examine the level and development of earnings relationships between spouses more directly, Annex Figure A2 shows working wives' real annual earnings, ranked by husbands' earnings deciles. If there is indeed a growing trend of "assortative mating" (either along educational or occupational characteristics),[8] one would see higher earnings correlations among household members which in turn would accentuate earnings inequality between households. Figure A2 indicates that the level of wives' earnings increases continuously when moving up the ladder of husbands' earnings, especially in the top three deciles. This trend is a departure from the past; in the mid-1980s, wives' annual earnings were still rather equally distributed across the husbands' earnings spectrum in many countries.

The greatest changes took place in the English-speaking countries, Luxembourg, Norway, Poland and Sweden. In the United Kingdom, for example, the earnings gap between wives of husbands in the top and the bottom decile was about GBP 3 900 in 1987, and this gap increased to GBP 10 200 in 2004 (both figures are expressed in 2005 constant values of national currency). The earnings gap almost tripled in Norway and Poland. In most countries, wives of men in the top deciles benefited most from earnings increases. Poland is a particularly striking example: working wives' earnings rose by almost two-thirds in the top decile, while there was no sizeable increase in the first five deciles.

There is, however, another group of countries which bucked the trend. In Italy and Mexico, the already existing strong correlation between men's and their wives' earnings did not increase further. In Finland, it decreased (when excluding the top decile). And in Austria and Germany, the correlation continues to be weak.

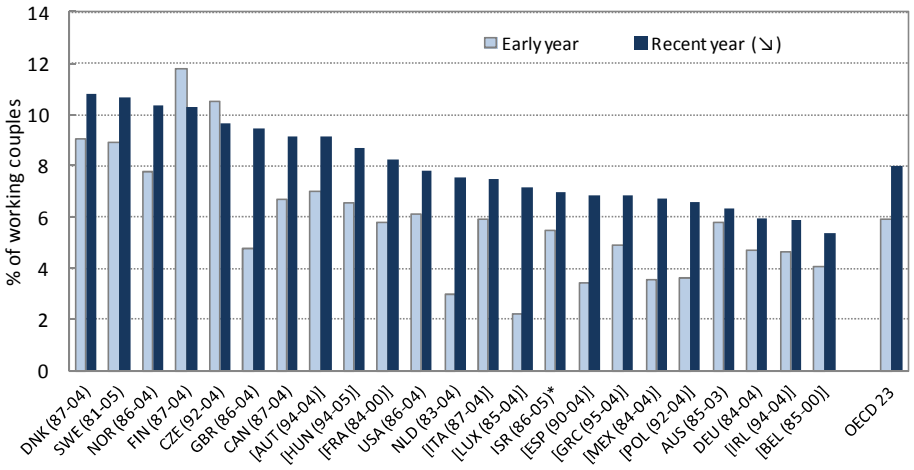
In order to build a summary measure of the degree of marital sorting that can be used for the decomposition analysis described below, we follow Fortin and Schirle (2006) to define assortative mating by the likelihood of a person in earnings decile *i* to be married to a spouse in earnings decile *j*, according to their respective earnings distribution.[9] In general, we find that assortative mating using this measure has increased in nearly all OECD countries. Figure 4 (Panel A) shows that on average

for the 23 OECD countries, the share of workers married to a person in the same earnings decile grew from about 6% in the mid-1980s to 8% in the mid-2000s. Luxembourg stands out with the largest increase, from 2.3% in 1985 to 7.4% in 2004. Significant increases were also recorded in the Netherlands and the United Kingdom (more than 4.5 points) and in Mexico, Poland and Spain (between 3.0 and 3.5 points). The Czech Republic and Finland are the only two countries that experienced a drop in the degree of assortative mating over the past two decades. Levels of assortative mating in terms of earnings have been converging across countries, with the highest levels recorded in the Nordic countries.

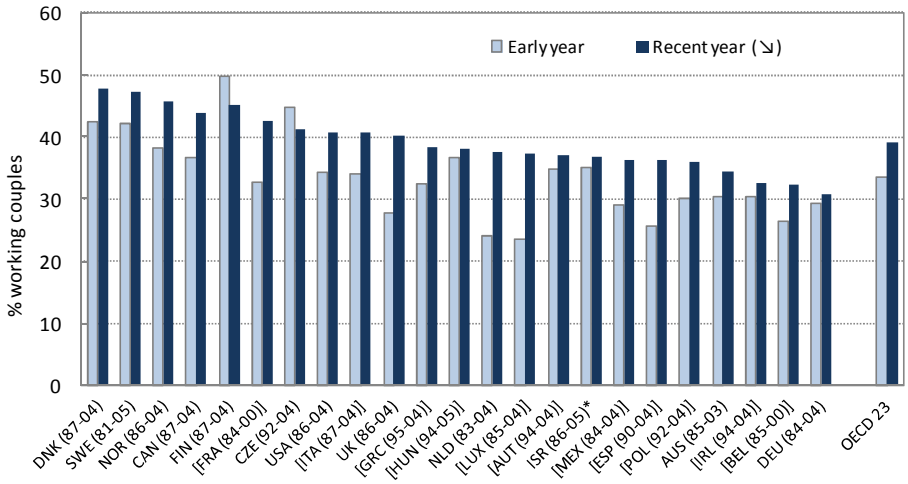
In Panel B of Figure 4 we broaden our definition by defining assortative mating as the likelihood of a person in earnings decile *i* to be married to a spouse in the same *or* the adjacent earnings decile *j*, where $|j-i| \leqq 2$. This is equivalent to using quintiles (instead of deciles) to categorise the earnings distribution. The overall pattern as well as country rankings remains very similar as before. With the broader definition, between one third and half of earners are living with spouses in the same gender-specific earnings quintile. The OECD average degree of assortative mating, under this broader measure, increases from 34% to almost 40%.[10]

Figure 4. A higher degree of assortative mating

Panel A. Percentage of workers in earnings decile *i* with a spouse in the same earnings decile



Panel B. Percentage of workers in earnings quintile *i* with a spouse in the same earnings quintile



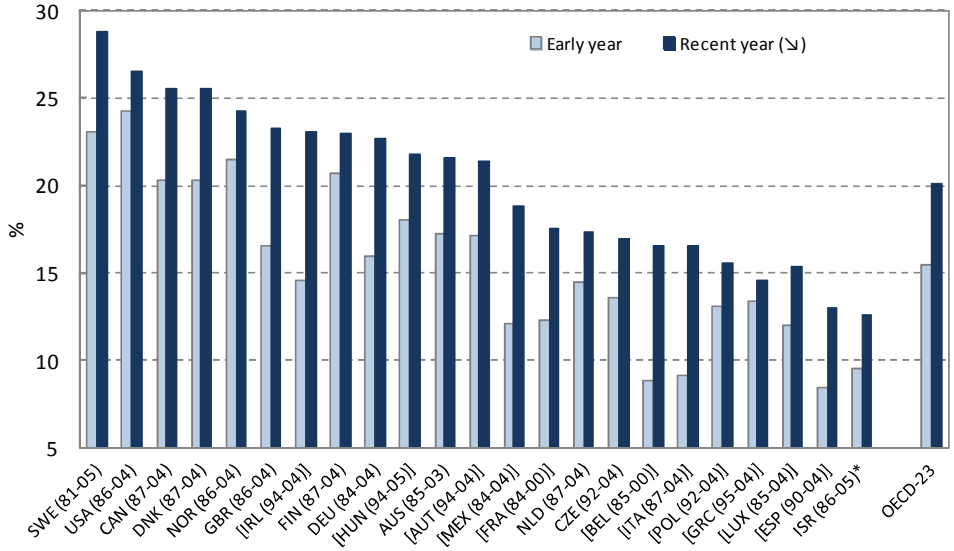
Note: Refers to couple households with both partners working. Earnings refer to net earnings for countries in brackets and to gross earnings for other countries. ***** Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

1.1.4. Trends in household composition

Another major change that has been happening at the household level and which may affect inequality is the shift towards more single-headed (*i.e.* single-parent, single unattached or single with unrelated persons) households.[11] Single-headed households are more common in the Nordic countries and in Canada and the United States where they make up about 25% and more of all working-age households (Figure 5). The share of this household type has increased across the board in all OECD countries under study, on average by almost 5 percentage points. By the mid-2000s, this household type accounted for more than 15% of all households in 20 out of the 23 countries under study. Some single-headed households are more likely to have low earnings (single parents) while others may more often be found among high earners (prime-age singles). An increase in the share of single-headed households therefore could contribute to widening the household earnings dispersion.

Figure 5. The share of single-headed households has increased in all OECD countries



Note: Single-headed households refer to single parents with children under 18, singles and singles with unrelated adults. Sample refers to all working-age households (head aged 25-64 years old). Earnings refer to net earnings for countries in brackets and to gross earnings for other countries. ***** Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

2. Explaining changes in household earnings inequality

This section discusses the empirical approach used to quantify the distributional impact of the aforementioned factors. Specifically, the analysis below decomposes the overall change in household earnings inequality among working-age households and assesses the relative impacts of changes in *i)* earnings dispersion among male workers[12]; *ii)* male employment share; *iii)* female employment share; *iv)* the degree of assortative mating[13], and *v)* household structure.[14]

The decomposition method is based on Daly and Valletta (2006) and DiNardo *et al.* (1996). The point of departure of the method is to develop a counterfactual earnings distribution keeping driving factors, other than family formation, constant (*i.e.* changes in employment and earnings). This hypothetical earnings distribution allows us to derive the level of inequality that would have prevailed at the end of the period had the general labour market conditions (in terms of men's earnings and labour supply of males and females) remained unchanged. The difference between this counterfactual earnings distribution and actual earnings inequality then represents a starting point for understanding the role of family formation. The impacts of other factors are then obtained based on the "conditional re-weighting procedure". This technique has been used in recent studies (*e.g.* Chen & Corak 2008;

Daly & Valletta 2006; Chiquiar & Hanson 2005) and is similar in spirit to the Oaxaca-Blinder decomposition (Oaxaca 1973).[15]

2.1. An illustration of results: Canada

We use Canadian samples (1987 and 2004) to illustrate the conditional reweighting and decomposition procedure introduced above and described in Annex B. Panels (1)–(5) in Figure 6 below display the density of equivalent household earnings for these two years in *primary-order decomposition sequences*. Each panel adjusts an additional modelled factor to its 1987 levels, and the impact of a given factor can then be assessed by comparing the differences between the counterfactual distribution with the actual and prior distribution.

The solid line and the dashed line in Panel (1) represent the original density of equivalent earnings for the years 1987 and 2004, respectively. They show that the distribution of household earnings across working-age households became more unequal in Canada over the years, as density moved from the middle to both tails. The increase in household earnings inequality in Canada is also documented by the summary indicators presented in Tables 1 and A1 in the Annex. The dotted line in Panel (1) delineates the counterfactual density for 2004 with adjustment of men's earnings to 1987 levels. The differences between the dashed and dotted lines therefore reveal the effect of the changing dispersion of men's earnings alone. It shows that the distribution of equivalent household earnings would have been clearly less dispersed if the structure of men's earnings were held constant at its 1987 levels: the adjusted distribution moved density from both tails to the middle.

Panel (2) further adjusts for changes in the employment rate of men. The effect of changing the conditional distribution of men's labour supply appears to have had almost no impact. If any, it reduced the density in the lower half and marginally increased the mass in the upper middle of the distribution, suggesting a very limited contribution to the overall increase in household earnings inequality.

Panel (3) displays the sequential effect of the increase in women's employment rates. The entire adjusted density shifts uniformly toward the left with a relatively greater mass of density in the lower tail. This suggests that the increase in women's employment rates had an appreciable equalising effect as it reduced the density in the left and moved it to the middle and the upper part of the distribution. Panel (3) also suggests that the change in this factor likely contributed a notable gain in median income between these periods.

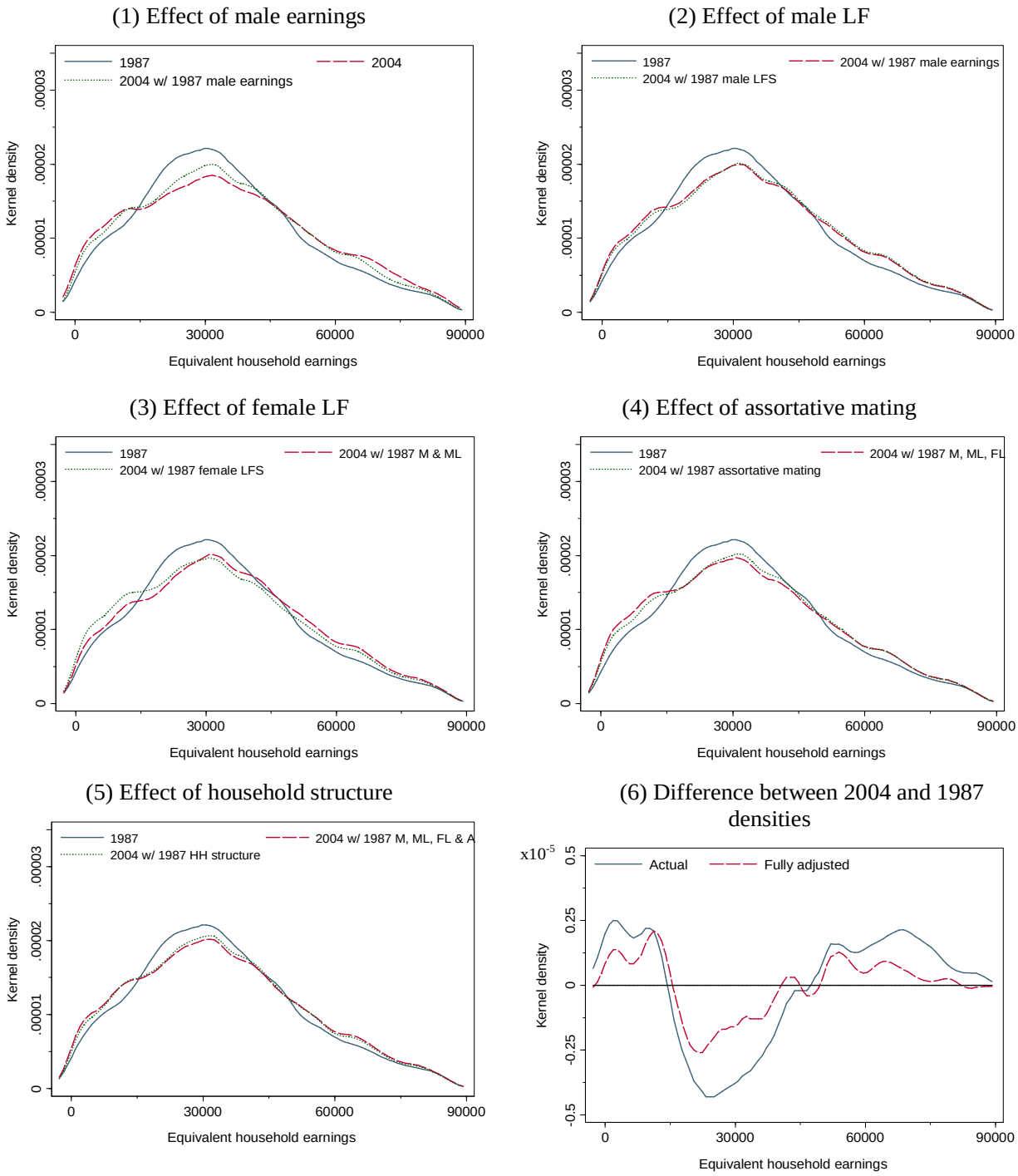
The effect of the growing tendency to assortative mating is shown in Panel (4). The impact is more visible in the lower tail of the distribution as the adjusted distribution shifted density from the lower tail to the middle. Inequality would have been somewhat lower in the absence of trends to increased assortative mating. This indicates a disequalising effect of this factor though the effect appears lower than for the factor of men's earnings dispersion [in Panel (1) above].

