

**Are increasing earnings correlations between partners of concern for inequality?  
A comparative study of 21 countries**

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Abstract

*The last few years have seen a dramatic increase in research addressing the question to what extent the association between partners' earnings matters for inequality between couples. Studies come to an apparent variety of results, ranging from conclusions that earnings similarity barely impacts inequality, to findings that changes in earnings similarity have been responsible for considerable increases in inequality.*

*In this paper, we aim to reconcile these earlier findings through a detailed literature review as well as a comparative empirical analysis. We first show that studies on the topic answer three similar yet distinct questions: How high would inequality be if people partnered at random? Did changes in earnings similarity over time, including changes in employment rates, contribute to inequality? Did changes in the association between partners' earnings, net of general changes in employment rates, contribute to inequality? Previous research comes to relatively consistent answers once divided according to these three questions.*

*We subsequently use data from the Luxembourg Income Studies on 21 countries from 1974 to 2016 to focus on the last two questions. Using decompositions based on log-linear models, we show that even though the correlation in earnings between partners increased in most countries, this only amplified inequality in a subset of these countries. In other countries, increases in the earnings correlation are primarily driven by general changes in employment rates. Given that these increases in employment equalized earnings across households, the inherently connected increases in the earnings correlation are of less concern from an inequality perspective.*

The idea that earnings similarity between partners contributes to inequality is very intuitive. Put in extremes, a society that consists of 50% dual-breadwinner households and 50% no-earner households is bound to be more unequal than a society with 100% single-breadwinner households. Despite this powerful intuition, existing empirical research reached mixed conclusions as to how important earnings similarity is for inequality. (Blackburn & Bloom, 1995; Bouchet-Valat, 2017; Chen et al., 2013; Esping-Andersen, 2007; Gonalons-Pons, 2017; Greenwood et al., 2014; Grotti & Scherer 2016; Harmenberg, 2014; Hryshko et al., 2017; Kuhn & Ravazzini, 2017; Larrimore, 2014; Nieuwenhuis et al., 2017; Pestel, 2017; Schwartz, 2010; Sudo, 2017).

Some studies report that earnings similarity between partners has a significant or even considerable impact on income or earnings inequality (Blackburn & Bloom, 1995; Burtless, 1999; Chen et al., 2013; Esping-Andersen, 2007; Fortin & Schirle, 2006; Gonalons-Pons, 2017; Greenwood et al., 2014; Nieuwenhuis et al., 2017; Pestel, 2017; Reed & Cancian, 2012; Schwartz, 2010), whereas others find it to matter quite little for income or earnings inequality (Bouchet-Valat, 2017; Grotti & Scherer 2016; Hryshko et al., 2017; Larrimore, 2014; Kuhn & Ravazzini, 2017). Part of this variation can be attributed to cross-national differences (Blackburn & Bloom, 1995; Chen et al., 2013; Nieuwenhuis et al., 2017) or due to variation across periods studied (Larrimore, 2014; Schwartz, 2010). But, very diverse conclusions are also reached when comparing studies within given contexts. For instance, conclusions from studies on the United States range from a negligible (Grotti & Scherer, 2016; Hryshko et al, 2017; Larrimore, 2014 in the 1990s and 2000s), to a small (Cancian & Reed, 1999; Chen et al., 2013; Harmenberg, 2014) or moderate (Greenwood et al., 2014; Larrimore, 2014 in the 1980s; Nieuwenhuis et al., 2017; Schwartz, 2010) impact of the association between partners' earnings on inequality between households.

How can such conflicting results be re-aligned? Confusion might have arisen due to results of Greenwood and colleagues (2014) indicating a sizeable role for earnings similarity in creating income inequality, which were subsequently adjusted downward to a very small role in a corrigendum.<sup>1</sup> Other possible sources include numerous differences in terms of methods, data, sample selection and measures employed that are likely to affect conclusions. It would be too ambitious to discuss all these differences in this article, but the first goal of our paper is to re-align the variety in conclusions reached so far by a thorough discussion and re-organization of the existing literature. We argue that a major divergence in results is caused by variation in the research questions asked across studies. We identify three distinct research questions posed in this body of literature that lead to different answers as to whether and where earnings similarity matters for inequality between households. These are: 1) How high would inequality be if people partnered at random? 2) How high would inequality be if partner similarity in employment and earnings had remained stable over time? 3) How high were inequality to be if the earnings association between partners had remained stable over time, *net of* general changes in labor force participation rates?

In our literature review, we will discuss empirical works that have answered each of these three different questions. In our empirical analysis, we use data from the Luxembourg Income Study on 21 countries covering the years 1973 to 2016 (maximal range, depending on the country) to answer the last two questions discussed above regarding the impact of changes over time in the association between partners' earnings on inequality.

We argue that even though changes over time in earnings associations have had an amplifying impact on inequality between households in several countries, these contributions were primarily a byproduct of increases in female employment. Given that increases in female

<sup>1</sup> [https://www.cemfi.es/~guner/ggks\\_corrigendum.pdf](https://www.cemfi.es/~guner/ggks_corrigendum.pdf)

employment have had an equalizing effect on the earnings distribution between households, the ‘package deal’ of higher female employment combined with an increased earnings association between partners should be welcomed from an inequality perspective. At the same time, in countries that already had high levels of female employment, changes in the earnings association were frequently driven by other processes including an increasing association in earnings among dual-breadwinner couples and an increasingly positive association between men’s earnings and women’s employment. These developments in general had small to modest inequality-amplifying effects (i.e. inequality would be 2% to 4% lower if earnings association were to be as in the past in these countries), and are of more concern from an inequality perspective.

## **Earnings similarity and inequality: Three different approaches**

The first major goal of our paper is to provide a structured overview of existing research, with the aim to reconcile apparent conflicting findings from earlier research. A major division line in terms of motivation and logic can be drawn between studies that focus on how much earnings associations contribute to inequality at a given point in time (e.g. Greenwood et al., 2014; Harmenberg, 2014; Hryshko et al., 2017; Kuhn & Ravazzini, 2017; Pestel, 2017) and studies that ask the question whether changes in this association over time have contributed to changes in inequality (e.g. Bouchet-Valat, 2017; Grotti & Scherer, 2017; Larrimore, 2014; Nieuwenhuis et al., 2017; Schwartz, 2010; see Cancian & Reed, 1998, 1999 and Gonalons-Pons, 2017 for a similar argument regarding studies on the impact of female employment).

### **The cross-sectional contribution of earnings association to inequality**

The former category of studies is based on simulating how high income inequality would be if individuals were to partner at random instead of as observed. In such type of analysis, observed

individuals are matched at random to form simulated households. Subsequently, household income is calculated either based on summing the individual incomes of the matched individuals (Hryshko et al., 2017) or by randomly assigning the income of an actual household that has the same characteristics (e.g. age, children) as the newly simulated household (Greenwood et al., 2014; Pestel, 2017).

A direct comparison of these methods showed that Gini-expressed inequality in the United States would be at most 0.02 lower as compared to observed levels of inequality using the latter method, and less than 0.01 lower once applying the method of summing individual incomes (Harmenberg, 2014). The conclusion that inequality would be only marginally lower if people were to select into partnerships at random has been reached for West Germany (Pestel, 2017), Switzerland (Kuhn & Ravazzini, 2017), and the United States (Greenwood et al., 2014 with corrigendum; Hryshko et al., 2017). In contrast, in a comparison of West and East Germany, Pestel (2017) found that inequality would be considerably lower in East Germany if partners selected at random, and this cross-sectional contribution has been increasing over time. The suggested reason for these differences is that in East Germany female labor force participation is higher and positively related to male earnings, whereas in West Germany the correlation between spouses earnings went from negative to flat (Pestel, 2017:105). In line with this conclusion, Frémeaux and Lefranc (2017) found that in the late 2000s in France, a context where a positive correlation in partners' earnings exists, inequality would be between 3% and 9% lower if individuals were to partner at random.

Nonetheless, in most settings studied, the cross-sectional contribution of earnings similarity to inequality is relatively minor. How can changes in the earnings association over time have contributed to inequality if this association has little impact on inequality to begin with? A first complication when comparing across approaches is that in several countries, like the United

States, the correlation between male and female partners' earnings reversed from negative to positive over the last decades (Nieuwenhuis et al., 2017:11; Schwartz, 2010). The cross-sectional contribution of the earnings association might therefore reverse from equalizing to disequalizing over time too, as actually observed for some of the randomization methods employed (Harmenberg, 2014). In such cases, the contribution of changes over time in assortative mating to changes in inequality can actually be larger than the cross-sectional contribution of mating patterns at a given point in time. In other words, a small cross-sectional contribution of an earnings association does not imply that changes over time will matter little too.

Some of the studies relying on randomization techniques have documented how the “cross-sectional” contribution of the earnings association to inequality changed over time (e.g. Hryshko et al., 2017). Such results speak to an, again, different question as the cross-sectional contribution of earnings association to inequality combines two elements: the strength of the association and the consequences of a given strength of the association for inequality.

To illustrate, in a society where women make 10% of what men make, a given strength in the earnings association will be much less consequential for inequality compared to an otherwise identical society where there is no gender gap in earnings (Sudo, 2017). Similarly, in a society where earnings inequality *among* women is very low, randomizing partners across households will barely impact inequality between households.

Hence, even if the association between partners' earnings stays constant, the cross-sectional contribution of this association to inequality can change over time due to factors such as reductions in the gender pay gap and changes in women's (or men's) earnings inequality. Techniques that compare changes over time in the cross-sectional contribution of earnings associations to inequality therefore capture a combined impact of changes in the earnings

association *and* of changes in the consequences of a given level of the earnings association.

