

Trends in Work and Leisure: It's a Family Affair*

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Abstract

In recent decades, the correlation between U.S. men's wages and hours worked has reversed: low-wage men used to work the longest hours, whereas today it is men with the highest wages who work the most. This changing correlation accounts for roughly 30 percent of the rise in the variance of male earnings between 1975 and 2015. In this paper, we rationalize these trends in a model of joint household labor supply. Our quantitative model generates similar changes to what is observed in the data as a reaction to shifts in women's education and labor supply, the gender gap, and assortative mating. Our model is consistent with the observations that the changing wage-hours correlation among men is driven by married men, and that there is little change in the wage-hours correlation among employed women and at the household level. The results suggest that taking into account joint household decision making is essential for understanding the dynamics of labor supply.

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1 Introduction

Throughout most of economic history, leisure appeared to have the characteristics of a luxury good. The starkest manifestation of this phenomenon was during pre-industrial times, when the masses toiled hard to ensure their survival, while the landowning upper class lived up to the moniker “leisure class” by not working at all. Even after industrialization led to a new economy where most families derived most of their income from labor, it continued to be true that those who earned more, worked less. Extrapolating this relationship, in his “Economic Possibilities for Our Grandchildren” John Maynard Keynes predicted that by the early 21st century, growing productivity would have resulted in most people working just a few hours each week, while enjoying ample leisure.

With the benefit of hindsight, we now know that this scenario did not pan out. While there has been some reduction in the typical hours of full-time workers, work still takes up a major fraction of time, and women have substantially increased their labor supply in recent decades. The focus of this paper is an even sharper deviation from the old pattern: in the last few decades, the cross-sectional relationship between income and labor supply has entirely reversed. Among full-time workers, the relationship between wages and labor supply (hours per week) was strongly negative in the first half of the twentieth century. These differences narrowed over time and reversed in the 1970s. Today, high-wage workers work substantially longer hours than low-wage workers. The reversal in the wage-hours relationship has made a substantial contribution to rising inequality in earnings: if the wage-hours relationship was the same today as in 1950, the 90-10 earnings inequality would be 46 percent lower.

The aim of this paper is to understand the causes of the recent reversal of the relationship between wages and labor supply. Our analysis examines the relative importance of a number of channels that can affect that wage-hours relationship, and provides a detailed account of changes in time use by also addressing changes in leisure and home production. The main novel finding of our analysis is that there is a close relationship between the recent reversal in the wage-hours relationship and a second major macroeconomic trend during the same period, namely the rise in female labor force participation. The entry of married women

into the labor force had an impact on married men's labor supply through joint determination of labor supply in the household. We argue that this change led to a large reduction in the labor supply for low-wage married men, but not for high-wage married men. Quantitatively, this "family channel" explains the largest part of the observed reversal in the wage-hours relationship.

Our quantitative model also considers the role of three additional channels. First, we allow for a flexible formulation of preferences that allows for the possibility that leisure is a luxury good at low income levels, but becomes inferior at high income levels. The first feature arises naturally from a subsistence constraint for goods consumption: very poor workers have to work a lot to satisfy their basic needs. At higher income levels, we allow the elasticity of substitution between consumption and leisure to deviate from one, so that leisure may rise or fall as the overall level of wages rises. Second, we account for the role of the tax and transfer system, which may affect work incentives at different income levels through the level and progressivity of taxation. Third, we also consider the role of the marketization of household production, e.g., high-income households freeing up time for work by buying cleaning and childcare services.

We assess the role of these channels by calibrating the model so that it matches a number of facts of the relationship between wages, labor supply, and other time use both in the 1970s and in the present. The full model provides a close match of the observed reversal in the wage-hours relationship, not just on average but also conditional on gender and marital status. We then selectively turn off specific channels to measure the contribution of each to the total change. Quantitatively, the family channel accounts for the bulk of the observations. The preference channel makes a relatively minor contribution, although one might suspect that preferences (in the form of subsistence consumption constraints) play a bigger role in explaining the very high labor supply of poor workers in earlier times. The tax and transfer channel turns out not to be important during the period that we consider. The marketization channel makes a moderate contribution, but is crucial for matching changes in the observed time allocation between home production and leisure among high-income households.

The basic empirical fact that motivates the paper was first documented by Costa

(2000). Aguiar and Hurst (2007) come to similar findings based on time use data. Long-run trends in time use in the United States are also summarized by Ramey and Francis (2009). We expand on Costa's work by also considering how changes in labor supply break down by marital status, which turns out to be crucial for identifying the family channel, and by considering time use data on additional activities such as household production.

Our work is also related to the recent study by Bick, Fuchs-Schündeln, and Lagakos (2018), who build a new data base with evidence on contemporary labor supply in a large cross section of countries. Their findings are consistent with the evolution of labor supply in the United States over time, that is, labor supply per worker is higher in poor countries, and in the cross section in a given country, labor supply is usually decreasing with income, except in some rich countries (such as the United States) where this relationship has reversed. Bick, Fuchs-Schündeln, and Lagakos conjecture that to explain the observed patterns, subsistence consumption constraints and the tax and transfer system play important roles.¹ We account for these channels in our own analysis, but find that a different channel, namely the role of family labor supply, is crucial to account for the reversal of the wage-hours relationship.²

The role of the marketization channel for explaining recent changes in patterns of fertility across households has been explored by Hazan and Zoabi (2015) and Bar et al. (2018). We build on their work by also examining the importance of this channel for explaining the reversal of the wage-hours relationship.

In the following section, we outline the empirical facts on trends in work and leisure in the United States that motivate our study. In Section 3, we describe the quantitative model that we match to the data. The estimation of the model and our main results are summarized in Section 4. In Section 5, we go beyond the case of the United States and examine whether trends in work and leisure in other industrialized countries follow similar patterns. Section 6 concludes.

¹Quantitative studies examining the role of the tax and transfer system for explaining cross-country differences in married couples' labor supply are provided by Bick and Fuchs-Schündeln (2018) and Bick et al. (2018).

²See Doepke and Tertilt (2016) for a recent survey on the role of family labor supply for the determination of aggregate labor supply.

2 Trends in Work and Leisure across Households in the United States

2.1 Hours and Wages

One of the most salient facts of empirical macroeconomics is the relative stability of hours worked in the post-war period. While true, the observation belies a tremendous reallocation of work hours across the population. Here, we focus specifically on the distribution of work hours across the wage distribution. Figure 1 highlights the facts.³ While average and median weekly hours declined by roughly a single hour from 1950-2015, the bottom decile of wage earners decreased their weekly hours by 10 while the highest decile of workers increased weekly hours by 3. While most pronounced at the tails, these shifts in working hours took place relatively smoothly across the whole wage distribution. Figure 2 plots the distribution of work hours as a function of a worker's wage percentile, normalized by the annual average, for census years 1950, 1980, and 2010. The figure documents a strong negative correlation between hours and wages in 1950, a nearly flat relation by 1980, and a significantly positive correlation by 2010.

This inversion in the relationship between wages and hours magnifies the effect of rising wage inequality on earnings inequality. In the past, earnings inequality was dampened by the fact that those with the lowest (highest) wages worked the longest (shortest) hours. The steady reversal of this relationship thus contributed to the rise of several headline measures of earnings inequality over the postwar period. For instance, between 1950 and 2007, 59% of the rise in 90-10 earnings inequality and 53% of the rise in the variance of log earnings can be attributed to changes in the distribution of hours across the wage distribution⁴. Since 1976, those contributions stand at 16% and 11%, respectively.