Panel (5) brings in the effect of the changing household structure. This seems to have had a fairly moderate but disequalising impact. The adjusted distribution appears to be less dispersed with a slightly reduced density mass in both tails and a corresponding increase of the mass in the middle of the distribution.

Finally, the residual effect is illustrated in Panel (6), which displays the difference between the adjusted distribution (accounting for the five aforementioned factors) and the original 1987 distribution (*i.e.* the dashed line). If our controlled factors fully accounted for the observed change in the distribution of equivalent household earnings, we would have obtained a flat line instead. The difference between the dashed line and the flat line therefore represents the residuals. Compared with the difference between the actual distributions for 1987 and 2004 (solid line), Panel (6) shows that

accounting for the five factors explains a substantial share (about 50%) in the changing distribution of household earnings between the two periods: the sizable mass that is presented at the bottom, middle and the upper portions of the 2004 distribution has greatly reduced.

Figure 6. Density of equivalent household earnings, Canada (1987 - 2004), Primary-order decomposition



Note: Samples are restricted to working-age households with positive household earnings. *M* refers to male earnings, *ML* and *FL* are male and female employment rates, respectively, *A* refers to assortative mating and *S* to household structure. Earnings are expressed in 2005 national currency.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

2.2. Results of the decomposition analysis

The quantitative assessment of the contribution of each explanatory factor to the changes in the distribution of household earnings is shown in Table 1, in Panel A for countries reporting gross earnings and in Panel B for countries reporting only net earnings. It is important to interpret results for the two samples of countries separately because first-order effects of changes to the tax system impact on changes in the distribution of *net* earnings but have not been modelled in the decomposition—these effects will thus appear in the unobserved residuals, to the contrary of the first country panel.

The first two rows of Table 1 display the actual levels of inequality for the earlier and the most recent year, for two alternative summary inequality indicators, the Gini coefficient and the D9/D1 ratio. The third row shows the changes in the measures between the two years. Decomposition results are presented in the following rows:[16] these numbers show the amount of change that can be attributed to changes in the explanatory factors, and those in parentheses report each factor's contributory share to the total change in the household inequality measures. Visual presentations of these contributions to changes in the Gini coefficient are presented in Figure 7.

Table 1. Factors influencing changes in household earnings inequality

Panel A. Countries reporting gross earnings

	Australia (1985, 2003)		Canada (1987, 2004)		Czech Republic (1992, 2004)		Denmark (1987, 2004)		Finland (1987, 2004)		Germany (1984, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.318	4.757	0.335	5.965	0.283	3.669	0.280	4.236	0.295	4.355	0.300	3.725
Recent year	0.350	5.815	0.389	8.222	0.336	4.954	0.302	4.837	0.322	5.380	0.353	6.687
Change	0.032	1.059	0.054	2.257	0.053	1.285	0.022	0.601	0.027	1.025	0.053	2.962
Contribution to change in inequality												
Primary-order decomposition												
1. Men's earnings dispersion	0.0173	0.288	0.0222	1.188	0.0049	0.0091	0.0092	0.311	0.0088	0.221	0.0227	1.589
	(.548)	(.272)	(.413)	(.526)	(.092)	(.007)	(.425)	(.517)	(.325)	(.215)	(.429)	(.537)
2. Male employment	0.0116	0.544	0.0037	0.138	0.0018	0.1548	0.0022	0.080	0.0071	0.358	0.0173	0.815
	(.367)	(.514)	(.070)	(.061)	(.034)	(.120)	(.099)	(.133)	(.261)	(.349)	(.326)	(.275)
3. Female employment	-0.0035	-0.241	-0.0134	-0.806	0.0073	0.2387	-0.0082	-0.337	0.0015	0.077	-0.0168	-0.622
	(-.112)	(-.227)	(-.249)	(-.357)	(.136)	(.186)	(-.380)	(-.561)	(.055)	(.075)	(-.317)	(-.210)
4. Assortative mating	0.0062	0.387	0.0082	0.595	-0.0035	-0.1164	0.0066	0.372	-0.0042	-0.200	0.0078	0.352
	(.197)	(.366)	(.152)	(.264)	(-.065)	(-.091)	(.306)	(.619)	(-.154)	(-.193)	(.147)	(.119)
5. Household structure	0.006	0.300	0.0043	0.393	0.0028	0.1385	0.0073	0.248	0.0041	0.249	0.0088	0.398
	(.190)	(.283)	(.080)	(.174)	(.053)	(.108)	(.338)	(.413)	(.152)	(.243)	(.167)	(.135)
6. Residual	-0.006	-0.219	0.0288	0.749	0.0402	0.8606	0.0046	-0.073	0.0098	0.319	0.0131	0.429
	(-.190)	(-.207)	(.535)	(.332)	(.750)	(.670)	(.212)	(-.121)	(.361)	(.311)	(.248)	(.145)

	Israel (1986, 2005)		Netherlands (1987, 2004)		Norway (1986, 2004)		Sweden (1981, 2005)		United Kingdom (1986, 2004)		United States (1986, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.398	7.324	0.305	3.668	0.256	3.242	0.285	4.017	0.329	5.259	0.367	7.229
Recent year	0.432	9.130	0.326	4.831	0.322	5.630	0.331	5.609	0.384	7.255	0.420	7.988
Change	0.034	1.806	0.021	1.163	0.065	2.388	0.047	1.593	0.055	1.996	0.054	0.759
Contribution to change in inequality												
Primary-order decomposition												
1. Men's earnings dispersion	0.0155	0.732	0.0241	0.8352	0.0333	1.429	0.0204	0.690	0.0261	1.173	0.0246	0.625
	(.456)	(.408)	(1.122)	(.718)	(.509)	(.598)	(.439)	(.433)	(.474)	(.587)	(.459)	(.824)
2. Male employment	0.0144	0.475	-0.0023	-0.0574	0.0089	0.348	0.0088	0.412	0.0015	0.132	-0.0052	-0.298
	(.424)	(.264)	(-.108)	(-.049)	(.136)	(.146)	(.189)	(.258)	(.027)	(.066)	(-.098)	(-.393)
3. Female employment	-0.0203	-0.178	-0.0397	-0.4398	-0.0013	-0.020	-0.0038	-0.140	-0.0201	-0.722	-0.0037	-0.17
	(-0.597)	(-0.100)	(-1.852)	(-.378)	(-.021)	(-.008)	(-.082)	(-.088)	(-.364)	(-.362)	(-.069)	(-.225)
4. Assortative mating	0.0056	0.139	0.0051	0.2264	0.0057	0.160	0.0063	0.256	0.0064	0.322	0.0052	0.229
	(.165)	(.077)	(.236)	(.195)	(.088)	(.067)	(.134)	(.161)	(.117)	(.161)	(.098)	(.302)
5. Household structure	0.0011	0.168	0.0022	0.2273	0.0029	0.111	0.0055	0.194	0.001	0.292	0.0016	0.188
	(.034)	(.094)	(.104)	(.196)	(.045)	(.046)	(.117)	(.122)	(.018)	(.146)	(.029)	(.248)
6. Residual	0.0177	0.460	0.0321	0.3708	0.0159	0.361	0.0095	0.181	0.0402	0.800	0.0311	0.185
	(.518)	(.256)	(1.497)	(.319)	(.243)	(.151)	(.203)	(.113)	(.729)	(.401)	(.580)	(.244)

Panel B. Countries reporting net earnings

	Austria (1994, 2004)		Belgium (1985, 2000)		France (1984, 2000)		Greece (1995, 2004)		Hungary (1994, 2005)		Ireland (1994, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.325	4.522	0.256	3.233	0.329	4.639	0.343	5.039	0.410	7.714	0.374	7.653
Recent year	0.334	4.597	0.278	3.439	0.358	5.878	0.346	5.000	0.387	7.427	0.361	6.632
Change	0.009	0.075	0.022	0.206	0.029	1.239	0.003	-0.039	-0.023	-0.287	-0.013	-1.021
Contribution to change in inequality												
Primary-order decomposition												
1. Men's earnings dispersion	0.0122	0.091	0.0203	0.042	0.0236	0.746	-0.0005	-0.357	-0.0166	-2.410	-0.0050	-0.409
	(1.333)	(1.220)	(1.000)	(.202)	(.818)	(.602)	(-.150)	(9.100)	(.736)	(8.390)	(.371)	(.401)
2. Male employment	-0.0072	-0.346	0.0099	0.260	-0.0001	0.050	0.0021	0.080	-0.0210	-2.210	0.0020	0.258
	(-.787)	(-4.63)	(.049)	(1.260)	(-.002)	(.040)	(.640)	(-2.04)	(.930)	(7.690)	(-.150)	(-.253)
3. Female employment	-0.0110	-0.227	-0.0258	-0.491	-0.0230	-0.420	-0.0167	-0.578	0.0033	0.242	-0.0151	-0.620
	(-1.20)	(-3.04)	(-1.28)	(-2.38)	(-.800)	(-.339)	(-4.99)	(-14.7)	(-.145)	(-.844)	(1.13)	(.608)
4. Assortative mating	0.0021	-0.101	0.0083	0.166	0.0029	-0.036	0.0111	0.249	-0.0029	-0.520	0.0026	0.029
	(.232)	(-1.35)	(.411)	(.808)	(.102)	(-.029)	(3.320)	(-6.35)	(.127)	(1.810)	(-.197)	(-.028)
5. Household structure	-0.0001	0.059	-0.0050	-0.097	0.0018	0.115	0.0004	0.093	0.0035	1.255	0.0010	0.245
	-(.016)	(.786)	(-.245)	(-.469)	(.062)	(.092)	(.109)	(-2.38)	(-.154)	(-4.37)	(-.078)	(-.240)
6. Residual	0.0131	0.599	0.0126	0.325	0.0236	0.786	0.0069	0.473	0.0112	3.350	0.0010	-0.524
	(1.430)	(8.010)	(.620)	(1.580)	(.820)	(.634)	(2.080)	(-12.1)	(-.495)	(-11.7)	(-.078)	(.513)

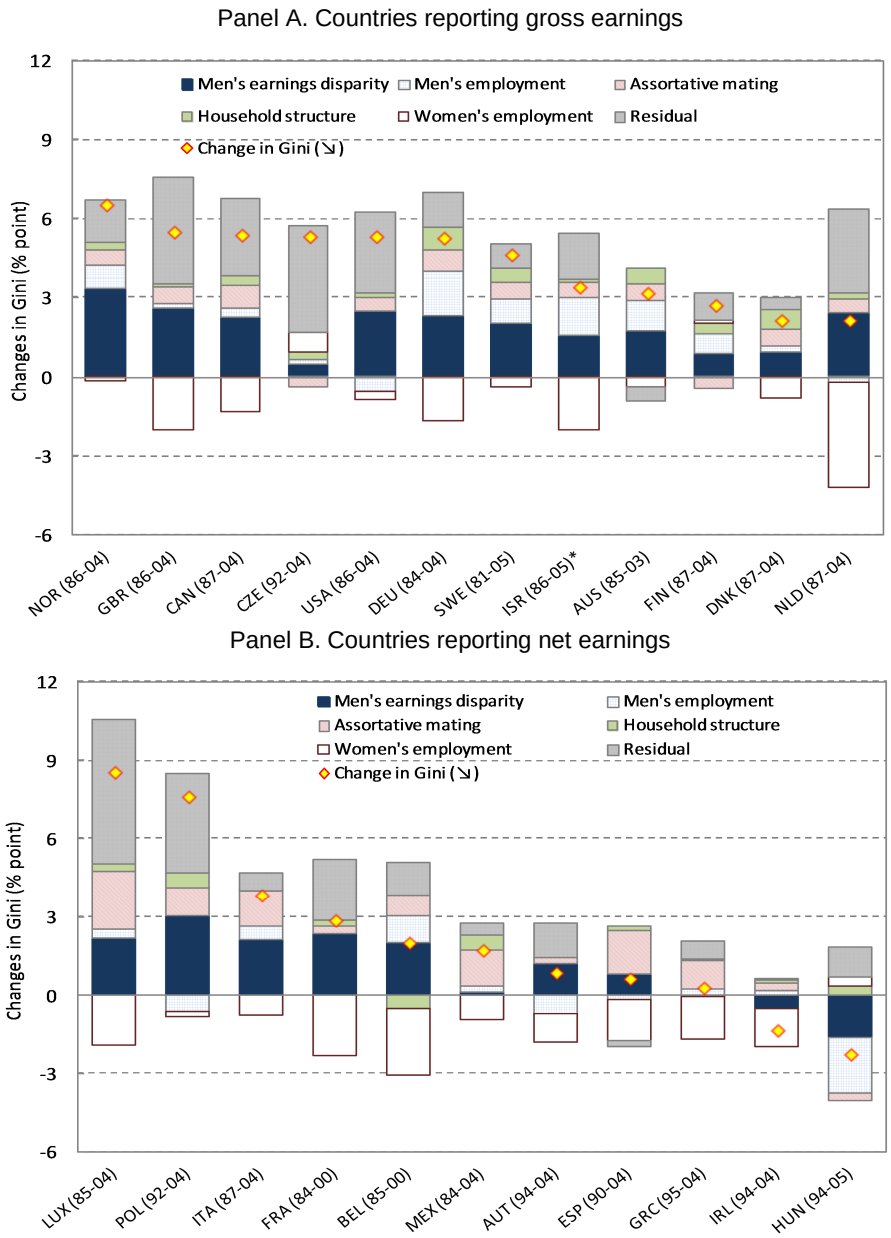
	Italy (1987, 2004)		Luxembourg (1985, 2004)		Mexico (1984, 2004)		Poland (1992, 2004)		Spain (1990, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.325	4.155	0.254	3.204	0.454	9.700	0.331	4.962	0.325	4.748
Recent year	0.363	5.190	0.340	5.363	0.472	10.230	0.408	7.497	0.331	5.073
Change	0.038	1.035	0.086	2.159	0.018	0.533	0.076	2.535	0.007	0.325
Contribution to change in inequality										
Primary-order decomposition										
1. Men's earnings dispersion	0.0213	0.642	0.0218	1.087	0.0014	-1.316	0.0302	1.231	0.0083	0.261
	(.556)	(.620)	(.254)	(.503)	(.082)	(-2.47)	(.396)	(.486)	(1.270)	(.802)
2. Male employment	0.0052	0.168	0.0033	0.134	0.0019	0.419	-0.006	-0.098	-0.0018	-0.035
	(.136)	(.163)	(.038)	(.062)	(.109)	(.787)	(-.079)	(-.038)	(-.272)	(-.107)
3. Female employment	-0.0082	-0.11	-0.0196	-0.235	-0.0096	-1.411	-0.0025	-0.091	-0.0158	-0.233
	(-.213)	(-.106)	(-.228)	(-.109)	(-.544)	(-2.65)	(-.033)	(-.036)	(-2.43)	(-.715)
4. Assortative mating	0.0134	0.28	0.0221	0.43	0.0137	1.695	0.0106	0.2843	0.0165	0.465
	(.349)	(.270)	(.257)	(.199)	(.778)	(3.181)	(.139)	(.112)	(2.530)	(1.430)
5. Household structure	0.0003	0.066	0.0028	0.086	0.0058	0.0902	0.0061	0.367	0.0017	0.09
	(.007)	(.063)	(.032)	(.040)	(.331)	(.169)	(.080)	(.145)	(.253)	(.277)
6. Residual	0.0063	-0.011	0.0555	0.657	0.0043	1.056	0.0378	0.841	-0.0023	-0.223
	(.164)	(-.011)	(.647)	(.304)	(.245)	(1.982)	(.495)	(.332)	(-.355)	(-.686)

Note: Numbers in parentheses show the share of the explained change in total change.
Source: Authors' calculations from the Luxembourg Income Study (LIS).