A large body of studies has come to the consistent conclusion that increases in female labor force participation have reduced inequality in earnings among women when including women with zero earnings (Bouchet-Valat, 2017; Cancian & Reed, 1998; 1999; Del Boca & Pasqua, 2003; Kollmeyer, 2013; Nieuwenhuis et al., 2017). These reductions in earnings inequality among women are likely to have had a suppressing impact on the cross-sectional contribution of earnings association to inequality. At the same time, many studies have documented simultaneous increases in the earnings association between partners (Bouchet-Valat, 2017; Cancian & Schoeni, 1998; Chen et al., 2013; Fortin & Schirle, 2006; Nieuwenhuis et al., 2017; Schwartz, 2010), which increase the cross-sectional contribution of earnings association to inequality. These counteracting forces can therefore lead to an overall pattern of little changes in the cross-sectional contribution of earnings association to inequality over time, as observed in some studies employing randomization techniques (Eika et al., 2014; Hryshko et al., 2017).

To answer the question to what extent changes in the association between partners' earnings have contributed to inequality scholars have therefore used other techniques, as discussed in the next section.

### **The role of changes in the earnings association over time**

A second group of studies look at the impact of changes over time in the earnings association on inequality, asking (a variant of) the question how high inequality would be in a given setting if the employment rates and/or earnings association between partners were to be as in the past (e.g. Bouchet-Valat, 2017; Chen et al., 2013; Grotti & Scherer, 2016; Larrimore, 2014; Schwartz, 2010). This type of studies mostly relies on simulation techniques based on decomposition or reweighting methods instead of randomization. These simulations normally apply distributions of couples with given characteristics of one period to another to investigate

the influence of changes in specific patterns of the association between partners' earnings.<sup>2</sup>

As noted above, these studies have reported negligible to moderate disequalizing effects of changes in the earnings association in the United States .at least for some periodsCancian & Reed, 1999; ,very limited effects (Bouchet-Valat, 2017) negligible (Grotti and Scherer, 2017) to moderately disequalizing (Chen et al., 2013 observe all three cases depending on the country considered). Within this category of studies, once again, a major difference in terms of approaches can be identified that is highly consequential for the conclusions reached: whether to account for changes in employment rates or not.

Increases in female labor force participation have made partners' earnings more similar over time (when attributing zero earnings to individuals not in employment). Simulating scenarios where earnings similarity would be as in the past therefore in most contexts also automatically implies simulating changes in female employment rates (as well as other changes in the earnings distribution). Since increased levels of female employment augment earnings similarity, one may expect this trend to amplify inequality between households. However, increases in female employment also have led to reduced earnings inequality among women which in turn reduces inequality between households.

A first sub-group of studies have shown that, overall, the equalizing effect of decreases in earnings inequality among women outweighs the inequality-increasing effect of augmented earnings similarity between partners due to increases in female employment rates (Bouchet-Valat, 2017; Callan et al., 1998; Chen et al., 2013; Cancian & Reed, 1999; Cancian & Schoeni, 1998; Grotti & Scherer, 2016; Mastekaasa & Birkelund, 2011; Nieuwenhuis et al., 2017; one

<sup>2</sup> Simpler methods, such as those based on decomposing the Coefficient of Variation (e.g. Esping-Andersen, 2007; Nieuwenhuis et al, 2017) apply earnings correlations of one period to another without considering specific patterns of how individuals distribute across types of households.



exception is Australia between 1982 and 1997 according to Austen & Redmond, 2013). The overall impact of increases in female employment rates has therefore been equalizing on many occasions. In their comparative study of 18 OECD countries, Nieuwenhuis and colleagues (2017:15) conclude that changes in women's earnings reduced inequality across practically all countries. Simulating the combined impact of changes in female employment and in earnings similarity over time is therefore likely to lead to the conclusion that changes in earnings similarity have reduced inequality over time.

A second sub-group of studies looking at changes over time has conceptually separated changes in overall employment rates from changes in earnings similarity *net of changes in employment*. Studies within this category have applied a large variety of simulation techniques to estimate how much increases in the association between the employment of a partner and the earnings of the other, and the earnings association among dual-earner couples contributed to inequality ; also Cancian & Reed, 1999 in their discussion section only

### **Distinguishing the effect of changes in overall employment rates**

One must be very careful when comparing results from such studies. In our view, some of these works suffer from a major issue that makes it difficult to interpret their results: this issue has to do with fact that it does not make sense to assume that overall employment rates can be changed without affecting the earnings correlation (including zero-earners) separate change over time but. Changes in general levels of male and female employment by definition affect the share of dual-breadwinner (and of jobless) households in society, and the share of dual-breadwinner couples affects the earnings correlation between partners (Schwartz, 2010: 1531). Even if employment changes are equally distributed across the household earnings distribution they affect the correlation between partners' earnings. A counterfactual situation where only

the earnings correlation between partners (including zero earners) is simulated to change but levels of employment are held constant is therefore of little relevance<sup>3</sup>. A proper counterfactual must control the earnings association using a measure which does not depend on the proportion of zero earners, rather than merely using the correlation coefficient. This methodological issue affects all studies based on the Coefficient of Variation decomposition (Austen & Redmond, 2013; Blackburn & Bloom, 1995; Cancian & Reed, 1999; Mastekaasa & Birkelund, 2011; Nieuwenhuis et al., 2017). While this decomposition is very useful to address the question of the combined effects of changes in employment rates and in earnings association, the way it decomposes the respective roles of these two components does not have any useful interpretation.

The key question to ask is therefore not whether earnings associations changed, but why they changed. If increases in the earnings correlation are due to augmented female employment rates, it is not so clear that increased correlations in partners' earnings are of concern from an inequality perspective. Because increases in female employment generally reduce inequality between households (Bouchet-Valat, 2017; Callan et al., 1998; Cancian & Reed, 1999; Cancian & Schoeni, 1998; Chen et al., 2013; Fortin & Schirle, 2006; Grotti & Scherer, 2016; Daly & Valletta, 2006; Harkness, 2013; Lu et al., 2011; Kollmeyer, 2013; Mastekaasa & Birkelund, 2011; Nieuwenhuis et al., 2017; Pasqua, 2003) increases in earnings correlations caused by augmented female employment rates might not have any real consequences for inequality between couples.

Moreover, the last counterfactual scenario used by Schwartz (2010) suffers from a different but related issue, as her baseline model assumes the absence of any association between partners' earnings, which is not a realistic assumption. Therefore, her measure of the disequalizing effect

<sup>3</sup> See Cancian & Reed (1998, 1999) regarding the importance of clearly defining counterfactual situations each measure corresponds to.

of combined changes in employment rates and earnings association is somewhat overestimated compared with taking a more appropriate baseline where the association is fixed to its value for the first year (as the Coefficient of Variation decomposition does). However, this problem does not affect her estimate of the effect of changes in earnings association net of employment (23% between 1968 and 2006 in the United States).

Some studies that allow distinguish effects of changes in overall employment rates from those in earnings associations do not suffer from this problem as they are based on reweighting methods (Chen et al., 2013; Larrimore, 2014; see DiNardo et al., 1995). However, they include all households rather than just couples: effects can therefore be expected to be smaller due to the presence of other factors (notably, the share of single-adult households). For the United States, Larrimore (2014:692) estimated the contribution of changes in earnings association to be 11% of the increase in the Coefficient of Variation between 1979 and 2007<sup>4</sup>. This estimate is in line with that obtained by Chen and colleagues' (2013:11) decomposition of the Gini coefficient between 1987 and 2004<sup>5</sup>. For Canada, Fortin and Schirle (2006) estimated this contribution to 17% of the increase in earnings standard deviation between 1997 and 1982.

Chen and colleagues' (2013) results for 23 OECD countries indicated that in most countries inequality would have been lower in the 2000s if *only* the correlation in partners earnings had remained at the level it had in the 1980s. The only three exceptions are Czechia, Finland and Hungary. In all cases, effects on inequalities are modest: less than 0.01 point for the vast majority of countries, with a maximum of 0.02 points in Luxembourg. More fundamentally, increases in overall employment rates have had an equalizing effect of a comparable or larger size in all countries (with the exception of the three mentioned ones). It is therefore unclear

<sup>4</sup> Earnings correlation contributed to a 0.06-point increase in the Coefficient of Variation, for an actual increase of 0.56.

<sup>5</sup> Earnings correlation (called "assortative mating") contributed to a 0.005-point increase in the Gini coefficient, for an actual increase of 0.054.

whether it makes sense from a policy perspective to stress the disequalizing effect of increased association without taking into account the parallel equalizing effect of increased female employment rates.

Grotti and Scherer (2016) have introduced a new method based on the decomposition of the Theil index. They concluded that changes in earnings association have had no significant effect in all studied countries between 1985 and 2005 (Denmark, Germany, Italy, United Kingdom and United States). However, their results systematically indicate a very slightly disequalizing effect of changes in the earnings association net of changes in overall employment rates. Since they only break the earnings distribution into quintiles, we cannot rule out that stronger effects would be found if a finer categorization were used.

In our empirical analysis, we adapt Schwartz's (2010) strategy to measure both the combined and separate effects of changes in employment and earnings associations, and apply simulations based on log-linear models to a wide variety of countries. This approach allows us to answer the main questions of our empirical analysis: Are the contributions of changes in the earnings association to earnings inequality between households primarily a byproduct of changes in employment? If not, do results appear primarily driven by who works or by an increasing association in earnings among dual-breadwinner couples? Our log-linear models allow us to determine the relative importance of changes in overall employment rates, changes in the correlations between earnings and partners' employment and changes in the earnings correlation among dual breadwinner couples for inequality between households.