Figure 3 delves deeper into the microdata and breaks down the aggregate trend

³Unless otherwise noted, our sample consists of all full time (20 hrs+) full year (40 weeks+) workers, ages 18-65, whom are in the private sector labor force. The data point for 1950 comes from the Decennial Census while all other data points are derived from the Current Population Survey.

⁴The identities used for these decompositions are: (1) $\log(earn_{90}/earn_{10}) = \log(wage_{90}/wage_{10}) + \log(hours_{90}/hours_{10})$ and (2) $var(\log(earn)) = var(\log(wage)) + var(\log(hours)) + 2cov(\log(wage), \log(hours))$

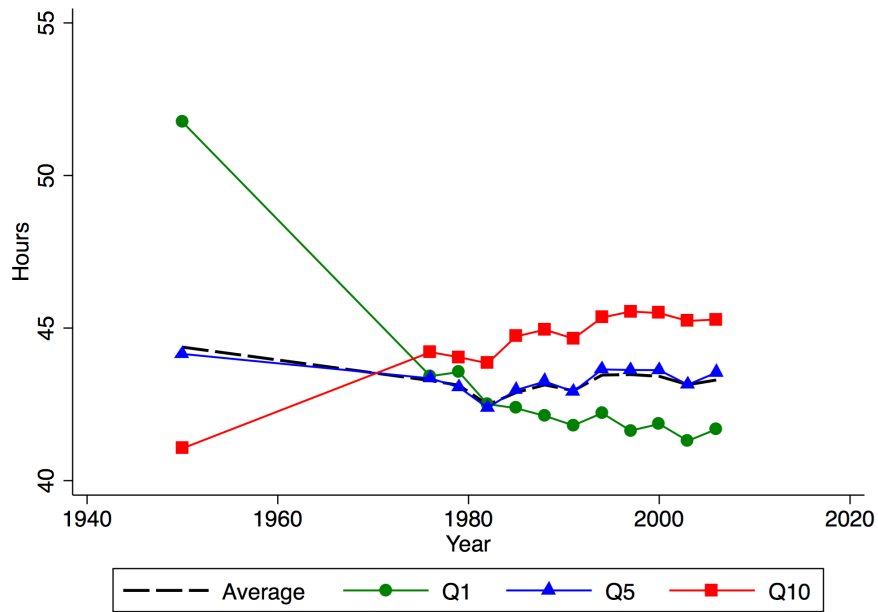


Figure 1: Hours worked by wage decile

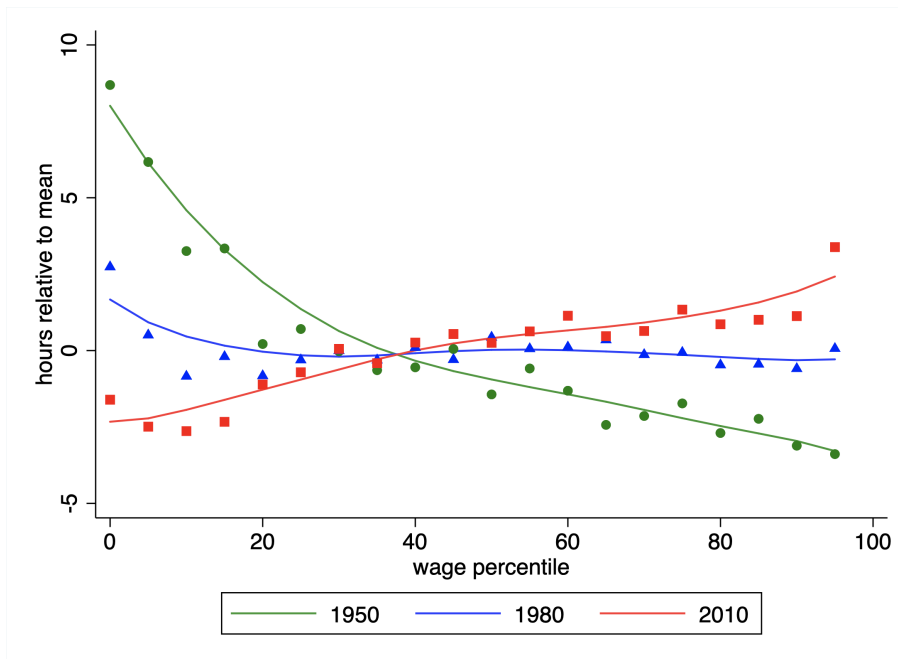


Figure 2: Hours worked across the wage distribution by year

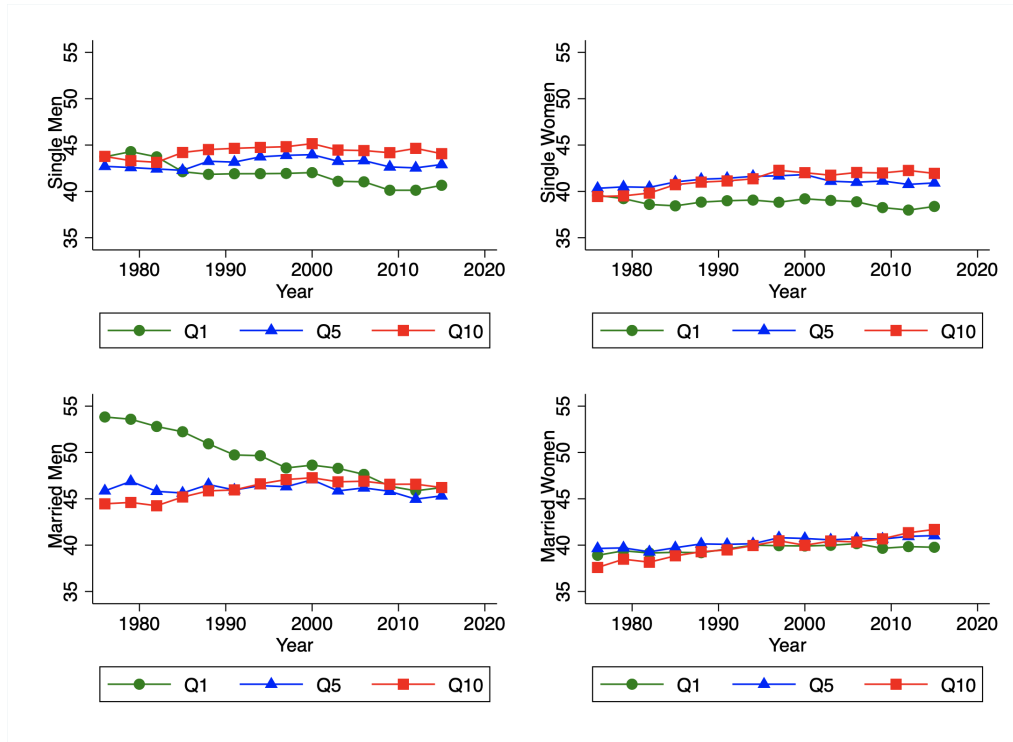


Figure 3: Hours worked by gender and marital status

by gender and marital status. The figure makes clear that while all groups experienced at least some reversal in the relationship between hours and wages, the effect was largest among working married men. The result is robust to purging hours of compositional effects due to changes in detailed occupation, industry, education, age, race, and ethnic makeups both within and between groups (see Figure 15 in the appendix). Given that these men also constitute a disproportionately large fraction of the working population (an average of 40% throughout our sample period) understanding what is driving their labor supply decisions is of first order importance.