Among countries reporting gross earnings, four main findings emerge from the summary presentation in Panel A, Figure 7. First, the increase in men's earnings disparities is the main factor driving household earnings inequality, contributing between one third and half to the overall increase. Second, the increase in women's employment had an equalising effect in nearly all countries. Third, the effect of changing men's employment rates had little impact on the trend in household earnings inequality, with the major exception of Australia, Germany and Israel. Fourth, demographic factors (assortative mating and household structure changes), while contributing positively to increased household earnings inequality, had much more modest effects, contributing less than 20% to the overall increase. These patterns hold for all countries.

Finally, the contribution of other factors not captured here ("residuals") is higher in the Czech Republic, the Netherlands and the United Kingdom, and lower in the Nordic countries. In the United Kingdom, for instance, more than 70% of the increase in the Gini coefficient of household earnings remains unexplained. On the other hand, the decomposition analysis seems to capture most contributors to the household earnings inequality in Denmark and Norway. Overall, the decomposition results suggest a more modest contribution of demographic relative to labour-market factors and are generally in line with findings from country-specific studies in many respects.[17]

Figure 7. Explaining changes in household earnings inequality: contributions of labour market and demographic factors



Note: Samples are restricted to the working-age population (25-64 years) living in a household with a working-age head. Equivalent household earnings are calculated as the sum of earnings from all household members, adjusted for differences in household size with an equivalence scale (square root of household size). * Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

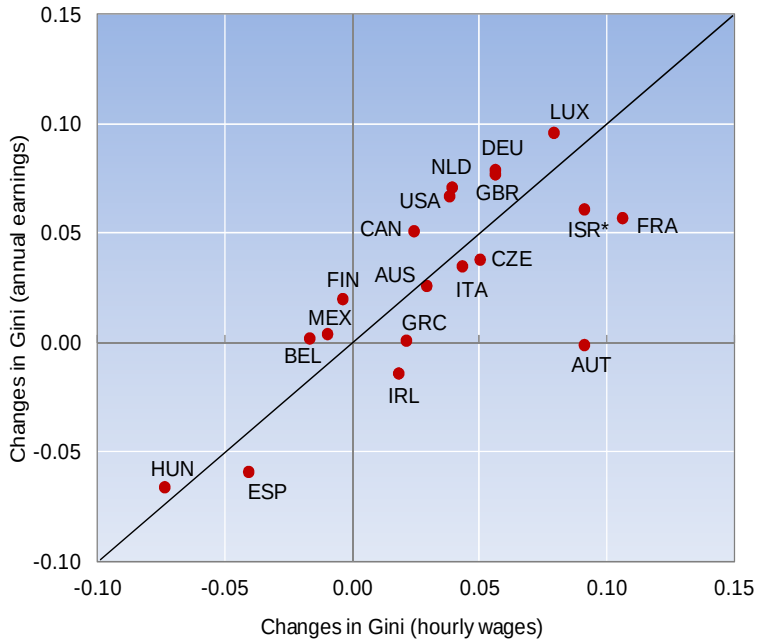
Source: Authors' calculations from the Luxembourg Income Study (LIS).

There is more diversity across the sample of countries for which only net earnings estimates are available. Overall changes in household earnings inequality ranged from an increase of over 8 percentage points (Luxembourg) to a 1 to 2 point decrease in Ireland and Hungary (for the specificity of Hungarian results, see Box 2). Demographic factors had more of an impact on trends in household earnings inequality than among the panel of countries reporting gross earnings above, in particular in Luxembourg, Mexico, Italy and Spain. Nonetheless, the increase in men's earnings disparities remains the main contributor to household earnings inequality in five of the eleven

countries. The rise in women's employment rates had a sizeable equalising effect, especially in France, Belgium and Luxembourg. The extent of unobserved factors impacting overall inequality (the residual) is higher among most of the countries in this sample, as the net earnings obviously include the effect of changes to the tax system.

However, the above analysis requires further investigation. First, rising annual earnings dispersion among men is a combined result of both widening wage dispersion and changing work patterns (e.g. more part-time or part-year employment). To gauge what underpins the increase in men's earnings dispersion, Figure 8 plots changes in inequality of hourly wages against changes in inequality of annual earnings for men for selected OECD countries. In an extreme scenario where all employees work the same number of hours per year, the extent of changes in annual earnings inequality would be determined solely by changes in hourly wage distribution, and all countries would lie along the 45° line. This is not the case in reality. In about half of the countries the increase in annual earnings inequality exceeded the increase in inequality measured by hourly wages, suggesting that changing work patterns can play a role in the upward earnings inequality trends, in particular for Canada, the United States, the Netherlands and Finland. For Luxembourg, on the contrary, the increase in annual earnings inequality is more attributable to rising dispersion in hourly wages. Changing work patterns can also lead to more equally distributed annual earnings if low-paid workers have gained more hours worked and/or high-paid workers have reduced hours. Examples of this include Austria and Greece, and to a lesser extent, France and Israel.

Figure 8. Changes in inequality of hourly wages versus changes in inequality of annual earnings, mid-1980s to mid-2000s, male workers



Note: Samples are restricted to male workers (25-64 years) with positive hourly wages and annual earnings during the reference year. Changes refer to a period from mid-1990s to mid-2000s for AUT, CZE, HUN, IRL and GRC; from mid-1980s to 2000 for BEL and FRA. ***** Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

Similarly, for the role of assortative mating the analysis above does not distinguish whether this is occurring mostly because the participation rate of women partnering high-earnings men rose particularly rapidly, or because they were already working and their earnings converged to those of their partners. While the exact answer to this question is beyond the scope of the paper, comparing

Table 1 and Figure 3 may provide some hints. For instance, assortative mating contributed about more than 1 percentage point increase to Gini coefficient for both Italy and Greece over time. However, the former experienced a marked increase in the employment rates among wives of high earnings men, while the comparable figure for the latter was rather modest. This may imply that a rising employment rate among women of high-earnings partners is a more important driver of assortative mating for Italy, but earnings convergence among already working couples may be a scenario better candidate for explaining increased marital sorting for Greece. Nevertheless, future analysis is required on this issue.

Finally, the impact of changing household structures (i.e. the trend away from traditional couple households with children towards single-headed households or households with no children) on the distribution of household earnings can be obscured due to the use of equivalence scales.[18] For instance, the relative earnings position of families may improve over time without a rise in *unequivalised* earnings if there is a drop in the average number of dependent children. This would arithmetically reduce the inequality impact of changing household structures due to the rising share of smaller-sized households (e.g. single parents), as the use of equivalisation of total household earnings moved such households further up the earnings distribution.

Box 2. The specificity of decomposition results for Hungary

Hungary stands out among all countries under study as it has registered a moderate decline in household earnings inequality between 1994 and 2005. The moderate fall in earnings inequality is, according to some authors, linked to a series of policy reforms in 2002/03 which raised the wages of all public sector employees (approximately 20% of the Hungarian labour force) by 50%. Telegdy (2006) documented that, prior to the change, the wages of civil servants were lagging behind the salaries earned in the private sector in all occupation groups and at every educational level. The findings above suggest that the changing structure of men's earnings alone has led to a 1.7 percentage-point decline in the Gini coefficient of households net earnings during this period, accounting thus for three-quarters of the decline.

Moreover, given the fact that the public sector often favours employees from more disadvantaged groups (such as new entrants and the elderly), the wage increase may induce higher participation among these groups, and in turn reduce earnings inequality. This is confirmed in the results above in that the increase in men's labour supply further contributed a large part to the decrease in the Gini coefficient.

Finally, despite a tendency toward assortative mating, which matches the OECD average, this factor also contributed to decreasing household net earnings inequality. On the other hand, household structure changes drove earnings inequality up, as did changes in the employment rates of women: Hungary is the only country in the sample in which the employment rate of men grew more than that of women (twice as much).

3. Robustness analysis

One potential problem of the decomposition technique applied above is that the estimated impacts of explanatory factors rely on assumptions about the particular order for the primary decomposition. For instance, the analysis considered household structure last in the decomposition as it assumes that changes in this factor do not affect labour market choices, but that changes in labour market outcomes (*e.g.* women's labour force participation) do affect family formation, *e.g.* by delaying fertility decisions and thus influencing household structures. Similarly, the approach above places women's participation before assortative mating in the decomposition order, assuming that the change in the degree of marital sorting does not have an impact on women's participation decisions. In reality, men's and women's employment rates as well as assortative mating are interdependent.

Although the preceding "primary" order seems a reasonable way to proceed and has been applied in similar types of analyses, it may still over- or underestimate some impacts if there is joint causation in the distribution of factors under examination. For instance, increasing marital sorting might

increase (or decrease) the chance of family dissolution and thus have influence on household structures. On the other hand, it can also be argued that it is the change to the household structure that made marital sorting more feasible. To address such possibilities and the sensitivity of the results, estimates from reverse-order decomposition are presented in Table 2.[19]

Table 2. Factors influencing on changes in household earning inequality, robustness test

Panel A. Countries reporting gross earnings

	Australia (1985, 2003)		Canada (1987, 2004)		Czech Republic (1992, 2004)		Denmark (1987, 2004)		Finland (1987, 2004)		Germany (1984, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.318	4.757	0.335	5.965	0.283	3.669	0.28	4.236	0.295	4.355	0.300	3.725
Recent year	0.35	5.815	0.389	8.222	0.336	4.954	0.302	4.837	0.322	5.38	0.353	6.687
Change	0.316	1.059	0.0538	2.257	0.053	1.285	0.0217	0.601	0.0271	1.025	0.053	2.962
Contribution to change in inequality												
Reverse-order decomposition												
1. Household structure	0.0189	0.855	0.0028	0.376	-0.0036	0.035	0.0095	0.453	0.0052	0.294	0.0133	0.993
	(.600)	(.808)	(.052)	(.167)	(-.067)	(.027)	(.437)	(.754)	(.193)	(.287)	(.251)	(.335)
2. Assortative mating	0.0003	0.088	0.0029	0.147	0.0004	-0.0067	0.0012	0.080	-0.0005	-0.015	0.0015	-0.0127
	(.008)	(.083)	(.054)	(.065)	(.007)	(-.005)	(.057)	(.133)	(-.017)	(-.015)	(.029)	(-.004)
3. Female employment	-0.0037	-0.085	-0.0053	-0.320	0.0036	0.1835	-0.0057	-0.197	0.0021	0.089	-0.0083	-0.591
	(-.116)	(-.080)	(-.099)	(-.142)	(.066)	(.143)	(-.263)	(-.328)	(.079)	(.086)	(-.157)	(-.199)
4. Male employment	0.0033	0.127	0.0014	0.168	0.002	0.1284	0.0026	0.112	0.0026	0.089	0.0051	0.497
	(.104)	(.119)	(.025)	(.074)	(.037)	(.100)	(.121)	(.186)	(.095)	(.087)	(.096)	(.168)
5. Men's earnings dispersion	0.0187	0.292	0.0233	1.138	0.0111	0.0846	0.0094	0.226	0.0079	0.250	0.0283	1.646
	(.593)	(.276)	(.433)	(.504)	(.208)	(.066)	(.435)	(.377)	(.290)	(.243)	(.535)	(.556)
6. Residual	-0.006	-0.219	0.0288	0.749	0.0402	0.861	0.0046	-0.073	0.0098	0.319	0.0131	0.429
	(-.190)	(-.207)	(.535)	(.332)	(.750)	(.670)	(.212)	(-.121)	(.361)	(.311)	(.248)	(.145)

	Israel (1986, 2005)		Netherlands (1987, 2004)		Norway (1986, 2004)		Sweden (1981, 2005)		United Kingdom (1986, 2004)		United States (1986, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.398	7.324	0.305	3.668	0.256	3.242	0.285	4.017	0.329	5.259	0.367	7.229
Recent year	0.432	9.130	0.326	4.831	0.322	5.630	0.331	5.609	0.384	7.255	0.420	7.988
Change	0.034	1.806	0.021	1.163	0.065	2.388	0.047	1.593	0.055	1.996	0.054	0.759
Contribution to change in inequality												
Reverse-order decomposition												
1. Household structure	0.0113	0.741	-0.0018	0.0583	0.0178	1.224	0.0157	1.034	0.0079	0.552	-0.0019	0.0062
	(.331)	(.412)	(-.082)	(.050)	(.273)	(.512)	(.337)	(.649)	(.143)	(.277)	(-.036)	(.008)
2. Assortative mating	0.0014	-0.009	0.0008	0.004	0.002	0.196	0.0011	-0.01	0.0017	0.059	0.0071	0.297
	(.041)	(-.005)	(.039)	(.003)	(.030)	(.082)	(.024)	(-.007)	(.030)	(.030)	(.133)	(.392)
3. Female employment	-0.0171	-0.256	-0.0382	-0.7931	-0.0048	-0.160	-0.0007	-0.056	-0.0172	-0.701	-0.006	-0.310
	(-0.502)	(-.142)	(-1.782)	(-.682)	(-.074)	(-.067)	(-.015)	(-.035)	(-.312)	(-.351)	(-.111)	(-.408)
4. Male employment	0.0053	0.301	-0.0024	-0.2218	0.002	0.097	0.0022	0.094	-0.0001	-0.009	-0.0022	0.0093
	(.157)	(.167)	(-.110)	(-.182)	(.030)	(.041)	(.046)	(.059)	(-.001)	(-.004)	(-.041)	(.012)
5. Men's earnings dispersion	0.0155	0.560	0.0308	1.7343	0.0325	0.670	0.0189	0.35	0.0227	1.295	0.0254	0.570
	(.455)	(.312)	(1.438)	(1.492)	(.497)	(.281)	(.405)	(.220)	(.411)	(.649)	(.474)	(.752)
6. Residual	0.0177	0.460	0.0321	0.3708	0.0159	0.361	0.0095	0.181	0.0402	0.800	0.0311	0.185
	(.518)	(.256)	(1.497)	(.319)	(.243)	(.151)	(.203)	(.113)	(.729)	(.401)	(.580)	(.244)

