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DISCUSSION PAPER SERIES

IZA DP No. 13425

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ISSN: 2365-9793

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ABSTRACT

Labour Force Participation and Job Polarization: Evidence from Europe during the Great Recession*

We document how differences in labour demand by gender explain the contrasting evolutions of labour force participation between men and women during the Great Recession in Europe. We first highlight that Europe is characterized by high levels of occupational segregation by gender. As a result, the large job losses in middle-paid occupations during the Great Recession affected male workers disproportionally. In contrast, the fact that higher- and lower-paid occupations were less affected was more favourable to women. Using individual panel data, we investigate how the labour force participation and regional mobility of men and women responded to these shocks. We find that the labour force participation of women increased considerably in the regions most affected by the destruction of men's jobs and with relatively higher labour demand in occupations more likely to employ women. Women with higher levels of education were also more likely to move to regions with higher labour demand in these occupations. We find that not considering the mobility of women with higher education levels can bias the estimates of the impact of labour demand shocks on participation. For men, unemployment increased in response to regional declines in male labour demand. However, regional shocks explain none of the decline in male labour force participation.

JEL Classification: J21, J23, J24

Keywords: labor force participation, Great Recession, job polarization

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* A revised version of this paper is forthcoming in *Labour Economics*. We thank the Eurostat for having made the data available. The data used in this paper are available to researchers upon request from Eurostat. The results and conclusions are ours and not those of Eurostat, the European Commission or any of the national statistical authorities whose data have been used. We thank two anonymous reviewers, Hélène Périvier and seminar participants at SOLE 2017, Université Paris Saclay, Evry, the OFCE and the Rencontres d'Aussois for insights that helped to shape the paper. This research was supported by the French Agence Nationale de la Recherche (ANR-16-FASI-0001 and ANR-11-IDEX-0003-02).

Introduction

Understanding what drives labour force participation is of prime importance for policy makers and economists. Labour force participation measures the amount of labour available for production in a country. As it directly influences the potential growth of the economy, it is a key indicator of the health of the labour market.

Labour force participation received renewed attention during the Great Recession, when participation rates varied widely across OECD countries.[1] Interestingly, while the unemployment rate increased almost everywhere, the evolution of participation rates diverged widely between Europe and the US. In the US, the labour force participation rate of prime-age adults declined by 2 p.p. between 2007 and 2013. In contrast, in the EU15, participation *increased* by 2 p.p. over the same period despite growing unemployment.[2] This increase in participation in Europe was almost entirely concentrated among females. Whereas in the US, the participation rate of prime age women decreased by 1.4 p.p. from 2007–2013, it *increased* by 8 p.p. in Spain, by 5 p.p. in Greece and by between 4 and 2 p.p. in Portugal, Austria, Italy and the UK, despite these economies plunging into a severe recession.

We investigate in this paper what explains this rapid and spectacular evolution of participation rates in Europe during the Great Recession. While many studies document how changes in social norms and attitudes starting long before the Great Recession contributed to increasing the participation of women (see e.g. Bertrand et al., 2016, or Fernández, 2013), our paper highlights the contribution of gender-specific shifts in labour demand during the Great Recession. We report that the decline in labour demand during the Great Recession appears to have been much more unfavourable to men

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[1] See Aaronson et al. (2014) for the US or Perivier (2018) for Europe.

[2] In the US the labour force participation of individuals aged 25 to 54 fell from 83 to 81% (Hall and Petrosky-Nadeau, 2016) while in the EU15 it grew from 83.7 to 85.6%.

relative to women in Europe compared with the US. As a consequence, we document that changes in relative labour demand can explain a large share of the increase in participation of women during that period, in particular in the countries most affected by the recession.

Using individual-level data from ten European countries, we first document that as in the US (Foote and Ryan, 2015; Jaimovich and Siu, 2012), job polarization (which denotes the reallocation of employment towards the lowest- and highest-paying occupations) continued to increase during the Great Recession in Europe as the share of jobs in middle-paid occupations in total employment declined rapidly in the most affected countries. However, a key difference from the US is that even today men and women remain much more segregated by gender across occupations in Europe and that these higher segregation levels declined neither in recent decades nor during the Great Recession. In particular, as of 2013, middle-paid routine jobs, which were strongly affected by the recession, remained 20% more likely to employ male workers in Europe than in the US. In contrast, low- and high-paid occupations, which were much less affected by the recession, employed a much larger share of female workers. Thus, these figures suggest that the large destruction of middle-skill jobs produced a much more dramatic decline in the labour market opportunities of men in Europe than those in the US, whereas the fact that the lowest- and highest-paying occupations were less affected was more favourable to women.

To quantify how much these differences in labour demand shocks by gender influenced the decision of women to join the labour market and explain their increase in participation during the Great Recession, we follow recent work and adopt a local labour market strategy.[3] Specifically, we relate regional changes in labour force participation by gender to local changes in male and female employment. However, changes in employment by gender are endogenous, as they are influenced not only by labour demand shocks but also by labour supply and participation decisions. To isolate labour demand shocks, we construct two shift-share or Bartik instrumental variables specific to each gender. The logic of these widely used instruments is that, to some extent, the shock of the Great Recession varied by gender across regions because of the initial gendered differences in the composition of employment across occupations. These instruments are valid if the predicted labour demand shocks are unrelated to local unobserved factors influencing labour supply.

An important but often neglected issue is that these large demand shocks should also influence the mobility of households across regions (Amior and Manning, 2018; Blanchard and Katz, 1992). Using a simple Roy model with endogenous location choice and participation decisions, we highlight that the mobility responses of households to gender-specific demand shocks should bias upward the coefficients capturing the effects on participation of female labour demand shocks.

To address these issues, our main estimates exploit within-individual changes in participation during the Great Recession from panel data that we aggregate at the regional level. This implies that in contrast to estimates that use data from repeated cross-sections as in most of the literature, our estimates are not affected by endogenous changes in the observed or unobserved characteristics of the population across regions in response to labour demand shocks. The fact that regional changes in participation are obtained from within-individual variation also implies that our results are not explained

[3] See, e.g., Charles et al. (2016) or Chodorow-Reich and Wieland (2016) for recent influential work on the Great Recession that also follows a local labour market approach.

by cross-cohort differences in attitudes towards the participation of women in the labour market.

The empirical results confirm that it is important to distinguish demand shocks by gender to understand the increase in participation of women during the Great Recession. First, we find that during the Great Recession, the participation of married women countercyclically *increased* in response to the decline in labour demand for occupations more likely to employ men. Second, the participation of women also responded to local demand shocks to female labour demand. Women were much more likely to participate in the labour market in regions that experienced less decline in demand for jobs more likely to employ women.

Across countries, the fit of the model is rather good because these regional-level shocks can account for most of the aggregate increase in participation of prime age married women during the Great Recession in France, Spain, Portugal, Italy, the UK and Finland in our sample. An important exception is Austria, where the model does not predict the observed increase in participation.

When estimating similar models for men, we find that although negative demand shocks to occupations dominated by men are strong predictors of increases in their unemployment rates, these shocks explain little of the decline in male participation during the Great Recession.

Adjusting for changes in the composition of the population across regions over this period also appears important, as we estimate that the population changes rapidly in response to labour demand shocks. In particular, the share of women with higher education levels increased rapidly in regions that experienced positive demand shocks for jobs more likely to employ women. Consistent with our theoretical predictions, these changes in the composition of the regional population tend to bias cross-sectional estimates that use observed changes in participation. In particular, we obtain a much lower coefficient for the effect of male labour demand shocks and a coefficient that is twice as large for female labour demand shocks when we do not use within-individual variation to calculate aggregate changes in regional participation rates.

One concern with empirical work based on shift-share or Bartik instruments is that the results might be driven by persistent trends across regions (Jaeger et al., 2018). To assess the relevance of this concern, we perform placebo regressions that test whether the demand shocks of the Great Recession from 2007 to 2013 that we use to estimate our model can explain earlier changes in participation from 2000 to 2006. We find little correlation between future shocks to labour demand for women and previous changes in female participation. We also show that our main results are robust to including past shocks in our baseline regression. In addition, when we extend the sample to include the decade before the Great Recession, our main results are robust to controlling for country- or region-specific trends.

This paper builds on and contributes to several strands of literature. First, we extend and update the literature on gender segregation in the labour market in Europe by examining its recent evolution in the context of job polarization and the Great Recession.[4] We underline the persistence over that period of high levels of segregation relative to the US despite the important reallocations of employment across occupations.

Second, we highlight that taking into account these higher levels of gender segregation across occupations in Europe helps to explain the evolution of labour force participation of women in Europe during the Great Recession. While some country-specific studies have emphasized the large countercyclical increase of the labour force

[4] See e.g. Dolado et al. (2001, 2003)

participation of women in Europe during the Great Recession[5], our study offers evidence from harmonized European panel data that allows for clear cross-country comparisons. Using harmonized cross-country data allows us to quantify the importance of labour demand shocks in the evolution of participation by gender across countries during the Great Recession, complementing existing studies, which have mostly focused on the US.[6]

Third, our paper emphasizes the importance of the response of the population to large labour market shocks. Our estimates indicate substantial changes in the composition of the population in response to local demand shocks; it appears important to adjust for these changes when the estimates exploit differences across local labour markets.

I) Data

We consider 9 core Eurozone countries plus the UK. Our sample includes large countries, such as France, Spain and Italy, and smaller countries, such as Ireland and Portugal, that were also particularly affected by the crisis. Also included in the sample are Austria, Belgium, Finland, and the Netherlands.

Our analysis is based on two complementary sources of harmonized European microdata. First, we exploit the European Union Labour Force Survey (LFS) over 1995–2013 to measure how the Great Recession affected labour markets across European regions and construct instrumental variables to isolate regional labour demand shocks.[7] These data contain detailed and harmonized information on labour force status, occupation, industry affiliation and household composition across European Union

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[5] See De la Rica and Rebollo-Sanz (2017), Addabbo and Muñoz (2015) for Spain and Italy, respectively.

[6] For the US, Aaronson et al. (2014) and Foote and Ryan (2015) observed a strong negative relationship between the decline in participation and the destruction of employment in middle-skill jobs across regions in the US.

[7] As in as in Goos, Manning and Salomons (2014), the time span of the analysis is dictated by the availability of data on occupations in the LFS. Although harmonized microdata are available since 1983, information on occupations is missing before 1995 for many countries.

countries. The major strengths of this dataset are that it is available over a long period of time and that its sample size is large, with approximately 200,000 annual observations per country per year. A limitation is that neither workers nor households can be tracked.[8]

To study individual transitions in the labour market, we use the European Union Statistics on Income and Living Conditions (SILC) collected from 2003 to 2014.[9] The SILC is a rotating panel in which an individual is surveyed annually over four years.[10] This panel allows us to follow workers over time, and it contains a rich set of information on household composition and monthly retrospective information indicating whether an individual was in the labour force, employed or unemployed, and working full- or part-time at the time of the survey.[11] The panel also reports the location at the regional level, which allows us to relate changes in labour force status to local labour demand shocks. A year contains, on average, 10,000 to 50,000 observations per country.[12] Finally, we compare Europe with the US using data from the US Current Population Survey.[13]

For each dataset, we restrict the sample to individuals aged 25–55 (inclusive). Given our use of multiple datasets, an important task was the creation of consistent definitions of regions and occupations. We provide details on the construction of crosswalk tables for occupational classifications in the Appendix. For regions, we adopt

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[8] Although most countries adopted a rotating panel sampling scheme to collect the data, as in the CPS for the US, we cannot follow individuals over time in the harmonized sample because of confidentiality issues.

[9] The data in SILC are periodically revised, and various errors are corrected in each release. To allow for replication of the results in this paper, the appendix indicates the version of the data that we used.

[10] An exception is France, in which an individual can be interrogated up to nine times.

[11] The SILC panel is not based on a harmonized questionnaire but is constructed using a set of 'target variables' specified by EU regulations. Countries can choose – relatively independently – how to collect each variable, implying that the SILC is potentially less homogeneous than are other surveys. Conversely, this decentralized approach allows the data to be collected and released more rapidly.

[12] The data appendix contains additional details on the construction of the sample.