To gain further insight, Figure 4 plots the total household labor supply for the families of rich and poor married men in the sample above⁵. The figure reveals

⁵Figure 4 restricts attention to households in which both husband and wife are working full time (i.e. only the intensive margin). Figure 16 in the appendix includes all households with married men in our sample, regardless of wife's working status (i.e. intensive and extensive margin). The main results are unchanged.

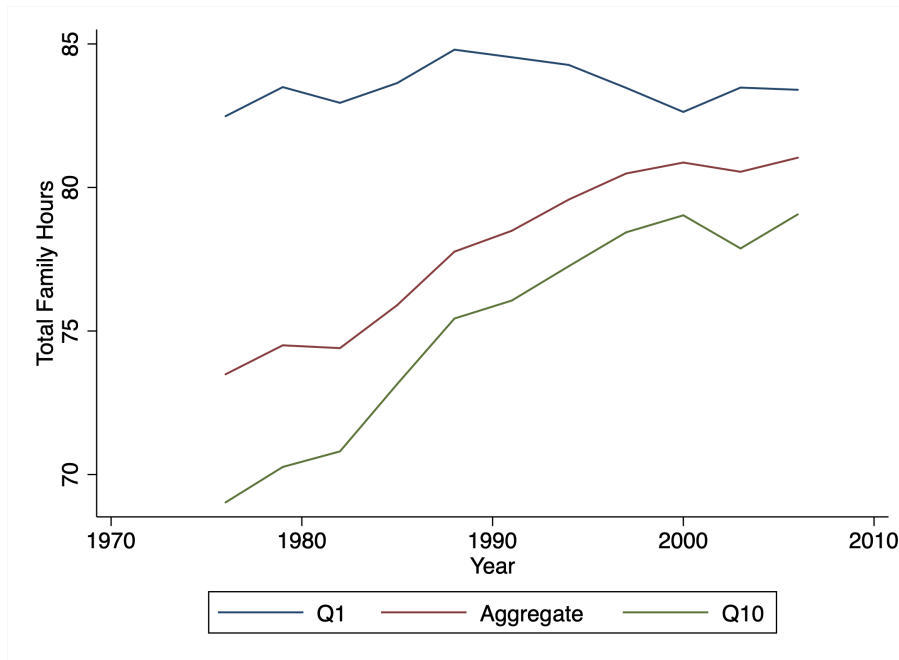


Figure 4: Family labor supply.

that household behavior is markedly different than that of the individuals. While low wage men significantly decreased their working hours, the total labor supply of their households remained largely unchanged. In contrast, the hours worked by rich households rose much more rapidly than the increases by rich men alone. These observations, of course, are due to the rapid increase in female labor force participation during the period we study. The nuance is that the increase in female hours in low wage households was offset nearly 1-to-1 with decreases in hours worked by their husbands, while in rich households both spouses increased hours worked.

These trends in hours worked can only partially be understood in the context of changing relative wages. Figure 5 plots the real hourly wages of married men and their wives by income group. The figure captures three well known facts about wage trends in recent decades: wage inequality increased, the real wage of low wage men has stagnated, and women have been experiencing a broad-based secular increase in wages. Less well known, but apparent from the figure, is how relative wages changed within the household across the income distribution. For

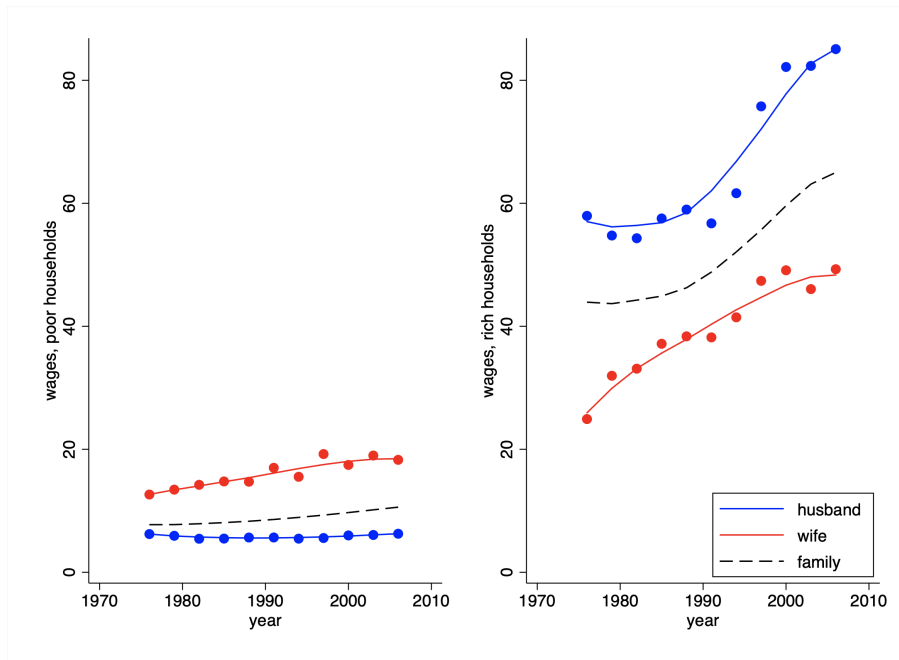


Figure 5: Wages by spouse and family. The black dashed line is the hourly weighted hourly wage at the family level.

poor households, women have increasingly become the primary breadwinners and, conditional on working, their wages are higher and growing faster than their husbands. As a result, the share of poor households where men out-earn their wives has fallen from 60% in the 1970s to 30% today (see appendix figure 17). In contrast, while the wives of rich men earn more and experienced greater wage increases than the wives of poor men, rich women are still nearly all out-earned by their husbands⁶ and the gap between them and their husbands has increased.

2.2 Time Use Data

The disparity between work hours documented above raises the question to what activities were these additional non-market work hours being allocated? To answer this question, we turn to the American Time Use Surveys for 1975 and 2005⁷. Our sample is the same married men used in the analysis above, with the exception that now (due to sparsity in the 1975 survey) rich and poor correspond to the

⁶More than 95% of rich men out-earn their wives, see appendix figure 17

⁷Time use data for 2005 pools data from 2004-2006 to increase precision.

top and bottom quintile of the wage distribution⁸. Our time use categories are defined following the approach in Aguiar and Hurst (2007). In order to understand the role of the family, we analyze the time use of married men alongside their wives. As the 1975 American Heritage Time Use Survey is a household survey, identifying spouses is straightforward. The 2005 American Time Use Survey, however, is conducted at the individual level and so we must construct representative households by classifying wives based on the self reported characteristics of their husbands (i.e. spouse wage, spouse hours, spouse age, etc.). The procedure ensures that the time use of wives in the 2005 ATUS survey truly reflects the time use of women whose husband's characteristics match the sample restrictions and income groups of the men being studied. Hence, given our classification procedure, representative family time use for rich and poor households can be calculated simply by summing the time of husbands and wives within each year-income category. See the data appendix for more details.

Table 1 summarizes the results from the time use data. Consistent with the Census data, the time use data reveal a large gap in the market hours of poor and rich married men in 1975 and a subsequent contraction in that differential between 1975 and 2005. Market work hours at the family level similarly coincide in the two data sources, with poor families' market hours remaining largely constant between 1975 and 2005 while rich families' market work substantially increased, nearly erasing the large differential in 1975.