Table 2. (cont.) Factors influencing on changes in household earning inequality, robustness test

Panel B. Countries reporting net earnings

	Austria (1994, 2004)		Belgium (1985, 2000)		France (1984, 2000)		Greece (1995, 2004)		Hungary (1994, 2005)		Ireland (1994, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.325	4.522	0.256	3.233	0.329	4.639	0.343	5.039	0.41	7.714	0.374	7.653
Recent year	0.334	4.597	0.278	3.439	0.358	5.878	0.346	5	0.387	7.427	0.361	6.632
Change	0.0092	0.075	0.022	0.206	0.0288	1.239	0.0033	-0.039	-0.0225	-0.287	-0.013	-1.021
Contribution to change in inequality												
Reverse-order decomposition												
1. Household structure	-0.0065	-0.365	0.0053	-0.020	0.0039	0.197	0.0102	0.360	-0.0083	-2.540	-0.0022	0.156
	(-.714)	(-4.88)	(.264)	(-.097)	(.135)	(.159)	(3.050)	(-9.10)	(.369)	(8.850)	(.167)	(-.153)
2. Assortative mating	-0.0018	-0.131	-0.0018	0.081	-0.002	-0.004	-0.0056	-0.295	-0.0037	-0.012	0.0025	0.0812
	(-.199)	(-1.75)	(-.088)	(.039)	(-.069)	(-.003)	(-1.66)	(7.520)	(.162)	(.040)	(-.185)	(-.080)
3. Female employment	-0.0052	-0.044	-0.0178	-0.422	-0.0207	-0.448	-0.0046	-0.015	0.0022	-0.031	-0.008	-0.205
	(-.566)	(-.592)	(-.878)	(-.205)	(-.718)	(-.362)	(-1.38)	(-.392)	(-.098)	(.107)	(.602)	(.201)
4. Male employment	-0.0007	-0.043	0.0049	0.049	-0.0023	-0.103	0.0007	-0.010	-0.0085	-0.562	0.005	0.218
	(-.071)	(-.574)	(.242)	(.236)	(-.079)	(-.083)	(.216)	(.262)	(.376)	(1.960)	(-.389)	(-.214)
5. Men's earnings dispersion	0.0102	0.059	0.017	-0.113	0.0263	0.811	-0.0044	-0.552	-0.0155	-0.494	-0.012	-0.747
	(1.120)	(.788)	0.841	(-.550)	(.912)	(.655)	(-1.30)	(14.09)	(.686)	(1.720)	(.884)	(.732)
6. Residual	0.0131	0.599	0.0126	0.325	0.0236	0.786	0.0069	0.473	0.0112	3.35	0.001	-0.524
	(1.430)	(8.010)	(.620)	(1.580)	(.820)	(.634)	(2.080)	(-12.1)	(-.495)	(-11.7)	(-.078)	(.513)

	Italy (1987, 2004)		Luxembourg (1985, 2004)		Mexico (1984, 2004)		Poland (1992, 2004)		Spain (1990, 2004)	
	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1	Gini	D9/D1
Early year	0.325	4.155	0.254	3.204	0.454	9.7	0.331	4.962	0.325	4.748
Recent year	0.363	5.19	0.34	5.363	0.472	10.23	0.408	7.497	0.331	5.073
Change	0.0384	1.035	0.0859	2.159	0.0176	0.533	0.0762	2.535	0.0065	0.325
Contribution to change in inequality										
Reverse-order decomposition										
1. Household structure	0.0112	0.524	0.0142	0.446	0.0132	0.607	0.0053	0.357	-0.0006	0.116
	(.293)	(.506)	(.166)	(.206)	(.746)	(1.140)	(.069)	(.141)	(-.090)	(.357)
2. Assortative mating	0.0023	0.038	-0.0111	-0.295	-0.0029	-0.127	0.0097	0.269	-0.0002	-0.046
	(.059)	(.037)	(-.129)	(-.137)	(-.165)	(-.238)	(.128)	(.106)	(-.038)	(-.140)
3. Female employment	-0.0051	-0.172	-0.0055	0.192	0.001	0.0107	-0.0069	-0.163	0.0012	0.212
	(-.133)	(-.166)	(-.064)	(.089)	(.057)	(.020)	(-.090)	(-.064)	(.178)	(.650)
4. Male employment	0.0029	0.178	0.0002	0.000	0.0002	0.248	-0.0013	-0.059	0.0016	0.07
	(.076)	(.172)	(.002)	(.000)	(.009)	(.466)	(-.016)	(-.023)	(.246)	(.215)
5. Men's earnings dispersion	0.0208	0.478	0.0326	1.159	0.0019	-1.263	0.0317	1.29	0.0069	0.196
	(.542)	(.462)	(.380)	(.537)	(.108)	(-2.369)	(.416)	(.509)	(1.060)	(.604)
6. Residual	0.0063	-0.011	0.0555	0.657	0.0043	1.056	0.0378	0.841	-0.0023	-0.223
	(.164)	(-.011)	(.647)	(.304)	(.245)	(1.982)	(.495)	(.332)	(-.355)	(-.686)

Note: Numbers in parentheses show the share of the explained change in total change.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

The sensitivity analysis shows that results are robust. The increased dispersion of men's earnings remains the most important factor in accounting for household earnings inequality even when it is considered last in the decomposition. Its quantitative impacts are roughly the same as in the primary-order and analysis. Among countries reporting gross earnings, the contribution of men's earnings disparities to household earnings inequality is similarly between one-third and half to the overall increase. The impact of the changing household structure is somewhat larger in magnitude, at the expense of assortative mating and men's and women's employment, suggesting that these three factors are likely to be interdependent. Nevertheless, the inequality-reducing effect of rising female employment remains visible in most countries. The contribution of the residuals is also similar and particularly large in the same countries as when using the "primary" order for the decomposition (the Netherlands, the United Kingdom). In the net income countries for which inequality increased over time, men's earnings were also the major explanatory factor behind the increase, except in Mexico where changes in household structure were more important. Similar to gross income countries, the reversed order of the decomposition leads to a decline in the importance of men's earnings and assortative mating (which contributes negatively to inequality in many cases) while changes in household structure become more prominent.

4. Summary and conclusions

How did the increase in earnings inequality among individuals translate into changes in *household* earnings inequality? The latter takes into account the pooling of earnings of the different household members, changes of labour force participation of men and women, as well as changes in household structures. Overall, the analysis in this chapter, based on a decomposition technique, finds that labour-market-related trends explain a much larger portion of household earnings inequality development than demographic or "societal" factors.

The dispersions of male earnings have become wider in 20 of the 23 countries under study. In ten of them, this was due to an increase in real earnings in the top decile combined with a decrease in the bottom decile. Female employment rates have substantially increased since the mid-1980s, especially in countries with low starting levels. The increase exceeds 10 percentage points in 14 out of 23 countries, with the strongest increases in the Netherlands, Luxembourg and Spain. In most countries, the rise in employment rates among the wives of men was greater in the top than in the bottom earnings decile.

Increasingly, people are married to spouses with similar earnings levels, known as "assortative mating". This trend was observed in all countries bar the Czech Republic and Finland. On average assortative mating increased by two to 6 percentage points, depending on whether a stricter or broader definition is used. Further, the share of single-headed (*i.e.* single-parent, single unattached, or single with unrelated) households has grown in all OECD countries under study by an average of 5 percentage points.

Three main findings emerge from the decomposition analysis for the group of countries reporting gross earnings. First, the increase in men's gross earnings disparities is the main factor driving household gross earnings inequality, contributing between one third and half to the overall increase. Second, the increase in women's employment had an equalising effect in all countries in that it contributed negatively to overall household gross earnings inequality. Third, demographic factors (*i.e.* assortative mating and household structure changes), while contributing positively to increasing gross household earnings inequality, had much more modest effects.

There is more diversity across the sample of countries for which only net earnings estimates are available. The demographic factors had somewhat more of an impact on trends in household net earnings inequality. Nonetheless, the increase in men's net earnings disparities remains the main contributor in six of the ten countries. The extent of unobserved factors impacting overall inequality is higher among most of the countries in this group, as it includes the effect of changes to the tax system.

Robustness analyses suggest that the estimated effects of the three labour market factors on changes in household earnings inequality display very similar patterns regardless of which decomposition order is used. The contributions of changing household formation practices, however, are somehow more sensitive to the order of decomposition, with a larger estimated inequality-enhancing impact of changing household structures when it is considered first in the decomposition.

REFERENCES

Blackburn, M. and D. Bloom (1995), "Changes in the Structure of Family Income Inequality in the United States and Other Industrial Nations during the 1980s", in Polacheck, Solomon W., ed., *Research in Labour Economics*, 14, pp. 141-170.

Burtless, Gary (1999), "Effects of Growing Wage Disparities and Changing Family Composition on the U.S. Income Distribution", *European Economic Review*, 43, pp. 853–865.

Burtless, Gary (2011), "Demographic Transformation and Economic Inequality". in The Oxford Handbook of Economic Inequality, Wiemer Salverda, Brian Nolan and Timothy M. Smeeding, eds., New York: Oxford University Press, pp. 435-454.

Callan, T., B. Nolan, D. O'Neill and O. Sweetman, (1998), "Female Labour Supply and Income Inequality in Ireland," Maynooth: Department of Economics Working Paper.

Cancian, Maria, Sheldon Danziger and Peter Gottschalk (1993), "Working Wives and the Distribution of Family Income", in *Rising Tides: Rising Inequality in America*. Sheldon Danziger and Peter Gottschalk, eds., New York: Russell Sage Foundation.

Cancian, Maria and Deborah Reed (1998), "Assessing the Effects of Wives' Earnings on Family Income Inequality", *The Review of Economics and Statistics*, 80(1), pp. 73–79.

Cancian, Maria and Deborah Reed (1999), "The Impact of Wives' Earnings on Income Inequality: Issues and Estimates", *Demography*, 36, pp. 173–184.

Chen, Wen-Hao and M. Corak (2008), "Child Poverty and Changes in Child Poverty", *Demography* 45(3), pp. 537-553.

Chiquiar, Daniel and Gordon H. Hanson (2005), "International Migration, Self-Selection, and the Distribution of Wages: Evidence from Mexico and the United States", *Journal of Political Economy*, 113(2), pp. 239-281.

Daly, Mary C. and Robert G. Valletta (2006), "Inequality and Poverty in the United States: The Effects of Rising Dispersion of Men's Earnings and Changing Family Behavior", *Economica*, 73(289), pp. 75-98.

Devereux, Paul J. (2004), "Changes in Relative Wages and Family Labour Supply," *Journal of Human Resources*, 39(3), 696-722.

DiNardo, John, Nicole M. Fortin and Thomas Lemieux (1996), "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach", *Econometrica*, 64, pp. 1001-1044.

Esping-Anderson, G. (2009), *The Incomplete Revolution - Adapting Welfare States to Women's New Roles*, Polity Press.

Fortin, N. and T. Schirle (2006), "Gender Dimensions of Changes in Earnings Inequality in Canada", in *Dimensions of Inequality in Canada*, David A. Green and Jonathan R. Kesselman, eds.,Vancouver, UBC Press, pp. 307-346.

Gottschalk, P. and S. Danziger (2005), "Inequality of Wage Rates, Earnings and Family Income in the United States, 1975–2002", *The Review of Income and Wealth*, 51(2), pp. 231-254

Halpin, B. and T. Chan (2002), "Union Dissolution in the United Kingdom", *International Journal of Sociology*, 32, pp. 76-93.

Harkness, S. (2010), "The Contribution of Women's Employment and Earnings to Household Income Inequality: A Cross-Country Analysis", *Luxembourg Income Study Working Paper* 531.

Hyslop, D. (2001), "Rising U.S. Earnings Inequality and Family Labor Supply: The Covariance Structure of Intrafamily Earnings", *American Economic Review*, 91, pp. 755-777.

Jäntti, M. (1996), "Inequality in Five Countries in the 1980's: The Role of Demographic Shifts, Markets and Government Policies", *Luxembourg Income Study Working Paper* 146.

Juhn, Chinhui, and Kevin M. Murphy (1997), "Wage Inequality and Family Labor Supply", *Journal of Labor Economics*, 15, pp. 72–97.

Karoly, Lynn A., and Gary Burtless (1995), "Demographic Change, Rising Earnings Inequality, and the Distribution of Personal Well-Being, 1959–1989", *Demography*, 32(3), pp. 379–406.

Lerman, R. and S. Yitzhaki (1985), "Income Inequality Effects by Income Source: A New Approach and Applications to the United States", *Review of Economics and Statistics,* Vol. 67, No. 1, pp. 151-156.

Lu, Yuqian, Rene Morissette and Tammy Schirle (2011), "The Growth of Family Earnings Inequality in Canada, 1980-2005", *The Review of Income and Wealth*, 57(1), pp. 23-39.

Luxembourg Income Study (LIS) Database, www.lisdatacenter.org (multiple countries: microdata runs completed batween 21 July 2010 and 3 August 2011), LIS, Luxembourg.

McCall, Leslie and Christine Percheski (2010), "Income Inequality: New Trends and Research Directions", in *Annual Review of Sociology*, Vol. 36, pp. 329-347.

Morissette, R. and F. Hou (2008), "Does the Labour Supply of Wives Respond to Husbands' Wages? Canadian Evidence from Micro Data and Grouped Data", *Canadian Journal of Economics*, 41(4), pp. 1185-1200.

Myles, J. (2010), "The Inequality Surge: Changes in the Family Life Course are the Main Cause", in *Inroads: A Journal of Opinion*, Quebec, January.

Oaxaca, R (1973), "Male-Female Wage Differentials in Urban Labor Markets", *International Economic Review,* 14, pp. 693–709.

OECD (2008), *Growing Unequal? Income Distribution in OECD Countries*, OECD Publishing, Paris.

OECD (2011), *Divided we Stand – Why Inequality Keeps Rising*, OECD Publishing, Paris.

Parker, S. (1995), "The Structure of the Earnings Distribution: How are Households and Individuals Related?", *Bulletin of Economic Research*, Vol. 47, Issue 2, pp. 127-142.

Peichl, A., N. Pestel and H. Schneider (2010), "Does Size Matter? The Impact of Changes in Household Structure on Income Distribution in Germany", *SOEPpapers 280*, DIW Berlin.