[13] We use the Annual Social and Economic Supplement of the Current Population Survey.

the more aggregated definition of the SILC.[14] Overall, we create an unbalanced sample of 66 regions from 10 countries observed from 2003 to 2013.[15]

II) European Labour Market in the Great Recession

Job polarization and gender segregation

We start in Table 1 by documenting how the Great Recession affected the distribution of occupations across countries. [16] Following Goos, Manning and Salomons (2014), we report the evolution of job polarization in Europe using changes in the shares in total employment across three occupation groups: lowest-paid, middle-paid and highest-paid occupations. [17] In Panel A, we report these evolutions for 2007-2013, during the Great Recession, while Panel B reports these figures for the earlier 2001-2007 period.

Consistent with recent work on the US that has emphasized that job polarization accelerates during recessions (Foote and Ryan, 2015; Hershbein and Kahn, 2018; Jaimovich and Siu, 2012), the share of employment in middle-paid occupations fell dramatically during the Great Recession in Ireland, Portugal and Spain, which were also the countries most affected by the recession.

In other countries in our sample, the decline in the share of middle-paid occupations is not systematically larger relative to pre-recession levels, consistent with Graetz and Michaels (2017), who show that polarization is not systematically episodic around recessions in Europe, in contrast with the US. Nevertheless, because the share of employment in middle-paid occupations remains large, approximately 40% on average

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[14] The definition corresponds to the NUTS1 definitions of Eurostat, but it might be more aggregated in some countries.

[15] The sample is unbalanced because observations are missing for the UK in 2003.

[16] As discussed in the Appendix, we adjusted the data on occupations in the LFS for Austria, Belgium, Finland and Italy to deal with a visible structural break in 2011 in the classification of occupations that remained despite our careful construction of crosswalk tables. Following OECD (2017), we apply the post-break average annual growth rates to the pre-break data for each occupation group (OECD, 2017 Figure 3.2).

[17] To form these three groups, Goos, Manning and Salomons (2014) rank occupations by ISCO codes at the two-digit level by their average wage measured in the 1990s. See the appendix of their paper for details.

in our sample in 2007, most of the net job losses were concentrated in occupations in the middle of the distribution during the Great Recession in all countries in our sample.

While the share of middle-paid occupations declined, the share of employment in high-paid occupations increased in most countries during the Great Recession, reflecting the fact that jobs in these occupations are less likely to be destroyed during recessions than jobs in middle-paid occupations. We also observe a moderate increase in the share of the lowest-paid occupations in most countries but to a lower extent in the recession than in the 2001-2007 period.

To understand how these reallocations affected employment by gender, we report in Table 2 the share of women within each occupation group in 2007, just before the Great Recession. Clearly, women are a small minority among employees in middle-paid occupations. Panel A shows that on average, across European countries, in 2007, only 33% of employees in middle-paid occupations were female. In contrast, women accounted for 64% of employees in low-paid occupations and 43% in high-paid occupations. Panel B indicates that the share of women among workers in middle-paid occupation was also low in 1996 and remained so in 2016, as it increased by less than 3 p.p. over the two decades despite the dramatic increase documented below in the participation of women over the period.

To summarize the evolution of gender segregation across occupations, Panel C reports dissimilarity indexes calculated using 20 occupation groups following Dolado et al. (2001, 2003).[18] Consistent with the previous evidence, the dissimilarity indexes do not decline between 1996 and 2013 in most countries, particularly after 2007 and the Great Recession. This implies that despite the rapid decline in the share of middle-paid

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[18] The dissimilarity index captures the share of women who would have to change their occupation for the occupational distribution of men and women to become similar. The index is described in the Appendix.

occupations, relatively few male workers reallocated into occupations historically dominated by females over the period.

In Table 3, we examine the evolution of employment by gender by showing the percentage changes in total male and female employment between 2007 and 2013. During the recession, the number of employed women declined much less than that of men, particularly in Ireland, Spain and Portugal. In Spain, for example, employment plummeted by 23% for men but 'only' by 8% for women. Overall, the Great Recession had a much stronger impact on male employment than on female employment in Europe.

The descriptive evidence in this section suggests that the decline in middle-paid occupations combined with high and persistent segregation by gender across occupations is associated with large differences in the aggregate labour market outcomes of men and women during the Great Recession. Differences by gender appear larger in the countries most affected by the recession, where middle-paid occupations declined most. In the rest of the paper, we quantify whether these gender-specific demand shocks might explain changes in labour force participation during that period.

Trends in participation before and during the Great Recession

We document in this section the evolution of labour force participation of prime age men and women during the Great Recession. To place the recent period in perspective, Figures 1 and 2 report the participation rates of prime age men and women, respectively, from 1995 to 2013. In contrast to the US, where the participation of prime age men started to decline at the onset of the 2000s, in Europe it declined only *after* the Great Recession. Figure 2 shows that for women, until 2007, participation rates converged across European countries, with the rates increasing at a particularly rapid pace in countries with an initially low participation level. During the Great Recession, the participation of women continued to increase but at a slower pace in most countries. In contrast, in the US, the participation of women reached a plateau as early as the late 1990s and declined by 2 p.p. thereafter.

To compare countries and genders during the Great Recession, in Figure 3, we report changes in participation with the evolution of unemployment. While unemployment increased sometimes starkly and the labour force participation of men declined, the participation of women increased countercyclically in all European countries in our sample except in Finland. Women's participation increased rapidly in Austria, the UK, Spain and Portugal despite the recession. Even if the growth in participation appears to have slowed down relative to the earlier period, this rapid increase contrasts sharply with the situation in the US, where the participation of women declined by 1.4 p.p.

A possibility is that the increase in participation of women in Europe during the Great Recession simply reflects a secular trend that started before the Great Recession in the labour supply of women, driven by changes in gender norms across cohorts (see e.g. Bertrand et al., Forthcoming). However, Figure 4 shows that while the two variables were previously uncorrelated, there is a clear negative correlation between the increase in participation of women and the decline in the share of middle-paid occupations during the Great Recession. While suggestive, these correlations are clearly not directly causal, as they might reflect the effects of other factors. In the rest of the paper, we estimate an econometric model designed to assess the role of gender-specific changes in labour demand in explaining recent changes in labour force participation.

III) Labour supply and gender-specific demand shocks

Conceptual framework

To motivate the empirical model and our choice to estimate the model on panel data, we present a stylized Roy (1951) model in which the location of the household and the participation decision of the wife are jointly determined. The model highlights the biases created by the regional mobility of households when labour demand shocks are negative for men but not for women.[19]

Output is produced in each region r from a CES production function with male M_r and female F_r labour such that $Y_r = [(A_{fr}F_r)^\rho + (A_{mr}M_r)^\rho]^{1/\rho}$ with A_{fr} and A_{mr} the associated labour augmenting technological parameters.[20] The parameter $\sigma = \frac{1}{1-\rho}$ governs the elasticity of substitution between male and female labour and is assumed constant across regions.

We abstract from the intensive margin for simplicity and assume that when a worker participates, she supplies one unit of labour. Workers within gender groups are perfect substitutes but have different ability levels and thus differ in the efficiency units they supply. We assume the efficiency units of labour (e_{ir}) of a type-i worker in region r can be written as $\log e_{ir} = \eta_r \alpha_i$, where α_i is the worker's fixed productivity and η_r captures returns to worker productivity and varies across regions.[21] Total female and male effective labour supplies in each region are given by $F_r = \sum_{i \in J_{fr}} e_{ir}$ and

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[19] The model is closely related to recent models that have been proposed to analyse the local consequences of manufacturing decline (Charles et al., 2016), the allocation of talents (Hsieh et al., 2013) or the sorting of workers across sectors (Gibbons et al., 2005).

[20] The human capital theory for the division of labour by gender assumes that men and women have, on average, different endowments of factors such as 'brain' and 'brawn'. See, e.g., Cortes et al. (2018) for recent evidence concerning the comparative advantages of women in high-wage occupations. Alternative theories emphasize the role of discrimination and gender stereotypes (Blau and Kahn, 2017).

[21] Differences in returns to skills across locations are consistent with De la Roca (2017), who finds that differences in returns to skill between small and large cities are driving internal migration between them. De la Roca and Puga (2017) find evidence of differences in returns to skills and experience across cities.

$M_r = \sum_{i \in J_{fr}} e_{ir}$, where J_{mr} and J_{fr} are the set of male and female workers in region *r*. With competitive labour markets, log wages can be expressed as $w_{ifr} = w_{fr} + \eta_r \alpha_i$ for female and $w_{imr} = w_{mr} + \eta_r \alpha_i$ for male, where $w_{fr} = \log\left(\frac{\sigma}{1-\sigma} A_{fr}^{\rho} Y_r^{1-\rho}\right) - \frac{1}{\sigma}\log F_r$ and $w_{mr} = \log\left(\frac{\sigma}{1-\sigma} A_{mr}^{\rho} Y_r^{1-\rho}\right) - \frac{1}{\sigma}\log M_r$ capture the log wages offered to workers with the lowest ability level.

Next, we consider the joint decisions of participation and location. For simplicity, we assume men are always participating. For women, following Devereux (2004), we consider a linear model of participation.[22] A married woman indexed by i with a spouse indexed by *s(i)* participates if the following inequality holds:

$$\gamma_F w_{ifr} - \gamma_M w_{s(i)mr} > \vartheta \qquad (1)$$

where w_{ir} is the offered log-wage of the wife, $w_{s(i)r}$ is the log-wage of the husband, and the parameter ϑ captures the opportunity cost of work (Mincer, 1962).[23]

For the location decision, we assume there are no mobility costs and households self-select into regions that offer the highest wages given their ability. If the wife does not participate, the location depends upon the wage of the husband, but when she participates, the household chooses the region offering the highest sum of wages.[24]

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[22] This equation can be interpreted as a log-linearized version of a simple static labour supply model (Cahuc et al., 2014). Consistent with standard labour supply theory (Becker, 1965), higher wages offered to the wife *increase* the probability of working with respect to not working. In contrast, when income is shared within the household, an increase in the wage of the husband *decreases* the probability to participate.

[23] A straightforward extension of the model might allow for differences in benefits of non-participation across regions, if for example, some region offers more generous welfare than others do. In this model, more-generous regions would attract non-participants as in Gelbach (2004).

[24] This baseline model has two key simplifying assumptions that can be relaxed in a more complete framework. First, the absence of idiosyncratic preferences for regions (counterfactually) implies that only the marginal workers at the top or at the bottom of the wage distribution move across regions. A second strong assumption of our baseline model is that all moves are motivated by differences in wages. Indeed, since Rosen (1979) and Roback (1982), a large literature has emphasized that location choice is driven not only by labour market opportunities but also by the quality of local amenities and the cost of housing.

Figure 5 illustrates graphically the equilibrium and comparative static with respect to the ability of husbands and wives. We consider the case of a simple economy with two regions with higher returns to skills in region 2 such that $\eta_2 > \eta_1$ (see the Appendix for formal derivations). Panel A depicts an initial equilibrium: whereas wives with productivity below the participation threshold $\alpha_F^*(\alpha_{s(i)})$ do not participate, this threshold increases with the ability of the husband and varies across regions.[25] When the ability level of the wife is below the participation threshold, the location of the household is only determined by the ability level of the husband and depends upon α_M^*.

Panel B illustrates what occurs following a negative demand shock to male wages in region 1 $(\Delta w_{m1} < 0)$. As predicted by a standard labour supply model, the decrease in the threshold $\alpha_F^*(\alpha_{s(i)})$ implies that a share of marginal low-ability wives joins the labour market in response to a decline in their husband's earnings, thus *increasing* regional participation. However, this negative shock also changes the location decision of households. First, as $\tilde{\alpha}_{1/2}(\alpha_{s(i)})$ shifts to the left, households with high-ability husbands and wives who both participate and are close to the threshold in region 1 move to region 2, which *decreases* the participation rate in region 1 but increases it in region 2 through compositional changes. Second, households with low-ability wives who do not participate but who are married to husbands with ability levels close to the α_M^* threshold move to region 2, thus *increasing* participation rates in region 1.

[25] Note that the threshold is discontinuous when it crosses the downward sloping line $\tilde{\alpha}_{1/2}(\alpha_{s(i)})$ that governs the allocation between region 1 and 2 when the wife participates.