The time use data also allow us to understand what differences in time allocations facilitated the large gap and subsequent contraction in market hours between rich and poor. Focusing on men, the 1975 time use data suggest that the gap in market work between rich and poor men (-9 hours) can be mostly accounted for by rich men spending more time on non-market work (+6 hours) and childcare (+2 hours). The same is true at the family level in 1975. The large gap in market hours between rich and poor households (-14 hours) is mostly accounted for by rich households investing more time in non-market work (+10 hours) and childcare (+5 hours).

⁸Qualitatively, the results do not change if we construct our time use results using deciles, but the specific time use estimates end up being sensitive to robustness check in the decile case due to the small sample size of each cell. Working with quintiles remedies this while maintaining the stylized results.

Time Use Category	AHTUS 1975 Survey				ATUS 2005 Survey			
	Low Wage		High Wage		Low Wage		High Wage	
	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives
Market Work	54	19	45	14	49	23	47	22
<i>core work</i>	47	17	38	12	45	21	42	21
<i>related work</i>	6	2	7	2	4	2	5	2
Non Market Work	7	30	13	34	10	26	12	26
<i>home production</i>	3	26	7	25	6	19	8	18
<i>purchasing</i>	4	4	5	9	4	7	4	8
Non Work Activities	103	110	103	107	100	104	100	103
<i>leisure</i>	32	35	32	35	30	29	31	31
<i>eat & sleep</i>	65	69	64	65	66	69	64	67
<i>personal care</i>	6	7	7	6	4	5	4	5
Child Care	0	4	2	7	4	9	5	11
Civic	3	5	2	4	2	2	2	3
Education	0	0	2	1	1	2	1	1

Table 1: Detailed time use by spouse and wage group.

In the time series, the time poor households allocate to market and non-market work remained virtually unchanged. The key insight is that within poor households, men and women appear to have swapped hours of market and non-market nearly 1-to-1, so that large swings at the individual level do not show up at the family level. The only meaningful change in household time allocation within poor households appears to be a substantial shift in hours from leisure to childcare, born relatively equally between husbands and wives.

Rich households, in contrast, witnessed a large increase in market work and large *decrease* in non-market work. Unlike poor households where husbands and wives appear to have swapped market and non-market work time, in rich households both spouses increased market work and decreased non-market work, with wives accounting for the lion's share of the effect. Alongside these changes, we see a similar substitution from leisure to childcare among wealthy households that we saw in poor households. While the total time dedicated to childcare was still greater in rich households, the proportional increase was smaller due to their larger initial time investments. The large decrease in non-market work and

relatively smaller increase in childcare time suggests an increasing portion of these activities are being purchased in the market by rich households.

Taken together, the time use data suggests that accounting for differences in non-market work is critical to understanding the differing labor supply of poor and rich married men. Furthermore, the data offers compelling evidence in favor of the family and marketization channels. Among poor married men, labor supply dynamics may best be understood as a swapping of market and non-market work between spouses as labor market prospects of wives outpace their husbands. The labor market gains of women are more muted on rich men due to the persistent earnings advantages of wealthy men over their wives as well as the increasing accessibility of marketization with growing incomes, which frees wealthy husbands from increasing home production and childcare as their wives enter the workforce.

2.3 Increasing Returns to Human Capital

An additional plausible hypothesis is that the inversion in the relationship between hours worked and wages is due to the rise in returns to human capital. The main argument is that while high wage jobs are increasingly reliant on human capital and low wage jobs are increasingly automated, the incentive for human capital accumulation through learning-by-doing has increased for high wage occupations and decreased for low wage occupations. While we believe this channel is plausible, we find little evidence in the data suggesting a meaningful contribution.

First, to the extent that this human capital channel is operating, we would expect to see some difference in the main trends we document when broken up by young versus old, or college versus non-college labor. Neither of these seems to be markedly apparent in the data (see appendix Figures 18 and 19).

Furthermore, we find no correlation at the occupational level between changes in the returns to experience and hours worked. Specifically, we employ Mincer regressions to estimate the returns to experience for each detailed census occupational category in 1975 and 2005 and plot changes in an occupation's returns to experience against its change in average hours worked. The result is displayed

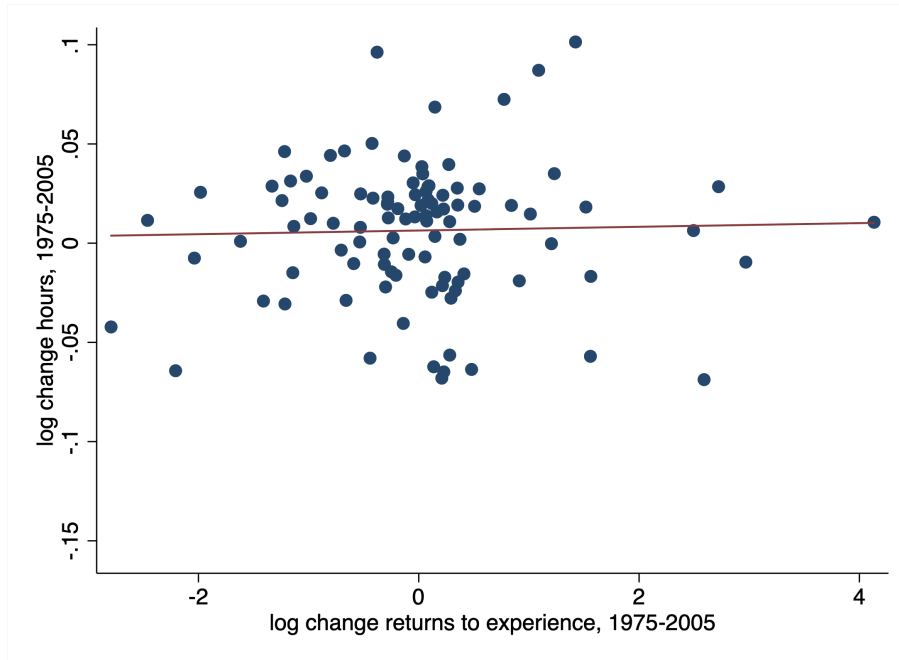


Figure 6: Changes in returns to experience and hours worked at the detailed occupational level, 1975-2005.

in Figure 6 and exhibits no meaningful correlation, whereas the human capital hypothesis would suggest a positive relationship. The result is robust to different sample populations, occupational classifications, as well as industry and demographic controls. Hence, while we continue to believe that the returns to experience is a plausible alternative mechanism, we omit it from our analysis due to a lack of concrete data supporting its relevance.

3 Quantitative Model

We would like to assess which mechanisms can account for the changing relationships between wages, work, and leisure observed in the US data. Motivated by the empirical observations outlined in the previous section, we focus on four channels through which overall wage growth, changes in the wage distribution, and changes in employment can affect the structure of labor supply:

1. *Preference channel*: Overall wage growth can affect labor supply if the elasticity of substitution between consumption and leisure deviates from one (i.e.,

preferences are not of the balanced-growth type) .

2. *Tax and transfer channel:* Changes in the tax and transfer system can affect labor supply through the schedule of marginal tax rates and income effects.
3. *Marketization channel:* The use of market alternatives to home production, such as cleaning services and paid child care, can affect labor supply by freeing up time for alternative uses.
4. *Family channel:* Joint decision making by couples can affect labor supply if there are changes in participation rates and/or the distribution of relative wages of couples.