Pencavel, John (1998), “Assortative Mating by Schooling and the Work Behavior of Wives and Husbands,” *American Economic Review*, 88(2), 326–329.

Pencavel, John (2006), “A Life Cycle Perspective on Changes in Earnings Inequality among Married Men and Women”, *The Review of Economics and Statistics*, 88(2), pp. 232–242.

Saunders, Peter (2005), “Reviewing Recent Trends in Wage Income Inequality in Australia”, in Isaac, Joe, Lansbury, Russell D. (eds), *Labour Market Deregulation—Rewriting the Rules*, Sydney: The Federation Press, pp. 68-88.

Schwartz, Christine (2010), “Earnings Inequality and the Changing Association between Spouses’ Earnings”, in *American Journal of Sociology*, Vol. 115, No. 5, pp. 1524–57.

Shorrocks, A.F. (1983), “The Impact of Income Components on the Distribution of Family Incomes,” *Quarterly Journal of Economics*, 98, 311–331.

Silverman, B.W. (1986), *Density Estimation for Statistics and Data Analysis*, London: Chapman and Hall.

Telegdy, Almos (2006), “The Effect of the Public Sector Wage Increase on the Public-Private Relative Wages”, in *In Focus: Wages New Developments*, P. Galasi and G. Kezdi (eds), Hungary.

Worner, Shane Mathew (2006), “The Effects of Assortative Mating on Income Inequality: A Decompositional Analysis”, The Australian National University Centre for Economic Policy Research *Discussion Paper* No. 538.

ANNEX A. ADDITIONAL TABLES AND FIGURES

Table A1. Decomposition of the variance of log annual earnings, mid-2000s

	Var(ln_annual earnings)	Var(ln_hourly wages)	Var(ln_annual hours)	2xCov(ln_hwage, ln_ahours)
	(1)	(2)	(3)	(4)
Panel A. **Countries reporting gross earnings**				
Australia 2003 [1]	0.460 (1.00)	0.210 (0.457)	0.255 (0.554)	-0.005 -(0.011)
Canada 2004	1.539 (1.00)	0.934 (0.607)	0.222 (0.144)	0.383 (0.249)
Czech Republic 2004 [1]	0.416 (1.00)	0.300 (0.721)	0.055 (0.132)	0.061 (0.147)
Finland 2004	1.085 (1.00)	0.553 (0.510)	0.233 (0.215)	0.298 (0.275)
Germany 2004	1.089 (1.00)	0.441 (0.405)	0.333 (0.306)	0.315 (0.289)
Israel 2005 [2]	0.769 (1.00)	0.504 (0.655)	0.198 (0.257)	0.066 (0.086)
Netherlands 2004	0.877 (1.00)	0.394 (0.449)	0.286 (0.326)	0.197 (0.225)
United Kingdom 2004 [1]	0.700 (1.00)	0.347 (0.496)	0.229 (0.327)	0.123 (0.176)
United States 2004	0.972 (1.00)	0.600 (0.617)	0.218 (0.224)	0.154 (0.158)
Average	0.879	0.476 (0.546)	0.225 (0.276)	0.177 (0.177)
		Corr(AE, hw)=0.91	Corr(AE, ah)=0.43	
Panel B. **Countries reporting net earnings**				
Austria 2004	0.532 (1.00)	0.386 (0.726)	0.267 (0.502)	-0.121 -(0.227)
Belgium 2000	0.358 (1.00)	0.209 (0.584)	0.139 (0.388)	0.010 (0.028)
France 2000	0.654 (1.00)	0.273 (0.417)	0.308 (0.471)	0.073 (0.112)
Greece 2004	0.440 (1.00)	0.318 (0.723)	0.191 (0.434)	-0.069 -(0.157)
Hungary 2005	0.498 (1.00)	0.299 (0.600)	0.156 (0.313)	0.043 (0.086)
Ireland 2004	0.604 (1.00)	0.264 (0.437)	0.340 (0.563)	0.000 (0.000)
Italy 2004	0.326 (1.00)	0.238 (0.730)	0.137 (0.420)	-0.049 -(0.150)
Luxembourg 2004	0.582 (1.00)	0.330 (0.567)	0.200 (0.344)	0.052 (0.089)
Mexico 2004 [2]	0.846 (1.00)	0.813 (0.961)	0.142 (0.168)	-0.108 -(0.128)
Spain 2004	0.529 (1.00)	0.280 (0.529)	0.208 (0.393)	0.041 (0.078)
Average	0.537	0.341 (0.627)	0.209 (0.400)	-0.013 -(0.027)
		Corr(AE, hw)=0.78	Corr(AE, ah)=0.31	

Note: Samples are restricted to all paid workers (aged 25-64) with positive wages and positive hours worked during the reference year. Following Blau and Kahn (2009), here we decompose the variance of logarithm annual earnings (AE) into three components: the variance of hourly wages (hw), the variance of annual hours (ah), and the covariance of the two components, as follows $Var(lnAE) = var(\ln_{hw}) + var(\ln_{ah}) + 2\mathrm{cov}(\ln_{hw}, \ln_{ah})$.

1. Hourly wage is calculated based on imputed weeks worked.
2. Hourly wage is calculated based on working 52 weeks. *Information on data for Israel: http://dx.doi.org/10.1787/888932315602*.

Source: OECD Secretariat calculations from the Luxembourg Income Study (LIS).

Table A2. Labour market and family formation factors impacting on household earnings inequality

Panel A. Countries reporting gross earnings

	Australia		Canada		Czech Republic		Denmark		Finland		Germany	
	1985	2003	1987	2004	1992	2004	1987	2004	1987	2004	1984	2004
Gini of HH equivalent earnings	0.318	0.35	0.335	0.389	0.283	0.336	0.28	0.302	0.295	0.322	0.309	0.353
1. Labour Market Factors												
Share of males working	0.85	0.8	0.91	0.89	0.85	0.86	0.89	0.86	0.9	0.85	0.9	0.87
Share of females working	0.58	0.64	0.71	0.78	0.72	0.7	0.79	0.82	0.86	0.84	0.55	0.75
Change in annual earnings of men	-2.5%		-4.2%		54.1%		9.1%		27.3%		9.6%	
At the bottom 10%	17.6%		-26.6%		33.3%		-4.6%		14.9%		-39.2%	
At the top 10%	14.1%		14.5%		70.2%		13.4%		30.8%		18.5%	
2. Family Formation Factors												
Household structure												
% Couple w/ kids under 18	61.5	51.3	56.2	47.1	61.3	47.5	55.4	49	54.4	47.9	52.5	45.5
% Couple w/o kids under 18	21.3	27.1	23.5	27.4	25.1	35.6	24.3	25.5	24.9	29.1	31.1	31.8
% Single parent	5.5	9.2	6.8	8.4	5.6	6	6.4	8.9	5.3	6.7	4.3	6.9
% Single or other HH types	11.7	12.4	13.5	17.1	8	10.9	13.9	16.6	15.4	16.3	12.1	15.8
Assortative mating (all couple HHs)												
- Wives'employment rates												
Husbands earnings in the top decile	0.66	0.64	0.70	0.80	0.81	0.84	0.81	0.91	0.89	0.92	0.47	0.72
Husbands earnings in the bottom decile	0.68	0.70	0.74	0.72	0.72	0.66	0.68	0.78	0.82	0.79	0.63	0.79
% of spouses in the same decile	15.7	17.4	10.8	13.1	16.8	18.2	12.3	15.1	14.3	14.3	10.6	14.6
% of spouses within (+/-2) deciles	40.3	45.6	40.8	47.7	51.3	49.9	45.6	52.2	52.3	49.2	36.0	39.4
	Israel		Netherlands		Norway		Sweden		United Kingdom		United States	
	1986	2005	1987	2004	1986	2004	1981	2005	1986	2004	1986	2004
Gini of HH equivalent earnings	0.398	0.432	0.307	0.326	0.256	0.322	0.285	0.331	0.329	0.384	0.367	0.42
1. Labour Market Factors												
Share of males working	0.83	0.78	0.81	0.86	0.95	0.90	0.94	0.89	0.80	0.81	0.82	0.87
Share of females working	0.48	0.62	0.38	0.70	0.82	0.86	0.86	0.85	0.50	0.69	0.68	0.74
Change in annual earnings of men	-1.9%		11.4%		20.1%		42.9%		44.1%		-1.3%	
At the bottom 10%	-9.5%		-32.7%		-45.1%		12.0%		19.4%		-3.3%	
At the top 10%	20.2%		14.8%		35.3%		60.0%		67.0%		17.8%	
2. Family Formation Factors												
Household structure												
% Couple w/ kids under 18	79.4	69.8	60.0	53.1	57.3	51.9	55.5	47.8	58.5	45.9	53.7	50.4
% Couple w/o kids under 18	11.1	17.6	25.5	29.6	21.2	23.8	21.5	23.4	25.0	30.8	22.0	23.1
% Single parent	4.9	5.7	4.5	4.8	8.8	8.9	7.3	9.7	7.4	10.6	11.5	12.7
% Single or other HH types	4.6	6.9	10.0	12.5	12.7	15.4	15.8	19.1	9.2	12.7	12.8	13.8
Assortative mating (all couple HHs)												
- Wives'employment rates												
Husbands earnings in the top decile	0.59	0.73	0.35	0.69	0.78	0.87	0.89	0.95	0.52	0.69	0.52	0.64
Husbands earnings in the bottom decile	0.32	0.63	0.33	0.65	0.83	0.80	0.80	0.82	0.49	0.67	0.69	0.71
% of spouses in the same decile	15.4	21.5	14.3	13.9	8.6	12.6	10.4	13.7	20.2	17.5	14.2	12.4
% of spouses within (+/-2) deciles	44.9	51.4	35.5	43.9	39.1	47.8	44.0	50.2	43.2	48.3	42.4	45.5

Table A2. (cont.) Labour market and family formation factors impacting on household earnings inequality

Panel B. Countries reporting net earnings

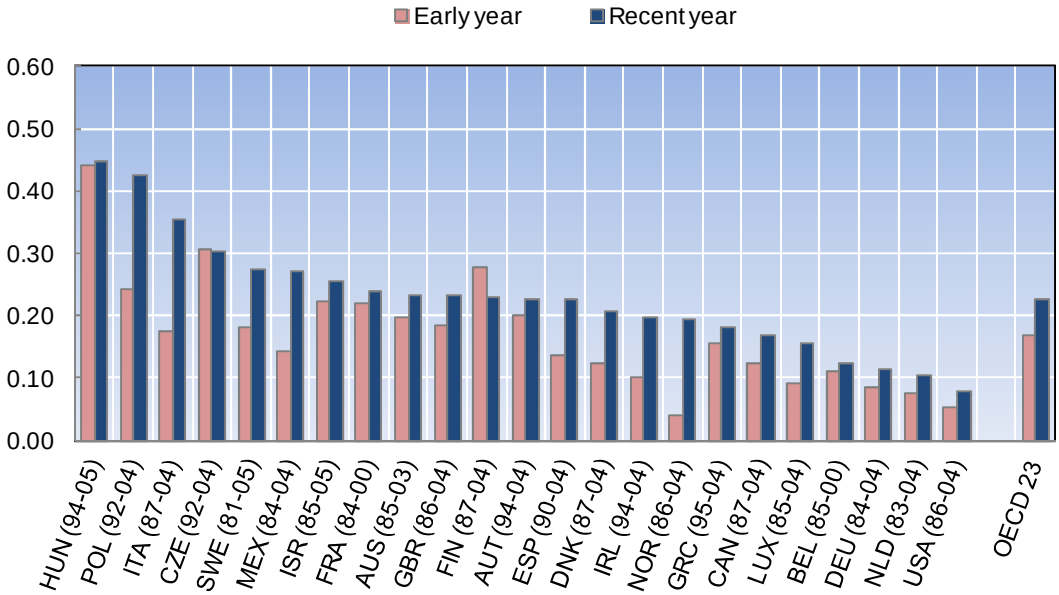
	Austria		Belgium		France		Greece		Hungary		Ireland	
	1994	2004	1985	2000	1984	2000	1995	2004	1994	2005	1994	2004
Gini of HH equivalent earnings	0.325	0.334	0.256	0.278	0.329	0.358	0.343	0.346	0.41	0.387	0.374	0.361
1. Labour Market Factors												
Share of males working	0.82	0.85	0.80	0.73	0.71	0.85	0.80	0.84	0.62	0.71	0.81	0.80
Share of females working	0.56	0.67	0.41	0.59	0.48	0.70	0.38	0.51	0.54	0.58	0.47	0.62
Change in annual earnings of men	2.4%		27.4%		-2.0%		23.4%		2.0%		34.2%	
At the bottom 10%	8.3%		13.4%		-25.0%		18.0%		20.8%		86.6%	
At the top 10%	18.1%		30.0%		7.6%		20.9%		-16.9%		29.1%	
2. Family Formation Factors												
Household structure												
% Couple w/ kids under 18	53.9	48.8	52.2	55.9	59.0	56.5	57.0	51.7	55.9	46.9	70.1	55.2
% Couple w/o kids under 18	29.0	29.9	38.9	27.5	28.7	26.0	29.6	33.7	26.1	31.3	15.4	51.7
% Single parent	5.5	5.6	2.7	6.3	4.1	6.7	3.0	2.7	6.8	6.0	5.4	11.3
% Single or other HH types	11.6	15.8	6.2	10.3	8.2	10.8	10.4	11.9	11.2	15.8	9.2	11.8
Assortative mating (all couple HHs)												
- Wives'employment rates												
Husbands earnings in the top decile	0.58	0.69	0.34	0.52	0.44	0.65	0.37	0.46	0.69	0.54	0.30	0.61
Husbands earnings in the bottom decile	0.52	0.72	0.53	0.54	0.49	0.65	0.34	0.46	0.56	0.59	0.43	0.52
% of spouses in the same decile	17.8	18.1	17.8	22.2	23.8	16.2	16.0	17.5	25.3	25.7	18.1	17.6
% of spouses within (+/-2) deciles	45.6	46.0	40.0	49.1	50.6	50.4	43.6	49.0	55.3	55.0	43.9	44.2

	Italy		Luxembourg		Mexico		Poland		Spain	
	1987	2004	1985	2004	1984	2004	1992	2004	1990	2004
Gini of HH equivalent earnings	0.325	0.363	0.254	0.34	0.454	0.472	0.331	0.408	0.325	0.331
1. Labour Market Factors										
Share of males working	0.83	0.82	0.84	0.87	0.93	0.92	0.67	0.78	0.91	0.86
Share of females working	0.38	0.54	0.31	0.62	0.31	0.48	0.48	0.60	0.31	0.59
Change in annual earnings of men	0.7%		72.3%		9.1%		0.6%		8.5%	
At the bottom 10%	-18.5%		16.1%		73.9%		-27.7%		7.6%	
At the top 10%	1.8%		115.0%		24.9%		17.5%		13.4%	
2. Family Formation Factors										
Household structure										
% Couple w/ kids under 18	60.3	48.3	60.1	54.2	83.8	70.6	69.9	60.7	68.5	50.2
% Couple w/o kids under 18	30.6	35.0	27.9	30.5	4.1	10.6	17.0	23.6	23.0	36.8
% Single parent	2.4	3.1	4.1	4.0	9.8	14.0	5.2	6.7	3.3	3.3
% Single or other HH types	6.7	13.5	7.9	11.4	2.3	4.8	7.9	9.0	5.2	9.7
Assortative mating (all couple HHs)										
- Wives'employment rates										
Husbands earnings in the top decile	0.33	0.63	0.25	0.53	0.20	0.46	0.33	0.54	0.32	0.56
Husbands earnings in the bottom decile	0.43	0.41	0.50	0.71	0.30	0.36	0.33	0.49	0.34	0.60
% of spouses in the same decile	17.0	20.6	12.5	14.5	9.7	11.1	13.8	17.8	15.8	17.2
% of spouses within (+/-2) deciles	45.2	53.8	33.8	44.6	35.1	40.7	40.1	47.3	38.0	46.6

Information on data for Israel: http://dx.doi.org/10.1787/888932315602.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

Figure A1. Correlation coefficients between husband and wife's earnings, couple households with at least one person working



Note: Figures refer to couple working-age households (head aged 25-64 years old) with at least partner working.