Panel C illustrates the consequences of positive shocks to female wages in region 1 $(\Delta w_{m1} > 0)$. As in the previous panel, the threshold $\alpha_F^*(\alpha_{s(i)})$ shifts downward such that low ability wives enter the labour market. However, as $\tilde{\alpha}_{1/2}(\alpha_{s(i)})$ shifts to the left, high ability women reallocate from region 2 to region 1, which increases the participation rate in region 1 but decreases it in region 2.

In summary, whereas the model predicts that low-ability wives in region 1 participate in the labour market in response to these two shocks, they have an opposite effect on the mobility of high-ability households and thus affect regional participation rates through compositional changes in opposite directions. In the Appendix, we use a standard omitted-variable bias analysis to demonstrate that these compositional changes should bias upward the (positive) coefficient associated with female labour demand. For negative male demand shocks, the direction of the bias is ambiguous because mobility of low and high-ability women is theoretically possible. Whether these compositional changes are empirically important is a question that we investigate in the following sections.

Empirical implementation

By averaging the previous participation equation at the regional level, taking first differences and adding an error term, we can approximate changes in regional participation rates with the following regression model:

$$\Delta LFPR_{rt} = \gamma_1 \Delta \overline{w}_{frt} + \gamma_2 \Delta \overline{w}_{mrt} + u_{rt} \,. \qquad \text{Eq. (1)}$$

where $\Delta LFPR_{rt}$ is a measure of changes in regional participation rates, $\Delta \overline{w}_{frt}$ and $\Delta \overline{w}_{frt}$ are changes in average offered wages for females and males, respectively, and, and u_{rt} is an error term.

There are two important challenges in estimating Eq. (1): first, offered wages are unobserved for those who do not work and might be difficult to predict for those who are out of the labour force (Heckman and Willis, 1977), particularly during recessions.[26] Because of these issues, to estimate the model, we follow Amior and Manning (2018) and use changes in log employment instead of wages in our econometric model, using the two Bartik instruments designed to isolate demand shocks, as discussed below.[27]

As highlighted by the previous model, a second challenge lies in measuring changes in participation in the region when the composition of the population changes endogenously. To address this issue, we use within-individual variation using the SILC panel, where individuals are observed over a maximum of four years, to obtain aggregated adjusted regional changes in participation.[28]

We construct our dependent variable in the following way: we use a retrospective calendar that reports the labour force status in each month of the previous year to calculate the total number of months in the labour force, denoted lf_{irt}, for each individual *i* in region *r* and year *t*. For each individual observed during a complete four-year period in the sample in the same region, we take the four-year difference by retaining the first and the last observations. Our individual measure of changes in participation, denoted $\Delta LFPR_{irt} = \Delta lf_{irt} / 12$, captures four-year within-individual changes in the share of the year in the labour force. We take the regional average of

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[26] Variations in wages during downturns are also difficult to measure because of composition biases. Recent evidence suggests these biases have been important in Europe during the Great Recession (Verdugo, 2016).

[27] Note that the equilibrium relationship between wages, labour supply and productivity can be rewritten as follows: $\log F_r = \sigma(\log\left(\frac{\sigma}{1-\sigma} A_{fr}^{\rho} Y_r^{1-\rho}\right) - w_{fr})$. The instruments described below are designed to isolate shocks from A_{fr} in the previous expression.

[28] Except in France is different where workers are observed over a period of 8 years.

within-individual variation, denoted $\Delta LFPR_{rt}$, as a dependent variable in our baseline first-differences model. Our baseline model is given by:

$$\Delta LFPR_{rt} = \gamma_1 \Delta \log F_{rt} + \gamma_2 \Delta \log M_{rt} + \gamma_3 X_{r03} + u_{it}$$

where $\Delta \log M_{rt}$ and $\Delta \log F_{rt}$ capture four-year changes in log employment in region *r* of men and women, respectively, estimated with the LFS.

We construct our dependent variable in the following way: we use a retrospective calendar that reports the labour force status in each month of the previous year to calculate the total number of months in the labour force, denoted lf_{irt}, for each individual *i* in region *r* and year *t*. For each individual observed during a complete four-year period in the sample in the same region, we take the four-year difference by retaining the first and the last observations. Our individual measure of changes in participation, denoted $\Delta LFPR_{irt} = \Delta lf_{irt} / 12$, captures four-year within-individual changes in the share of the year in the labour force. We take the regional average of

within-individual variation, denoted $\Delta LFPR_{rt}$, as a dependent variable in our baseline first-differences model. Our baseline model is given by:

$$\Delta LFPR_{rt} = \gamma_1 \Delta \log F_{rt} + \gamma_2 \Delta \log M_{rt} + \gamma_3 X_{r03} + u_{it}$$

where $\Delta \log M_{rt}$ and $\Delta \log F_{rt}$ capture four-year changes in log employment in region *r* of men and women, respectively, estimated with the LFS.

Our sample covers the period from 2003 to 2013: our first observations are thus the 2007-2003 four-year differences, and our last observations are the 2013-2009 differences. Because marriage status might be endogenously affected by labour demand shocks, we focus on a sample of women who were initially married.[29]

Note that while $\Delta LFPR_{rt}$ is calculated using the SILC panel, we use the LFS to measure changes in log employment $\Delta \log M_{rt}$ and $\Delta \log F_{rt}$. Using the LFS, which has a much larger sampling size, should reduce sampling errors in the measurement of regional changes in regional employment.

Our parameters of interest are γ_1 and γ_2, which capture the response of participation to gender-specific labour demand shocks. Other covariates X_{r03} are introduced in the model to account for differences in the initial characteristics of the region, including the share of the prime age population with a university degree and the share of the prime age population employed in middle-paid occupations. These variables are taken at their 2003 value and are adjusted by subtracting the country-level average in the same year for each region.[30]

Construction of the instruments

Clearly, the variations of $\Delta \log M_{rt}$ and $\Delta \log F_{rt}$ are endogenous because they are driven not only by changes in labour demand but also by changes in labour supply. To isolate the variations driven by changes in labour demand, we instrument the change in male and female log employment using two shift-share or Bartik instruments following Bartik (1991), Blanchard and Katz (1992) and more recently Autor, Dorn, and Hanson (2013), Amior and Manning (2018) and Charles, Hurst and Notowidigdo (2016) among many others.

[29] Focusing on men or women that remain married in both periods does not change the results.
[30] The regression results are very similar if these variables are not included in the model.

These instruments exploit differences in initial specialization by gender across local labour markets that made male and female employment across regions more or less vulnerable during the Great Recession. For each gender S, in region *r*, the instruments for log employment change are given by

$$\Delta B_{rt}^{S} = \sum_{k} \phi_{kr,95}^{S} (emp_{kt}^{ref} - emp_{k,t-4}^{ref})$$

where $\phi_{kr,95}^{S} = \dfrac{Emp_{kr,95}^{S}}{Emp_{r,95}^{S}}$ is the initial share of employed individuals from gender S in region *r* in occupation k in 1995. The term $(emp_{kt}^{ref} - emp_{k,t-4}^{ref})$ denotes the change in *national*-level log employment in occupation group k in reference country *ref* and is estimated using both genders. We use the year 1995 as a baseline year for the initial share $\phi_{kr,95}^{S}$ because it is the more distant year with available information on occupations in the LFS.[31] The baseline year is thus observed 12 years before the start of the Great Recession and before other major shocks such as the accession of China to the WTO.

We experiment with alternative reference countries to calculate the growth of occupations $(emp_{kt}^{ref} - emp_{k,t-4}^{ref})$. Ideally, we would like to exploit common variations in the distribution of occupations across developed economies that are exogenous to unobserved factors influencing labour supply in European regions. In our baseline specification, we follow Acemoglu and Restrepo (2019) by using a country not included in our sample to construct our Bartik instruments. Our baseline specification uses as a reference the aggregate growth across occupations as observed in the US instead of the standard approach of using the growth of these occupations at the national level.[32]

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[31] The LFS data reports information on 20 occupations. Details on these occupations are reported in the Appendix.

[32] The approach of using a country not included in the sample to construct the Bartik instrument is similar to the one adopted by Autor, Dorn, and Hanson (2013) and Bloom, Draca and Van Reenen (2016) to estimate the local consequences of Chinese imports.

While such an approach is not without drawbacks, using the US should isolate variations in the growth of occupations that are common across countries but not linked to specific features or idiosyncratic shocks across European regions that might influence labour force participation. Such an approach would be compromised if changes in the distribution of occupations in Europe and the US are correlated with common shocks to labour supply and labour force participation. While we cannot rule out this possibility, the fact that the participation of women declined in the US while it simultaneously increased in Europe during the Great Recession suggests that there are no systematic correlations in the evolution of aggregate participation of women.

IV) Empirical Results

First-stage regressions

Table 4 compares first-stage regressions with alternative Bartik instruments based on the aggregate growth of occupations in the US (columns 1 and 4), in Europe (2 and 5) and at the national level for the country from each region (3 and 6). Throughout the paper, we report standard errors clustered by region to address possible correlations of the error term within regions over time (Cameron and Miller, 2015).

A first important issue is whether there is sufficient variation in the data to separately identify the effects of labour demand shocks by gender.[33] The results in Table 4 show that the Bartik instruments specific to each gender are clearly strong predictors of changes in employment for their own gender when both instruments are introduced simultaneously in the regression. The table also reports the Sanderson-Windmeijer (2016) F-stats, which formally test whether there is sufficient variation from the two instruments to separately identify the effects of the two endogenous

[33] Despite the substantial occupational segregation documented earlier, Table A1 in the online Appendix reports that our two endogenous measures of employment change for men and women are positively correlated with each other ($\rho = .54$).

variables in the second stage. The large F-stats that are reported allow us to reject the hypothesis that the coefficients of the two endogenous variables cannot be identified separately. The other first-stage F-stats that test whether the instruments are weak are always higher than 12 in each regression, suggesting that the instruments are reasonably strong.

Baseline estimates

The second-stage 2SLS estimates of our baseline model are presented in Table 5 in Panel A for initially married women and in Panel B for men. Within each panel, the dependent variable is the four-year change in the participation rate, obtained by aggregating from within-individual changes from the SILC panel at the regional level.

In columns (1) and (2), we separately introduce changes in male and female labour demand. For married women, changes in female labour demand have a strong positive effect on participation, whereas the coefficient of changes in male labour demand is negative and statistically nonsignificant when the variable is introduced separately. In column (3), we find that while both demand shocks are statistically significant, their effects on participation are of opposite sign. Consistent with the predictions of a simple labour supply model, the results suggest that the participation of women decreased in response to positive shocks to male labour demand, while it increased in response to shocks to female labour demand. This confirms that the large negative shocks that affected male labour demand during the Great Recession increased the participation of women.

The estimated effects are economically large: they indicate that a one-standard-deviation *decrease* in male employment over four years (approximately 0.05) increases the participation of women by 1.6 p.p. In contrast, a one-standard-deviation increase in female employment driven by labour demand (also approximately 0.05) increases their participation by 1.3 p.p.[34]

For men, Panel B shows a quite different picture. For this group, most reported coefficients are small and statistically insignificant. Surprisingly, and in contrast to recent work on the US (Aaronson et al., 2014; Foote and Ryan, 2015), regional labour demand shocks do not explain much of the recent decline in the participation of men in Europe.

In Table A2 in the online Appendix, we explore whether our results depend upon the inclusion of a specific country by reporting estimates that exclude each country one by one from the sample. If anything, the coefficients become more imprecise when Spain is excluded from the sample, but the results are broadly similar in most specifications. In Table A3 in the online Appendix, we assess whether the results vary between countries from Northern and Southern Europe, in which the crisis differed in intensity. Once again, the results are very similar across the two groups. In Table A4 in the online Appendix, we check the extent to which our baseline results depend upon the choice of the US as a reference country to construct the instrument. We find that estimation results using employment growth across occupations in Europe (each time excluding the reference country) or the growth of each occupation at the national level for the country representing the region are very similar.

In Figure 6, we use the previous estimates to quantify how much these labour demand shocks can account for the adjustment of married women's labour force participation during the Great Recession. The figure compares, for each country, the observed and predicted changes in participation from 2005 to 2013, as observed in the

[34] For both men and women, the standard deviation increases in four-year changes in log employment is about 0.05.