We would like to develop a parsimonious model that captures these four channels. Since our interest is on how household decisions respond to given changes in the macroeconomic environment, we carry out this analysis in partial equilibrium. Specifically, we take as given the underlying driving forces of our four channels, namely overall wage growth, changes in the distribution of potential wages, changes in the tax and transfer system, changes in the cost of marketization, changes in overall female labor supply; and changes in the distribution of relative wages within couples. Our objective is to assess the relative importance of the four channels in accounting for changes in the structure of work and leisure between the 1970s and the present.

Our model economy is populated by women and men, denoted by gender $g \in \{f, m\}$, who can be either single, denoted by marital status $s = 1$, or married, $s = 2$. Female and male potential wages w_f and w_m are heterogeneous in the population. Individuals derive utility from goods consumption c , consumption of home-produced services d , and leisure l . Goods consumption and leisure are private goods, whereas home-produced services are a public good for married couples. The utility function is given by:

$$u(c, d, l, s) = \left(\left(\alpha_{c,s} (c - \bar{c})^{\frac{\sigma_c - 1}{\sigma_c}} + \alpha_{d,s} d^{\frac{\sigma_c - 1}{\sigma_c}} \right)^{\frac{\sigma_c(\sigma_l - 1)}{\sigma_l(\sigma_c - 1)}} + \alpha_{l,s} l^{\frac{\sigma_l - 1}{\sigma_l}} \right)^{\frac{\sigma_l}{\sigma_l - 1}} . \quad (1)$$

Here $\alpha_{c,s}, \alpha_{d,s}, \alpha_{l,s} > 0$ are given parameters that satisfy $\alpha_{c,s} + \alpha_{d,s} + \alpha_{l,s} = 1$, $\sigma_c > 0$ is the elasticity of substitution between consumption of goods and home services, $\sigma_l > 0$ is the elasticity of substitution between consumption and leisure, and $\bar{c} \geq 0$ is a subsistence consumption parameter for goods consumption. The utility setup is chosen to be parsimonious but sufficiently flexible to allow for a U-shape in labor supply as the level of wages grows. We allow the share parameters in the utility function to depend on marital status to capture that married households may have different demand for home-produced services, which may arise from returns to joint consumption and other factors such as the presence of children.

To allow the model to capture the secular rise in the employment of married women during the study period, for married women we allow for an additional additively separable disutility of labor that takes the simple form of a heterogeneous parameter $\psi \geq 0$ times labor supply. This disutility allows us to capture barriers to women's employment that go beyond relative wages and home production (such as social norms), which is necessary to match the observed rise in married women's employment precisely. In the calibrated model, for the main results we treat married female labor supply as exogenous and match it to the observed rise over time, separately for different income quantiles. In a second step, we can then back out the additional disutility that rationalizes the observed labor supply, which allows us to construct counterfactuals with variable married female labor supply.

Home-produced services are produced with a production function involving time and purchased goods, given by:

$$d(h_f, h_m, z, s) = A_d \left(\left(\omega_{f,s} (e_f h_f)^{\frac{\eta_h - 1}{\eta_h}} + \omega_{m,s} (e_m h_m)^{\frac{\eta_h - 1}{\eta_h}} \right)^{\frac{\eta_h (\eta_z - 1)}{\eta_z (\eta_h - 1)}} + \omega_{z,s} z^{\frac{\eta_z - 1}{\eta_z}} \right)^{\frac{\eta_z}{\eta_z - 1}}. \quad (2)$$

Here h_f is the woman's time input, h_m is the man's time input, z are market-bought services, and e_f and e_m are the productivity of women and men in home production. We allow these productivities to depend on market productivity, i.e., people who are productive in the formal labor market may also be more productive at home. We again allow share parameters to depend on marital status

to allow for the different household production needs of single versus married households. Naturally, in a single household we have either $h_f = 0$ or $h_m = 0$. The share parameters sum to one, $\omega_{f,s} + \omega_{m,s} + \omega_{z,s} = 1$.

Taxes and government transfers are represented by a two-parameter tax system whereby net income of a household with marital status s and market income y is given by $\tau_{l,s} Y^{1-\tau_p,s}$. Here τ_l captures the level of taxation, and τ_p represents the progressivity of the tax system. Heathcote, Storesletten, and Violante (2017) argue that this simple parametric family provides a close match to the actual tax system in the United States.

The decision problem of a single woman is given by:

$$\max \{u(c, d, l_f, 1)\} \quad (3)$$

subject to:

$$d = d(h_f, 0, z, 1), \quad (4)$$

$$c + pz = \tau_{l,1} (w_f n_f)^{1-\tau_p,1}, \quad (5)$$

$$n_f + h_f + l_f = 1. \quad (6)$$

The decision problem of a single man is given by:

$$\max \{u(c, d, l_m, 1)\} \quad (7)$$

subject to:

$$d = d(0, h_m, z, 1), \quad (8)$$

$$c + pz = \tau_{l,1} (w_m n_m)^{1-\tau_p,1}, \quad (9)$$

$$n_m + h_m + l_m = 1. \quad (10)$$

For couples, we assume that decisions are taken by efficient bargaining with a fixed bargaining power parameter $\theta_f, \theta_m > 0, \theta_f + \theta_m = 1$. We also assume that all goods consumption in marriage is public, i.e., the same consumption c enter's both the woman's and the man's utility. This is because we do not have separate

observations for female and male consumption in marriage and we already have one private good (namely leisure), so that restricting consumption to be public does not substantially alter the ability of the model to match the data.

The decision problem solved by a couple can then be written as

$$\max \{ \theta_f (u(c, d, l_f, 2) - \psi n_f) + \theta_m u(c, d, l_m, 2) \} \quad (11)$$

subject to:

$$d = d(h_f, h_m, z, 2), \quad (12)$$

$$c + pz = \tau_{l,2} (w_f n_f + w_m n_m)^{1-\tau_p,2}, \quad (13)$$

$$n_f + h_f + l_f = 1, \quad (14)$$

$$n_m + h_m + l_m = 1. \quad (15)$$

3.1 Illustrating the Family Channel

Before going to the full calibrated model, we illustrate the working of the family channel using a simplified version of the model. Specifically, we abstract from home production and taxation, the subsistence parameter is set to zero, and the elasticity of substitution in utility is set to one. What remains is the joint determination of labor supply of couples as a function of participation costs and relative wages. We are interested in how family labor supply adjusts to expanding earnings opportunities for women, modeled as a decline in the gender wage gap.