Source: Authors' calculations from the Luxembourg Income Study (LIS).

Figure A2. Working Wives' annual earnings by husband's earnings decile, couple households, mid-1980s and mid-2000s

Panel A. Countries reporting gross earnings

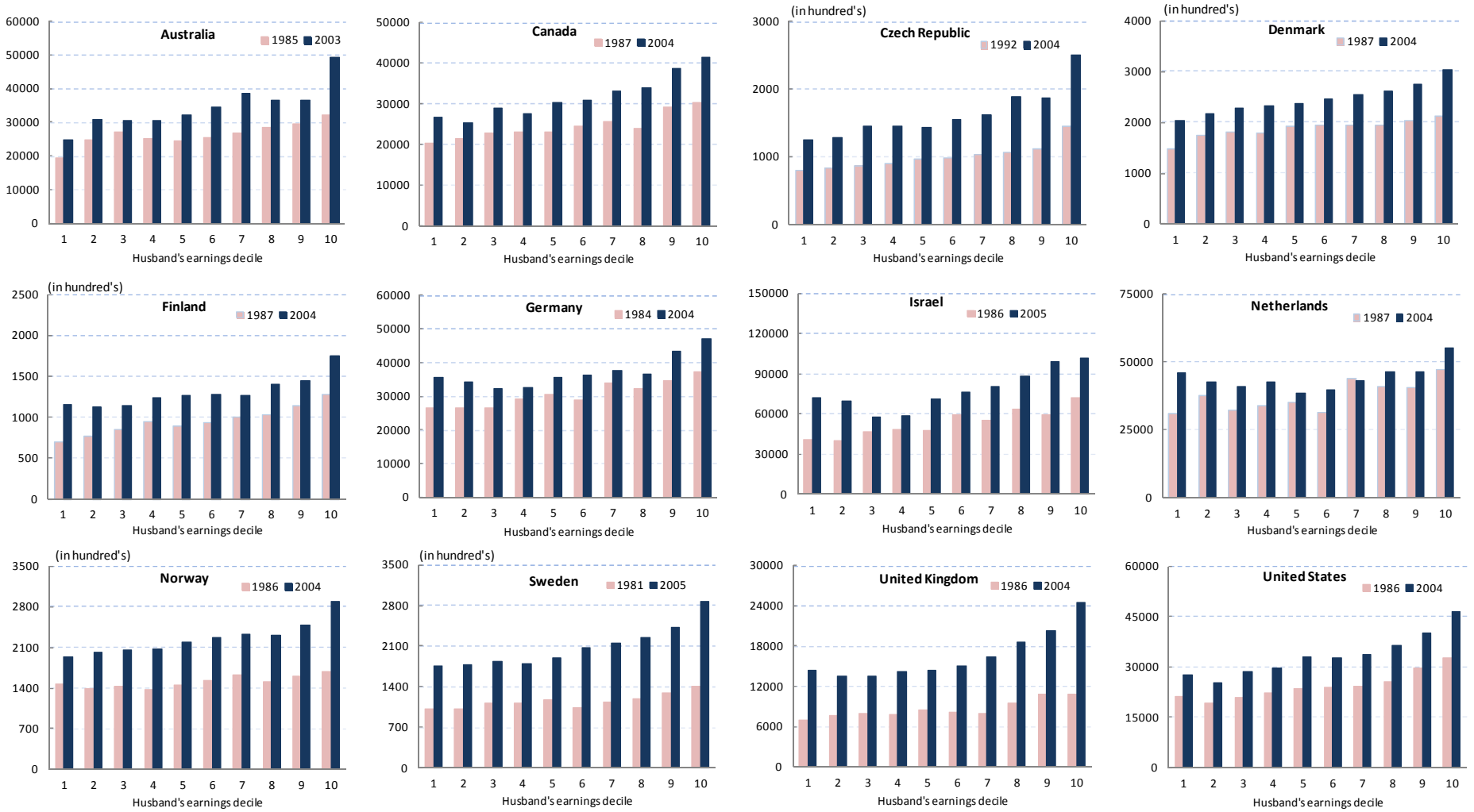
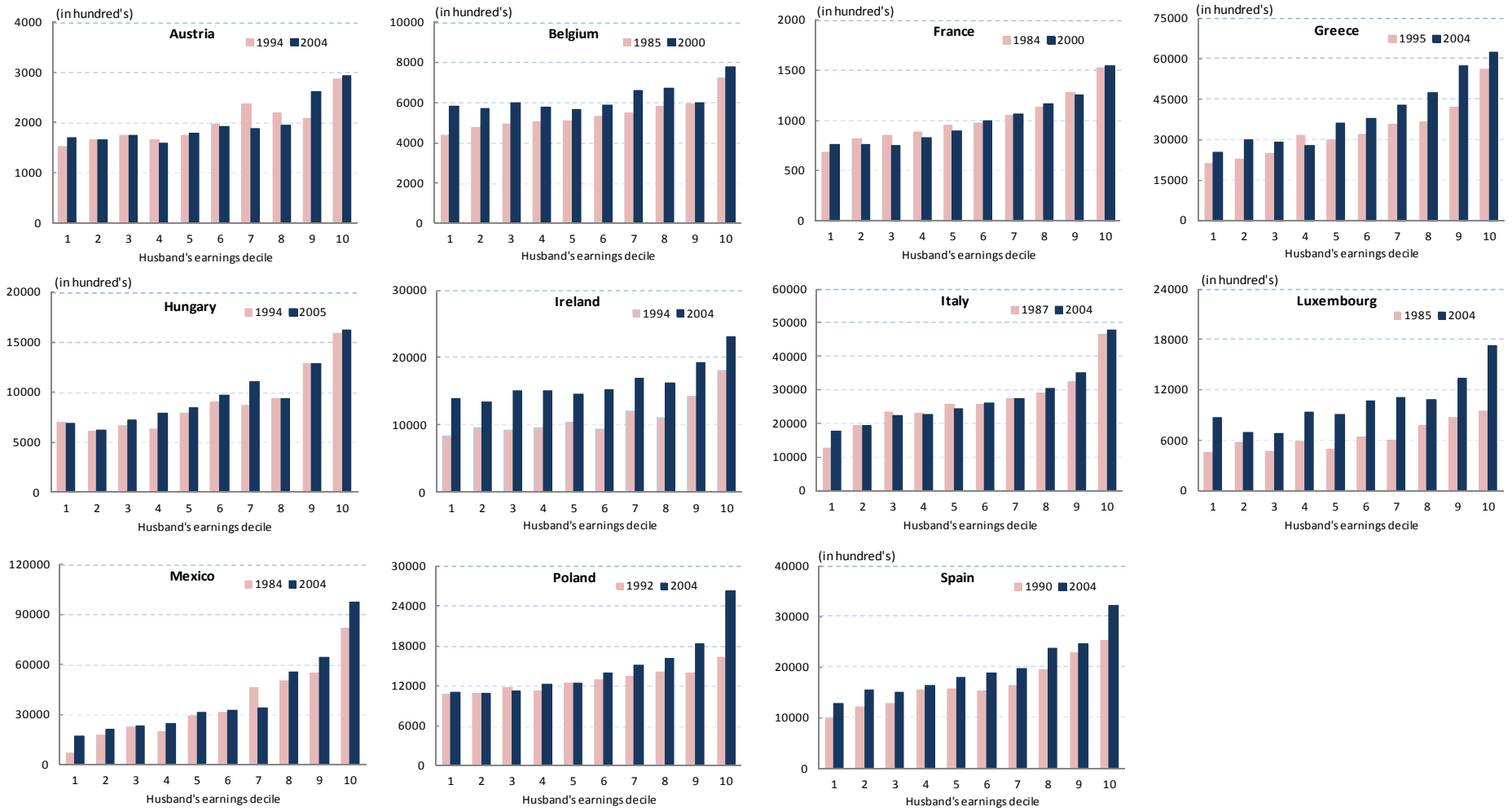


Figure A2. (cont.) Working Wives' annual earnings by husband's earnings decile, couple households, mid-1980s and mid-2000s

Panel B. Countries reporting net earnings



Note: Figures refer to couple working-age households (head aged 25-64 years old) with both partners working. Amounts are in national currencies (constant values of 2005).

Source: Authors' calculations from the Luxembourg Income Study (LIS).

ANNEX B. METHODOLOGY

B.1. Decomposition technique

The analysis in the paper decomposes the overall change in household earnings inequality into contributions due to labour market effects (men's earnings dispersion; male and female employment rates) and due to household formation effects (assortative mating, changes in household structure), following the methods used in Daly and Valletta (2006) and DiNardo *et al.* (1996). It starts by developing a first counterfactual earnings distribution that is based upon influences other than family formation being constant. This hypothetical earnings distribution allows to derive an inequality level that would have prevailed at the end of the period had the general labour market conditions (in terms of men's earnings and labour supply of males and females) remained unchanged. The difference between this counterfactual inequality and the actual inequality represents a starting point for understanding the role of the *family formation*. We create the counterfactual distribution for each country combining two methods, referred to as "re-weighting" and "rank-preserving exchange".

Similar to Daly and Valletta (2006) we treat the changing dispersion of men's earnings as exogenous and estimate the impact of this factor in an unconditional framework, through a rank-preserving distributional exchange.[20] The impacts of *other factors* are then obtained based on the "conditional re-weighting procedure" developed by DiNardo *et al.* (1996)—hereafter called DFL. The method is similar in spirit to the Oaxaca-Blinder decomposition (Oaxaca, 1973). However, unlike the Oaxaca decomposition, which only focuses on changes in averages, the DFL procedure allows the *entire* conditional distribution to be analysed. With this method, estimated conditional weights are combined with sampling survey weights to produce a counterfactual distribution. As such, it can be used to examine issues associated with changes at different points in the earnings distribution, and in particular the change in inequality in our analysis.

This involves using kernel density estimates of the household (equivalent) earnings distribution:

$$\hat{f}(y) = \frac{1}{n}\sum_{i=1}^{n} \frac{\theta_i}{h} K\left(\frac{y - Y_i}{h}\right) \quad (1)$$

Equation (1) is an estimate of a kernel density based on a random sample ($Y_1 \ldots Y_n$), with sampling weights ($\theta_1 \ldots \theta_n$) using a bandwidth h and a weighting function K.[21] To provide an illustration of this technique, consider a simple binary variable, L^F, that equals 1 if a working-age woman is employed and zero otherwise. The density of year t household earnings can be expressed as the weighted sum of the densities of households with a working female and households without a working female:

$$f_t(y) = pr_t(L^F = 1) f_t(y|L^F = 1) + (1 - pr_t(L^F = 1)) f_t(y|L^F = 0). \quad (2)$$

Let the proportion of households with a working female be 70% in year *t*, and suppose this is an increase from 50% in year *t-1*. Then the simplest way to impose the unconditional earlier distribution on the year *t* household earnings distribution is to reweight each observation according to the percentage change in the share of each group over time, that is, to replace $pr_t(L^F=1)$ in equation (2)

with $pr_{t-1}(L^F=1)$. In our example, every household with a working female in year *t* should be down-weighted by 0.71 (0.5/0.7) since the possibility of being in this group has increased over time, and every household without a working female needs to be up-weighted by 1.67 (0.5/0.3) because the chance of being in this group has declined over the years. Every household in *t*, therefore, is assigned a new weight.

The increase in female employment will differ noticeably by household type and also by the earnings levels of male spouses (if in a married-couple household). Therefore, it is more plausible to construct a counterfactual distribution that holds constant female labour supply at the earlier year's level conditional on other factors ($\lambda_{L^F|\,Others}$). In other words, each household will be re-weighted according to the proportional change in female employment *within* groups. Such a technique therefore accounts for the inter-relationships between factors, and thus provides a more clear understanding of their independent effects.

To begin with, consider the distribution of household equivalent earnings in year *2005*, Y_{05}, is a function of five explanatory factors: *i)* a binary variable, L^M, that equals 1 if a male is employed and 0 otherwise; *ii)* L^F is defined in the same way for females; *iii)* a discrete variable, *A*, measuring the degree of assortative mating (0-10 from the least to most sorting);[22] *iv)* a discrete variable, *S*, that indicates the five types of household structure; and *v)* the structure of men's earnings, *M*. The distribution of household earnings can be shown as the product of joint densities L^M, *LF*, *A*, *S*, and *M*:

$$f_t(Y) = f\left(Y\middle|t_Y = 05, M_{05}, t_{L^M|L^F,A,S} = 05, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right). \tag{3}$$

Next we are constructing a counterfactual density of *Y* in 2005 (*t*) if men's earnings, (M), the employment rate of men and women (L^M & L^F), the degree of assortative mating (A) and household structure (S)—but nothing else—had remained the same as the 1985 (*t-1*) levels:

$$f_t(Y) = f\left(Y\middle|t_Y = 05, M_{85}, t_{L^M|L^F,A,S} = 85, t_{L^F|A,S} = 85, t_{A|S} = 85, t_S = 85\right). \tag{4}$$

This can be done through a two-stage procedure. In the first stage of the decomposition, we create the counterfactual density of equivalent household earnings if men's earnings structure was held constant as it was in 1985, and all other household attributes remain at their 2005 levels, such as:

$$f_t^*(Y^{m85}) = f\left(Y^{m85}\middle|t_{Y^{m85}} = 05, t_{L^M|L^F,A,S} = 05, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right). \tag{5}$$

where the distribution of Y^{m85} is obtained through a rank-based distributional exchange (see Section B.2 below).