SILC panel.[35] Overall, although their importance varies, the combination of these gender-specific labour demand shocks explains most of the recent aggregate increase in labour force participation across countries. For Spain, France and Finland, the fit is rather good, as suggested by the fact that the predicted effects are very close to the 45° line. In contrast, the model predicts larger increases in participation in Italy and in Portugal than those observed. For Austria, the fit of the model is rather poor, as it does not predict the increase in participation that is observed in this country.

Overall, even if the fit of the model is not perfect, our results suggest that gender-specific labour demand shocks explain a large share of the increase in the participation of women during the Great Recession in most countries in our sample. For men, on the other hand, there is little correlation between regional shocks to labour demand and changes in participation.

Gender or occupation shock?

Next, we examine how much the results change when instead of defining demand shocks by gender, we define changes in demand by using broad occupation groups. Clearly, as indicated by Table A1, changes in log male employment are strongly correlated with changes in middle-paid occupations (ρ=0.65), while changes in female employment are even more strongly correlated with changes in the lowest- and highest-paying occupations (ρ=0.79).

The estimates reported in Table 6 from this alternative specification are consistent with previous evidence. In accordance with the fact that men are much more likely to be employed in middle-paid occupations, the estimation results suggest that the participation of women increased in response to the negative shocks to middle-paid

[35] Using the baseline estimates of the model, we predict change in participations for each region and average these predictions at the country level using the regional population as weights.

occupations during the Great Recession. In contrast, women are more likely to participate in response to positive shocks to the lowest-paid or highest-paid occupations. For men, as before, Panel B indicates that these regional demand shocks explain little of the change in participation.

Adjustment through unemployment

While regional demand shocks do not explain the decline in the participation of men during the Great Recession, one possibility is that most of the adjustment to regional demand shocks among men instead occurred through unemployment. To investigate this hypothesis, in panel A of Table 7, we report regressions using the changes in regional unemployment rates estimated as before using within-individual variation from panel data aggregated at the regional level.[36]

Consistent with the fact that most of the increase in unemployment during the Great Recession was driven by workers initially in middle-paid occupations, we find a strong response of unemployment to shocks to occupations more likely to employ men. The effects are also twice as large for men, which is in accordance with the fact that most of the increase in unemployment affected men during the Great Recession. In contrast, the coefficient on shocks to occupations more likely to employ women is small and not statistically significant.

Quantitatively, the coefficient implies that a decrease by one standard deviation in male employment (approximately 0.05) driven by negative labour demand shocks increased local unemployment by 3 p.p. for men and by 1 p.p. for women. Overall, while both participation and unemployment were important adjustment factors in the

[36] As for the participation rates, our dependent variable is constructed using within-individual variations over four years in the share of the year in unemployment that we aggregate across regions.

labour market for women, most of the adjustment for men occurred through unemployment.

Adjustment of wages

As discussed earlier, our main empirical model uses changes in log employment to approximate labour demand shocks. This approach is based on the hypothesis that our Bartik instruments capture demand-driven changes in potential wages that determine the participation decision of men and women. An important question is thus whether the actual changes in wages observed in the data are related to these measures of labour demand shocks.

We assess the empirical relationship between our measure of demand shocks and actual changes in wages in Panel B of Table 7. Since wages are also influenced by changes in the composition of employees (Solon et al., 1994), we measure regional wage changes using within-individual variation in the monthly wages of full-time workers that we aggregate to the regional level.[37] Focusing on full-time workers should diminish measurement errors but at the price of selecting individuals with a stronger labour market attachment. A limitation of this analysis is that changes in the average wage of employed workers might be poorly correlated with the relevant unobserved wage that drives the participation decision of the marginal individual. Consistent with this idea, a large body of literature has shown that the wages of employed individuals are much more rigid than the wages of new entrants (Devereux and Hart, 2006).

The results reported in Panel B of Table 7 indicate that regional wages were cyclical during the Great Recession, consistent with the results of Verdugo (2016) obtained with the same wage data. When the demand shocks are introduced separately,

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[37] We follow Verdugo (2016) when constructing our wage measure from the SILC panel. We use the monthly wage of full-time workers. See the data Appendix for more details on its construction and Verdugo (2016) for a discussion of the quality of the wage data across European countries in the panel.

wages seem to be positively correlated with each type of demand shock. However, when the two shocks are introduced simultaneously, the coefficients are not statistically significant, and the estimates are imprecise. If anything, our results tend to suggest that the wages of women respond more to shocks to female labour demand, while the wages of men respond more to shocks to male labour demand, consistent with our underlying assumptions.

Demand shocks and changes in the regional population

Next, we examine how each labour demand shock influenced the composition of the population across regions. While the question is interesting per se, looking directly at how the composition of the population responded to these shocks also allows us to assess the importance of using within-individual variation from panel data to measure changes in participation.

To investigate these issues, we use data from the LFS, which offers a much larger sample and a better measure of regional changes in population than the SILC panel. [38] We concentrate on changes in the education level in the population, as education remains strongly correlated with the participation of women. To minimize composition effects related to the entry and exit of younger and older cohorts in the prime age population, we follow pseudo-cohorts of prime age individuals at the regional level, matching individuals aged 25–49 in the first period with those aged 30–54 in the second period of our four-year changes. [39]

Table 8 reports how the population of regions changes in response to demand shocks. In columns (1) and (2), we find that the population increases in response to both

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[38] Because the SILC is a rotating panel, it might be much less representative of the population because of the difficulties of tracking households changing regions, which appears to vary systematically across countries.

[39] For confidentiality reason, the LFS report age in five-year brackets, which implies we cannot perfectly follow our pseudo-cohort because we use four-year differences. We experimented with specifications using five-year differences instead, which allows matching the age groups perfectly and obtained very similar results.

types of shock. Quantitatively, a 0.05 log increase in the number of employees from either gender driven by a demand shock is predicted to increase the log population by 0.01.

In columns (3) and (4), we report separate estimates using the log population of women by education level as a dependent variable.[40] Consistent with earlier evidence that less educated individuals are less likely to move across regions (Bound and Holzer, 2000; Notowidigdo, 2019), the change in the number of women with a secondary and tertiary education in response to demand shocks is twice as large as that among women with lower levels of education. In column (5), our dependent variable is the changes in the log ratio between the numbers of women with a secondary and tertiary education level over those with a lower education level. Both negative male demand shocks and positive female demand shocks are associated with increases in the relative share of women who are at least high-school graduates in the population of the region.

Does using adjusted participation rates matter?

The results in the previous subsection suggest that the labour demand shocks captured by our Bartik instrument are associated with important regional changes in the composition of the regional population. These changes in composition should mechanically affect regional participation rates. To assess the importance of using within-individual variation from panel data instead of cross-sectional data to estimate regional changes in participation, we report alternative regressions using regional changes in participation rates as a dependent variable from a "cross-sectional" sample designed to mimic cross-sectional variation by retaining only the first observation for each individual in the SILC panel. Table 10 compares our baseline estimates for

[40] We focus on women without conditioning on marriage because the probability of marriage is affected by labour demand shocks, as we highlight in the next section. However, the results are similar when the groups of married women are used instead.

women, reproduced for convenience in column 1, with those estimates obtained using cross-sectional variation to estimate regional changes in participation in column 2. Consistent with the hypothesis that not considering regional changes in the composition of the population biases the estimates of each coefficient in a different direction, the coefficient on male demand shocks is statistically nonsignificant in the cross-sectional sample, while the coefficients associated with female demand shocks are twice as large as their equivalent in the panel data.

In column 3, we use changes in participation rates estimated from a pseudo-cohort of women in the LFS and adjusted for changes in composition in terms of age and education using separate regressions for each country on age and education dummies.[41] Although differences in the measurement of participation between the LFS and the SILC complicate the comparisons[42], both specifications suggest that labour demand shocks influenced regional participation rates.

V) Robustness

As discussed earlier, one concern with the use of a shift-share instrument is that the initial distribution of employment by gender might be correlated with long-run trends that affected labour demand by gender before the Great Recession and the participation of women. To address this concern, in Panel A of Table 10, we report the results of a simple placebo test where we assess whether labour demand shocks from 2007 to 2013 predict earlier four-year changes in participation from 2001 to 2006.[43] If long-run trends in participation drive our results, future demand shocks and past increases in

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[41] The adjusted participation rates were obtained by using the residuals from a regression of the probability to participate in the labour force on 3 education dummies and 6 age dummies performed separately for each country over the entire period 2003–2013.

[42] The LFS measures participation during the reference week, whereas we use a measure of participation from the SILC using the number of months in the labour force that captures changes in participation within a year.

[43] As the SILC panel only starts in 2003, these four-year changes in participation were estimated using LFS data from 1997 to 2006.

participation should be correlated. However, the results show little correlation between the two.

In Panel B, we follow Jaeger et al. (2018) and test directly whether our instruments can separate recent and past shocks by estimating models including 7-year lags of the Bartik shocks. Although the results are considerably noisier in these very demanding specifications and the first-stage F-stat is low, the sign and magnitude of the main coefficients do not change significantly.

Another way to test whether long-run trends drive our results is to extend the estimation period by using the LFS data that starts in 1995 instead of 2003. Using the LFS allows us to directly include country- or region-specific fixed effects in the regression model. As the model is estimated in differences, these fixed effects should capture country- or region-specific long-run trends. Of course, one limitation of using the LFS is that we are not able to adjust the participation rates for changes in the composition of the population across regions as we do when we use panel data. To address this issue, we follow pseudo-cohorts by matching the same age groups over the four-year changes and adjust the participation rates using the residuals of regressions on age and education.[44]

The estimation results from the LFS using four-year changes from 2000 to 2013 are reported in Table 11. Reassuringly, we find that including country fixed effects, as in columns (2) and (5), or region fixed effects, as in columns (3) and (6), does not significantly change the results. If anything, estimates with region fixed effects are larger and more precisely estimated.

VI) Concluding Remarks

[44] As in the previous section, we use the residuals of the probability to participate in in the labour force on 3 education dummies and 6 age dummies. These regressions are performed separately for each country.

This paper has investigated whether gender differences in labour demand explain the changes in labour force participation during the Great Recession. We reported that Europe is characterized by persistent segregation by gender across occupations such that middle-paid occupations, which were those most affected during the Great Recession, were more likely to employ men. As a consequence, the recomposition of the labour market during the Great Recession was more unfavourable to men than to women.

To assess the influence of labour demand shocks on the increase in participation of women, we exploit differences across regions in the intensity of demand shocks by gender. Our estimates indicate that these regional changes in labour demand in occupations more likely to employ women can explain a large share of the increase in their participation in the labour market during the Great Recession.

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VIII)Appendix

Data Appendix

LFS: We use annual files from the European LFS from the Dec 17, 2015, release from Eurostat. The labour force status is obtained with the variable ILOSTAT, which refers to the International Labour Organization's definition of labour force status. Accordingly, labour force participation is defined as being employed during the reference week or seeking employment and being available for work.
SILC Data: We use longitudinal SILC data from the July 28, 2016, release. We estimate the number of months in the labour force using the variables 211A-211L and 210A-210L. Individuals are classified as being in the labour force if the respondent declares that he is unemployed, employed or self-employed either full or part-time. We correct for panel errors by checking that there are no changes in gender or age of the respondent over time. In the regressions, we eliminate from the sample those who move to another region during the four-year period in the sample.
Occupations: Following Goos et al. (2014), we use ISCO88 at the two-digit level. For years after 2011, we convert data from ISCO08 into ISCO88 using a crosswalk table that we constructed. As in Goos et al. (2014, Table 1, p. 2512 and Appendix Table A3), low-paid occupations includes occupations 93, 51, 52 and 91. Middling occupations includes 81, 72, 83, 73, 71, 42, 82, and 74. High-paying occupations includes 12, 21, 22, 24, 13, 31, 34 and 32.
CPS occupations codes: We combine the variable OCC2000 from CPS with codes ISCO88 using the crosswalk table established by the Centre for Longitudinal Studies from UCL and available online at http://www.cls.ioe.ac.uk/page.aspx?&sitesectionid=351&sitesectiontitle=Occupational+segregation (accessed January 26, 2017).
Adjustment for the 2011 break in occupational classifications: We adjusted the LFS data on occupations for Austria, Belgium, Finland and Italy to deal with a structural break in the classification of occupations in 2011 that we were unable to correct by

adjusting crosswalk tables at the three or four digit level. To adjust the data for the break, we follow the OECD (OECD, 2017 Figure 3.2) and apply the post-break average annual growth rates to the pre-break data by skill level (high, middle, low) for the break in 2011. This adjustment only affects the measures of changes in each occupation groups using European data.