Figure 7 shows how in this model the labor supply of a couple conditional on both being in the labor force depends on the relative wage of the two spouses (the level of wages does not matter because the preferences are of the balanced growth type). We see that the wife's labor supply is decreasing in the gender wage gap within the couple: the more the husband earns, the lower the incentive for the wife to put in long hours. Conversely, the husband's labor supply is increasing in the gender wage gap. The interesting feature for our purposes is that the *slope* of the man's labor supply curve becomes flatter as the wage gap rises. The intuition is that a low level of the initial wage gap, a rise in the wage gap leads to a relatively large reduction in the wife's earnings, which induces the husband to increase

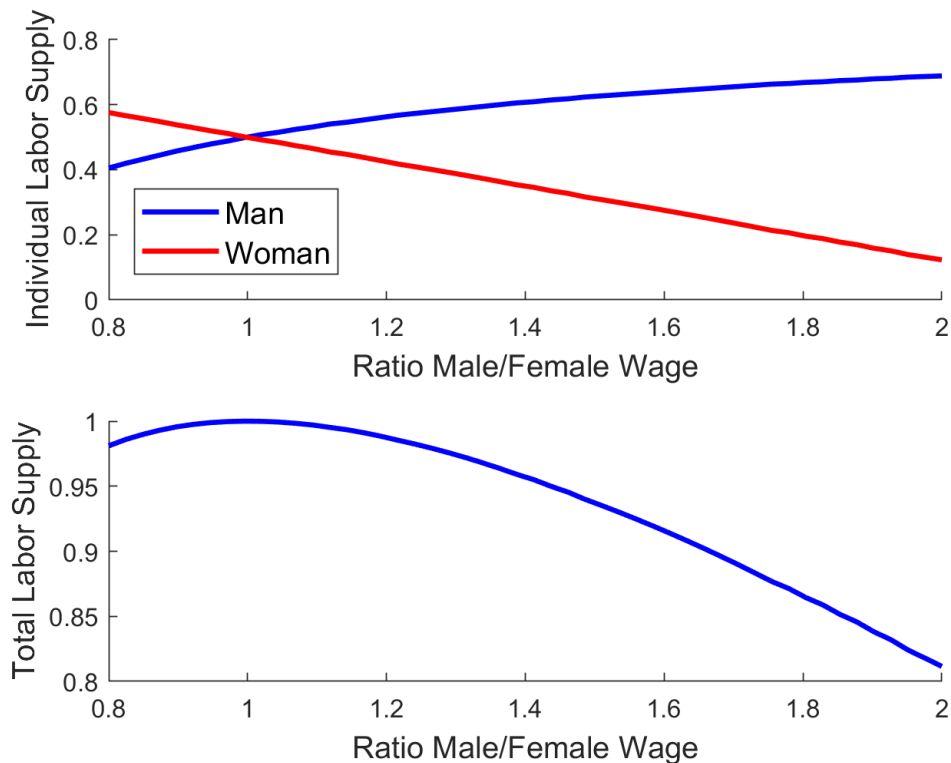


Figure 7: Relative wages and labor supply in the family

labor supply to make up for this change. In contrast, if the wage gap is very large, the wife contributes only a small share of household income to begin with, so that the effect of making up for lower earnings of the wife starts to vanish. The lower panel of Figure 7 shows what this implies for the total labor supply of the household. Around a relative wage of one (i.e., wife and husband have the same wage and the gender gap is zero) total labor supply is flat in the relative wage. In this region, the household substitutes smoothly between male and female labor supply, keeping total labor supply roughly fixed. In contrast, when the wage gap is high, male labor supply flattens out, and total labor supply becomes strongly decreasing in the wage gap.

Figure 8 shows what this pattern of labor supply implies for how households at different parts of the wage distribution react to a rise in women's labor market opportunities. What matters here is the relative wage *within* each household.

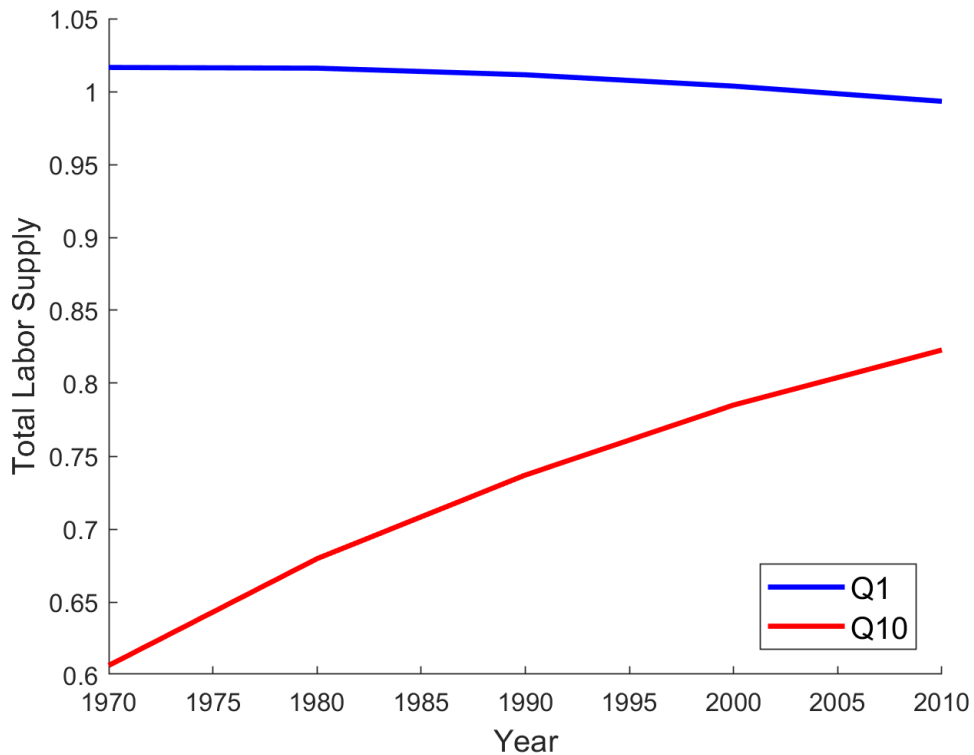


Figure 8: Total labor supply in household (both working): model

As documented in Section 2, in the US data the wage gap within households is increasing with male wages. That is, low-wage men tend to be married to women who make as much as or even more than they do, whereas high-wage men outearn their wives by a large margin. Putting this feature in the model, Figure 8 shows how the total labor supply of households at the top (Q10) and bottom (Q1) of the income distribution reacts to a gradual rise in female wages as observed in the data. For the household at the bottom (Q1), the rise in women’s wages leads to a reduction in men’s labor supply that roughly offsets the rise in women’s labor supply. This corresponds to the flat portion of the total labor supply curve in the bottom panel of Figure 7. As a result, total labor supply for these households with low-wage husbands is mostly flat. In contrast, in households high up in the income distribution the rise in women’s labor supply does not reduce men’s labor supply by much, because these men continue to be the dominant earners in their household. As a consequence, total labor supply for these households is strongly

rising in the relative female wage.

