# The Role of Gender in Employment Polarization*

Fabio Cerina[†] University of Cagliari

Alessio Moro[‡] University of Cagliari

Michelle Rendall[§] University of Zurich

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**Abstract**

We show that the process of employment polarization in the U.S. is largely generated by women entering the labor market during a period of sustained skill-biased technological change and rise of the services economy. For women, employment shares increase both at the bottom and at the top of the skill distribution, generating the typical U-shape polarization graph, while for men employment shares decrease in a similar fashion along the whole skill distribution. We extend the canonical model of skill-biased technological change by introducing three building blocks: a gender dimension, an endogenous market/home labor choice and a multi-sector environment. In the calibrated model, technological change induces a higher participation to the labor market of educated women who, in turn, reduce work time at home and increase the demand for low skilled services, generating a higher participation of uneducated women to the labor market. The model performs well in replicating polarization graphs by gender, marital status and sector and is consistent with several empirical observations of the U.S. economy that are not calibration targets.

**JEL Classification**: E20, E21, J16.

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[†]Contact: fcerina@unica.it

[‡]Contact: amoro@unica.it.

[§]Contact: michelle.rendall@econ.uzh.ch.

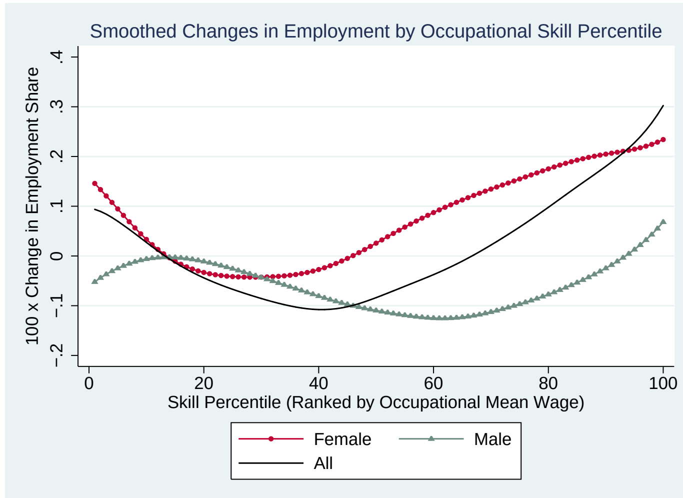


Figure 1: Changes in employment shares in the U.S. between 1980 and 2008. Data are from Census IPUMS 5 for 1980 and Census American Community Survey for 2008.

# 1 Introduction

Employment polarization in the U.S. has been extensively documented. For instance, Autor and Dorn (2013) show the change from 1980 to 2008 in the share of U.S. employment by skill rank and find an increase in employment shares both at the bottom and the top of the skill distribution, combined with a decline in the middle. This pattern, reported by the black continuous line in Figure 1, has become a well-known stylized fact. Less well known in the literature instead, is the behavior of job polarization when distinguishing by gender, which we also report in Figure 1. As the red line suggests, the overall phenomenon of job polarization is mainly driven by women. These individuals are responsible for the rise at the bottom and most of the rise at the top of the skill distribution, and for a small (relative to the aggregate economy) decline in the middle. Men instead, see their employment shares decline along the whole skill distribution except at the very top. The U-shape at the aggregate level emerges from the aggregation of these two groups. Thus, Figure 1 makes clear that the change in employment shares during the 1980-2008 period is not only heterogeneous along the skill distribution, but also substantially different across gender.

The empirical observations discussed above suggest that to gain additional insights on the process of employment polarization, a theory that can account for the observed gender differences in employment changes is needed. In this paper we build such a theory by focusing on the following observations on the polarization era (commonly referred to the 1980-2008 period).[1] First, during this period the average growth of skill-biased technological change is

[1] Barany and Siegel (2015) suggest that the process of job-polarization started in the early 1950. However,

substantial, while the same average growth is around zero between 1965 and 1980 (Heathcote, Storesletten, and Violante (2010) and Acemoglu and Autor (2011)). Second, during the same period, women increase their labor force participation rate and decrease the amount of time spent in home production, while the opposite occurs with men (Rendall (2010) and Ngai and Petrongolo (2013)). In 2008 the typical women spends 29% more time working in the market and 18% less time working at home than in 1980. For men these changes are -11% and 29%, respectively. Third, after 1980 the share of home production in total value added starts declining steadily until the end of the 2000s, while it has been flat during the rest of the post-war period (Moro, Moslehi, and Tanaka (forthcoming)). This decline coincides with a rise in the market share of services substitutable to home production, which are tipically low-skilled services (Autor and Dorn (2013) and Bridgman (2016)) and an acceleration of modern market services with respect to the pre-1980 period (Moro, Moslehi, and Tanaka (forthcoming)). In this paper we show that a theory that can account for these facts can also account for a large fraction of the process of job-polarization.

Our theory thus aims at studying the interaction between skill-biased technological change and changes in the individual choices of labor supply in the market and at home of women and men, in an economy in which the size of sectors changes over time. To see why this is important for the process of job polarization, consider the following scenario. Skill-biased technological change improves market opportunities so that a high-skilled women working at home decides to enter the labor market and she obtains a high-skilled job. This event has three effects on employment shares. First, it increases employment shares at the top of the skill distribution. Second, as the agent abandons home production, she is likely to purchase substitutes for this in the market, typically represented by low skilled services. By increasing the demand for low skilled services the agent fosters an increase in employment shares of low skilled individuals, who represent the bulk of employment in that market sector. Finally, as the change in employment shares at the top and the bottom of the skill distribution is positive, the change of employment shares in the middle turns out to be negative. This example suggests that the entrance in the market of a high-skilled women can potentially produce a U-shaped pattern of employment polarization as the one observed in Figure 1 for females and for the aggregate economy. The main aim of this paper is to investigate whether this hypothesis can hold in a general equilibrium setting and if it is quantitatively relevant for the process of employment polarization.

With the above intuition in mind, we extend the canonical model of skill-biased technological change (Acemoglu and Autor (2011)) by introducing the three building blocks of

here we focus on the period 1980-2008, which is the one in which polarization in terms of employment is most pronounced, as showed in Barany and Siegel (2015).

our theory: i) a gender dimension; ii) an endogenous home/market labor supply; and iii) a multi-sector environment. Such a model allows us to obtain predictions about changes in employment shares of the two gender along the skill distribution as skill-biased technological change occurs. We stress here that our three building blocks are crucial for the model to reproduce the data pattern in Figure 1. In fact, it is well known that in general the canonical model is not able to make predictions on job polarization.[2] This is because, with only one good produced in the economy, there are no interesting goods-demand effects that emerge from changes in employment shares of skilled and unskilled individuals. In our setting instead, the demand for a particular type of good plays a key role, because its evolution concurs to determine employment shares of the various types of workers employed in the sector producing that good. This point is key in the literature on structural transformation, in which the interaction between preferences and technological change determines, over time, employment levels in the various sectors of the economy. Thus, in an economy with a low elasticity of substitution among goods, the sectors experiencing slower productivity growth are those that see their employment shares increase over time. This point has also been stressed in the literature on polarization by Autor and Dorn (2013), who show how the rise of employment shares at the bottom of the distribution can be determined by a particular interaction between preferences and technological change that reduces the price of capital (computers) and, recently, in Barany and Siegel (2015).

We thus assume that there are three market sectors and a home sector. The three market sectors represent high-skilled services, low-skilled services and manufacturing. We borrow this characterization of the structure of the economy from the literature of structural transformation for two reasons. In the first place, following the intuition given above, we need a model in which there is a market sector that produces an output that is substitutable to home production (low-skilled services), and a modern sector attracting high-skilled individuals when skill-biased technological change occurs (high-skilled services). Secondly, we need to model different employment opportunities in the market for men and women. Recent work on the topic suggests that manufacturing is a sector in which men have a comparative advantage while services is one in which women display a comparative advantage.[3] We thus assume that a male agent with the same characteristics of a female agent has a comparative advantage in manufacturing while the opposite occurs in services.