Wage data: To estimate four-year changes in regional wages using panel data, we only retain observations with valid information on wages, and we exclude imputed observations. We focus on monthly wages of full-time workers. To eliminate the influence of outliers, we trim the top and bottom 1% of wage observations within each country and year. Finally, we compute real wages using the national HICP index obtained from the OECD website.

Dissimilarity Indexes: The formula of the dissimilarity index in year t is given by $D_t = \frac{1}{2}\sum_k |m_{kt} - f_{kt}|$, where m_{kt} and f_{kt} are respectively the share of men and women employed in occupation k .

Theoretical model

We consider an economy with two regions $r = 1,2$ in which returns to ability are higher in region 2 such that $\eta_2 > \eta_1$. The equilibrium is characterized by an allocation of households across regions such that no household gains by moving to another region or, for the wife, by participating in the labour market. From the log wage equations, a necessary condition to have a positive number of workers from both gender in each region is $w_{f1} > w_{f2}$ and $w_{m1} > w_{m2}$, and we assume these two conditions hold in equilibrium. For each household, there are four possible cases depending upon the labour market status of the wife (participation/non-participation) and the location choice (region 1/region 2). From Eq. (1), women i participate in region 1 if

$$\alpha_i > \alpha_{F1}(\alpha^*_{s(i)}) = \frac{\vartheta + \gamma_M (w_{m1} + \eta_1 \alpha_{s(i)}) - \gamma_F w_{f1}}{\eta_1} \quad \text{(A1)}$$

and participate in region 2 if

$$\alpha_i > \alpha_{F2}(\alpha^*_{s(i)}) = \frac{\vartheta + \gamma_M (w_{m2} + \eta_2 \alpha_{s(i)}) - \gamma_F w_{f2}}{\eta_2} \quad \text{(A2).}$$

The location decision is governed by the choice of the region offering the highest wages. If both partners work, assuming joint consumption, the location is determined by the region that maximizes $w_{ifr} + w_{s(i)mr}$. This result implies that when both spouses work, a household chooses region 2 instead of 1 when

$$\alpha_i > \tilde{\alpha}_{1/2}(\alpha_{s(i)}) = \frac{(w_{f1} - w_{f2}) - \alpha_{s(i)}(\eta_2 - \eta_1) + (w_{m1} - w_{m2})}{\eta_2 - \eta_1} \quad \text{(A3).}$$

When the wife does not work, region 2 is chosen instead of 1 when

$$\alpha_{s(i)} > \alpha^*_M = \frac{w_{m1} - w_{m2}}{\eta_2 - \eta_1} \quad \text{(A4).}$$

These four equations (A1–A4) determine the location and participation for each pair α_i and $\alpha_{s(i)}$.

Omitted variable bias analysis of composition effects

We discuss formally in this section how different types of shocks affect the compositional biases, defined as the difference between changes in participation as observed in a cross-sectional sample with respect to a sample of "stayers". By definition, the cross-sectional change in participation $\Delta LFPR_{rt}^{CS}$ in region *r* can be decomposed as

$$\Delta LFPR_{rt}^{CS} = s_{rt}(p_{st} - p_{st-1}) + (1 - s_{rt-1})(p_{st-1} - p_{ot-1}) + (1 - s_{rt})(p_{it} - p_{st-1})$$

where $\Delta LFPR_{rt}^{S} = p_{st} - p_{st-1}$ is the change in participation for *stayers*, which denotes individuals that remained in the region in both periods, s_t is the share of stayers in the population in period t, p_{st} is the participation rate of stayers in t and p_{it} and p_{ot} are the participation rates of incoming and outgoing individuals in the region. Notice that by definition, outflow and inflow rates are captured by $o_{t-1} = 1 - s_{rt-1}$ and $i_t = 1 - s_{rt}$, respectively.

We initially consider separately the two types of shocks to illustrate how they might influence the difference between cross-sectional and panel data estimates changes. In response to a positive female labour demand shock, there should be no outflows $o_{t-1} = 0$, but there should be positive inflows $i_t > 0$ from positively selected movers such that $p_{ot-1} > p_{st-1}$, which implies that $\Delta LFPR_{rt}^{CS} > \Delta LFPR_{rt}^{S}$.

In contrast, in the case of a negative male demand shock, outflows should be positive $o_{t-1} > 0$ and there should be no inflows, such that $i_t = 0$. However, the prediction in terms of selection is ambiguous because there are outflows of both high-and low-ability workers. If the positive selection of movers dominates, then $p_{ot-1} > p_{st-1}$ and $\Delta LFPR_{rt}^{S} > \Delta LFPR_{rt}^{CS}$.

Consider the problem of an econometrician attempting to estimate

$$\Delta LFPR_{rt}^{S} = \gamma_1 \Delta \log F_{rt} + \gamma_2 \Delta \log M_{rt} + u_{rt}$$

However, the econometrician only observe $\Delta LFPR_{rt}^{CS}$ and not $\Delta LFPR_{rt}^{S}$. Write the linear projection of the compositional bias $(\Delta LFPR_{rt}^{CS} - \Delta LFPR_{rt}^{S})$ on the explanatory variables as $(\Delta LFPR_{rt}^{CS} - \Delta LFPR_{rt}^{S}) = \beta_1 \Delta \log F_{rt} + \beta_2 \Delta \log M_{rt} + e_{rt}$.

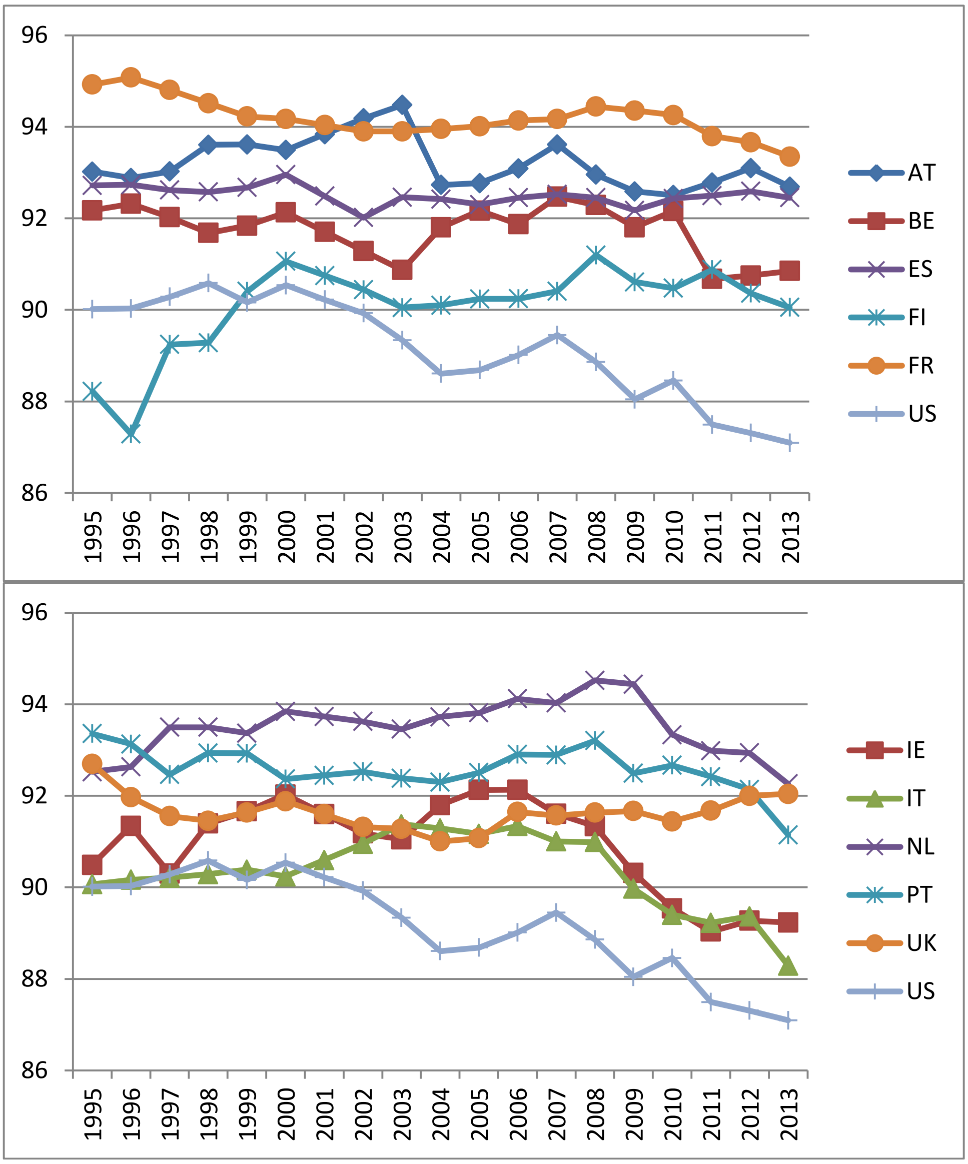
From the previous discussion, we expect β_1 to be positive, whereas the sign of β_2 is ambiguous. Thus, the regression using $\Delta LFPR_{rt}^{CS}$ instead of $\Delta LFPR_{rt}^{S}$ will estimate

$$\Delta LFPR_{rt}^{CS} = \tilde{\gamma}_1 \Delta \log F_{rt} + \tilde{\gamma}_2 \Delta \log M_{rt} + \tilde{u}_{rt}$$

where $\tilde{u}_{rt} = u_{rt} + e_{rt}$ and $\tilde{\gamma}_1 = (\gamma_1 + \beta_1) > \gamma_1$ which will be biased upward, whereas the direction of the bias of $\tilde{\gamma}_2 = (\gamma_2 + \beta_2)$ is ambiguous.