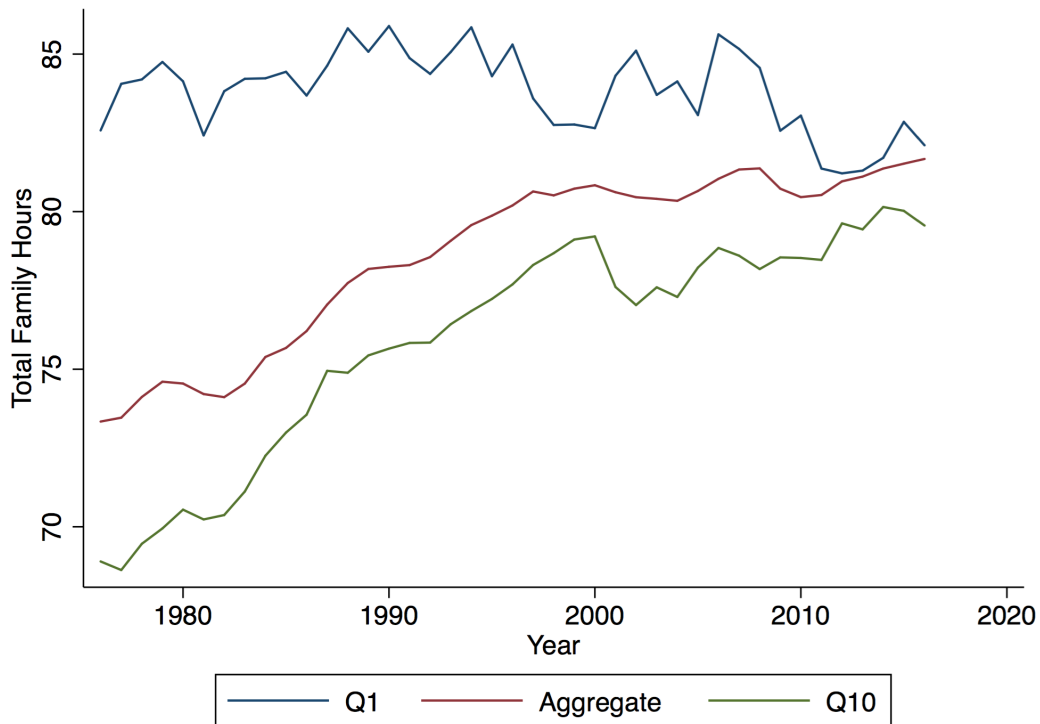


Figure 9: Total labor supply in household (both working): data

The family channel therefore predicts roughly constant total labor supply in the households of low-wage men and rising total labor supply in the households of high-wage men. Figure 9 shows that this is the exact pattern that is observed in the data. The fact that this differential adjustment of different types of households to rising female earnings empirically accounts for much of the reversal in the wage-hours relationship suggests that the family channel is crucial for explaining this reversal. Of course, it remains to be seen whether this intuition holds up in a richer model that accounts for taxation, home production, and allow for richer functional forms to match detailed time use across the income distribution. To answer this question, we now turn to the calibration of the full model.

4 Calibration and Analysis

4.1 Calibration Procedure

We would like to use the quantitative model to assess the contribution of the preference, tax and transfer, marketization, and family channels to the evolution of the distribution of work and leisure across the wage distribution from 1970 to the present. We do this by parameterizing the model to be consistent with the observed changes during the period, and then decomposing the overall change by turning the different channels on and off. Our analysis focuses on the determination of labor supply in a given macroeconomic environment. The elements of the environment that change in the model and that can trigger a response in labor supply are the following:

- Wage distribution: The distribution of (hourly) wages conditional on gender and marital status.
- Female labor supply: Married women's labor supply and earnings conditional on their husband's earnings.
- Assortative mating: The joint distribution of married spouses' wages.
- Cost of marketization: The price of services that can replace time used for home production.
- Taxes and transfers: The level and progressivity of the tax and transfer system, conditional on marital status.

Among these driving forces, the wage distribution, assortativeness of mating, female labor supply, and the tax and transfer system are matched to data directly, as described below. For the marketization channel, it is difficult to get direct measures of both the price of marketization and its use (e.g., the use and price of cleaning services often goes unreported). We capture this channel by including the price of marketization with the other parameters that are chosen jointly, and targeting changes in home production time by marital status and wage.

The remaining model parameters are chosen jointly to match a set of target moments, namely:

- Average weekly labor hours, by gender, marital status, and wage quintile.
- Average weekly home production hours, by gender, marital status, and wage quintile.
- Average weekly leisure hours, by gender, marital status, and wage quintile.

4.2 Parameter Estimates and Model Fit

As a first step, our calibration exercise focuses on matching the behavior of married couples, leaving singles aside. This is motivated by the observation that the observed changes in the structure of labor supply are primarily driven by married women. However, in the next iteration we will include targets for single households to make sure that the estimated model is consistent with the behavior of these households also.

The target moments for the calibration exercise are the average weekly work, home production, and leisure hours for married couples in each quintile of the husband's wage, for 1975 and 2015. The exogenous inputs in this calibration procedure are:

- The observed wages of husbands and wives in each quintile in 1975 and 2015. Notice that because the quintiles are defined by the wage of the husband, the wives' wages are those of women *married to men* in a given quintile. Because of assortative mating, these wages are increasing by quintile, but less so than what we would get by sorting by women's wages (because assortative mating is less than perfect). Notice that the change in the wives' wage distribution between 1975 and 2015 in part reflects changes in assortative mating during this period.
- The labor supply of wives in each quintile. The rise in labor supply between 1975 and 2015 primarily reflects the increase in married women's labor force participation, and the husbands' reaction to this change is the central part of the family channel.

- The level and progressivity of taxation in 1975 and 2015. The tax parameters are estimated outside of the main estimation procedure using NBER TAXSIM data.

Apart from the given calibration inputs listed above, we allow the productivity of the home production function A_d and the relative price of good inputs in home production p to vary between 1975 and 2015. The change in these parameters is the central component of the marketization channel.

In addition to the parameters already listed in the model description, we also have to parameterize the productivities e_f and e_m of women and men in home production. To match the data, it turns out to be important to allow for the possibility that individuals who are productive in the market (high wages) are also productive in the home (high e). Otherwise, the model would predict counterfactual high levels of specialization; in particular, low-wage men would then be predicted to do much more home production than they actually do. To parameterize the link between market and home productivity, we set:

$$e_{i,g,t} = \left(\frac{w_{i,g,t}}{\frac{1}{5} \sum_j w_{j,g,t}} \right)^{\phi_g}.$$

Here $e_{i,g,t}$ is the home productivity of people of gender $g \in \{f, m\}$ in quintile $i \in \{1, 2, 3, 4, 5\}$ in year $t \in \{1975, 2015\}$. Hence, log productivity is linear in market productivity, normalized by the average market productivity by quintile, gender, and year, with gender-specific slope ϕ_g . The two ϕ_g parameters are estimated as part of the overall calibration.

The model parameters are estimated by minimizing a weighted sum of squares of deviations of model-generated moments and data moments. The calibration procedure puts additional weight on the first and the fifth quintiles to ensure a good fit at the extremes of the distribution where the largest changes take place. However, equal weighting results in similar estimates.

Table 2 summarizes the estimation results.

Figure 10 displays the model fit for male labor supply, which is the main fact to be explained.

Weights		Elasticities	
$\alpha_c, \alpha_d, \alpha_l$	0.50, 0.20, 0.30	σ_c	0.692
$\omega_f, \omega_m, \omega_z$	0.30, 0.24, 0.46	σ_l	0.701
\bar{c}	0.570	σ_z	1.806
θ_f	0.282	σ_h	0.715
ϕ	-0.686		
Marketization		Taxes	
p_{75}, A_{75}	4.587, 0.856	$\tau_{l,75}, \tau_{p,75}$	0.454, 0.216
p_{15}, A_{15}	0.397, 0.035	$\tau_{l,75}, \tau_{p,15}$	0.536, 0.157

Table 2: Estimated structural parameters

In the calibration procedure, we did not directly target measures of labor supply elasticities, but clearly these play an important role in generating the overall results. To assess whether the model makes realistic predictions in this regard, Table 4.2 displays the model-implied Frisch labor supply elasticities as well as wealth elasticities of labor supply, which are relevant for the reaction of male labor supply to increased female earnings.