Agents in the economy are heterogeneous in that each agent is born with a triple of skills, one for each market sector. Each of these skills determines the amount of efficiency units per unit of time that the agent can supply in the corresponding market sector. Agents are also

[2] Acemoglu and Autor (2011).

[3] See Ngai and Petrongolo (2013) and references therein.

allowed to obtain education by paying a cost. If an agent becomes educated she increases her skill levels by a certain amount. Thus, for a unit of time supplied and the same skill level, the productivity and the wage received by the educated individual are larger than those of the uneducated. An agent, taking as given market wages, makes a contemporaneous decision on the sector in which to work and whether to obtain education or not.

Each market sector is then given by a representative firm that employs four types of labor: educated males, educated females, uneducated males and uneducated females. It is important to note here that all sectors can employ any type of worker, by gender, skill and education level. However, the proportions of these groups will be different in the three market sectors and calibrated to the data.

Finally, the model is closed by determining the marital status of each agents. Once addressing gender issues, one cannot avoid dealing with the fact that some households are formed by a single agent while other are composed of two agents (leaving aside offsprings considerations). This is because the type of home/market labor choice is normally affected by the marital status of the individual.[4] Also, in Census data we find that the increase in working time in the market of married women between 1980 and 2008 is a striking 43%, compared to only 6% of singles.[5] For this reasons, we assume in the model that a fraction of agents is single and the rest is paired to an agent of the other gender to form a two-person household. The difference between the two types of agents is that a married couple maximizes the unique utility function of the household and each agent participates in home production. Imagine for instance a married man experience a layoff. Ceteris paribus, his spouse would react by increasing her hours worked in the market, as the married couple substitutes market hours between the two components.

Our strategy is to calibrate the model to two equilibria representing the years 1980 and 2008 to match a set of targets in the data and evaluate the performance of the model in replicating the main facts of job-polarization. The two equilibria differ in the following exogenous dimensions: i) the level of labor productivity of market sectors and the home sector; ii) the level of skill-biased technology; iii) the level of gender-biased technology; iv) marriage rates; and v) the cost of education. Given these differences, the model endogenously generates heterogeneous changes of employment shares along the skill distribution. Our first contribution is to show that the model replicates fairly well employment polarization by gender, by marital status and by sector, together with a number of features of the data that are not calibrated. In particular, the model shows that overall polarization (i.e. the

[4] See for instance the discussion in Costa (2000).

[5] See Rendall (2010) and Jones, Manuelli, and McGrattan (2015) on trends in market hours for married and single women.

u-shapeness of the black curve in Figure 1) results from the interaction of the following mechanisms:

- the upward twist at the top of the skill distribution is mainly driven by skilled married women. Due to structural change, both high- and low-skilled service increase their employment shares. Because of comparative advantage, the increase in labor demand for services is mainly absorbed by women. Married women are those who mostly absorb the increase in the demand of (educated) labor of high-skilled services for two main reasons: a) their education level grows faster than that of single women and b) a reallocation of working hours that take place within the couple: women work more and compensate for the reduction in working hours by their husbands, who are more likely to work in manufacturing in the first equilibrium, and they devote more time to home production in the second equilibrium. Such a reallocation cannot take place in the case of single agents.

- the upward twist at the bottom of the skill distribution is mainly driven by single women. Since their education level grows relatively slower than that of married women, the increase in the demand of (uneducated) labor in low-skilled services due to structural change is mainly absorbed by the latter. Also, unskilled men absorb part of this increase but to a smaller extent, due to comparative advantage.

- the downward twist in the middle of the skill distribution is mainly driven by married men in manufacturing. Such reduction takes place along the whole skill distribution but the upward twists at the bottom and the top of the women distribution offsets it at those skill levels, and generates the overall polarization phenomenon. The reduction in working hours by men is only partly compensated by an increase of unskilled labor demand in low-skilled services and by skilled labor demand in high-skilled services. As a consequence, our model is also able to replicate the increase of time devoted to home production by men and the reduction of home time of women observed in the U.S.

This paper links three fields of research that so far have been intersected only marginally. The one on the effect of female labor force participation on macroeconomic outcomes, the one on structural transformation, and that on employment polarization. We connect these strands of the literature by showing that the process of job polarization can be accounted for by the interaction between skill-biased technological change and women entering the labor market in a multi-sector environment.

Heathcote, Storesletten, and Violante (2010) use a dynamic one-sector heterogenous agents model with both skill-biased and gender-biased technological change to study the rise of wage inequality in the U.S. They find that women participating more in the labor market over time play a key role in shaping this process. Here we study the effect of female labor force participation on changes in employment shares along the skill distribution. We thus introduce the production function used by Heathcote, Storesletten, and Violante (2010) in each market sector in our model. This allows us to model both skill-biased and gender-biased technological change, but also to differentiate these processes across sectors.[6] As discussed above, the multi-sector assumption is key to generate a demand for low-skilled services that substitute for home production when women participate more in the labor market. This mechanism is described in Ngai and Petrongolo (2013) in a multi-sector model with home production. They describe how the process of *marketization,* occurring together with structural transformation, implies that women progressively abandon home production to work in the market.[7] Ngai and Petrongolo (2013) show that marketization and structural transformation explain together a large fraction of the evolution of the gender wage gaps of wages and hours in the U.S.

Recently, several contributions proved that the process of structural transformation affects several dimensions of the macroeconomy, including aggregate productivity (Duarte and Restuccia (2010) and Herrendorf and Valentinyi (2012)), growth (Moro (2015)), volatility (Carvalho and Gabaix (2013) and Moro (2012)), the amount of skill-biased technological change (Buera, Kaboski, and Rogerson (2015)) and, last but not least, employment levels (Rogerson (2008)). However, few works relate this process to job-polarization. Autor and Dorn (2013) provide an explanation for job-polarization based on a mechanism that has a flavor of structural transformation. They show how a two-sector environment with high-skilled workers, low-skilled workers and capital can generate employment polarization when there is technological change that reduces the price of capital over time. On another note, Barany and Siegel (2015), are the first to suggest that structural transformation can be *per-se* a main driver on employment polarization. This is because, by assuming a utility function in high-skilled service, low-skilled services and manufacturing with a low elasticity of substitution, productivity trends of these three sectors imply that the share of manufacturing shrinks with respect to the other two sectors. As by definition low-skilled services employ mostly workers at the bottom of the skill distribution, high-skilled services those at the top, and manufacturing the middle ones, the process of structural transformation generates

[6] Thus, skill-biased technological change occurs also in the low-skilled sector.

[7] The relationship between home production and structural transformation has been extensively studied in the literature. Se among others Rogerson (2008), Ngai and Pissarides (2008) and Rendall (2011). Consistent with a lower working time at home, Bridgman (2016) and Moro, Moslehi, and Tanaka (forthcoming) show that, when measuring home production at factor prices, the value added share of home in total value added (i.e. GDP plus home production) starts declining after 1980.

job polarization in their environment. While we use a specification of preferences similar to Barany and Siegel (2015), and a Roy-type model, we depart in several dimensions from their framework. First, we allow for different labor inputs by gender and education, and skill-biased and gender-biased technological change in production. This implies that each of our market sectors employ all types of workers. Second, we construct polarization graphs from the model's outcome, which allow us to make a close comparision with the data by skill level. And third, by modelling home production we are able to show that employment polarization is largely a female phenomenon.