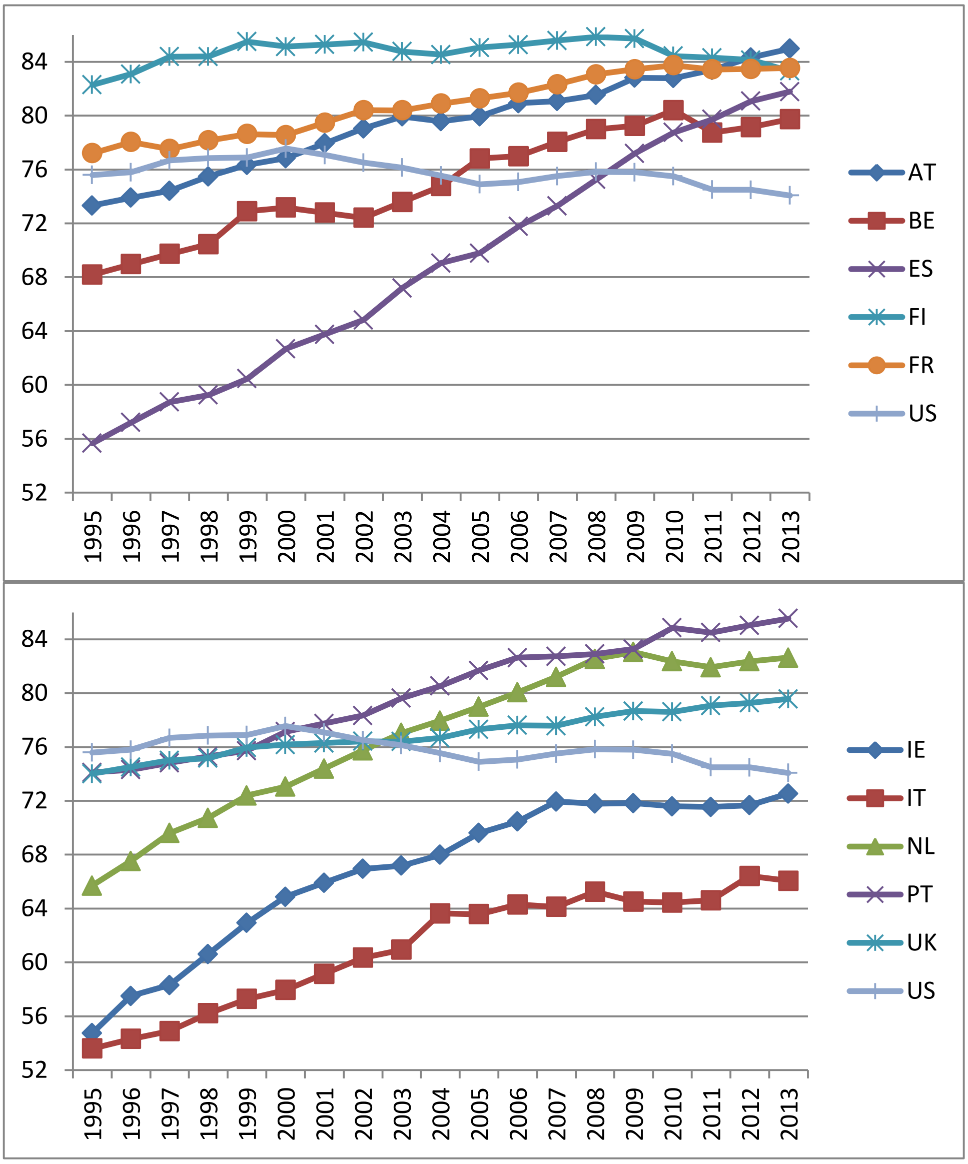
Figures

Figure 1: Labour Force Participation Rates, men ages 25-54



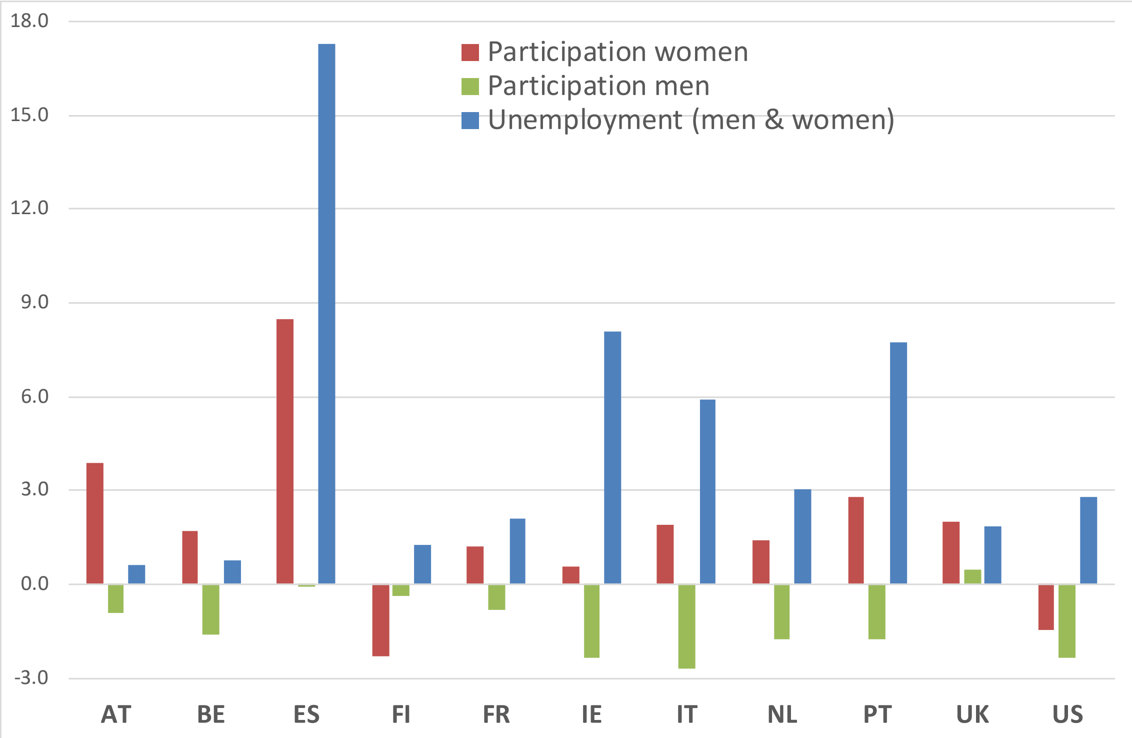
Notes: For each country and year, the figures reports the labour force participation rates of men aged 25-54. Sources: EU-LFS for Europe and CPS-ASEC for the US. Tabulations by the authors.

Figure 2: Labour Force Participation Rates, women ages 25-54



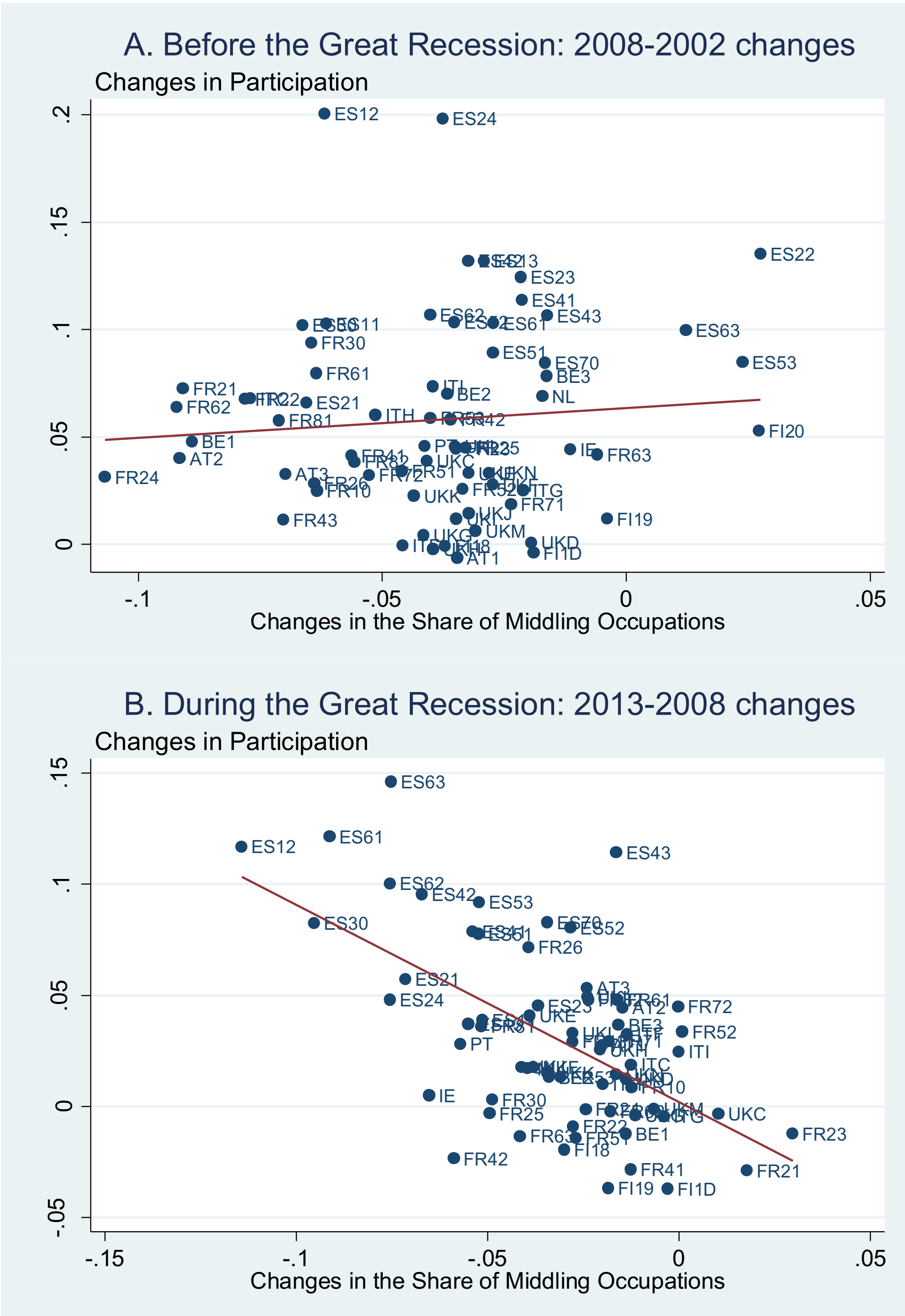
Notes: For each country and year, the figures reports the labour force participation rates of men aged 25-54. Sources: EU-LFS for Europe and CPS ASEC for the US. Tabulations by the authors.

Figure 3: Changes in participation by gender and changes in unemployment rate, ages 25-54, 2007-2013



Notes: The graph shows changes in labour force participation rates of men and women and changes in the unemployment rate across countries between 2007 and 2013. The figures focus on population aged 25-54. Sources: EU-LFS for Europe and CPS ASEC for the US. Tabulations by the authors.

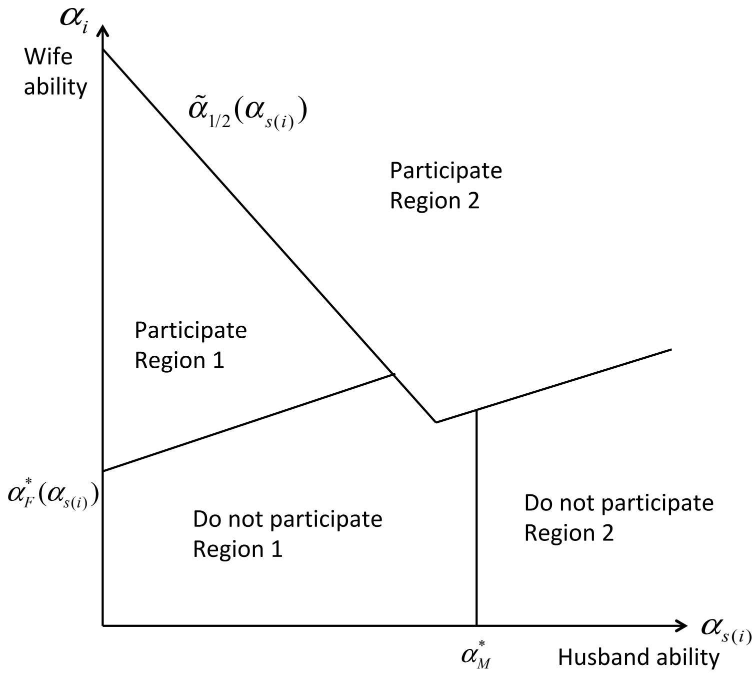
Figure 4: Changes in participation and in the share of middling occupation



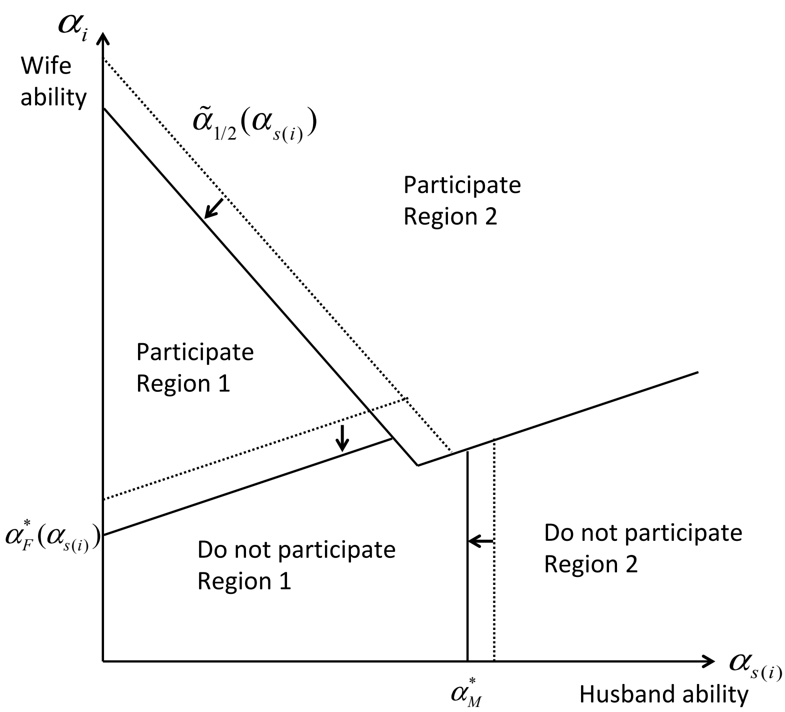
Notes: The graph relates changes in the share of middling occupations with changes in labour force participation rates of women aged 25-55 across European region. Panel A shows these changes for 2008-02 and Panel B for 2013-08.