In the second stage of the decomposition, we want to hold the other four factors (L^M, L^F, A, S) constant at 1985 levels—in addition to men's earnings—as:

$$\begin{aligned} f_t^*(Y^{m85}) &= f\left(Y^{m85}\middle|t_{Y^{m85}} = 05, t_{L^M|L^F A,S} = 85, t_{L^F|A,S} = 85, t_{A|S} = 85, t_S = 85\right). \\ &= \int \iiint f\left(Y^{m85}\middle|L^M, L^F, A, S, t_{y^{m85}} = 05\right) dF\left(L^M\middle|L^F, A, S, t_{L^M|L^F,A,S} = 85\right) \\ &\quad dF\left(L^F\middle|A, S, t_{L^F|A,S} = 85\right) \cdot dF\left(A\middle|S, t_{A|S} = 85\right) dF(S|t_S = 85). \end{aligned} \tag{6}$$

With proper arrangement, the counterfactual density in (7) can be expressed as:

$$f_t^*(Y^{m85}) = f\left(Y^{m85}\middle|t_{Y^{m85}} = 05, t_{L^M|L^F,A,S} = 85, t_{L^F|A,S} = 85, t_{A|S} = 85, t_S = 85\right).$$

$$
\begin{aligned}
&= \int \iiint f\left(Y^{m85}\middle|L^M, L^F, A, S, t_{y^{m85}} = 05\right) \\
&\cdot\ dF\left(L^M\middle|L^F, A, S, t_{L^M|L^F,A,S} = 05\right)\frac{dF(L^M|L^F,A,S,t_{L^M|L^F,A,S}=85)}{dF(L^M|L^F,A,S,t_{L^M|L^F,A,S}=05)} \\
&\cdot\ dF\left(L^F\middle|A, S, t_{L^F|A,S} = 05\right)\frac{dF(L^F|A,S,t_{L^F|A,S}=85)}{dF(L^F|A,S,t_{L^F|A,S}=05)} \\
&\cdot\ dF\left(A\middle|S, t_{A|S} = 05\right)\frac{dF(A|S,t_{A|S}=85)}{dF(A|S,t_{A|S}=05)} \\
&\cdot\ dF(S|\ t_S = 05)\frac{dF(S|\ t_S=85)}{dF(S|\ t_S=05)}. \\
&= \int \iiint f\left(Y^{m85}\middle|L^M, L^F, A, S, t_{y^{m85}} = 05\right)dF\left(L^M\middle|L^F, A, S, t_{L^M|L^F,A,S} = 05\right) \\
&\cdot dF\left(L^F\middle|A, S, t_{L^F|A,S} = 05\right)\cdot dF\left(A\middle|S, t_{A|S} = 05\right)dF(S|t_S = 05) \\
&\ \lambda_{L^M|L^F A,S}(L^M, L^F, A, S)\cdot\lambda_{L^F|A,S}(L^F, A, S)\cdot\lambda_{A|S}(A, S)\cdot\lambda_S(S)
\end{aligned}
\tag{7}
$$

Equation (7) is equal to the exact density of the equivalent household earnings in 2005, adjusted for men's earnings, times three re-weighting functions: $\lambda_{L^M|L^F A,S}(L^M, L^F, A, S)$, $\lambda_{L^F|A,S}(L^F, A, S)$, $\lambda_{A|S}(A, S)$, and $\lambda_S(S)$. The new weights (λ_i) can then be incorporated into the estimation of the kernel density:

$$\hat{f}^*(y) = \frac{1}{n}\sum_{i=1}^{n}\frac{\theta_i\cdot\lambda_i}{h}K\left(\frac{y-Y_i}{h}\right). \tag{8}$$

The decomposition sequences are given in the order as detailed in Table B1. In the primary-order decomposition (panel A), men's earnings are placed in the first sequence, followed by the employment rate of men and women, respectively, assortative mating, family structure and residuals. The last category represents some important but unexplained (or not controlled) factors, including changes to family characteristics (*e.g.* age, race, migration status or education of head), regional characteristics (*e.g.* population size of areas, urban/rural, neighbourhood segregation) and of course macroeconomic forces such as trade/financial integrations, skill-biased technological shocks and labour market institutions. For robustness, reverse-order decomposition is also employed (panel B).

Table B1. Weights used in the density decomposition

A. Primary-order decomposition

Order	Counterfactual distribution of equivalent household earnings in 2005 held constant factors to 1985 levels in the following order	Equivalent household earnings measure	Weight
	1. Original 2005 distribution	Y_{05}	W_{05}
M	2. (1) with 1985 men's earnings	Y_{85}^{m}	W_{05}
L^M	3. (2) with 1985 male emp. rate	Y_{85}^{m}	$W_{05} \cdot \lambda_{L^M \mid L^F,A,S}$
L^F	4. (2) with 1985 female emp. rate	Y_{85}^{m}	$W_{05} \cdot \lambda_{L^M \mid L^F,A,S} \cdot \lambda_{L^F \mid A,S}$
A	5. (3) with 1985 assortative mating	Y_{85}^{m}	$W_{05} \cdot \lambda_{L^M \mid L^F,A,S} \cdot \lambda_{L^F \mid A,S} \cdot \lambda_{A \mid S}$
S	6. (4) with 1985 household structure	Y_{85}^{m}	$W_{05} \cdot \lambda_{L^M \mid L^F,A,S} \cdot \lambda_{L^F \mid A,S} \cdot \lambda_{A \mid S} \cdot \lambda_{S}$

B. Reverse-order decomposition

Order	Counterfactual distribution of equivalent household earnings in 2005 held constant factors to 1985 levels in the following order	Equivalent household earnings measure	Weight
	1. Original 2005 distribution	Y_{05}	W_{05}
S	2. (1) with 1985 household structure	Y_{05}	$W_{05} \cdot \lambda_{S \mid A,L^F,L^M}$
A	3. (2) with 1985 assortative mating	Y_{05}	$W_{05} \cdot \lambda_{S \mid A,L^F,L^M} \cdot \lambda_{A \mid L^F,L^M}$
L^F	4. (3) with 1985 female emp. rate	Y_{05}	$W_{05} \cdot \lambda_{S \mid A,L^F,L^M} \cdot \lambda_{A \mid L^F,L^M} \cdot \lambda_{L^F \mid L^M}$
L^M	5. (3) with 1985 male emp. rate	Y_{05}	$W_{05} \cdot \lambda_{S \mid A,L^F,L^M} \cdot \lambda_{A \mid L^F,L^M} \cdot \lambda_{L^F \mid L^M} \cdot \lambda_{L^M}$
M	6. (4) with 1985 men's earnings	Y_{85}^{m}	$W_{05} \cdot \lambda_{S \mid A,L^F,L^M} \cdot \lambda_{A \mid L^F,L^M} \cdot \lambda_{L^F \mid L^M} \cdot \lambda_{L^M}$

Note: Y_{05} refers to equivalent household earnings in 2005, W_{05} is the original survey sampling weights, and λs are estimated conditioning weightings.

B.2. Adjusting for the distribution of men's earnings

This section describes the construction of a counterfactual distribution of equivalent household earnings adjusted for the changing dispersion of men's earnings, through a rank preserving exchange approach. Basically, this involves subtracting each man's equivalised earnings from his total equivalent household earnings and adding back the amounts to which his rank in the 2005 (*t*) earnings distribution would have implied in 1985 (*t-1*).

Let household equivalent earnings in year *t*, Y_t, be the sum of earnings from both male and female household members divided by an equivalence scale:

$$y_t = \frac{\sum E_t^{males} + \sum E_t^{females}}{HH\ size^{0.5}} \quad (9)$$

The equivalent household earnings in 2005, adjusted for men's earnings at 1985 levels, therefore can be expressed as:

$$Y_{05}^{m85} = Y_{05} - M_q^{05} + M_q^{85}. \quad (10)$$

More specifically, the procedure first ranks working-age males from lowest to highest according to the amount of their equivalised earnings in each year. The samples in each year are then divided into 100 equally sized groups taking household sampling weights into account. The median incomes within each of these percentiles in 1985 are calculated. Then for each man we subtract the equivalised earnings component from the equivalised household earnings in 2005 and replace it with the 1985 information for the same percentile rank in the equivalised earnings distribution. The resulting distribution of household earnings can therefore be regarded as a counterfactual, which holds constant (or preserves) the distribution of earnings at 1985 levels. For households in which no working-age man is present, no adjustment is made. This approach is similar to an analysis in Burtless (1999) and Daly and Valleta (2006).

B.3. Estimation of the conditionally re-weighting functions

This section provides the derivation of the conditioning weights described in the main text. Recall that the distribution of equivalent household earnings in year 2005, conditional on male employment rate (L^M), female employment rate (L^F), assortative mating (A) and household structure (S) can be written as:

$$\begin{aligned} f_t(Y) &= f\left(Y \middle| t_Y = 05, t_{L^M|L^F A,S} = 05, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right). \\ &= \int \iiint f\left(Y \middle| L^M, L^F, A, S, t_{y^{m85}} = 05\right) dF\left(L^M \middle| L^F, A, S, t_{L^M|L^F,A,S} = 05\right) \\ &\quad \cdot dF\left(L^F \middle| A, S, t_{L^F|A,S} = 05\right) \cdot dF\left(A \middle| S, t_{A|S} = 05\right) \cdot dF(S|t_S = 05). \end{aligned} \quad (11)$$

To investigate the impact of rising female labour force participation on the change in household earnings, the following question was asked: "What would the distribution of household earnings be if the employment rate of males, conditional on the female employment rate, the degree of assortative mating and household structure, had remained unchanged at its 1985 levels?" That is:

$$\begin{aligned} f_t(Y) &= f\left(Y \middle| t_Y = 05, t_{L^M|L^F A,S} = 85, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right) \\ &= \int \iiint f\left(Y \middle| L^M, L^F, A, S, t_y = 05\right) dF\left(L^M \middle| L^F, A, S, t_{L^M|L^F,A,S} = 85\right) \\ &\cdot dF\left(L^M \middle| L^F, A, S, t_{L^M|L^F,A,S} = 05\right) \cdot dF\left(A \middle| S, t_{A|S} = 05\right) \cdot dF(S|t_S = 05) \end{aligned} \quad (12)$$

As explained previously, equation (12) can be expressed as the original density of 2005 multiplied by a re-weighting factor (λ),

$$f_t(Y) = f\left(Y \middle| t_Y = 05, t_{L^M|L^F A,S} = 85, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right)$$

$$\int \iiint f\left(Y \middle| L^M, L^F, A, S, t_y = 05\right) \cdot \lambda_{L^M|L^F,A,S} \cdot dF\left(L^M \middle| L^F, A, S, t_{L^M|L^F,A,S} = 05\right)$$

$$\cdot dF\left(L^F\middle|A,S,t_{L^F|A,S}=05\right)dF\left(A\middle|S,t_{A|S}=05\right)dF(S|t_S=05)$$

Given the fact that L^F is a binary variable with value 1 indicting a male is employed and zero otherwise, the conditional weighting function can be written as:

$$\lambda_{L^M|L^F,A,S}(L^M,L^F,A,S)=\frac{dF(L^M|L^F,A,S,t_{L^M|L^F,A,S}=85)}{dF(L^M|L^F,A,S,t_{L^M|L^F,A,S}=05)} \tag{13}$$

$$=L^M\cdot\frac{\Pr(L^M=1|L^F,A,S,t_{L^M|L^F,A,S}=85)}{\Pr(L^M=1|L^FA,S,t_{L^M|L^F,A,S}=05)}+(1-L)\frac{\Pr(L^M=0|L^F,A,S,t_{L^M|L^F,A,S}=85)}{\Pr(L^M=0|L^FA,S,t_{L^M|L^F,A,S}=05)}.$$

An estimate of the weighting function can be derived by assessing the conditional probabilities in (13) through a probit model. For household without a male, the original sample weights are used.

The conditional weighting function for the changes in female employment rate can be calculated in the similar way.

$$f_t(Y)=f\left(Y\middle|t_Y=05,t_{L^M|L^FA,S}=85,t_{L^F|A,S}=85,t_{A|S}=05,t_S=05\right)$$

$$\int\iiint f\left(Y\middle|L^M,L^F,A,S,t_y=05\right)\cdot\lambda_{L^M|L^F,A,S}\cdot dF\left(L^M\middle|L^F,A,S,t_{L^M|L^F,A,S}=05\right)$$

$$\cdot\lambda_{L^F|A,S}\cdot dF\left(L^F\middle|A,S,t_{L^F|A,S}=05\right)dF\left(A\middle|S,t_{A|S}=05\right)dF(S|t_S=05)$$

where

$$\lambda_{L^F|A,S}(L^F,A,S)=\frac{dF(L^F|A,S,t_{L^F|A,S}=85)}{dF(L^F|A,S,t_{L^F|A,S}=05)}.$$

Again, the estimate of the weighting function can be derived by assessing the conditional probabilities through a probit model. For households without a female, the original sample weights are used.

In addition to the change in employment probabilities, we adjust the density of equivalent household earnings for the changes in assortative mating:

$$f_t(Y)=f\left(Y\middle|t_Y=05,t_{L^M|L^FA,S}=85,t_{L^F|A,S}=85,t_{A|S}=05,t_S=05\right)$$

$$\int\iiint f\left(Y\middle|L^M,L^F,A,S,t_y=05\right)\cdot\lambda_{L^M|L^F,A,S}\cdot dF\left(L^M\middle|L^F,A,S,t_{L^M|L^F,A,S}=05\right)$$

$$\cdot\lambda_{L^F|A,S}\cdot dF\left(L^F\middle|A,S,t_{L^F|A,S}=05\right)\cdot\lambda_{A|S}\cdot dF\left(A\middle|S,t_{A|S}=05\right)dF(S|t_S=05)$$

where

$$\lambda_{A|S}(A,S)=\frac{dF(A|S,t_{A|S}=85)}{dF(A|S,t_{A|S}=05)}. \tag{14}$$

The degree of assortative mating is described by the likelihood of a husband in earnings decile *i* being married to a wife in earnings decile *j*, according to their respective earnings distribution. Below we explain how we define assortative mating. Specifically, we first divided men/women's earnings into decile groups (1-10) according to their respective earnings distribution from all workers. This can

be presented by a 10x10 cross-tabulation. Then we assigned each dual-earner household into one of the 10 categories, according to their relative degree of marital sorting using information from cross-tabulation. That is, we assigned the highest value "10" to households whose husband's and wife's earnings are in the same decile. Then, the value "9" is given to households with a husband in earnings decile *i* married to a wife in the immediate adjacent earnings decile *j*, where |*j*-*i*|=1. Similarly, the value "8" is assigned to households whose couple's earnings are two deciles apart, |*j*-*i*|=2, and the remaining categories are defined accordingly.

Based on this definition, the conditional weighting function, adjusted for assortative mating, therefore can be written as:

$$\lambda_{A|S}(A,S) = \sum_{d=1}^{10} I_d \frac{Pr(A=d|S,t_{A|S}=85)}{Pr(A=d|S,t_{A|S}=05)}. \quad (15)$$

Where I_d is a binary indicator that takes on a value of 1 if $A=d$ and zero otherwise. Since assortative mating applies to only two household types: couple households with children and couple households without children. The probabilities in (15) can be obtained from the cross-tabulation of husbands' and wives' earnings deciles, separately for couple households with and without children (see Annex Table A.1). For observations of people living in other household types, no adjustments are made.