The question whether the changes in earnings association observed over the last decades in many countries are a byproduct of increasing levels of employment is crucial from a policy perspective. If an increasing association in earnings is part of a 'package-deal' with increasing levels of female employment – which have had an equalizing effect – these developments

should be welcomed if the policy goal is to reduce inequality. On the other hand, if changes in earnings association are driven by partners of high-earning individuals increasing employment more than partners of low-earning individuals and/or by an increased association among dual-earner couples, changing earnings associations should be of much more concern.

## **Data and Measures**

We use data from the Luxembourg Income Study for 19 European countries plus Australia, Canada and the United States. The LIS data are harmonized representative cross-sectional surveys that have been used in many key studies on income inequality. Countries are selected based on the availability of data spanning at least more than a decade, and the provision of comparable data on personal labor income. Most countries provide data from the 1980s or early 1990s until the 2010s, but some countries provide longer series (e.g. 1974-2013 for the United Kingdom) and others shorter ones (e.g. 2000-2013 for Greece). For each country-year we select households where the head of household and partner are both between age 30 and 54. Households where the head of household is single and same-sex couples are dropped from the analysis, as we divide couples' earnings into male and female earnings.<sup>6</sup> Table 1 displays the countries selected and the time period covered for each country, as well as the range of the sample sizes for each annual dataset available for a given country. Final sample sizes range across country-years from 440 to 52,000 couples (only 13 datasets out of 163 comprise less than 1,000 observations).

Our main variable of interest is individual labor income (including self-employed income) of the head of household and her or his partner (the *pil* variable in LIS). We disregard labor income of other household members, but keep households in the analysis regardless of their composition. Negative incomes are recoded to zero. In several countries, self-employed income

<sup>6</sup> Households living in overseas regions of France are dropped from the analysis.

is only reported on the household level. In such cases, we split household-level self-employed income evenly across all self-employed individuals in the household. In other datasets, individual self-employed income is recorded to be zero for large parts of the sample and not recorded at the household level either. We therefore exclude all couples in which a self-employed individual has zero labor income (after redistributing household-level self-employed income) from all samples, as these are likely to represent situations of missing information rather than actual zero earnings. Finally, in nine out of 163 datasets, large shares of employed individuals (between 3% and 11%) have zero labor income recorded. For these datasets we exclude all couples in which an employed individual has zero earnings too.<sup>7</sup> To ensure that our final samples still give accurate indications of country-level inequalities we compare estimates of household labor income inequality based on our sample to estimates from Solt (2016) using the same data. These estimates prove to be very consistent (a correlation of 0.97).<sup>8</sup> Household weights provided by LIS are employed in all of the analysis.

7 These datasets are Canada 1981; Hungary 1994; United Kingdom 1986 & 1995; Switzerland 1992; France 1984; Hungary 2009; Netherlands 1983; Poland 1992.

8 See Online Appendix A for a more detailed description of how inequality estimates based on our sample and earnings measure compare to those of Solt (2016).

**Table 1.** Selected datasets and sample size ranges.

Country	Years	<i>N (range)</i>	Country	Years	<i>N (range)</i>
Australia	1985-2010	1,901-4,170	Italy	1987-2014	1,594-3,208
Austria	1994-2013	652-1,652	Luxembourg	1985-2013	594-1,954
Canada	1987-2013	3,588-12,555	Netherlands	1983-2013	1,400-3,531
Czechia	1992-2013	1,150-9,281	Norway	1986-2010	1,681-52,299
Denmark	1987-2013	2,938-20,203	Slovenia	1997-2012	1,075-1,637
Finland	1987-2013	2,722-4,683	Spain	1990-2013	1,532-7,818
France	1978-2010	2,882-3,281	Sweden	1975-2005	3,205-4,443
Germany	1973-2015	1,650-19,880	Switzerland	1982-2013	1,509-2,387
Greece	2000-2013	1,077-1,967	United Kingdom	1974-2013	1,708-7,131
Hungary	1991-2012	440-651	United States	1974-2016	3,316-26,541
Ireland	1994-2010	904-1,651			

Note: N expresses the final (unweighted) number of couples used in the analysis

## Method

We use a decomposition approach based on log-linear models inspired by Schwartz (2010), but with several adjustments in order to separate the effect of changes in employment rates from other changes affecting the earnings association between partners.<sup>9</sup> To this end, we divide the earnings distribution of men and women into twenty equally sized groups based on every 5<sup>th</sup> percentile of the earnings distribution. To these twenty groups we add a specific category for zero earners. We then build for each country-year a 21×21 homogamy table crossing partners' earnings (including zero earnings). The idea behind the decomposition approach developed by

<sup>9</sup> The innovative approach developed by Schwartz (2010) does not allow decomposing the total effect of changes in employment and earnings association on inequalities. The baseline scenario against which contributions of changes in the earnings association are calculated corresponds to a situation in which employment rates would vary over time but no earnings association would exist in any year. This implausible reference does not allow evaluating the effect of fixing employment rates and earnings association to the level observed in the first year. In addition, as explained later, we take the first year observed for each country as the reference period, rather than basing our analysis on a cross-year average, which makes the results insensitive to the addition or exclusion of extra years to the analysis.

Schwartz (2010) is to simulate alternative distributions of households across the cells of the table using log-linear models. These simulated distributions of households are combined with the observed median earnings of women and men in each group to compute a simulated distribution of couples' earnings, defined as the sum of partners' earnings. Inequality for the corresponding country-year is subsequently calculated by computing the Coefficient of Variation on this distribution. Dividing continuous earnings into discrete categories introduces an approximation of levels of inequality, but given the high number of categories used the discrepancy is relatively small. A major advantage of this discretization step is that the association between the earnings of one partner and the employment of the other partner can be described in detail without making any parametric assumptions (contrary to using e.g. the correlation coefficient).

Four nested log-linear models are used to simulate counterfactual distributions across the  $21 \times 21$  table of households for each country. The starting point is a saturated model that corresponds to the observed data (S4; see below). We then progressively add constraints to the models, forcing components of the association to take the values observed in the first year. All models therefore perfectly reproduce the observed level of inequality in the first year, but they are allowed to diverge in subsequent years.

As a first restriction (scenario S3), we fix the association between partners' earnings among dual-earner couples to their value in the first year, but we still allow other components to vary over time: this includes inequality among women and among men, the share of women and men with non-zero earnings, and the association between the earnings of one partner and the employment of the other partner. As a second restriction (scenario S2), we additionally fix the employment-partner's earnings associations for men and women to the value observed in the first year. Finally, in the baseline scenario (S1), we also constrain the proportions of non-zero



earners among women and among men to be the same as in the first year. This scenario implies that both the earnings association and employment rates are the same for all years: only earnings inequalities among women with non-zero earnings and among men with non-zero earnings are allowed to change over time.

The models are based on the following equations. Contrary to standard log-linear modeling practice, time-invariant parameters are fixed to values for the first year rather than freely estimated: this is necessary to ensure that observed data is reproduced exactly for the first year. Noting the counts of couples with men in earnings group  $m$  and women in earnings group  $w$  for year  $t$ :

$$M1: m_{mwt} = \lambda + \lambda_m^M + \lambda_w^W + \lambda_t^T + \lambda_{mw}^{MW}$$

$$M2: M1 + \lambda_{mt}^{MT} + \lambda_{wt}^{WT}$$

$$M3: M2 + \lambda_{mt}^{MW_0T} 1_{w=0} + \lambda_{wt}^{WM_0T} 1_{m=0}$$

$$M4: M3 + \lambda_{mwt}^{MWT}$$

with  $w = 0$  and  $m = 0$  corresponding to situations where the woman or the man (respectively) has zero earnings, and  $1_{w=0}$  and  $1_{m=0}$  indicator functions taking value 1 when the woman or the man (respectively) has zero earnings, and 0 otherwise.

The difference between M4 and M3 indicates the contribution of changes in the earnings correlation among dual breadwinners to inequality, whereas the difference between M3 and M2 quantifies the contribution of changes in the employment-partner's earnings association. This latter component quantifies the impact of unequal changes in employment across society, as

M1 only allows for general changes in the employment rate (i.e. the proportion of zero-earners) for each sex over time. The contribution of both components can be driven by changes in partner selection as well as by unequal changes in labor supply in society. For instance, the earnings correlation among dual-breadwinner couples can go up because partners with a high earnings potential increasingly select each other for partnership or because partners of high earners start working more hours. Both changes in partner selection and unequal changes in labor supply might be of concern for earnings inequality between couples in society and the difference between observed inequality (M4) and simulated inequality (M2) gives an overall indication of the impact of these two processes combined.

The difference between M1 and M2 provides an estimate of how important general changes in employment rates have been. This estimate combines the impact of two mechanical consequences of general changes in employment rates: changes in inequality among women and among men due to changes in the number of zero-earners, and changes in the earnings association between partners due to changes in the proportion of zero-earner and dual-earner couples. In other words, this component indicates to what extent increases in the earnings association due to general changes in employment rates are of concern from an inequality perspective or whether their influence is outweighed by other effects of changing employment rates on inequality (such as their effects on earnings inequality among men and women).

Let us stress that the scenarios considered here do not allow measuring whether inequalities would be higher if women labour force participation was set to zero: our models correspond to a situation in which the employment rate would have remained stable over the period. Likewise, none of our models corresponds to the scenario of a complete absence of association between partners' earnings (i.e. we do not estimate the cross-sectional contribution of earnings similarity), only to the scenario of a stable association over time.