Our modelling strategy is also related to the intuition discussed in Manning (2004) and Mazzolari and Ragusa (2013). The idea is that of consumption "spillovers": an increase in high-skill workers in the market, who have a high opportunity cost of working at home, increases the demand for services in the market that have a home counterpart. While Manning (2004) and Mazzolari and Ragusa (2013) take a local approach, by correlating an increase in high-skilled workers with the demand for workers in the same geographical area, we show that this mechanism is quantitatively relevant in a general equilibrium and it is mainly due to female agents increasing participation in the labor market. The above gender considerations about gender and female labor force participation are only partially addressed in the polarization literature. Acemoglu and Autor (2011) provide evidence on *wage polarization* by gender, but not on employment polarization. In that chapter, they also provide a description of the canonical model with skill-biased technological change and show why it cannot address job-polarizations issues. They suggest that a theory of job-polarization should consider a clear distinction between skills and tasks. There are several advantages in doing this, in particular that of being able to study one of the main drivers of job-polarization, which is the process of routinization. However, embedding heterogeneous skills and tasks in a general equilibrium framework to obtain quantitative predictions still represents a challenge. Here we take another path and, by adding our three building blocks, we show that the canonical model can generate a pattern of employment polarization that is comparable with the one in the data. To the best of our knowledge this is the first general equilibrium model that can be used to produce polarization graphs that are comparable to the one commonly used in the literature like the one in Figure 1.

The remainder of the paper is as follows. Section 2 presents the model; section 3 discusses the calibration; section 4 provides the benchmark results; section 5 provides the counterfactual experiments. Finally, section 6 concludes.

# 2 Model

The model economy consists of three market sectors, high skilled services, $hs$, low skilled services, $ls$, manufacturing goods $g$, and a home sector, $h$.

## 2.1 Agents

There are two masses of agents in the economy, one of female agents and one of male agents. The female and the male population can be of different size. Both types of agents are heterogenous such that each one has a skill level to work in low-skilled services, a skill level to work in manufacturing and a skill level to work in high-skilled services. Hence, each agent is endowed with a triple of skills $a^i = [a^i_{ls}, a^i_g, a^i_{hs}]$, where $i = f, m$, and $f$ stands for female and $m$ for male. Thus, there exist two density functions of agents with characteristics $[a^i_{ls}, a^i_g, a^i_{hs}]$. Each characteristic is between $a_{min}$ and $a_{max}$ and an agent of type $i$ is perfectly identified by a point in the support of the trivariate distribution $f(a^i) = f\left(a^i_{ls}, a^i_g, a^i_{hs}\right)$.

Each agent is also endowed with one unit of time. She splits this between work at home $(l)$ and work in the market $(1 - l)$. Thus, a unit of time of agent of type $i$ can supply: i) $a^i_{hs}$ efficiency units of labor to production in sector $hs$; ii) $a^i_g$ efficiency units of labor to production in sector $g$; iii) $a^i_{ls}$ efficiency unit of labor to production in sector $ls$; iv) 1 efficiency unit of labor to production in sector $h$.

## 2.2 Education and job decision

The education level and the sector where the agent works are jointly chosen. There are two different education levels $e = 0, 1$. If the agent chooses $e = 1$, then by paying a fixed cost $\chi^i$ she is able to increase her ability from $a^i_j$ to$\left(a^i_j\right)^{1+\zeta_j}$. Also, she will upgrade her wage per unit of efficiency, $w^{i,e}_j$, from that of uneducated, $w^{i,0}_j$, to that of educated individuals, $w^{i,1}_j$, where $j = ls, g, hs$ is the sector where the agent decides to work. Notice that we allow the education premium $\zeta_j$ to be sector-specific in a way that returns to education are increasing in skills. This last assumption is driven by the complementarity between skill levels and education attainment documented in recent work.[8] If the agent chooses $e = 0$ then she pays no cost, her ability does not increase and her wage per unit of efficiency remains $w^{i,0}_j$. Since there are two education levels and three market sectors, the agent, depending on her skill vector, and taking as given the equilibrium market wages per unit of efficiency in the three sectors and for each level of education, chooses the pair $(e, j) \in \{0, 1\} \times \{ls, g, hs\}$ in order to maximize her efficiency wage net of education costs.

[8] See Heckman, Stixrud, and Urzua (2006) and Findeisen and Sachs (2015).

In formulas, the optimal choice by an agent of type $i$ $(e^i, j^i)$ is such that

$$(e^i, j^i) = argmax_{(e,j)} \left[ w_j^{i,e} \left(a_j^i\right)^{(1+e\zeta_j)} - e\chi^i \right] \tag{1}$$

Notice that conditional on $e^i = 0$, then $(0, j^i) = argmax_{(0,j)} \left[ w_j^{i,0} \left(a_j^i\right) \right]$, so that the agent chooses to work in the sector $j$ which, given her ability and the market wages per unit of efficiency, ensures the highest efficiency wage $w_j^{i,0} a_j^i$. By contrast, conditional on $e^i = 1$, $(1, j^i) = argmax_{(1,j)} \left[ w_j^{i,1} \left(a_j^i\right)^{(1+\zeta_j)} - \chi^i \right]$, so that the agent chooses to work in the sector which ensures the highest actual wage net of the education cost.

Finally, note that we might have $argmax_{(j)} \left[ w_j^{i,0} a_j^i \right] \neq argmax_{(j)} \left[ w_j^{i,1} \left(a_j^i\right)^{(1+\zeta_j)} - \chi^i \right]$, so that the sector which ensures the maximum wage with education investment might well be different from the sector which ensures the maximum wage without education. Put it differently, we allow for an interaction between human capital investment and structural change: on the one hand, investing in human capital might be convenient only if the agent switches to another sector; on the other hand, switching to another sector might be profitable only conditional on human capital investment.

## 2.3 Consumption and time allocation decisions

Before choosing the consumption and time allocations, each agent chooses the combination of education level $e$ and in which sector $j$ to work to maximize her wage net of education costs, $w_j^{i,e} \left(a_j^i\right)^{(1+e\zeta_j)} - e\chi_i$. This implies that this wage is taken as given in the maximization problem involving consumption and labor. We define the maximum efficiency wage net of education for an agent of type $i$ as follows

$$W\left(a_{j^i}^i, w_{j^i}^{i,e}, e^i\right) = w_{j^i}^{i,e^i} \left(a_{j^i}^i\right)^{\left(1+e^i\zeta_{j^i}\right)} - e^i\chi^i \tag{2}$$

being $e^i$ and $j^i$ the level of education and the sector of work optimally chosen by an agent of type $i$.

Regarding the consumption and time allocation there are three kinds of decision units (i.e. households) in the model, $z = c, f, m$ : 1) a household $c$, which is formed by a couple of a female and a male individual; 2) a single female $f$; 3) a single male $m$. The utility function of a decision unit $z = c, f, m$ is

$$U^z = \left( (\omega_{hs})^{1/\sigma} \left(c_{hs}^z\right)^{\frac{\sigma-1}{\sigma}} + (\omega_g)^{1/\sigma} \left(c_g^z\right)^{\frac{\sigma-1}{\sigma}} + (\omega_s)^{1/\sigma} \left(\tilde{c}_s^z\right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

$$\tilde{c}_s^z = \left( \psi \left(c_{ls}^z\right)^{\frac{\gamma-1}{\gamma}} + (1-\psi) \left(c_h^z\right)^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} + \bar{c}_s \tag{4}$$

where $c_{hs}^z$ is consumption of high-skilled services, $c_g^z$ is consumption of manufacturing, $c_{ls}^z$ is consumption of low-skilled services and $c_h^z$ is consumption of home services. Following the findings in Moro, Moslehi, and Tanaka (forthcoming) we assume that the income elasticity of the aggregate of low-skilled services and home services is different from that of high-skilled services, and introduce the negative non-homothetic term $\bar{c}_s$.