Figure 5: Graphical solution of the model

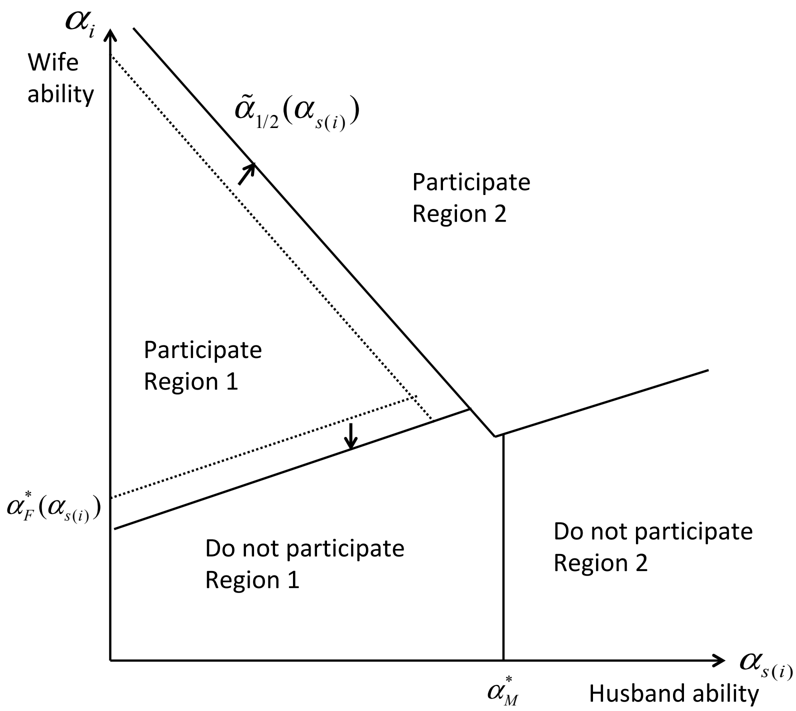
Panel A: Initial Equilibrium



Panel B: Negative shock to male productivity in region 1 ($\Delta A_{m1} < 0$)

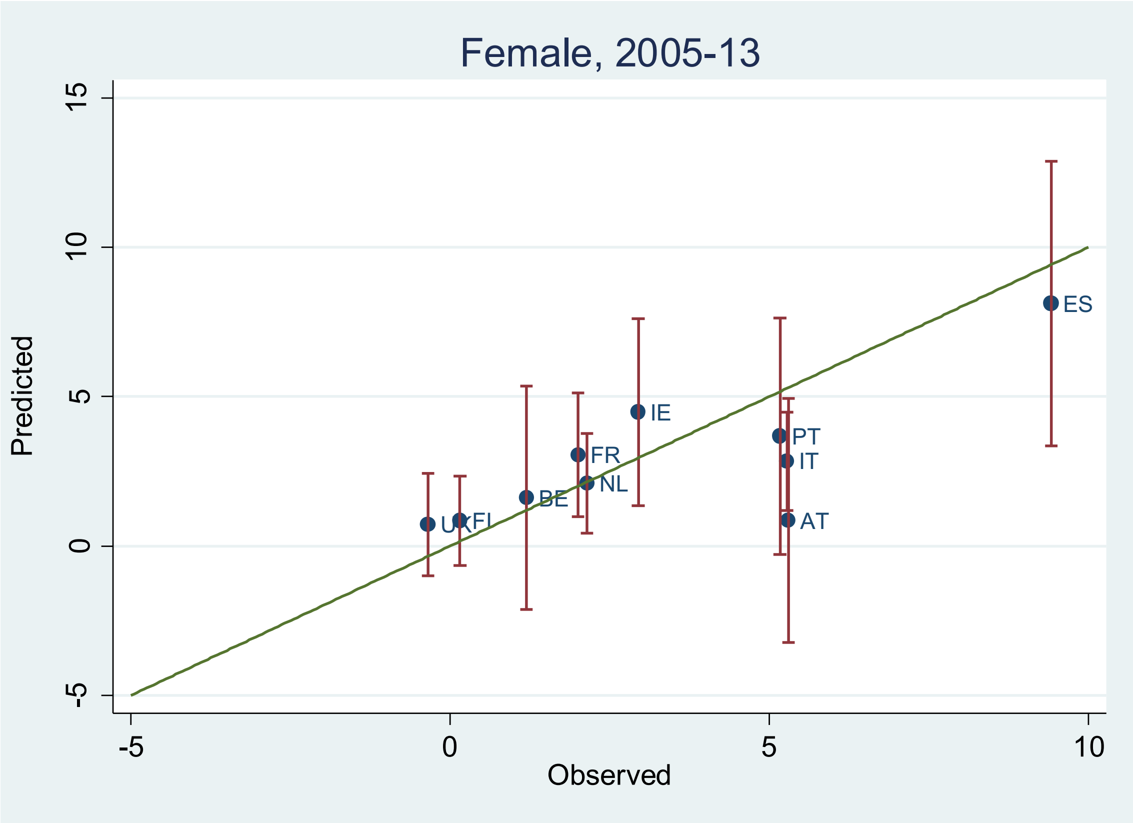


Panel C: Positive shock to female productivity in region 1 ($\Delta A_{f1} > 0$)



Notes: Panel A represents the equilibrium participation and location of households for each pair of ability of husbands (x-axis) and wife (y-axis). Panel B describes how a negative demand shock to male wages affects the participation and sorting of households. Panel C describes the consequences of a positive shock to female wages.

rFigure 6: How well does the model predict cross-country differences in participation of women during the Great recession?



Notes: The figure compares the predicted (y-axis) and observed (x-axis) changes in participation rates for women as observed in the SILC panel from 2005 to 2013. The 95% confidence intervals of the prediction are reported. Participation is measured by the share of the year in the labour force. To facilitate comparisons, a 45-degree line is draw on the graph.

Tables

Table 1: Job polarization before and during the Great recession

	Percentage changes in the share of total employment					
Period	Percentage point change 2007-13			Percentage point change 2001-2007		
Country	Lowest-paid occupations	Middling occupations	Highest-paid occupations	Lowest-paid occupations	Middling occupations	Highest-paid occupations
US	0.7	-2.5	1.8	2.8	-2.5	-0.3
Austria	-0.4	-2.0	2.4	2.2	-6.6	4.4
Belgium	0.3	-2.7	2.4	-1.1	-2.3	3.4
Spain	2.4	-6.5	4.2	1.0	-2.9	1.9
Finland	0.1	-2.4	2.3	4.0	-2.7	-1.2
France	1.2	-2.2	1.0	1.5	-5.2	3.7
Ireland	-0.3	-6.5	6.8	4.4	-0.8	-3.5
Italy	3.0	-1.1	-1.9	-4.9	-6.1	11.0
Netherlands	0.7	-4.0	3.3	2.1	-2.0	0.0
Portugal	1.9	-5.7	3.8	1.3	-3.9	2.5
UK	0.9	-2.5	1.6	-0.2	-3.3	3.5

Notes: The table shows changes in the share of total employment across each occupations group for each country. The occupation groups are defined following Goos, Manning and Salomons (2014). The left panel refers to the 2007-13 growth rates while the right panel shows the 2001-2007 growth rates. Sources: EU-LFS and CPS ASEC for the US.

Table 2: Occupational segregation by gender

	A. Share women in group in 2007			B. Share of women in middling occupation in		C. Dissimilarity Indexes by Gender across Occupations		
	Low pay occupations	Middling occupations	High pay occupations	1996	2013	ISCO 2 digit: *20 occupations*		
						1996	2007	2013
US	53.7	39.0	51.5	43.0	38.5	37.4	36.5	34.5
Austria	66.1	32.6	40.3	32.2	36.4	46.6	47.9	47.8
Belgium	60.7	35.8	41.4	32.0	33.9	43.1	41.7	46.4
Spain	62.3	24.6	43.4	20.8	29.0	39.8	46.7	42.8
Finland	73.4	30.0	48.3	na	31.5	50.0	53.5	51.0
France	70.3	36.1	43.5	36.7	38.5	49.9	48.9	45.8
Ireland	58.9	32.4	44.7	37.1	39.0	44.1	46.7	45.6
Italy	54.4	28.9	39.4	28.7	32.5	35.2	39.3	41.0
Netherlands	63.6	35.4	43.3	31.9	38.6	45.6	42.9	43.4
Portugal	67.4	29.4	41.2	24.0	31.0	38.0	42.1	42.3
UK	62.2	41.0	41.8	40.9	41.0	43.1	46.6	42.7
European average	63.9	32.6	42.7	31.6	35.1	43.5	45.6	44.9

Sources: EU-LFS and CPS ASEC for the US. Notes: For each country, Panel A shows the share of women among employees within each of the three occupation groups in 2007. Panel B shows the share of women among employees in middling occupations in 1993 and 2013. Panel C shows the dissimilarity index of the distribution of men relative to women across 20 occupations groups in 1996, 2007 and 2013. The index of dissimilarity indicates the proportion of men or women who would need to change occupation for the distribution of each gender across occupations to be similar. The European average is the unweighted average across all displayed European countries.

Table 3: Employment change by gender during the Great recession

Growth rate in employment, 2007-2013			
country	Women	Men	Percentage point difference Women-Men
US	-0.8	-2.8	2.0
Austria	6.6	2.1	4.5
Belgium	6.0	0.4	5.6
Spain	-5.7	-22.8	17.1
Finland	-0.5	-2.2	1.7
France	2.0	-1.2	3.2
Ireland	-3.7	-15.7	12.0
Italy	1.4	-6.4	7.9
Netherlands	0.9	-2.5	3.4
Portugal	-8.3	-16.0	7.7
UK	3.7	1.3	2.4

Sources: EU-LFS and CPS ASEC for the US. Notes: The table shows the growth rate from 2007-13 of the number of employees per gender for each country.

Table 4: First stage regressions using alternative Bartik instruments

Dependent variable	Δ Employment male			Δ Employment female		
Reference country for the Bartik shock	US	Europe	National	US	Europe	National
Bartik male	1.345***	0.831***	0.798***	0.596***	-0.133	-0.121***
	(0.177)	(0.152)	(0.058)	(0.135)	(0.096)	(0.042)
Bartik female	-0.864***	-0.744***	-0.212***	0.862***	0.833***	0.907***
	(0.194)	(0.204)	(0.078)	(0.125)	(0.117)	(0.081)
N	384	384	384	384	384	384
F-test	33.8	17.3	227.1	45.3	30.3	112.9
Sanderson-Windmeijer F-Stat	62.3	29.5	312.2	87.7	41.9	148.5

Sources: Panel EU-SILC and EU-LFS. Notes: The table shows first-stage regressions for each of our two endogenous covariates using alternative Bartik instruments constructed with three different reference countries. The dependent variables are the four-year changes in log male employment (panel A) and four-year changes in log female employment (panel B). The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Within each panel, the table reports the coefficients for the male and female Bartik instrument. Column 1 and 4 report results from Bartik instruments based on the growth of occupations in the US, column 2 and 4 in Europe, and column 3 and 6 from the country in which the region is located (excluding the region). The model includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.

Table 5: Did gender specific labour demand shocks influence participation rates?

Dependent variable: Change in share of the year in the labour force, Four-year changes observed from 2007-13			
	A. Married women		
	(1)	(2)	(3)
Δ Employment male	-0.130		-0.320***
	(0.125)		(0.105)
Δ Employment female		0.367***	0.257**
		(0.137)	(0.125)
N	384	384	384
Kleibergen-Paap F statistic	62.4	70.8	41.1
	B. Men		
Δ Employment male	-0.059		-0.040
	(0.125)		(0.115)
Δ Employment female		-0.011	-0.025
		(0.068)	(0.057)
N	384	384	384
Kleibergen-Paap F statistic	62.4	70.8	41.1

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable is the average changes in participation into the labour market over a four-year period in the SILC. Changes in participation used as a dependent variable are calculated using within-individual changes from SILC panel data which are aggregated at the regional level. Participation is defined as the share of the year in which the individual declared to be participating to the labour market. The endogenous covariates are changes in male and female log employment. The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using the Bartik instruments constructed with US data. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average. Panel A reports estimates of the model on women initially married and panel B on men.