## Results

Table 2 gives an overview of some of the key changes that took place in the countries under study (trends for all countries are displayed in Appendix B). The first column ( $\Delta$ FPL) shows how female labor force participation increased in most countries, with the exceptions of Czech Republic, Finland and Slovakia. In some countries, such as Germany, Luxembourg and the Netherlands, the female employment rate increased by more than 40 percentage points across the period studied. The second column ( $\Delta$ CV) shows how the Coefficient of Variation in earnings between couples changed over time between the first and last year considered in this study: inequality went up in virtually all countries with only a few exceptions.

The third column ( $\Delta$ ECP) shows the percentage point change over time in the correlation between partners' earnings (including zero-earners). The earnings correlation went up in almost all of the countries included, with the exception of Austria, Czech Republic and Slovakia. The most dramatic increases in the earnings correlation are observed in Germany, Luxembourg, Switzerland and the United States (increases of more than 0.2). In principle, this would imply that changes in earnings similarity have increased inequality between households in most countries considered here. However, whether this is a development of concern depends on whether eventual equalizing effects of connected increases in female employment outweighed the impact of increases in the earnings correlation. To investigate this we resort to our decomposition results based on log-linear models.

The remainder of Table 2 gives an overview of how high inequality is simulated to be under the various scenarios considered here. To ease the discussion of these results we categorized the results into five broadly defined patterns. Each of these five patterns will be discussed in turn by presenting the detailed results for a country that best exemplifies that particular situation (in boldface in Table 2).



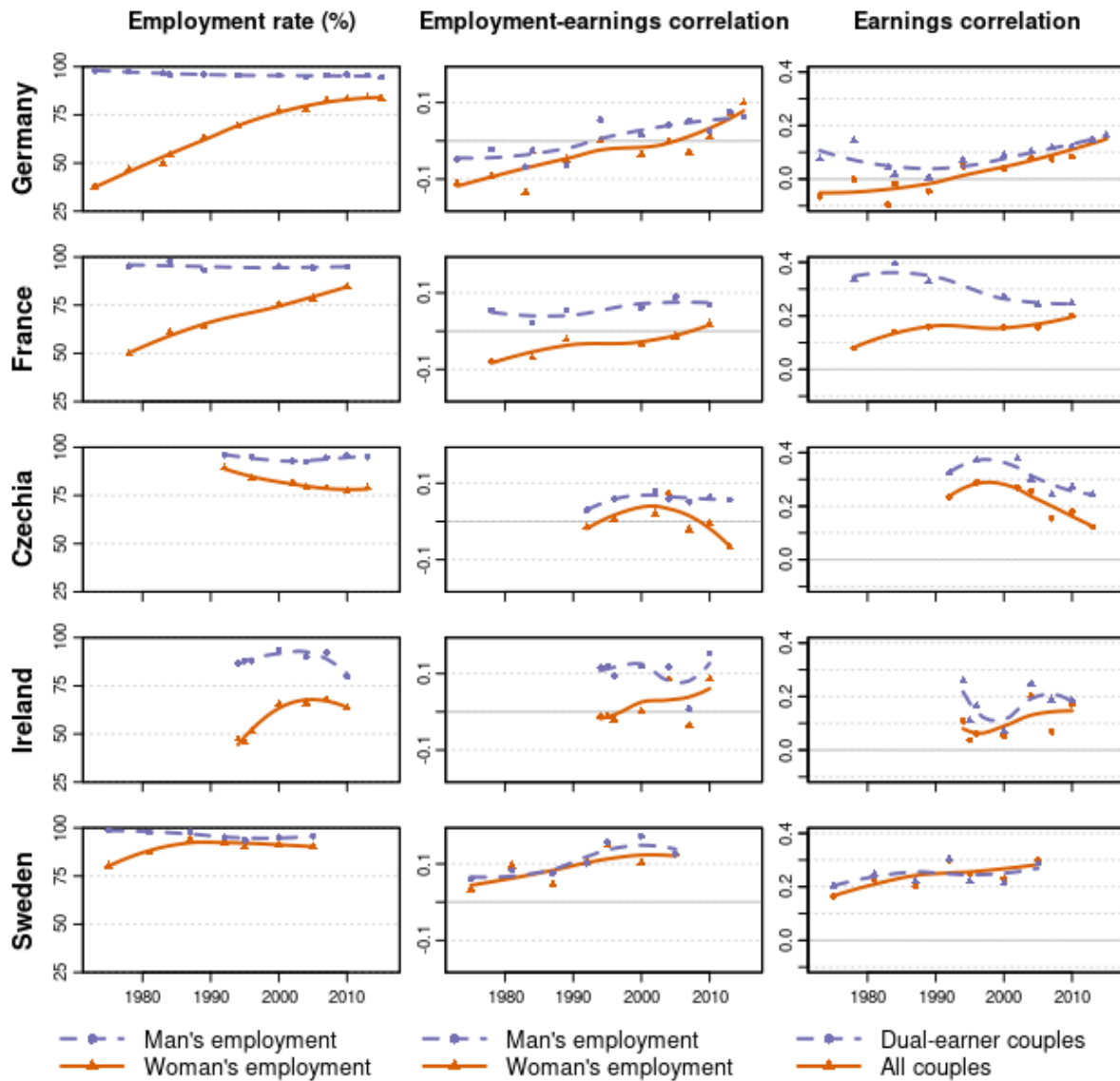
**Table 2.** Overview of changes in earnings correlations, employment and simulated levels of inequality

	$\Delta$ FLP	$\Delta$ CV	$\Delta$ ECP	S4	S3	$\Delta$ 3	S2	$\Delta$ 2	S1	$\Delta$ 1
<b>Pattern 1: (Averages)</b>						<b>-0.04</b>		<b>-0.05</b>		<b>-0.01</b>
<b>Germany</b> 1973-2015	+0.44	0.12	+0.22	0.55	0.54	-0.02	0.51	-0.04	0.55	0.00
Luxembourg 1985-2013	+0.50	0.12	+0.28	0.60	0.57	-0.03	0.57	-0.03	0.63	0.03
Switzerland 1982-2013	+0.38	0.02	+0.22	0.54	0.50	-0.05	0.48	-0.07	0.53	-0.02
United States 1974-2016	+0.20	0.22	+0.20	0.72	0.68	-0.04	0.67	-0.06	0.69	-0.03
<b>Pattern 2: (Averages)</b>						<b>0.01</b>		<b>0.01</b>		<b>0.07</b>
<b>France</b> 1978-2010	+0.35	-0.02	+0.12	0.57	0.58	0.02	0.57	0.00	0.64	0.07
Austria 1994-2013	+0.20	0.06	-0.01	0.58	0.58	0.00	0.57	0.00	0.60	0.03
Netherlands 1983-2013	+0.50	-0.08	+0.01	0.52	0.55	0.03	0.56	0.04	0.67	0.15
Slovenia 1997-2012	+0.05	0.05	+0.06	0.55	0.55	0.00	0.54	-0.01	0.57	0.02
Spain 1990-2013	+0.35	0.15	+0.14	0.76	0.77	0.01	0.78	0.01	0.83	0.07
<b>Pattern 3: (Averages)</b>						<b>-0.01</b>		<b>-0.01</b>		<b>-0.04</b>
<b>Czechia</b> 1992-2013	-0.15	0.16	-0.12	0.56	0.57	0.01	0.57	0.00	0.54	-0.02
Finland 1987-2013	-0.07	0.06	+0.06	0.50	0.51	0.01	0.50	0.00	0.48	-0.02
Hungary 1991-2012	-0.10	0.00	+0.10	0.63	0.58	-0.05	0.60	-0.03	0.56	-0.07
<b>Pattern 4: (Averages)</b>						<b>0.01</b>		<b>-0.01</b>		<b>-0.04</b>
<b>Ireland</b> 1994-2010	+0.20	0.02	+0.07	0.78	0.78	0.00	0.78	0.00	0.78	-0.01
Greece 2000-2013	+0.02	0.15	+0.07	0.74	0.74	0.00	0.74	0.00	0.68	-0.06
Italy 1987-2014	+0.20	0.05	+0.10	0.58	0.61	0.02	0.57	-0.02	0.53	-0.05
<b>Pattern 5: (Averages)</b>						<b>-0.02</b>		<b>-0.03</b>		<b>-0.03</b>
<b>Sweden</b> 1975-2005	+0.10	0.08	+0.09	0.51	0.49	-0.02	0.47	-0.04	0.47	-0.03
Norway 1986-2010	+0.04	0.11	+0.13	0.49	0.47	-0.02	0.45	-0.04	0.44	-0.05
Canada 1987-2013	+0.10	0.08	+0.02	0.61	0.61	0.00	0.59	-0.02	0.60	-0.01
Denmark 1987-2013	+0.04	0.05	+0.13	0.48	0.47	-0.01	0.45	-0.03	0.46	-0.02
United Kingdom 1974-2013	+0.15	0.26	+0.13	0.69	0.66	-0.03	0.66	-0.04	0.64	-0.06
<i>Other</i>										
Australia 1985-2010	+0.10	0.12	+0.02	0.63	0.62	-0.01	0.63	0.00	0.63	0.00

Note.  $\Delta$ ECP = Total change in earnings correlation among partners between first and last year;  $\Delta$ FLP = Absolute change in share of women with non-zero earnings;  $\Delta$ CV= observed change in inequality from first to last year; S4 = observed level of inequality in last year; S3 = simulated level of inequality in last year if earnings correlation among dual-breadwinner couples were to have remained stable; S2 = simulated level of inequality in last year if earnings correlation among dual-breadwinner couples & employment-earnings associations were to have remained stable ; S1 = simulated level of inequality in last year if earnings correlation among dual-breadwinner couples & employment-earnings associations & levels of employment were to have remained stable across study period.  $\Delta$ 1/ $\Delta$ 2/ $\Delta$ 3 = Simulated change in Coefficient of Variation under S1-S3 as compared to observed inequality (S4).