The first three types of consumption are purchased in the market, while home services are produced within the household. Since each agent is endowed with 1 unit of time, each household devotes a fraction of this time for home production and the remaining time to market work. In the case of the couples, $z = c$, both male and female labor is used to produce home services. This is not so when the decision unit is a single women ($z = f$, no male labor is available) or when it is a single man ($z = m$, no female labor is available). For each type of household, home services are produced according to the following technology

$$Y_h^z = A_h L^z, \tag{5}$$

where

$$\begin{aligned} L^c &= A_h \left[\varphi_h^c \left(l^f\right)^{\frac{\eta-1}{\eta}} + \left(1-\varphi_h^c\right)\left(l^m\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, & (6)\\ L^f &= A_h \left(\varphi_h^f\right)^{\frac{\eta}{\eta-1}} l^f, & (7)\\ L^m &= A_h \left(\varphi_h^m\right)^{\frac{\eta}{\eta-1}} l^m, & (8)\end{aligned}$$

The budget constraint changes across households' types being

$$p_{hs}c_{hs}^z + p_g c_g^z + p_{ls}c_{ls}^z = E^z, \tag{9}$$

where

$$\begin{aligned} E^c &= \left(w_{j^f}^{f,e^f}\left(a_{j^f}^f\right)^{\left(1+e^f\zeta_{j^f}\right)} - e^f\chi^f\right)(1-l^f) + \left(w_{j^m}^{m,}\left(a_{j^m}^m\right)^{\left(1+e^m\zeta_{j^m}\right)} - e^m\chi^m\right)(1-l^m), & (10)\\ E^f &= \left(w_{j^f}^{f,e^f}\left(a_{j^f}^f\right)^{\left(1+e^f\zeta_{j^f}\right)} - e^f\chi^f\right)(1-l^f), & (11)\\ E^m &= \left(w_{j^m}^{m,e^m}\left(a_{j^m}^m\right)^{\left(1+e^m\zeta_{j^m}\right)} - e^m\chi^m\right)(1-l^m). & (12)\end{aligned}$$

Here $w_{j^f}^{f,e^f}\left(a_{j^f}^f\right)^{\left(1+e^f\zeta_{j^f}\right)}$ is the efficiency wage of the woman agent working in sector $j^f = hs, m, ls$ and with level of education $e^f = 0, 1$. Every woman agent for which it is optimal to work in sector $j^f$ earns $w_{j^f}^{f,e^f}$ per each efficiency unit, for a total of $\left(a_{j^f}^f\right)^{\left(1+e^f\zeta_{j^f}\right)}(1-l^f)$

efficiency units, minus the cost of education $e^f \chi^f$ . We highlight that, when $z = c$ (when the decision unit is a couple) every woman agent always works in the market in the sector with the highest $\left( w_{j^f}^{f,e^f} \left( a_{j^f}^f \right)^{\left(1+e^f \zeta_{j^f}\right)} - e^f \chi^f \right)$ unregarding the choice of her spouse because the households maximizes total utility.[9] This is all the more true when $z = f, m$.

Each decision unit $z = c, f, m$ chooses the amount of consumption of each good $c_j$ and the time devoted to home production by men and women $l^m$ and $l^f$ in order to maximize utility (3), subject to the service aggregator (4), the budget constrain (9) and the home production technology constraint (5).

From first order conditions we obtain the relative time of work at home of spouses, which, in an interior solution, is given by

$$\frac{l^f}{l^m} = \left( \frac{\varphi_h}{1-\varphi_h} \frac{W\left(a_{j^m}^m, w_{j^m}^{m,e^m}, e^m\right)}{W\left(a_{j^f}^f, w_{j^f}^{f,e^f}, e^f\right)} \right)^{\eta} . \tag{13}$$

Thus, the time of work at home of a female agent increases with the wage and the ability of the male in the market (which can be boosted by education) and declines with the wage and the ability of the female herself in the market.

From utility maximization we can derive an implicit price for home services, which is the key dimension in which singles and married are different. This is given by

$$p_h = \frac{1}{A_h} \left[ \varphi_h^{\eta} \left[ W\left(a_{j^f}^f, w_{j^f}^{f,e^f}, e^f\right) \right]^{1-\eta} + (1-\varphi_h)^{\eta} \left[ W\left(a_{j^m}^m, w_{j^m}^{m,e^m}, e^m\right) \right]^{1-\eta} \right]^{\frac{1}{1-\eta}} . \tag{14}$$

The price of home services is household specific, and depends on four continuous variables, $w_j^1$, $a_j^1$, $w_k^2$ and $a_k^2$ plus two education levels $e^f$ and $e^m$. This is due to the fact that, the higher the efficiency wage of a member of the household, the higher the opportunity cost of working at home rather than in the market. Thus, the model predicts that households with higher abilities tend to work more in the market and less at home, compared with households with lower abilities.

The home price for a single individual is

$$p_h^i = \frac{W\left(a_{j^i}^i, w_{j^i}^i, e^i\right)}{A_h} \left(\varphi_h^i\right)^{-\frac{\eta}{\eta-1}} . \tag{15}$$

This implicit price is increasing in ability so that a single agent with higher ability works more in the market and less at home, compared with a single agent with lower abilities. By

[9] A similar discussion can be made for a married men.

comparing (14) and (15) it is also possible to see that changes in market conditions (i.e. wages) have a different effect on the price of home production of married and singles, which translates, ceteris paribus, into a different decisions on how much to work at home and in the martket for the two types of households.

## 2.4 Firms and sectors

There is a representative firm in each market sector $j$=$hs$, $ls$, $g$. Each representative firm has the following production function

$$Y_j = A_j N_j, \tag{16}$$

where

$$N_j = \left[ \phi_j \left( \varphi_j N_j^{f,1} + (1 - \varphi_j) N_j^{m,1} \right)^{\frac{\eta_s - 1}{\eta_s}} + (1 - \phi_j) \left( \varphi_j N_j^{f,0} + (1 - \varphi_j) N_j^{m,0} \right)^{\frac{\eta_s - 1}{\eta_s}} \right]^{\frac{\eta_s}{\eta_s - 1}}, \tag{17}$$

where $N_j^{i,e}$ is the aggregator of labor efficiency units of agents of gender $i = m, f$ and education level $e = 0, 1$ in sector $j$. Our production function follows Heathcote, Storesletten, and Violante (2010) in displaying 1) perfect substitutability across gender; 2) gender-biased technology (through the parameter $\varphi_j$) 3) imperfect substitutability across education levels ($\eta_s > 1$ being the elasticity of substitution between educated and non-educated workers); 4) skilled-biased technology (through the parameter $\phi_j$).

The representative firm operating in sector $j$ maximizes profits

$$\pi_j = p_j Y_j - w_j^{f,1} N_j^{f,1} - w_j^{m,1} N_j^{m,1} - w_j^{f,0} N_j^{f,0} - w_j^{m,0} N_j^{m,0} \tag{18}$$

subject to (16) and (17).