Finally, the last conditioning weight adjusted for the change in the underlying distribution of household structure is:

$$\lambda_S(S) = \frac{dF(S|\, t_S = 85)}{dF(S|\, t_S = 05)}.$$

Applying Bayes' rule, this can be rewritten as:

$$\lambda_S(S) = \frac{dF(S|\, t_S = 85)}{dF(S|\, t_S = 05)} = \frac{\Pr(t_S = 85|S)}{\Pr(t_S = 05|S)} \cdot \frac{\Pr(t_S = 05)}{\Pr(t_S = 85)}. \quad (16)$$

It is equal to the relative probability of observing a household with structure *S* in the 1985 sample *versus* the 2005 sample times the unconditional probabilities of being in either sample. The conditional probabilities are obtained through a probit model, while the unconditional probabilities are simply obtained as the population ratio.

Changes in the density of equivalent household earnings between 1985 and 2005 are, therefore, model-based on the following decomposition:

$$f_{05}(Y) - f_{85}(Y) = f_{05}\left(Y;\, M_{05}, t_{L^M|L^F,A,S} = 05, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right)$$

$$-f_{05}\left(Y;\, M_{85}, t_{L^M|L^F,A,S} = 05, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right) \quad \text{(i)}$$

$$+f_{05}\left(Y;\, M_{85}, t_{L^M|L^F,A,S} = 05, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right)$$

$$-f_{05}\left(Y;\, M_{85}, t_{L^M|L^F,A,S} = 85, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right) \quad \text{(ii)}$$

$$+f_{05}\left(Y;\, M_{85}, t_{L^M|L^F,A,S} = 85, t_{L^F|A,S} = 05, t_{A|S} = 05, t_S = 05\right)$$

$$-f_{05}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=05, t_S=05\right) \quad \text{(iii)}$$
$$+f_{05}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=05, t_S=05\right)$$
$$-f_{05}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=85, t_S=05\right) \quad \text{(iv)}$$
$$+f_{05}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=85, t_S=05\right)$$
$$-f_{05}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=85, t_S=85\right) \quad \text{(v)}$$
$$+f_{05}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=85, t_S=85\right)$$
$$-f_{85}\left(Y;\ M_{85}, t_{L^M|L^F,A,S}=85, t_{L^F|A,S}=85, t_{A|S}=85, t_S=85\right) \quad \text{(vi)}$$

The six components in the above equation represent the effects of change to the dispersion of men's earnings, the employment rate of males, the employment rate of females, the degree of assortative mating, household structure, and residual factors, respectively.

B.4. Reverse-order decomposition

Criticism of the above decomposition approach often relates to its inability to distinguish overlapping effects between factors. The possibility of a general equilibrium or an endogenous relationship between factors would confound the "true" contribution of each factor. A simple alternative is to perform the same decomposition but in different order sequences and control whether the results are as sensitive under an alternative arrangement. To test the robustness of results, this section employs reverse-order decomposition. That is,

$$f_t(Y) = f\left(Y\middle|t_Y=05, t_{S|A,L^F,L^M}=05, t_{A|L^F,L^M}=05, t_{L^F|L^M}=05, t_{L^M}=05\right)$$

$$=\int\iiint f\left(Y\middle|S,A,L^F,L^M,t_y=05\right)dF\left(S\middle|A,L^F,L^M,t_{S|A,L^F,L^M}=05\right) \quad (17)$$

$$dF\left(A\middle|L^F,L^M,t_{A|L^F,L^M}=05\right)dF\left(L^F\middle|L^M,t_{L^F|L^M}=05\right)dF(L^M|t_{L^M}=05)$$

The four weighting functions to be estimated are $\lambda_{S|A,L^F,L^M}(S,A,L^F,L^M)$, $\lambda_{A|L^F,L^M}(A,L^F,L^M)$, $\lambda_{L^F|L^M}(L^F,L^M)$ and $\lambda_{L^M}(L^M)$ respectively. Given a simple property that

$$\lambda_{L^M|L^F,A,S}(L^M,L^F,A,S)\cdot\lambda_{L^F|A,S}(L^F,A,S)\cdot\lambda_{A|S}(A,S)\cdot \text{and } \lambda_S(S)$$

$$=\lambda_{S|A,L^F,L^M}(S,A,L^F,L^M)\cdot\lambda_{A|L^F,L^M}(A,L^F,L^M)\cdot\lambda_{L^F|L^M}(L^F,L^M)\ \cdot\lambda_{L^M}(L^M)$$

we only need to estimate three of the four conditional weighting functions, $\lambda_{A|L^F,L^M}(A,L^F,L^M)$, $\lambda_{L^F|L^M}(L^F,L^M)$ and $\lambda_{L^M}(L^M)$ for reverse-order decomposition, and the last weighting function can be obtained by

$$\lambda_{\mathrm{S}|A,L^F,L^M}(\mathrm{S},\mathrm{A},L^F,L^M)=\frac{\lambda_{L^M|L^F,\mathrm{A,S}}(L^M,L^F,A,S)\cdot\lambda_{L^F|\mathrm{A,S}}(L^F,A,S)\cdot\lambda_{\mathrm{A|S}}(A,S)\cdot\lambda_S(S)}{\lambda_{A|L^F\mathrm{L^M}}(\mathrm{A},L^F,L^M)\cdot\lambda_{L^F|\mathrm{L^M}}(L^F,L^M)\cdot\lambda_{L^M}(L^M)}. \quad (18)$$

For weights that adjusted for the change in the underlying distribution of male employment, $\lambda_{L^M}(L^M)$, we follow the procedures similar to those used for the derivation of $\lambda_S(S)$ above. That is:

$$\lambda_{L^M}(L^M) = \frac{dF(L^M|\, t_{L^M} = 85)}{dF(L^M|\, t_{L^M} = 05)} = \frac{\Pr(t_{L^M} = 85|L^M)}{\Pr(t_{L^M} = 05|L^M)} \cdot \frac{\Pr(t_{L^M} = 05)}{\Pr(t_{L^M} = 85)}. \quad (19)$$

Equation (19) can be obtained by estimating the probabilities of observing a working male in the 1985 *versus* the 2005 samples, multiplied by the population ratio. The weighting function of the female employment rate, conditional on the male employment rate, can be written as:

$$\lambda_{L^F|L^M}(L^F, L^M) = \frac{dF(L^F|L^M, t_{L^F|L^M} = 85)}{dF(L^F|L^M, t_{L^F|L^M} = 05)}$$

$$= L^F \cdot \frac{\Pr(L^F = 1|L^M, t_{L^F|L^M} = 85)}{\Pr(L^F = 1|L^M, t_{L^F|L^M} = 05)} + (1 - L^F)\frac{\Pr(L^F = 0|L^M, t_{L^F|L^M} = 85)}{\Pr(L^F = 0|L^M, t_{L^F|L^M} = 05)}. \quad (20)$$

Similarly, the re-weighting function for changing assortative mating, conditional on the female employment rate is:

$$\lambda_{A|L^F,L^M}(A, L^F, L^M) = \frac{dF(A|L^F, L^M, t_{A|L^F,L^M} = 85)}{dF(A|L^F, L^M, t_{A|L^F,L^M} = 05)}$$

$$= \sum_{d=1}^{10} I_d \frac{Pr(A = d|L^F, L^M, t_{A|L^F,L^M} = 85)}{Pr(A = d|L^F, L^M, t_{A|L^F,L^M} = 05)}. \quad (21)$$

Again, the probabilities in (21) can be computed from the cross-tabulation of husbands' and wives' earnings deciles, separately, for households with and without a working female/male.

NOTES

1. The definition of household refers to all members living in the same dwelling unit regardless of whether or not they are related to each other by blood or marriage. Young adults (16-24) as well as older workers (65+) were excluded in this study to avoid the difficulty of disentangling the effects of labour supply (as thus earnings) due to schooling as well as retirement behaviours.

2. To measure the individual's economic well-being derived from household earnings, the total household earnings are standardised through an equivalence scale in order to adjust for differences in household composition. Following OECD convention, the equivalence scale is defined as the square root of household size (see http://www.oecd.org/els/soc/OECD-Note-EquivalenceScales.pdf). Total household earnings include earnings from all household members. That means earnings of elderly (65+) and young adults (16-24) who lived in a working-age head household are counted in total household earnings 'attributed' to each household member even though the elderly and younger individuals are not included in the sample.

3. There are other factors that are not considered in the analysis below because of lack of data which may affect trends in the distribution of household earned income. One example is changes in the composition of the workforce driven by international migration. Empirical studies on the impact of migration on wage disparities remain largely inconclusive (see, for example, Borjas *et al.*, 1997; Card, 2005.

4. These include full-time and part-time earnings, as well as income from self-employment.

5. Note that the employment rates here refer to the proportion of workers in the working-age population. Workers are defined as persons who receive positive annual earnings regardless of the hours and weeks worked. This is different from the common LFS definition that defines employment as working at least one hour during a brief period (either one week or one day).

6. Juhn and Murphy (1997), for instance, find that the increase in female labour supply over time (either in terms of participation or hours worked) has been strongly non-uniform among all married women in the United States, with wives of high-paid husbands experiencing more pronounced increases in labour market activities than wives of low-paid husbands. Morissette and Hou (2008) also report similar findings for Canada. Esping-Andersen (2009) observes, for five OECD countries, that women's employment participation increased to a much larger extent at the top end of the income distribution, contributing to increased household income inequality.

7. Nevertheless, Cancian *et al.* (1993) and Cancian and Reed (1998) suggest that wives' earnings equalise the distribution of family income and Harkness (2010) finds an inverse relationship between female employment and income inequality for a sample of 17 OECD countries.

8. The extent of marital sorting may well reflect a more general pattern of educational (or occupational) homogamy. Therefore, another strand of research on assortative mating uses measures of husbands' and wives' education levels (see, for instance, Worner 2006).

9. That is, we first create decile categories for mens's and women's earnings distributions, separately, for all workers. Then we assign a husband (wife) to earnings decile *i* if his (her) annual earnings falls into decile *i* of men's (women's) earnings distribution. This can be presented by cross-tabulations (10x10) showing husbands' and wives' earnings deciles for each year, respectively. The most rudimentary measure of assortative mating therefore is simply the summation of the diagonal elements.

[10] These results are in line with findings in other empirical literature and country studies that used educational homogamy (usually 5 categories) as a measure for assortative mating. See, for instance, Halpin and Chan (2002) for the United Kingdom, and Worner (2006) for Australia.

11. Karoly and Burtless (1995), Burtless (1999), and Daly and Valletta (2006), for instance, suggest that the increase in single-headed families is responsible for a sizeable proportion of the spread in overall income inequality in the United States. Peichl *et al.* (2010) find that the changing household composition in Germany between 1991 and 2007 was associated with increasing inequality but the effect was stronger for pre-tax household income inequality than after accounting for taxes. Focusing on family earnings in Canada, Lu *et al*. (2011) show that about 20% (30%) of the growth in inequality between 1980 and 1995 (1995 and 2005) can be explained by changing family composition. By contrast, Jäntti (1996) finds that demographic shifts cannot be assigned any major role in the increase in inequality in five OECD countries (including Canada) over the 1980s.

12. Here, only male earnings dispersion is considered. Female wage dispersion is not included in the analytical framework as the evolution of women's wage distribution ties closely to rising women's labour force participation which is one of the labour-market related behavioural changes that is investigated. Because of this correlation, past empirical research similarly did not include women's wage dispersion in such decomposition analyses (*e.g.* Daly and Valletta, 2006).

13. The degree of assortative mating is described by the likelihood of a husband in earnings decile *i* being married to a wife in earnings decile *j*, according to their respective earnings distribution. This can be presented by a 10x10 cross-tabulation. In the counterfactual exercise, we assigned each dual-earner household into one of the 10 categories, according to their relative degree of marital sorting using information from the 10x10 cross-tabulation. That is, we assign the highest value "10" to households where husbands and wives earnings are in the same decile. Then, the value "9" is given to households with a husband in earnings decile *i* married to a wife in the immediately adjacent earnings decile *j*, where $|j-i|=1$. Similarly, the value "8" is assigned to households whose earnings as a couple are two deciles apart, $|j-i|=2$, and the remaining categories are defined accordingly.

14. Household structure is defined according to five mutually exclusive types: *i)* couple households with children; *ii)* couple households without children; *iii)* single-parent households; *iv)* single unattached persons; and *v)* single persons with other adults.

15. Since the decomposition analysis also investigated factors other than earnings, the estimations of the conditional reweighting functions are based on the sample of all working-age individuals (including non-workers). Although reweighting factors were estimated for each individual, only workers with positive earnings were used to create the counterfactual distributions of household earnings. See Annex B for the detailed decomposition procedure.

16. See Annex B for the detailed decomposition procedure.

17. Daly and Valletta (2006), for instance, found that men's earnings contributed the largest share to the change in equivalent family *income* between 1969 and 1989 in the United States (64%), rising female labour supply had a moderate equalising effect and changing family structures had a disequalising effect. Pencavel (2006) also drew similar conclusions from US data for 1968 to 2001, with assortative mating playing a negligible role in accounting for the growth in family earnings inequality over time. For Canada, Lu *et al*. (2011) showed that 22% of the increase in family earnings inequality between 1980 and 2005 was explained by changing men's wage dispersion, while demographic changes played a rather moderate role. Worner (2006) found that 2–6% of the increase in inequality of household weekly gross earnings between 1986 and 2003 in Australia can be attributed to assortative mating, a contribution increasing to 4–7% for a broader definition. By contrast, changing patterns in labour force participation explain roughly one-third of the increase in earnings inequality.

18. This article uses the so-called square-root equivalence scale to adjust household earnings and other income for the household size in order to take account of economies of scale (see http://www.oecd.org/els/soc/OECD-Note-EquivalenceScales.pdf). This scale assumes that the economic needs of a household with four persons is twice as large as that of a one-person household.

19. See Annex B.4 for the derivation of re-weighting functions for reverse-order decomposition.

20. See also Burtless (1999).

21. The choice of h and K may be sensitive to the distribution and has been subject to many discussions in the literature. In this context, the "optimal bandwidth" (Silverman, 1986) and Gaussian kernel function are used.

22. The degree of assortative mating is described by the likelihood of a husband in earnings decile i being married to a wife in earnings decile j, according to their respective earnings distribution. This can be presented by a 10x10 cross-tabulation. In the counterfactual exercise, we assigned each dual-earner household into one of the 10 categories, according to their relative degree of marital sorting using information from the 10x10 cross-tabulation. That is, we assign the highest value "10" to households where husbands and wives earnings are in the same decile. Then, the value "9" is given to households with a husband in earnings decile i married to a wife in the immediately adjacent earnings decile j, where $|j-i|=1$. Similarly, the value "8" is assigned to households whose earnings as a couple are two deciles apart, $|j-i|=2$, and the remaining categories are defined accordingly.