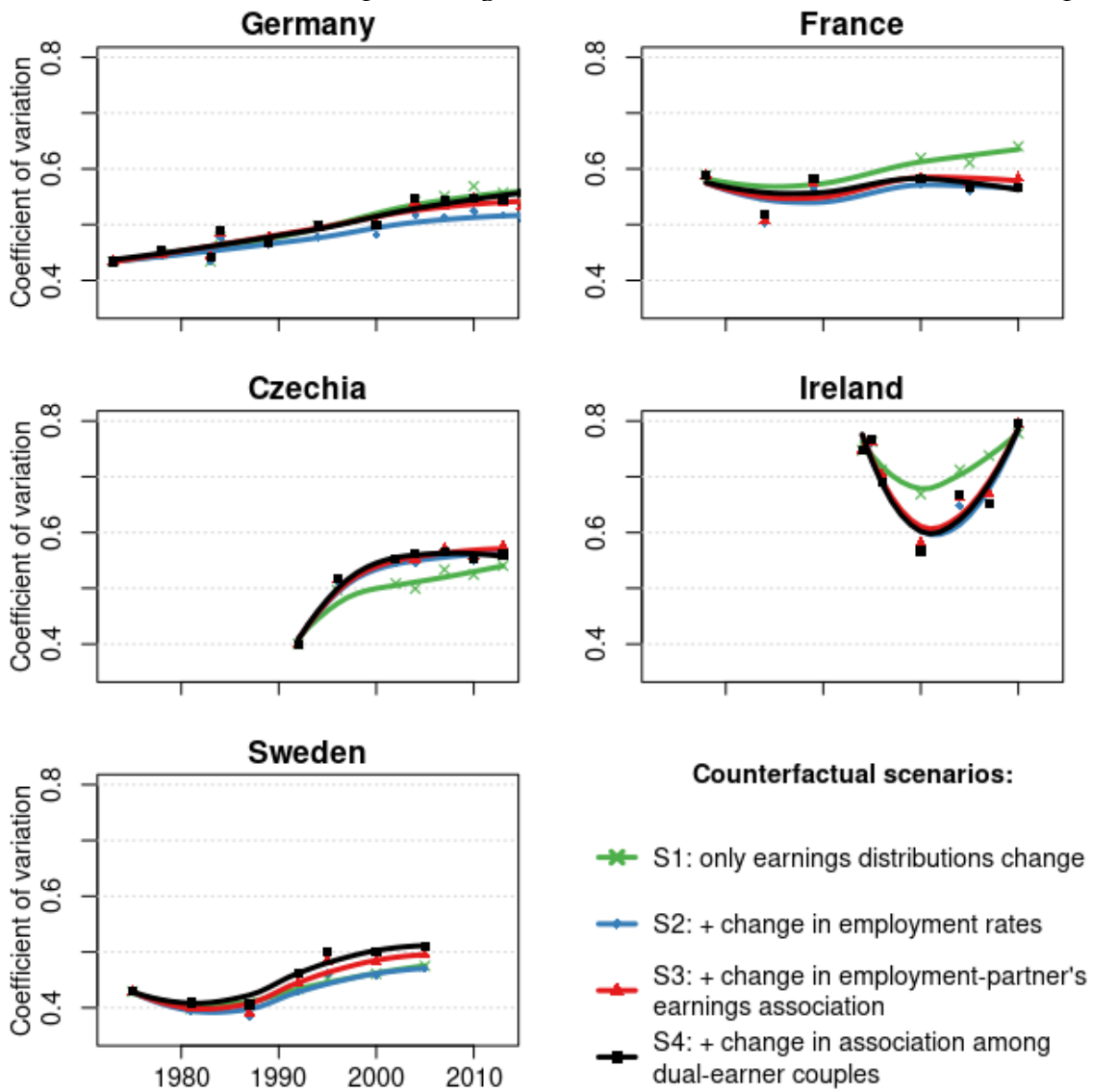
**Figure 1.** Changes in employment rates, employment-earnings associations, and partners' earnings correlations in countries representing five patterns



Source: Luxembourg Income Study

Sample: for employment rates, single individuals and couples where the head of household and partner are both between age 30 and 54; for correlations, couples where the head of household and partner are both between age 30 and 54

**Figure 2.** Coefficient of Variation of couples earnings under counterfactual scenarios for countries representing five patterns



Source: Luxembourg Income Study

Sample: couples where the head of household and partner are both between age 30 and 54



## **Pattern 1: Equalizing employment changes countered by increase in earnings association**

The first pattern discussed is exemplified by Germany, which appeared similar in its results to Switzerland and the United States. The first row of Figure 1 illustrates the most important changes that took place in Germany. Female employment increased dramatically, but these changes have not been equal across society: the employment-earnings association used to be negative in the 1970s, but it turned positive in the 2000s, implying that men and women whose partners have the highest earnings are now more frequently employed. The earnings correlation increased over time in general and so did the earnings correlation among dual-breadwinner couples.

The first panel in Figure 2 displays the results of the decomposition analysis based on simulating levels of inequality for Germany under various scenarios (inequality levels for all countries in the final year under each scenario are reported in Table 2; Figures are presented for all countries and years in Appendix C). The black line corresponds to observed inequality (S4). The red line indicates a scenario where only the earnings association among dual-breadwinner couples is simulated to not have changed over time (S3), whereas all other components are allowed to change as observed. In other words, the difference between the red and black lines indicates the estimated contribution of changes in the earnings correlation among dual-breadwinner couples to inequality. As visible in Figure 2 the inequality trend depicted by the red line is located very slightly below observed inequality (black line). Inequality in 2015 were to be 0.02 points (or 3%) lower if the earnings association among dual-breadwinner couples would be as in 1973.

The scenario represented by the blue line in Figure 2 (S2) also holds constant the employment-

earnings association over time (i.e. on top of holding the earnings association among dual-breadwinners constant). The numbers show that unequal changes in employment according to partners' earnings are also estimated to have amplified inequality. If the two components considered so far had not changed over time, inequality would have been 0.04 points lower in 2015 as observed (or 7%).

Finally, if employment had also remained stable (green line, S1), inequality would have been roughly as high as observed inequality across the period studied. This suggests that the equalizing effect of increases in female employment has cancelled out the inequality-amplifying effects of the other two components in the case of Germany.

The results are similar for Switzerland and the United States where increases in employment also equalized earnings across couples. However, inequality would have been respectively 0.02 and 0.03 points (or 3% and 5%) lower than observed if both employment rates and changes in the earnings association had not changed over time. In other words, the equalizing effects of increased employment have not been large enough to cancel out the inequality-amplifying impact of the other processes at play.

## **Pattern 2: Equalizing employment changes, earnings association of little importance**

The second pattern we discuss is the one exemplified by France, which is similar to Austria and Spain, and to a lesser extent to Luxembourg and Slovenia. In France, as in Germany, both female employment rates and the earnings correlation between partners increased over time (Figure 1). But contrary to Germany, the earnings correlation was already positive in France in 1978, and it increased only moderately. The employment-earnings correlation also increased less markedly, which was primarily driven by a rise in employment of women with high-earning partners, rather than to a decline in the employment of women with low-earning partners as in Germany (not shown). Moreover, the earnings correlation among dual-earner couples decreased.

In line with these trends, the decomposition analysis for France indicates that the scenarios in which the association among dual-earners and the employment-earnings associations are fixed across time (red and blue lines) are both very similar to observed trends in inequality (Figure 2). This shows that unequal changes in employment had virtually no impact on inequality; the same can be concluded for the decreases in the earnings association among dual-breadwinner couples.

Once simulating a situation where employment would also have remained stable over time (green line), we see that inequality would have increased more than the observed trend by 0.07 points (or 13% of the level of inequality in 2010). Hence, changes in earnings similarity over time, including general changes in employment rates, actually came with a more equal distribution of earnings across households. General changes in employment increased the earnings correlation among couples in France, but given the stronger equalizing effect of

increases in female employment (through reductions in earnings inequality among women) this is a “package-deal” that is to be welcomed from an inequality perspective.

These trends have been very similar in Spain and Austria (inequality decreased by 0.07 and 0.03 points, or 9% and 5%, respectively, due to changes in employment primarily). In the Netherlands, the equalizing effect is even more pronounced (inequality lower by 0.15 points, or 29%), since the earnings correlation has remained very close to zero over the whole period.

### **Pattern 3: Dinequalizing employment, earnings association of little importance**

So far, all patterns presented referred to contexts where female employment rates increased. In the Czech Republic female employment was at high levels in 1992, but decreased over time (Figure 1). While until 2002 the correlation between women’s employment and their partner’s earnings increased somewhat, it has decreased in recent years, indicating that women whose partners have the highest earnings have withdrawn from the labor market. These two trends have caused a decrease in the earnings correlation overall. However, the decomposition analysis (Figure 2) shows that these trends have barely impacted levels of inequality: fixing the earnings association among dual-breadwinner couples (red line) and employment-earnings associations (blue line) does not lead to a clear difference compared with observed inequality (black line). On the contrary, keeping the employment rate stable too (green line) predicts a decrease in inequalities by 0.02 points (or 4%). This scenario is therefore similar to the one observed for France, but going back in time, with an inequality-amplifying rather than equalizing effect of changes in employment. Even though the earnings correlation decreased over time in Czech Republic, its equalizing effect was limited, and once considering changes in employment, an inequality-amplifying contribution is observed.