## 2.5 Definition of equilibrium

The equilibrium is defined as a set of prices $\{p_{ls}, p_g, p_{hs}\}$, a set of wages per unit of efficiency $\left\{w_{ls}^{f,1}, w_g^{f,1}, w_{hs}^{f,1}, w_{ls}^{m,1}, w_g^{m,1}, w_{hs}^{m,1}, w_{ls}^{f,0}, w_g^{f,0}, w_{hs}^{f,0}, w_{ls}^{m,0}, w_g^{m,0}, w_{hs}^{m,0}\right\}$, a set of choices for each agent $(e^i, j^i)$ and a set of allocations for each household $\left\{c_{ls}^z, c_g^z, c_{hs}^z, l^{fz}, l^{mz}\right\}$ such that:

1. Given wages and prices, the choice $(e^i, j^i)$ maximizes wages net of education costs for agent $i$ by solving (1);

2. Given wages, prices, and $(e^i, j^i)$ of each household member, the allocation $\left\{c_{ls}^z, c_g^z, c_{hs}^z, l^{fz}, l^{mz}\right\}$ maximizes utility (3) of the household subject to the budget constraint (9);

3. Given wages and prices, each representative firm in sectors $ls$, $g$, and $hs$ maximizes profits (18);

4. Labor markets in sectors $ls$, $g$, and $hs$ clear;

5. Goods markets in sectors $ls$, $g$, and $hs$clear.

# 3 Calibration

We calibrate the model to two equilibria to replicate a series of targets of the U.S. economy in the years 1980 and 2008. We allow for the following exogenous differences between the two equilibria: i) the level of labor productivity of market sectors and the home sector; ii) the level of skill-biased technology; iii) level of gender-biased technology; iv) marriage rates; and v) the cost of education.

A number of parameters, $\{\sigma, \gamma, \eta, \eta_s\}$, is set from previous study. Following Ngai and Pissarides (2008) we set $\sigma = 0.3$ and $\gamma = 2.3$. $\eta$ is estimated in Knowles (2013) to 3, while the elasticity of substitution between educated and uneducated workers is taken from Heathcote, Storesletten, and Violante (2010) and set to $\eta_s = 1.43$.

Ability is assumed to be uniformly distributed, with $a_j \in (\underline{a}_j, \overline{a}_j)$ and with men and women drawing from the same ability distribution by sector when born. Spouses' abilities are correlated with correlation coefficient $\rho_j$. These correlations are computed using data on U.S. wages. To compute the correlation between husband and wife wages, we first compute female wages by sector correcting for selection bias using the Heckman correction, and second correlate wages of husbands and wives that work in the same sector. The correlation, averaging from 1978 to 2010, is 0.32 for manufacturing, 0.25 for low-skilled services and 0.26 for high skilled services. These values provide our correlation of skills measure.

Initial productivities by sector, including the home sector, are normalized to one, $A_{j,1980} = 1$ and $A_{h,1980} = 1$. The lower bound of ability in the low-skilled service sector is $\underline{a}_{ls} = 0.5$. For education, we follow Heathcote, Storesletten, and Violante (2010): individuals draw a disutility cost from the distribution $\log(\chi^g) \sim N\left(\mu_\chi^g, \sigma_\chi^2\right)$, where $i = f, m$. The mean cost is allowed to vary over time and gender to match the rise in education shares for both men and women, while the standard deviation is fixed over time and equal across men and women. The remaining 24 parameters: (1) ability $\{\overline{a}_{ls}, \underline{a}_{hs}, \overline{a}_{hs}, \underline{a}_i, \overline{a}_i, \zeta\}$, (2) productivity (market and home) $\{\{\varphi_j, \phi_j\}_{j=hs,ls,i}, \varphi_h, \varphi_h^f, \varphi_h^m\}$, (3) preference $\{\omega_{hs}, \omega_i, \psi, \bar{c}_s, \sigma_\chi\}$, and (4) time trends for sector productivity, gender biased and skill biased technological change $\{\{\gamma_j\}_{j=hs,ls,i}, \gamma_\varphi, \gamma_\phi\}$ are calibrated to match a number of moments. Note that $\omega_{ls} = 1 - \omega_{hs} - \omega_i$.

Table 1: *Model Parameters*

| Parameter | Type | Value |
|---|---|---|
| $\{\underline{a}_{ls}, \overline{a}_{ls}\}$ | low-skilled services ability | $\{0.50, 3.94\}$ |
| $\{\underline{a}_{hs}, \overline{a}_{hs}\}$ | high-skilled services ability | $\{0.65, 5.23\}$ |
| $\{\underline{a}_{g}, \overline{a}_{g}\}$ | manufacturing ability | $\{0.88, 3.82\}$ |
| $\omega_{hs}$ | Consumption market weights | 0.41 |
| $\omega_{g}$ | Consumption market weights | 0.41 |
| $\psi$ | Low-skilled market service weight | 0.41 |
| $\varphi_h$ | Home female-labor weight | 0.64 |
| $\varphi_h^{sing}$ | Single home labor weight | 0.74 |
| $\varphi_{hs}$ | Female-labor weight in high skilled services | 0.43 |
| $\varphi_{g}$ | Female-labor weight in manufacturing | 0.36 |
| $\varphi_{ls}$ | Female labor weight in low-skilled services | 0.38 |
| $\zeta$ | Schooling factor | 0.3541 |
| $\sigma_\chi$ | Variance of the cost of schooling | 0.51 |
| $\phi_{hs,1980}$ | Educated workers labor weight in high-skilled services | 0.50 |
| $\phi_{i,1980}$ | Educated workers labor weight in manufacturing | 0.31 |
| $\phi_{ls,1980}$ | Educated workers labor weight in low-skilled services | 0.19 |
| $\bar{c}_s$ | Non-homothetic consumption in low skilled service aggregator | -0.28 |
| $\gamma_{hs}$ | Annual growth in $A_{hs}$ | 0.0014 |
| $\gamma_{ls}$ | Annual growth in $A_{ls}$ | 0.0214 |
| $\gamma_{g}$ | Annual growth in $A_{g}$ | 0.0299 |
| $\gamma_{\phi}$ | Skill-biased technological change (annual growth rate in $\phi_j$) | 0.0139 |
| $\gamma_{\varphi}$ | Gender-biased technological change (annual growth rate in $\varphi_j$) | 0.0050 |

In order to match labor market choices of both married and single couples we make two assumptions: (1) home productivity of singles, is equal for men and women $\varphi_h^f = \varphi_h^m = \varphi_h^{sing}$, but potentially different from married men, $1 - \varphi_h$, and women, $\varphi_h$; and (2) the non-homothetic parameter $\bar{c}_s$ for couples is divided by 1.7. That is, OECD economies of scales assume the first adult in consumption accounts for 1.0, but the second adult accounts for a factor of 0.7 in a multi-person household. Therefore, it is assume that couples have non-homotheticity parameters 1.7 times larger than single households. Table 1 lists the parameter values used in the simulation.

While the calibration procedure matches all 24 parameters to 26 moments concurrently, by minimizing the distance between data targets and model moments, some targets are more informative for certain parameters than others. Below we outline the general strategy.

Ability parameters, $\{\overline{a}_{ls}, \underline{a}_{hs}, \overline{a}_{hs}, \underline{a}_i, \overline{a}_i\}$ (5 targets): male high-skilled services (industry) to low skilled services wage premiums and the standard deviation of log male wages of full-time full-year workers from the CPS in 1980. Relative weights in consumption, $\{\omega_{hs}, \omega_i\}$ (2 targets): relative hours in low-skilled services and industry in 1980. Home production

$\{\varphi_h, \varphi_h^{sing}, \psi\}$ and relative market productivity $\{\varphi_j\}_{j=hs,ls,i}$ (8 targets): (1) married female, and (2) single male hours all relative to married male hours. (3) female to male hours gap by sector and (4) gender wage gap by sector. Education determinants, $\{\zeta, \sigma_\chi, \{\phi_{1980}\}_{j=hs,ls,i}\}$ (5 targets):, the male college wage premium in 1980, the relative hours of uneducated (LTC=less than college) in all three sectors, and a measure of ability difference of educated to uneducated individuals (taken from the NLSY armed forces test score). Non-homotheticity in consumption $\{\bar{c}_s\}$ and sector growth rates $\{\gamma_j\}_{j=hs,ls,i}$ (4 target): (1) relative sector hours in 2008 and (2) male high-skilled services (industry) to low skilled services wage premiums in 2008. SBTC, $\{\gamma_\phi\}$ (1 target): the male college wage premium in 2008. Gender-biased technological change, $\{\gamma_\varphi\}$ (1 target): gender wage gap in 2008. All targets are computed using the 1980 Census and the 2008 American Community Survey unless noted.