Table 6: Alternative definitions of labour demand shocks

Dependent variable: Change in share of the year in the labour force, Four year changes observed from 2007-13			
	A. Married women		
	(1)	(2)	(3)
Δ Middling occupations	-0.207***		-0.122**
	(0.061)		(0.056)
Δ Lowest-paid or highest-paid occupations		0.410***	0.286***
		(0.118)	(0.111)
N	384	384	384
Kleibergen-Paap F statistic	63.5	140.4	41.8
	B. Men		
Δ Middling occupations	-0.002		0.002
	(0.048)		(0.027)
Δ Lowest-paid or highest-paid occupations		0.010	0.014
		(0.117)	(0.108)
N	384	384	384
Kleibergen-Paap F statistic	62.8	139.2	41.9

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable is the average changes in participation into the labour market observed over a four-year period in the SILC. Changes in participation used as a dependent variable are calculated using within-individual changes from SILC panel data which are aggregated at the regional level. Participation is defined as the share of the year, in months, in which the individual declared to be participating to the labour market. The endogenous covariates are changes in male and female log employment. The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using the Bartik instruments constructed with US data. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average. Panel A reports estimates of the model on women initially married and panel B on men.

Table 7: Labour demand shocks and regional changes in unemployment and wages

	Women			Men		
	A. Changes in Unemployment					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Employment male	-0.201**		-0.219***	-0.393***		-0.613***
	(0.098)		(0.079)	(0.088)		(0.084)
Δ Employment female		0.099	0.024		0.05	0.029
		(0.102)	(0.093)		(0.110)	(0.081)
	B. Changes in Wages					
Δ Employment male	0.863***		-0.419	0.593***		0.771
	(0.194)		(1.060)	(0.183)		(0.906)
Δ Employment female		0.794***	1.142		0.576***	0.215
		(0.164)	(0.867)		(0.134)	(0.741)
N	384	384	384	384	384	384
Kleibergen-Paap F statistic	62.4	70.8	41.1	62.4	70.8	41.1

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable is the average changes in unemployment and wages observed over a four-year period in the SILC. Changes in wages or unemployment used as a dependent variable are calculated using within-individual changes from SILC panel data which are aggregated at the regional level. The endogenous covariates are changes in log employment in middling and lowest-paid or highest-paid occupations. The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using the Bartik instruments constructed with US data. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.

Table 8: Labour demand shocks and changes in composition of the population

Dependent Variable: Change in log population of the indicated demographic group, pseudo cohort					
	(1)	(2)	(3)	(4)	(5)
	Prime age men	Prime age women	Prime age Women Less than High-school	Prime age Women at least High-school	Relative education supply
Δ Employment male	0.254**	0.197*	0.241	0.574***	-0.625***
	(0.126)	(0.118)	(0.256)	(0.159)	(0.088)
Δ Employment female	0.290**	0.234	0.525*	0.312**	0.466***
	(0.144)	(0.151)	(0.224)	(0.155)	(0.090)
N	384	384	384	384	384
Kleibergen-Paap F statistic	41.1	41.1	41.1	41.1	41.1

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable are the four-year changes at the region level in the log population of pseudo-cohorts of prime age men in column 1, prime age women in column 2, prime age women with less than high-school education in column 3, prime age women with at least high-school education in column 4. These changes are calculated with the LFS by following pseudo-cohort of individuals in the region, aged 25-49 in the first period and 30-54 in the second period. In column 5, the dependent variable is the four-year change in the log ratio of women with at least high-school education over women with less education. The endogenous covariates are changes in male and female log employment in panel A and changes in log employment in middling and lowest-paid or highest-paid occupations in panel B. The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using Bartik instruments constructed with US data. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.

Table 9: Comparisons of panel with cross-sectional estimates

	Changes in participation of prime-age married women using different methods to calculate changes in participation		
	(1)	(2)	(3)
	Within individual from SILC panel	"Cross-sectional" SILC panel	Adjusted cross-sectional LFS
Δ Employment male	-0.320***	-0.160	-0.278***
	(0.105)	(0.176)	(0.030)
Δ Employment female	0.257**	0.609***	0.268***
	(0.125)	(0.179)	(0.041)
N	384	384	384
Kleibergen-Paap F statistic	41.1	41.1	41.1

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variables are the four-year changes in participation into the labour market observed over a four year period. Changes in participation calculated using a within individual variations from SILC panel data aggregated at the regional level are reported in column 1. In column 2, we mimic cross-sectional data and only use the first-observation in the panel for each individual to estimate participation rate and do not exploit within-individual variations. In column 3, we use regional four-year changes in participation observed in the LFS as a dependent variable. We adjust these four-year changes following the same pseudo-cohort of prime age workers aged 25-49 in the first period and 30-54 in the second period and by using the residuals of a regression of the probability to participate on age and education dummies estimated separately for each country. The endogenous covariates are changes in male and female log employment. The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using the Bartik instruments constructed with US data. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.

Table 10: Placebo tests and robustness tests

A. Placebo Tests: Do the shocks of the Great recession (07-13) explain past changes in participation (01-06)?			
	(1)	(2)	(3)
Δ Employment male	-0.056		0.006
	(0.036)		(0.064)
Δ Employment female		-0.083**	-0.085
		(0.037)	(0.055)
N	339	339	339
Kleibergen-Paap F statistic	58.6	39.6	39.7
B. Estimates controlling for past Bartik shocks			
Reference country for the Bartik shocks	US	Europe	National
Δ Employment male	-0.370	-0.728	-0.240
	(0.904)	(1.060)	(0.192)
Δ Employment female	0.423	0.713	-0.038
	(0.900)	(1.440)	(0.197)
Bartik male lagged 7 years	-0.372	0.801	0.094
	(0.839)	(0.787)	(0.128)
Bartik female lagged 7 years	0.168	-0.803	0.001
	(0.302)	(1.136)	(0.059)
N	384	384	384
Kleibergen-Paap F statistic	1.3	0.3	29.2

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable is the average changes in participation observed over a four-year period in the SILC. Changes in participation are calculated using a within individual variations from SILC panel data aggregated at the regional level. Participation is defined as the share of the year in which the individual declared to be participating to the labour market. The endogenous covariates are changes in male and female log employment. In Panel A, we use four-year changes in participation from 2001-2006 as a dependent variable that we regress on changes in employment by gender from 2007-2013. In Panel B, the model additionally controls for male and female Bartik shocks lagged 7 years in columns 1-3 and lagged 14 years in columns 4-6. The sample contains an unbalanced sample of 66 regions. Each model is estimated with 2SLS using Bartik instruments constructed with US data in column 1 and 1, European data in column 2 and 5, and the country of the region in column 3 and 6. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.

Table 11: Estimates from LFS over 2000-2013 with country and region effects

Dependent variable: changes in adjusted participation rate of prime age women estimated using the LFS						
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Employment male	-0.555***	-0.581***	-0.700***			
	(0.057)	(0.189)	(0.244)			
Δ Employment female	0.350***	0.385***	0.476**			
	(0.032)	(0.142)	(0.185)			
Δ Middling occupations				-0.265***	-0.136***	-0.118***
				(0.038)	(0.035)	(0.033)
Δ Lowest-paid or highest-paid occupations				0.112***	0.014	-0.003
				(0.040)	(0.035)	(0.036)
Country fixed-effect	No	Yes	No	No	Yes	No
Region fixed-effect	No	No	Yes	No	No	Yes
N	1039	1039	1039	1039	1039	1039
Kleibergen-Paap F statistic	34.6	10.1	7.1	14.8	33.2	29.2

Sources: Panel EU-LFS. Notes: The table reports regression estimates in which the dependent variable are the four-year adjusted changes in participation into the labour market observed in the LFS from 2000-2013. The four-year changes are adjusted by following the same pseudo-cohort of prime age women aged 25-49 in the first period and 30-54 in the second period of each first-differences. For each LFS year, we adjust the participation rates using the residuals of a regression of the probability to participate on age and education dummies estimated separately for each country. Columns (2) and (5) include country fixed effects. Columns (3) and (6) include region fixed-effects. Reported standard errors are clustered by region.

Appendix Tables, for online publication only

Table A1: Correlation and autocorrelation of log employment changes, 2007-13

	Δ Employment male	Δ Employment female	Δ Middling occupations	Δ Lowest-paid or highest-paid occupations
Δ Employment male	1			
Δ Employment female	0.55	1		
Δ Middling occupations	0.65	0.38	1	
Δ Lowest-paid and highest-paid occupations	0.52	0.79	0.21	1

Notes: The table reports correlation coefficients between the indicated variables.
Δ Employment male, Δ Employment female, Δ Middling occupations, Δ Lowest-paid and Highest-paid occupations refer to four year changes in log employment of men, women, in middling and lowest or highest paid occupations, respectively.

Table A2: Are the results robust to the exclusion of a country from the sample?

Dependent variable: Change in share of the year in the labour force, Four-year differences observed from 2007-13										
Country Excluded	AT	BE	ES	FI	FR	IE	IT	NL	PT	UK
Δ Empl. Male	-0.332***	-0.346***	-0.410***	-0.306***	-0.369***	-0.275***	-0.364***	-0.320***	-0.327***	-0.259***
	(0.105)	(0.103)	(0.136)	(0.105)	(0.098)	(0.094)	(0.110)	(0.105)	(0.109)	(0.097)
Δ Empl. Female	0.197	0.302**	0.180	0.231*	0.287**	0.267**	0.288**	0.256**	0.261**	0.291**
	(0.123)	(0.135)	(0.197)	(0.127)	(0.137)	(0.127)	(0.129)	(0.128)	(0.126)	(0.124)
N	366	369	284	366	256	381	354	378	378	324
Kleibergen-Paap F statistic	39	36.6	11.3	39.9	33.5	39.3	35.8	39.2	36.4	39.4

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable is the average changes in participation into the labour market observed over a four-year period in the SILC. Regressions excluding each country one-by-one from the sample are reported across columns. Changes in participation used as a dependent variable are calculated using within-individual changes from SILC panel data which are aggregated at the regional level. Participation is defined as the share of the year in which the individual declared to be participating to the labour market. The endogenous covariates are changes in male and female log employment instrumented. The sample contains initially an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using the Bartik instruments constructed with US data. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.

Table A3: Are the Results Similar between from the South and North of Europe?

Dependent variable: Change in share of the year in the labour force, Four year changes observed from 2007-13		
Group of countries	North	South
Δ Employment male	-0.665**	-0.300***
	(0.322)	(0.071)
Δ Employment female	0.346	0.320**
	(0.250)	(0.154)
N	248	136
Kleibergen-Paap rk Wald F statistic	12.3	49.4

Note: The North includes Austria, Belgium, Finland, the Netherlands, Ireland, and the United Kingdom. The South includes Spain, France, Italy, and Portugal.

Table A4: Do the results change with alternative Bartik instruments?

Dependent Variable: Change in share of the year in the labour force, 2003-13			
Construction of the instrument	US growth	European growth	National growth
	A. Married women		
Δ Employment male	-0.377***	-0.346**	-0.398***
	(0.105)	(0.144)	(0.091)
Δ Employment female	0.333***	0.258*	0.304***
	(0.111)	(0.151)	(0.102)
N	384	384	384
Kleibergen-Paap F statistic	40.9	14.2	74.6
	B. Men		
Δ Employment male	-0.040	-0.011	-0.143
	(0.115)	(0.144)	(0.111)
Δ Employment female	-0.025	-0.102	-0.047
	(0.057)	(0.151)	(0.061)
N	384	384	384
Kleibergen-Paap F statistic	41.1	14.4	74.7

Sources: Panel EU-SILC and EU-LFS. Notes: The table reports regression estimates in which the dependent variable is the average changes in participation into the labour market observed over a four-year period in the SILC. Changes in participation used as a dependent variable are calculated using within-individual changes from SILC panel data which are aggregated at the regional level. Participation is defined as the share of the year in which the individual declared to be participating to the labour market. The endogenous covariates are changes in male and female log employment. The sample contains an unbalanced sample of 66 regions observed from 2007 to 2013. Each model is estimated with 2SLS using the Bartik instruments constructed with US data in column 1, European data in column 2, and using the country of the region in column 3. Reported standard errors are clustered by region. The model also includes controls for differences in the share of workers in middling occupations and with a university degree both taken at their 2003 value and normalized with respect to the country average.