Other countries that experienced similar scenarios are Finland and to a lesser extent Hungary (Table 2). In all three countries employment changes increased inequality, but while in Czechia and Finland other changes besides employment rates had little impact on inequality, in Hungary there were additional inequality-amplifying effects of increases in the earnings correlation among dual-breadwinner couples.

#### **Pattern 4: Decreases in employment after the financial crisis amplify inequality**

The fourth group has a relatively similar final outcome as compared to Czechia: employment changes amplified inequality. However, the trajectory to this final outcome is very different from pattern 3, as exemplified by Ireland. Contrary to the relatively steady decreases in employment observed in pattern 3, female employment was increasing until the 2008 economic crisis and decreased inequality in Ireland (Figure 1; see also Callan et al., 1998). However, decreases in both female and male employment following after the crisis reversed this trend and amplified inequality and -. Earnings-employment associations and the earnings association among dual-breadwinner couples increased slightly over time, but are estimated to have had little impact on inequality . A similar scenario unfolded in Greece, which was hit hard by the financial crisis. Italy followed a slightly different path: there male employment decreased only moderately, and female employment stopped increasing after 2008 but did not really decrease. Spain shares some traits with this pattern, but the increase in female employment since 1990 has been so large that it has completely canceled out the consequences of the crisis on male and female employment. Let us also note that employment rates have increased significantly for both sexes in these countries since the last year covered by the LIS data, though without reaching their pre-2008 levels.

### **Pattern 5: Employment high and stable, earnings association amplifies inequality**

The final pattern discussed is one that unfolded in countries where employment for men and women was high at the start of the period and changed relatively little across the period: Sweden, Norway, Denmark, Canada and the United Kingdom. Changes in employment rates per se can therefore only play a minor role in these contexts. Figure 2 confirms this expectation for Sweden: the green line simulating no changes in employment over time overlaps with the blue line where employment rates are allowed to vary (but the employment-earnings association is held constant). At the same time, the employment-earnings association increased for both sexes (Figure 1) due to decreases in employment rates of individuals with low-earning partners since the 1990s (not shown). The earnings correlation among dual breadwinners also increased (Figure 1). These changes in who is employed (blue line) and in the correlation among dual breadwinners (red line) are simulated to have increased inequality between couples over time. Inequality would have been 0.04 points (or 8%) lower than observed inequality (black line) by the end of the period if both components had remained stable over time. This corresponds to 51% of the increases in earnings inequality between households observed across the period in Sweden. Given the absence of major changes in the overall level of employment in Sweden, the increasing earnings correlation translates directly into an inequality-amplifying effect. Given the relative irrelevance of changes in employment levels, this conclusion holds regardless of whether one sees earnings similarity as including or net of changes in employment rates. The inequality-amplifying effects of changes in earnings similarity in the other countries within this group range from 2% in Canada to 3% in Denmark and 4% in Sweden, Norway and the United Kingdom.

## **Are changes in earnings correlations of concern for inequality between couples?**

The results presented here show a large variety of situations across countries. Even though the earnings correlation increased in almost all countries, this appeared to be of concern for inequality between couples only in a subset of these countries. As illustrated by the case of France, increases in employment rates equalize earnings across households, but come together with increased earnings correlations, even if employment changes are distributed relatively evenly across partner earnings levels. Increasing earnings correlations might therefore not necessarily be of concern for inequality. In fact, estimating the joint contribution of changes in earnings correlations and changes in employment rates led to the conclusion that they helped reducing inequality in 6 out of 21 countries (see last column of Table 2). In these countries, inequality would have been between 4% (Slovenia) and 29% (Netherlands) higher if both components were to have remained stable over time. In three countries (Germany, Switzerland and the United States) increases in female employment also clearly reduced inequality between households, but unequal changes in employment according to partners' earnings and increases in the earnings correlation among dual-breadwinner couples cancelled out this equalizing development. These two disequalizing trends also took place in 7 other countries (Canada, Denmark, Hungary, Italy, Norway, Sweden, UK), but in these countries there were no increases in employment rates to cancel out their effects. In two of these countries, Hungary and Italy, changes in employment rates decreased and further amplified inequality between households. The largest contributions of changes in earnings similarity (including changes in employment rates) to inequality were observed there: 12% and 9%, respectively. In the other countries, changes in the earnings association are estimated to have increased inequality between 2% (Canada) and 9% (Norway), and this conclusion holds regardless of whether one accounts for

changes in employment rates or not.

## Discussion

Did changes in earnings similarity over time contribute to earnings inequality between couples? There are two ways of interpreting this question, which lead to slightly different answers. One interpretation is to see changes in employment rates as inseparable from changes in the earnings correlation. Another interpretation is to consider both separately, and to estimate the contribution of changes in the earnings association *net of* changes in employment rates. In our analysis, we relied on a decomposition approach based on log-linear models to answer the question using both possible interpretations for 21 countries using data from the Luxembourg Income Study. Depending on whether one considers employment changes to be part of changes in earnings similarity or not, changes in earnings similarity increased inequality between couples in 13 to 14 out of 21 countries, with contributions ranging from 1% to 12% of inequality at the end of the observation period. At the same time, despite increasing earnings correlations observed in most of the remaining countries, changes in the earnings association were estimated to have reduced inequality in 5 to 6 countries (depending on whether changes in employment rates are considered or not).

We have argued that it is not correct to consider changes in employment rates separately from changes in the earnings association. Increases in employment rates almost ‘mechanically’ increase the number of dual-breadwinner couples, which implies a higher association between partners’ earnings (including zero earners). Simulating a scenario where the earnings association changes but employment rates do not therefore has little practical relevance. We aimed to address this problem by decomposing the joint contribution of changes in the earnings association *and* changes in employment rates to inequality into three parts: 1) a part



due to changes in the correlation in earnings among dual-breadwinner couples; 2) a part due to changes in the correlation between earnings and partners' employment status; 3) a part due to changes in the overall employment rates. The impact of the first two components is likely to be driven by either changes in partner selection or by unequal changes in labor supply. These changes are likely to be of concern from an inequality perspective as they directly lead to a less equal distribution of earnings across households. The impact of the third component, changes in employment rates, combines that of changes in the earnings association due to changes in the proportions of dual-breadwinner and zero-earner couples on the one hand, and of changes in earnings inequality among men and women on the other hand. Previous research has documented that these two effects normally go in opposite directions and that the effects of the latter development generally dominate over that of the first (Bouchet-Valat, 2017; Cancian & Reed, 1999; Cancian & Schoeni, 1998; Kollmeyer, 2013; Nieuwenhuis et al., 2017). When employment rates increase over time, the partners' earnings association increases too. But, this is generally not concerning for inequality as equalizing effects of concomitant decreases in earnings inequality among women or men cancel out this impact.

This was a situation we observed in France, Spain and Austria, and even more clearly in the Netherlands. The estimated contribution of changes in the earnings correlation among dual-breadwinner couples and employment-earnings associations was negligible despite considerable increases in the earnings correlation in Spain and France. But overall, if employment rates had remained stable across time, inequality would have been between 5% (Austria) and a staggering 29% (Netherlands) higher than observed. The observed increases in the earnings association are therefore not of concern for inequality in these countries. In fact, they are to be welcomed as they are "mechanically" connected to equalizing effects of increases in employment rates over time.

In contrast, the opposite scenario unfolded in some other countries. Even though the correlation between partners' earnings decreased in Czech Republic and Finland, it was accompanied by reductions in employment rates, and hence related overall to an increase in inequality of 4% to 5% compared to what would have happened in the absence of changes in employment and earnings associations. Decreasing earnings associations are therefore also not always a welcome development for levels of inequality. In Hungary, the decline in employment was compounded by an increased earnings correlation among dual breadwinners, leading to an inequality-amplifying effect of 12%.

Equalizing effects of changes in employment were observed in several other countries, but in these cases increases in employment were less equally distributed across society or earnings of partners in dual-breadwinner couples. The equalizing effects of employment were large, but fell short of cancelling out these inequality-amplifying processes in Germany, Switzerland and the United States (even though they did in Luxembourg and Slovenia). These inequality-amplifying processes therefore appear of most concern for inequality in our study. This is seen most clearly in a group of countries where employment was already high and did not change much over time. In Sweden, Norway, Denmark, Canada and the United Kingdom the earnings association increased relatively strongly despite only modest or nonexistent increases in employment rates. In these countries, the earnings correlation among dual-breadwinner couples increased and employment become more stratified according to partners' earnings. Both processes combined increased inequality between couples by 2% to 4% of its observed level in the recent years.

Changes in the earnings association among dual-breadwinner couples and changes in employment-partner earnings associations are therefore important processes driving up inequality between couples in a significant group of countries. In some countries these processes directly translated into higher inequality, in other countries they cancelled out the

equalizing effects of increases in employment rates. How important were these two processes across all the countries studied? And what drives these processes in the countries studied here?

In around half of the countries, changes in the earnings association among dual-breadwinner couples increased inequality between households. This might be the result of various processes including changes in partner selection, changes in hours worked or changes in hourly wages earned by employed men and women. In their analysis of the United States Gonalons-Pons and Schwartz (2017) pointed at hours worked as the primary responsible for increases in the earnings association across time. Future research could investigate whether this is also the case in the other ten countries where increases in the earnings association among dual-breadwinner couples amplified inequality. At the same time changes in the earnings association among dual-breadwinner couples had an equalizing effect over time in six countries. This suggests that answers should not be sought for in a universal force driving trends in the earnings association among dual-breadwinner couples upward. The answer is likely to lie in country-specific changes in access to careers for women and/or changes in partner selection. Changes in employment may also exert an indirect effect by moving in or out of the labor market individuals (mainly women) whose earning potential is much lower than that of their partner.