In order to split the service sector into low and high-skilled services, we compute the share of college graduates within 3 digit census industry classifications from 1978 to 1982. All service industries with a share of more than 20 percent college graduate labor in this time frame are classified as high-skilled service industries. The classification details can be found in appendix A.[10] It follows a sample list of typical industries by service sector type. High-skilled services: Air transportation; machinery, equipment, and suppliers; miscellaneous retail stores; FIRE; advertising; computer and data processing service; health services; colleges; R&D. Low-skilled services: nursing and personal care facilities; bus service and urban transit; taxi; trucking; USPS; grocery stores; hotels; automotive repair and related services; eating and drinking places; motor vehicle dealers; gasoline service station; lodging places; barber shops; beauty shops; laundry, cleaning, and garment services.

Changes in the demographic structures are summarized in table 3. It is worth emphasizing the following differences between the two equilibria: 1) The share of educated individuals grows for both men and women but relatively faster for women; 2) among the latter, the share of educated individuals increases faster for married rather than for single women; 3) the marriage rate decreases.

Finally, note that this is the first paper that compares polarization graphs in the data with the outcome of a general equilibrium model. Thus, one challenge is how to draw polarization graphs in the model that are comparable with those in the data. We proceed as follows. First, within each market sector in the model we create bins of workers with similar ability along the sector skill distribution. We do this because, for instance, the ability level of a worker in manufacturing cannot directly compared with the ability level of a worker in high-skilled services. Next, we compute the average wage in each bin. Then, we rank all

[10]Buera and Kaboski (2012) use a similar approach but a different threshold (12,5%) and a different initial year (1940). However, they argue that the ranking is very stable overtime.

Table 2: *Model Targets*

| **Type** | **Data** | **Model** |
|---|---|---|
| 1980 - ability $\left(\{\underline{a}_j, \overline{a}_j\}_{j=hs,ls,i}\right)$ | | |
| Male industry to low-skilled services wage premium | 1.110 | 1.015 |
| Male high-skilled to low-skilled services wage premium | 1.187 | 1.044 |
| Std dev of industry log male wages | 0.596 | 0.324 |
| Std dev of low skilled to industry log male wages | 1.029 | 0.819 |
| Std dev of high skilled to industry log male wages | 1.040 | 1.103 |
| 1980 - consumption $(\{\omega_j\}_{j=hs,ls,i})$ | | |
| Relative Hours in industry | 0.331 | 0.356 |
| Relative Hours in low-skilled services | 0.376 | 0.354 |
| 1980 - home production $\left(\psi, \varphi_h, \varphi_h^{sing}\right)$ | | |
| Married Female to Married Male labor hours | 0.439 | 0.474 |
| Single Male to Married Male labor hours | 0.781 | 0.755 |
| 1980 - market productivity $(\{\varphi_j\}_{j=hs,ls,i})$ | | |
| Gender Wage Gap industry | 0.556 | 0.531 |
| Gender Wage Gap low-skilled services | 0.550 | 0.590 |
| Gender Wage Gap high-skilled services | 0.575 | 0.668 |
| Female to Male I-hours gap in manufacturing | 0.322 | 0.331 |
| Female to Male LS-hours gap in low-skilled services | 0.616 | 0.591 |
| Female to Male HS-hours gap in high-skilled services | 1.115 | 1.171 |
| 1980 - education ability returns $(\zeta, \sigma_\chi, \{\phi_{1980}\}_{j=hs,ls,i})$ | | |
| Male College Wage Premium | 1.423 | 1.618 |
| Relative LTC Hours in manufacturing | 0.885 | 0.841 |
| Relative LTC Hours in low-skilled services to industry | 0.982 | 1.094 |
| Relative LTC Hours in high-skilled services to industry | 0.702 | 0.752 |
| Relative C+ ability (in std dev) (Source: NLSY) | 1.084 | 1.122 |
| 1980-2008 - non-homotheticity and productivity $(\bar{c}_s, \{\gamma_j\}_{j=hs,ls,g})$ | | |
| Growth in relative Hours in industry | -0.110 | -0.093 |
| Growth in relative Hours in low-skilled services | 0.049 | 0.051 |
| Growth in male industry to low-skilled services wage premium | 0.015 | -0.021 |
| Growth in male high-skilled to low-skilled services wage premium | 0.313 | 0.267 |
| 1980-2008 - skill-biased and gender-biased technological change $(\{\gamma_j\}_{j=\phi,\varphi})$ | | |
| Growth in relative female wages | 0.194 | 0.222 |
| Growth in relative college wages | 0.424 | 0.456 |

Table 3: *Demographic Changes*

| | 1980 | 2008 |
|---|---|---|
| Education | | |
| Male | 0.20 | 0.28 |
| Female | 0.13 | 0.30 |
| Singles | | |
| Male | 0.24 | 0.33 |
| Female | 0.27 | 0.32 |
| Share Educated | | |
| Single Men | 0.16 | 0.20 |
| Single Women | 0.13 | 0.23 |
| Married Men | 0.22 | 0.37 |
| Married Women | 0.14 | 0.38 |
| Couple Types | | |
| Educated Couples | 0.10 | 0.25 |
| Educated Husband Only | 0.12 | 0.11 |
| Educated Wife Only | 0.04 | 0.11 |
| Uneducated Couples | 0.74 | 0.53 |

bins from the three market sectors into a unique classification by using the average wage in each bin in the first equilibrium. We apply the same method to the data. That is, within each market sector we create bins of workers with similar wage, and compute the average wage in each bin. Then we rank bins from the three sectors into a unique classification using average wage in each bin in 1980.

Note that in the data, certain occupations are in all three sectors (e.g., secretaries), but others are likely just in one of the three (miner). So in our method we have four occupations and wage rates in 1980. Instead, the original method in Acemoglu and Autor (2011) computes an average wage for secretaries in the U.S. economy in 1980 and one for miners. So instead of four occupations and wage rates in 1980, they have two. Besides that the two methods are identical, that is, we rank occupations by their wages in 1980 from 0 to 100. As the appendix shows, the differences between the two methods in the data are very minor, and mostly at the right tail of the overall distribution. The reason for this difference is that in our methodology some occupation group is a bit more homogenous.

# 4 Results

Table 4 reports some aggregate statistics for the model in the two equilibria. Since the model does not have leisure we use data by Aguiar and Hurst (2006) to obtain hours worked

Table 4: *Aggregate Results*

| | Data | | | Model | | |
|---|---|---|---|---|---|---|
| | 1980 | 2008 | *Diff.* | 1980 | 2008 | *Diff.* |
| **Hours (relative to Married Men)** | | | | | | |
| Married Men (market) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 |
| Married Women (market) | 0.44 | 0.64 | 0.20 | 0.48 | 0.68 | 0.21 |
| Single Men (market) | 0.78 | 0.77 | -0.01 | 0.76 | 0.80 | 0.04 |
| Single Women (market) | 0.63 | 0.71 | 0.08 | 0.64 | 0.75 | 0.11 |
| Men (home) | 0.30 | 0.40 | 0.10 | 0.11 | 0.13 | 0.03 |
| Women (home) | 0.81 | 0.72 | -0.09 | 0.49 | 0.32 | -0.17 |
| **Hours (relative to Educated Men)** | | | | | | |
| Educated Men (market) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 |
| Educated Women (market) | 0.59 | 0.76 | 0.17 | 0.67 | 0.83 | 0.16 |
| Uneducated Men (market) | 0.85 | 0.81 | -0.04 | 0.95 | 0.92 | -0.03 |
| Uneducated Women (market) | 0.45 | 0.59 | 0.14 | 0.54 | 0.71 | 0.16 |

relative to home hours[11]. The model performs well in replicating aggregate trends of the working hours of each population group. In particular, the rise in market hours of females and the constancy in the hours of single males is quantitatively similar to the one observed in the data, regardless the fact that neither of these is a target of the calibration. Regarding hours by education the model replicates the same changes over time as in the data. However, while the model reproduces the increase of male home hours and the decrease of female home hours, the magnitude is smaller than the data for the former and larger for the latter.

Figure 2 presents the comparison between polarization in the data and the respective polarization graphs generated by the model.[12] The top-right panel of Figure 2shows that model performs well in replicating the main features of the data, in particular the standard pattern of overall polarization. Employment shares increase both at the bottom and the top of the skill distribution, while they decline in the middle of the distribution. Decomposing patterns by gender, the model also generates similar patters with respect to the data. Women generate an increase in employment shares at the bottom and the top of the skill distribution, with a decrease in the middle. The behavior of men is also broadly consitent with the data, with a decrease of employment shares along most of the skill distribution, except for an increase at the top. However, the model understimates the increase of female hours at the top of the distribution and generates a small decline in the middle of the distribution compared to the data.

The second row of Figure 2 compares the performance of the model conditional on marital

[11] That is, we impose that home hours plus market hours equal one in both 1980 and 2008

[12] As a general strategy we comment in the main text polarization graph, while tables with polarization facts by quintiles can be found in the appendix.

status. Similarly to the data, singles display a flatter behavior across the skill distribution with respect to married, and increase their employment shares along the whole skill distribution. This is due to the fact that couples can reallocate working hours within the family, while single individuals cannot. Also, as in the data, married women are largely responsible for the increase at the top of the distribution, while single women contribute to a large extent to the increase at the bottom. The intuition for this pattern can be found in the different fraction of married and single women that acquire education between the two equilibria. In the first equilibrium, the share of educated individuals is very similar between single (0.13) and married (0.14) women. In contrast, in the second equilibrium, the share of educated individuals among married women increases by a factor of 2.71, while that of single women only by a factor of 1.77. Hence, the former are more likely to satisfy the increase of (educated) labor demand while the latter are more likely to absorb the demand of (uneducated) labor.

We also report polarization across sectors in the bottom four panels of Figure 2. The outcome of the model is again similar to the data and supportive of the mechanism proposed in this paper. First, the third row of Figure 2 shows how the model reproduces polarization in services and the flat behavior of manufacturing (except at the top of the distribution) observed in the data. Second, the fourth row of Figure 2 suggests that the model does well even when decomposing sectoral polarization by gender. In particular, it replicates the upward twists for women in services at the top and at the bottom of the distribution. And third, the model also replicates the relative homogeneity and "flatness" of the negative change in men hours in manufacturing along the whole skill distribution. The latter phenomenon, when coupled with the strong female polarization, is key in explaining the downward twist in the middle of the distribution of the overall economy. In fact, this result suggests that the decline at the bottom of the overall distribution is the result of services occupation increasing at the middle less than in the rest of the distribution, and manufacturing occupation declining similarly along the whole distribution.

# 5 Counterfactuals

In this section we run some counterfactual exercises to assess the role of exogenous channels in generating employment polarization in our model. To do this, we study the effect of shutting down productivity growth in the market and skill-biased technological change. Results for the overall economy are reported in figures 3, 4 and 5 for the overall economy, for women and for men, respectively.

By setting market productivity to zero, we are shutting down the main price effects across the various market sectors, and one of the drivers of structural transformation. Figure 3 shows that the main effect on overall polarization is to reduce employment shares at the bottom, generating an almost monotone pattern of employment shares. This is mainly due to a reduction of women employment shares, which is particularly significant at the bottom of the skill distribution. This is because in the counterfactual sectors favoring female labor (i.e high-skilled and low-skilled services), grow less than in the benchmark. This implies an increase in employment shares of men along the whole distribution.

By closing the skill-biased technological change channel there is a large increase in employment shares at the bottom of the distribution and and a large decline of employment shares at the top. By looking at figures 4, it appears that women are driving the large increase at the bottom. Along the rest of the distribution, women lose employment shares. The opposite occurs with men, who gain employment share in the low and middle part of the distribution but experience a large decline of employment shares at the top. This counterfactual suggests that by removing skill-biased technological change in our setting has the expected effect of raising the lower tail and dampening the higher tail of changes in employment shares along the skill distribution. At the same time this counterfactual shows that in our setting, the standard Ngai and Pissarides (2007) channel of structural transformation cannot generate employment polarization alone.

By removing both productivity growth and skill biased technological change the model produces an inverted U-shape of employment shares. That is, the graph of employment polarization is the mirror image of that in the data. However, while the behavior of women becomes flat, men are those driving the inverted U-shape. This confirms the view that entrance of women in the labor market due to structural transformation, and the interaction of this process with skill-biased technological change, is the main determinant of employment polarization in the U.S.

# 6 Conclusions

In this paper we studied the role of gender in employment polarization. To do this we constructed a multi-sector general equilibrium model of structural transformation with occupational choice. The model shows that by taking into account the endogenous response of heterogeneus individuals to skill-biased technological change and sectoral productivity growth it is possible to account for overall and gender specific job-polarization facts. Also, the model is consistent with job-polarization by broad sectors of economic activity and marital status.

Thus, we show here that the response of individuals to skill-biased technological change crucially depends on their gender, their marital status and the sector they work in. Our results suggest that the process of overall polarization results from the interaction of an upward twist at the top of the skill distribution driven by educated married women, an upward twist at the bottom of the skill distribution driven by uneducated single women and a downward twist in the middle of the skill distribution driven by married men in manufacturing. In this light, our model provides a setting which can be used to evaluate the impact of skill-biased technological change on the different types of individuals in the economy.

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# Appendix

[To be added]