A second process contributing to inequality in many countries consists of changes in the employment-earnings associations over time. However, even if the contribution of this process amplified inequality in most countries (i.e. once comparing the results of S2 to those of S3), this effect is generally quite limited. In 5 countries did changes in employment-earnings associations actually (very slightly) reduce inequality: Spain, Luxembourg, the Netherlands, Hungary and Australia. Therefore, the relatively uniform trend observed across countries that increases in employment have been more pronounced among women whose partners earn

more (see also Chen et al., 2013) is not a main driver for increased inequality between couples in the vast majority of countries. It might seem surprising that the Scandinavian countries, known for providing a good work-life balance to families, are among the countries where this component contributes the most to increased inequality between couples (the differences between scenarios S3 and S2 displayed in Table 3 are between 3% and 5% of inequality levels in the last year in Norway and Sweden, but zero in Norway). It could very well be that in countries where female employment reaches a high level, employment changes are more likely to depend on macro-economic conditions rather than changes in individual decisions regarding the division of labor. An open question is therefore whether this is a scenario that can be expected to be observed in other countries too as female employment reaches high levels in more contexts.

How do the results presented here compare to earlier research that has considered earnings homogeneity as the earnings association net of changes in employment? Comparisons with Schwartz (2010) must be done with care since contrary to her analysis we considered that it does not make sense to measure the effect on inequality of changes in overall employment rates when assuming the absence of any earnings association changes in . However, it is possible to compare results regarding the contribution to inequality of changes in the employment-partner earnings association and of changes in the association among dual-earner couples (our scenario 2). Schwartz estimated that these two factors contributed to 23% of the total increase in the Coefficient of Variation in the United States between 1968 and 2006. Our corresponding estimates are very close: 24% for the period 1974-2016, and 26% for the period 1974-2007. We also confirm that increases in the association among dual-earner couples account for the most part of the change (scenario 3). On the contrary, the different decomposition approach we developed provides a quite different estimate of the overall contribution of changes in

employment and in partners' earnings association: 10% for the 1974-2016 period, and 8% for the 1974-2007 period, to contrast with Schwartz's estimate of 29% for the 1968-2006 period. The difference between these is due to our scenarios taking as a reference the association observed in the first year, rather than assuming the absence of any association as Schwartz does in her baseline model. We give preference to our estimate, as it corresponds to a meaningful counterfactual, namely how high would inequality be employment and association between partners' earnings had remained stable (Cancian & Reed, 1999).

Like Larrimore (2014), we also note that changes in female employment and in the employment-partner's earnings association have become disequalizing in the United States in the 2000s. This explains the overall disequalizing effect of combined changes in employment and in earnings association that we noted above, which has only appeared around 2007 and accounts for most of the increase in between-couple inequality since then. However, at the end of the observed period (2013), increases in the earnings association among dual-earner couples appears to be driving most of the disequalizing trend.

Contrary to Grotti and Scherer (2016), we have observed clear (although limited) effects of changes in earnings association on inequalities. One reason for the discrepancy between their results and the rest of the literature is their reliance on earnings quintiles, which may mask most of the disequalizing impact of earnings associations. The very small effects they observe are disequalizing, and therefore point in the same direction as our results (scenario 2) for the countries they consider (Denmark, Germany, Italy, United Kingdom and United States).

Results for other countries are less comparable to earlier research, as most of it is based on the decomposition of the Coefficient of Variation. While informative, such approaches do not take into account changes in specific patterns of earnings association and do not filter out all effects of general changes in employment on the earnings correlation between partners.

To conclude, do changes in earnings homogamy matter for inequality between couples? Previous research based on simulations where partners are matched at random indicated that the cross-sectional contribution of earnings association to inequality is small to negligible (Greenwood et al., 2014 with corrigendum; Hryshko et al., 2017; Kuhn & Ravazzini, 2017). In our literature review, we argued that such results are informative but do not necessarily imply that changes in assortative mating cannot lead to changes in inequality over time. As earnings correlations are relatively weak in many countries, but are also increasing, comparing the current situation to a situation of random matching is not ideal to evaluate the potential impact earnings association could have in the future. In line with this argument, our analysis of 21 countries shows that concerns of increasing earnings correlations contributing to inequality between households are partly valid. In 8 out of 21 countries inequality would be more than 5% lower if the earnings association, net of changes in employment, had remained constant over time.

At the same time, increases in earnings correlations, observed in all but 3 countries studied here, are not necessarily a concern from a policy perspective. In many cases, changes in earnings correlations appeared connected to general changes in levels of employment. Given that increases in employment are related to lower inequality, increases in earnings correlations resulting from such trends were of little concern in such countries. This shows that there is no universal trend of changes in earnings homogamy increasing equality between households over time. The task for future research is to take a closer look under which conditions different scenarios are likely to evolve.

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**Appendix** to “*Are increasing earnings correlations between partners of concern to inequality? A comparative study of 21 countries*”

**Online Appendix A.** Measuring earnings and selection of datasets.

To determine the suitability of datasets we first inspected the earnings of employed and self-employed individuals. As mentioned in the main text, we found some suspiciously high shares of (self) employed individuals reporting no individual earnings in many countries. On further inspection, we found that in several countries, self-employed income is only reported on the household level and individual earnings were therefore set at 0 for self-employed individuals with no other sources of income. In such cases, we split household-level self-employed income evenly across all self-employed individuals in the household.

In other datasets, individual self-employed income was recorded to be zero for large parts of the sample and not recorded at the household level either. We therefore exclude all couples in which a self-employed individual has zero labor income (after redistributing household-level self-employed income) from all samples, as these are likely to represent situations of missing information rather than actual zero earnings.

Finally, in nine out of 163 datasets, large shares of employed individuals (between 3% and 11%) have zero labor income recorded. For these datasets we exclude all couples in which an employed individual has zero earnings too. These datasets are Canada 1981; Hungary 1994; United Kingdom 1986 & 1995; Switzerland 1992; France 1984; Hungary 2009; Netherlands 1983; Poland 1992. After applying these corrections, there were still several datasets for which we could not reproduce employment rates or inequality trends as found in other sources well, and we therefore decided to exclude them. These excluded datasets are: Australia 1989, Belgium 1992-2000; Canada 1981; Spain 1995; Hungary 1994; Hungary 2009; Luxembourg 1997; Netherlands 1993; Norway 1979; Norway 2013; Poland 1992-2013; Slovakia 1992-2013; United Kingdom 1995. In some cases these discrepancies were produced by small sample sizes, such as the Hungarian datasets.

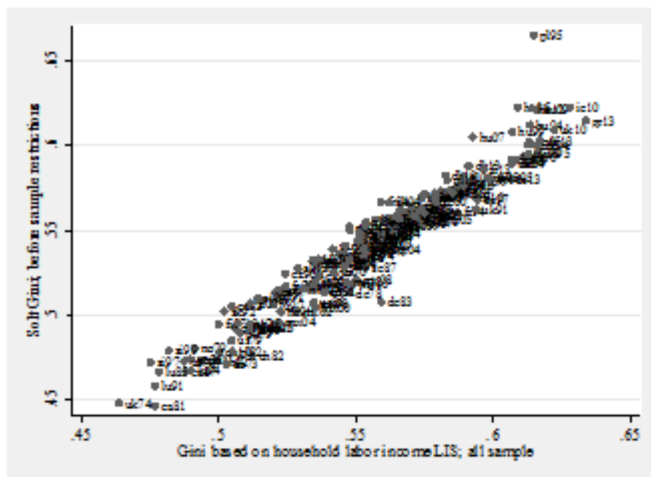
To double check whether our final measure of individual earnings and sample produced inequality estimates in line with those of inequality estimates from LIS data based on household-level earnings, we compared estimates of inequality with more consolidated estimates of inequality provided by Solt (2016).

Solt provides in the SWIID database (available at <https://fsolt.org/swiid/>) estimates of household level market income inequality based on various data sources, including LIS. Our estimates of inequality differ on various aspects:

- 1) Market income in Solt's estimates includes labour income, capital income and private transfers received by the household. Our measure of earnings excludes capital income and private transfers.
- 2) We set negative incomes at zero.
- 3) We exclude households with at least one self-employed individual without earnings recorded.
- 4) For 9 datasets, we exclude households with at least one employed individual without recorded earnings.

These four decisions were relatively inconsequential for inequality estimates. Figure A1 displays a scatterplot of estimates of inequality from Solt as compared to estimates of inequality based on household level labor income (*hil* in (old) LIS) after applying these 4 adjustments. The correlation between estimates is 0.97. The outlier is Poland 1995 (a country excluded due to our inability to reproduce consistent estimates of employment trends and inequality trends).