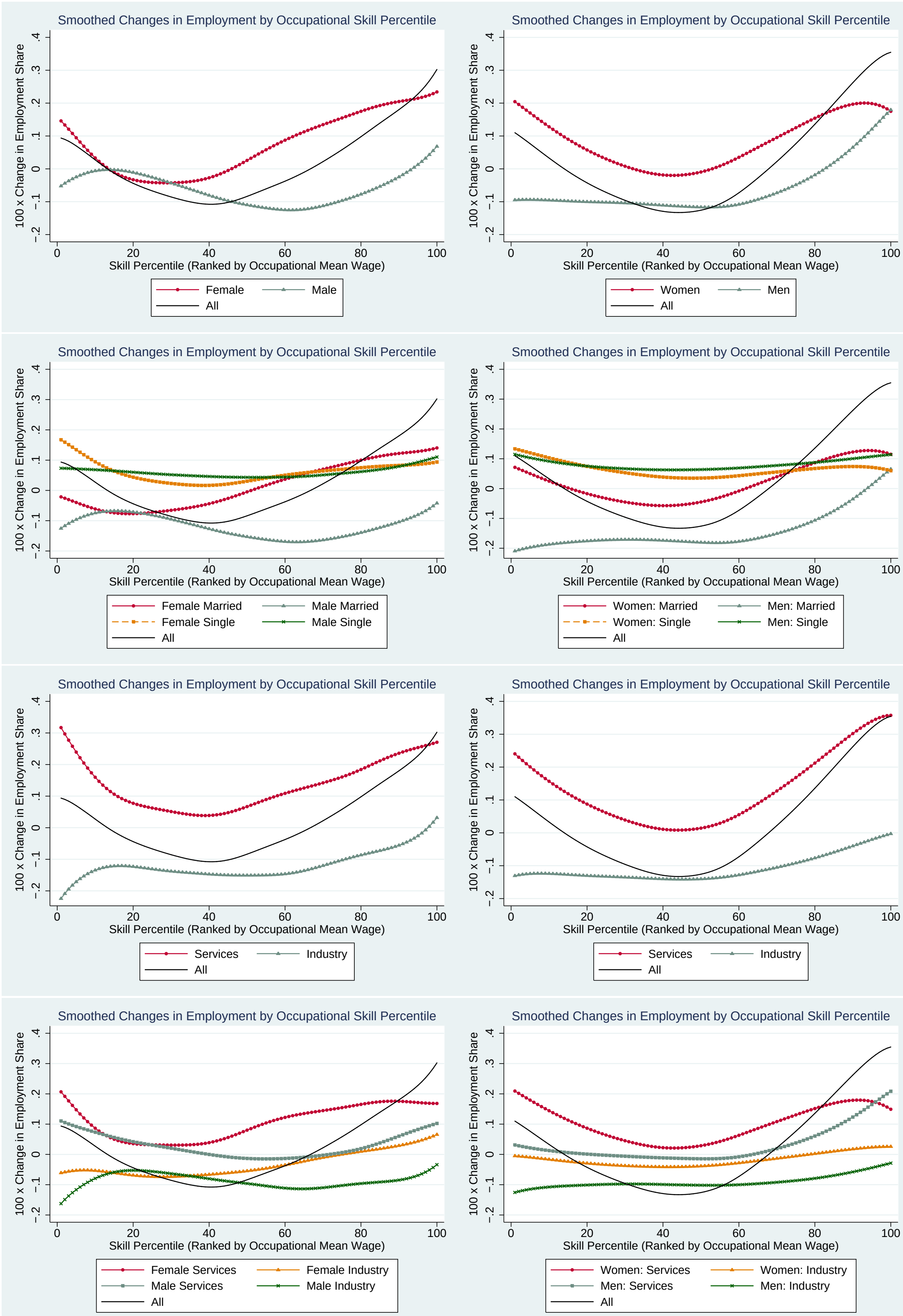


Figure 2: Job polarization in the data (left) and in the model (right). First row: gender; second row: marital status and gender; third row: sectors; fourth row: sectors and gender.

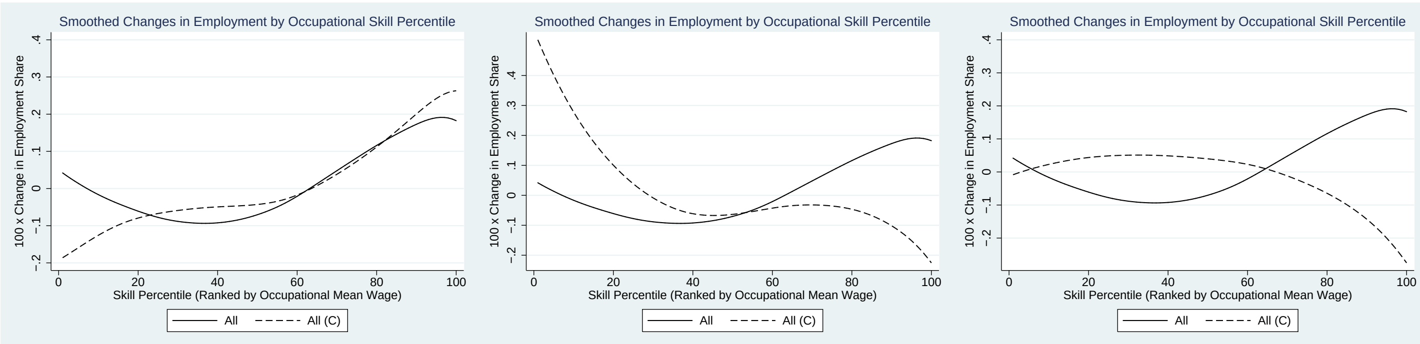


Figure 3: Counterfactual Job-Polarization (Overall economy): no labor productivity growth in the market (left); no SBTC (middle); no labor productivity growth in the market and no SBTC (right).

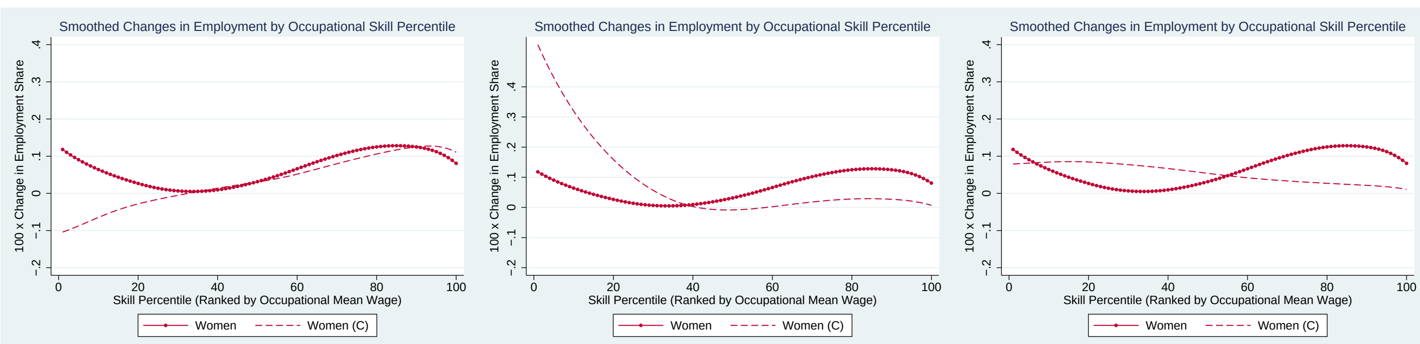


Figure 4: Counterfactual Job-Polarization (Women): no labor productivity growth in the market (left); no SBTC (middle); no labor productivity growth in the market and no SBTC (right).

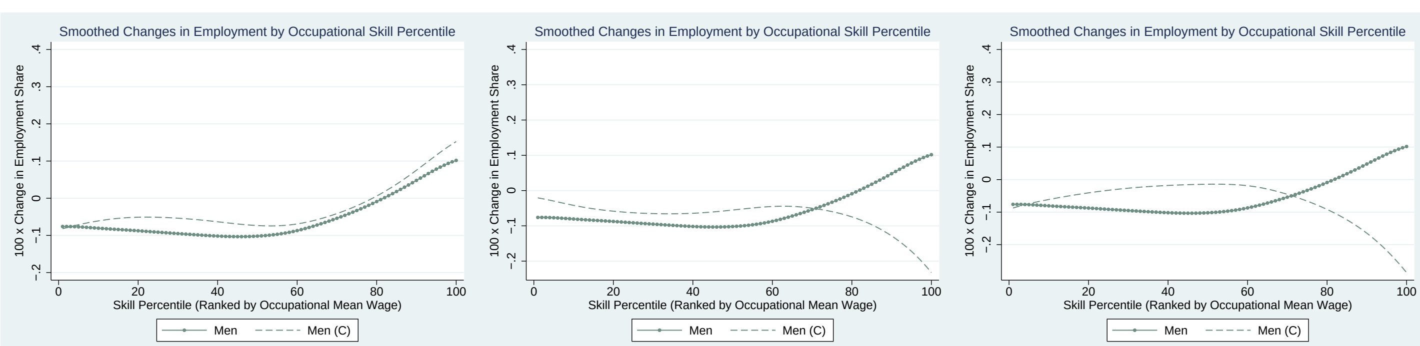


Figure 5: Counterfactual Job-Polarization (Men): no labor productivity growth in the market (left); no SBTC (middle); no labor productivity growth in the market and no SBTC (right).