**Figure A1.** Comparison of Solt (2016) inequality estimates of household market income, with inequality estimates of household labor income after making adjustments 2-4

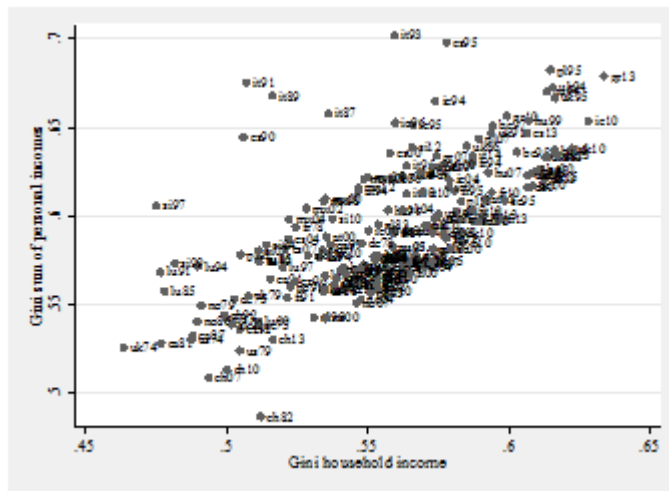


*From household to individual income*

More consequential is the switch from estimates of household level labour income as provided by LIS, to estimates of household level labour income based on summing the individual incomes of the head of household and her/his partner. Figure A2 shows the correlation between

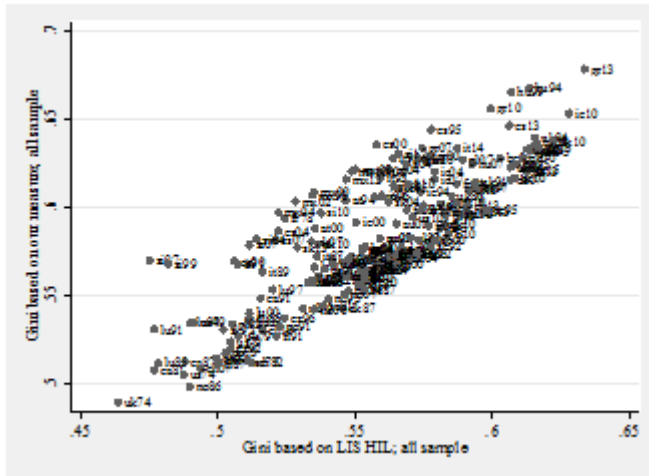
inequality in household labor income as provided by LIS, and inequality estimates based on summing the earnings of the head of household and her/his partner. The correlation is 0.66.

**Figure A2.** Comparison of inequality estimates of household labor income after making adjustments 2-4, to estimates of inequality based on summing personal earnings of head of household & partner



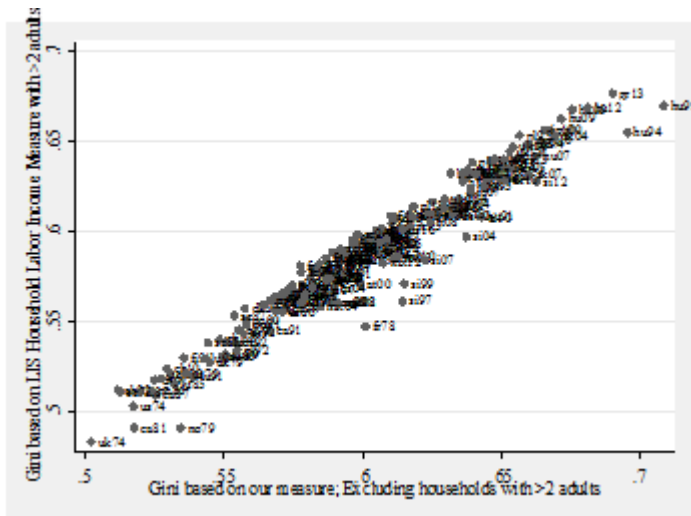
A further adjustment we made was to “redistribute” household-level self-employed income across self-employed individuals in a given household, if individual level self-employed income was not recorded. Figure A3 shows how this adjustment made inequality more comparable to those based on household level labor income (correlation 0.83).

**Figure A3.** Comparison inequality estimates of household labor income after making adjustments 2-4, to estimates of inequality based on summing personal earnings of head of household & partner and redistributing household self-employed income.



A final difference that explains these remaining differences between our estimates and those based on household labor income as provided by LIS is that we only look at earnings of the head of household and partner, and therefore ignore earnings from other household members. Once restricting the sample to households with at most two adults for both measures, inequality estimates become more comparable as shown in Figure A4 (correlation of 0.97). This increases our confidence that our final sample and measures used produce inequality estimates relatively congruent with earlier research.

**Figure A4.** Comparison of inequality estimates of household labor income after making adjustments 2-4 but excluding households with more than two adults, to estimates of inequality based on summing personal earnings of head of household & partner and redistributing household self-employed income & excluding household with more than two adults



*Exclusion of countries and datasets:*

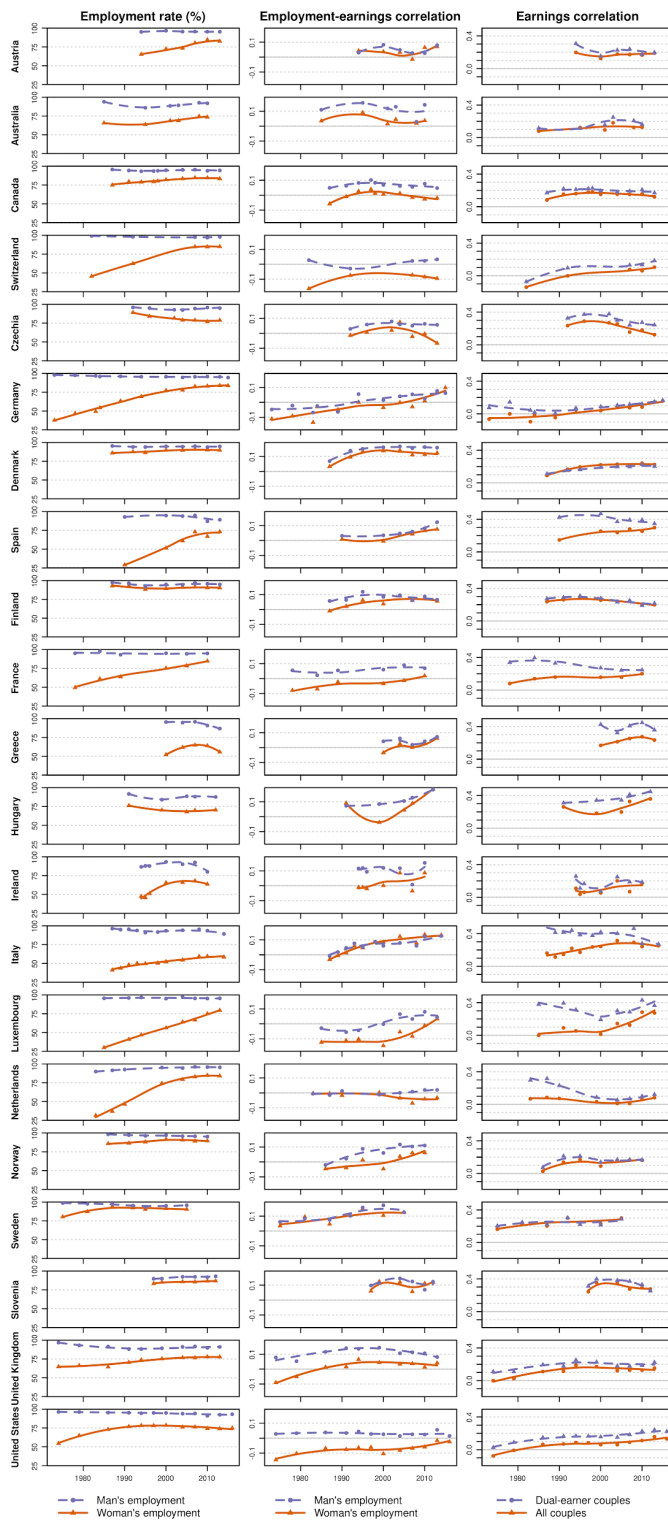
For this paper we selected all datasets available in the LIS database for EU-countries as well as Australia, Canada, and the United States. Requirements for inclusion were a data series spanning at least more than a decade, providing comparable measures of individual earnings across time, and including a sufficiently large sample size.

Several datasets were excluded from the analysis because estimated trends in employment or inequality deviated too much from other external sources, or because trends appeared unreliable, for instance, due to small sample sizes. In some cases, the exclusion of such datasets led to very short time periods covered for given countries. We excluded data from Belgium, Estonia, Poland and Slovakia after taking into account these considerations.

Our final list of datasets included is (LIS abbreviations): at94 at00 at04 at07 at10 at13 au85 au95 au01 au03 au08 au10 ca87 ca91 ca94 ca97 ca98 ca00 ca04 ca07 ca10 ca13 ch82 ch92 ch07 ch10 ch13 cz92 cz96 cz02 cz04 cz07 cz10 cz13 de73 de78 de83 de84 de89 de94 de00 de04 de07 de10 de13 de15 dk87 dk92 dk95 dk00 dk04 dk07 dk10 dk13 es90 es00 es04 es07 es10 es13 fi87 fi91 fi95 fi00 fi04 fi07 fi10 fi13 fr78 fr84 fr89 fr00 fr05 fr10 gr00 gr04 gr07 gr10 gr13 hu91 hu99 hu05 hu07 hu12 ie94 ie95 ie96 ie00 ie04 ie07 ie10 it87 it89 it91 it93 it95 it98 it00 it04 it08 it10 it14 lu85 lu91 lu94 lu00 lu04 lu07 lu10 lu13 nl83 nl87 nl90 nl99 nl04 nl07 nl10 nl13 no86 no91 no95 no00 no04 no07 no10 se75 se81 se87 se92 se95 se00 se05 si97 si99 si04 si07 si10 si12 uk74 uk79 uk86 uk91 uk94 uk99 uk04 uk07 uk10 uk13 us74 us79 us86 us91 us94 us97 us00 us04 us07 us10 us13 us16

## Online Appendix B. Results for all countries.

**Figure A5.** Changes in employment rates, employment-earnings associations, and partners' earnings correlations in all countries





**Figure A6.** Coefficient of Variation of couples earnings under counterfactual scenarios for all countries