Group	Income Elasticity		Frisch Elasticity	
	1975	2015	1975	2015
Q1	-0.50	-0.43	1.37	1.78
Q2	-0.52	-0.43	1.46	1.82
Q3	-0.54	-0.44	1.57	1.89
Q4	-0.57	-0.44	1.63	1.98
Q5	-0.58	-0.45	1.64	2.01

Table 3: Model implied wealth and Frisch labor supply elasticities

The Frisch elasticities are larger than estimates of the micro-elasticity of labor supply at the intensive margin but similar to estimates of the macro-elasticity

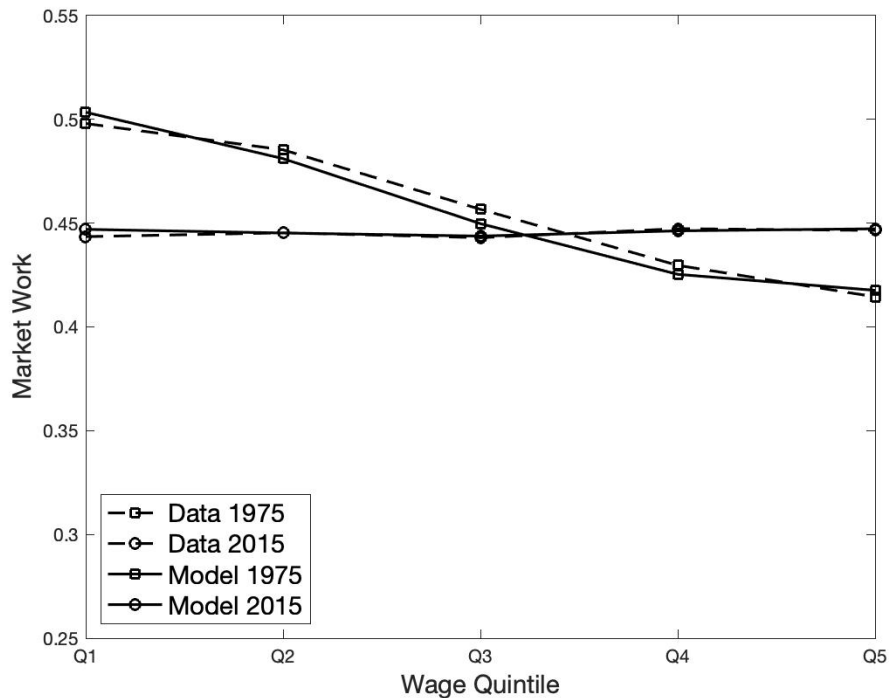


Figure 10: Model fit for male labor supply across the wage distribution

of labor supply, comprising both intensive and extensive margins. Our model should be interpreted as a model of lifetime labor supply, and hence the macro estimates are a better standard of comparison. The wealth elasticities of labor supply are somewhat larger than cross-state estimates by Fukui, Nakamura, and Steinsson (2019) of crowding out of male by female employment. However, their estimates do not capture a pure wealth effects but also additional channels such as rising marketization as women enter the labor force, which would lower the total response of income. The estimates are also somewhat higher than the measures of the wealth elasticity of labor supply by Cesarini et al. (2017) using data on Swedish lottery winners. We plan to assess in a robustness exercise how much results change if, as an alternative, we include existing measures of the wealth elasticity of labor supply among the calibration targets.

4.3 Counterfactuals

The estimated model allows us to assess the causes of the changed structure of labor supply by turning on and off the various channel that our theory incorporates. The following figures illustrate these results.

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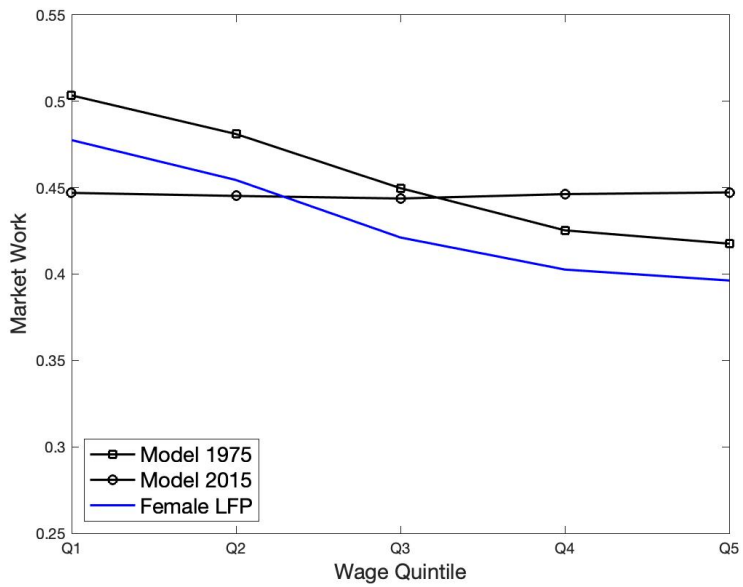
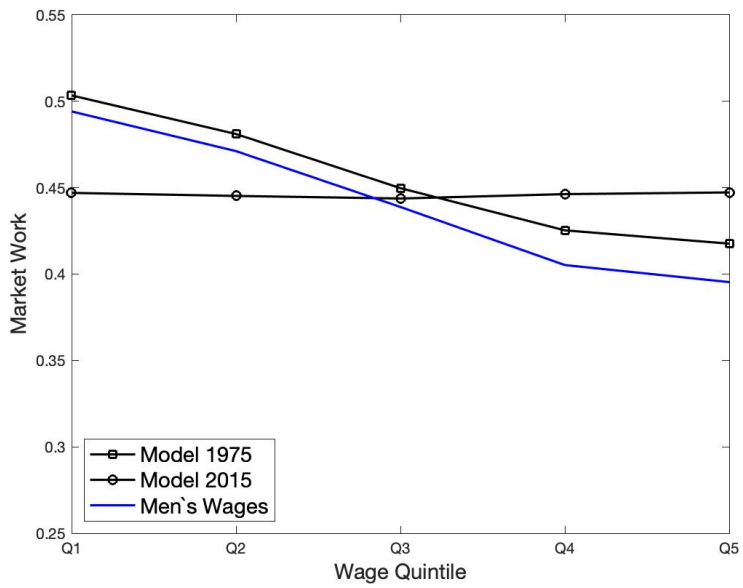
5 International Evidence

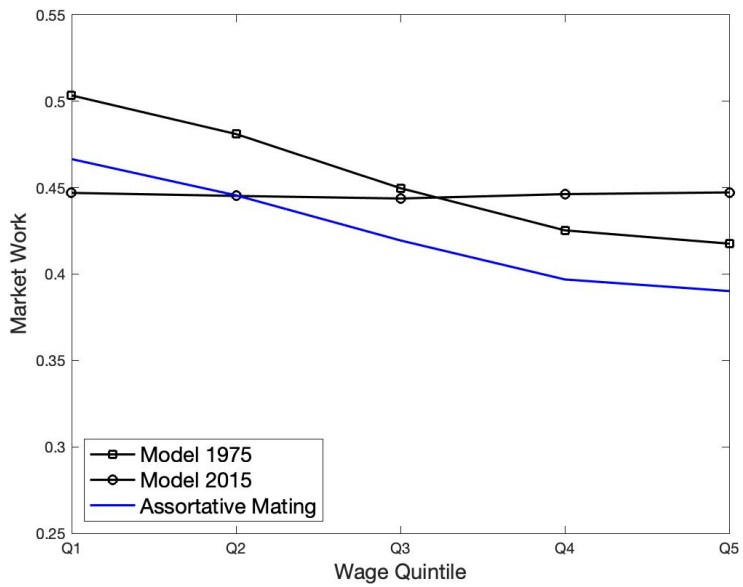
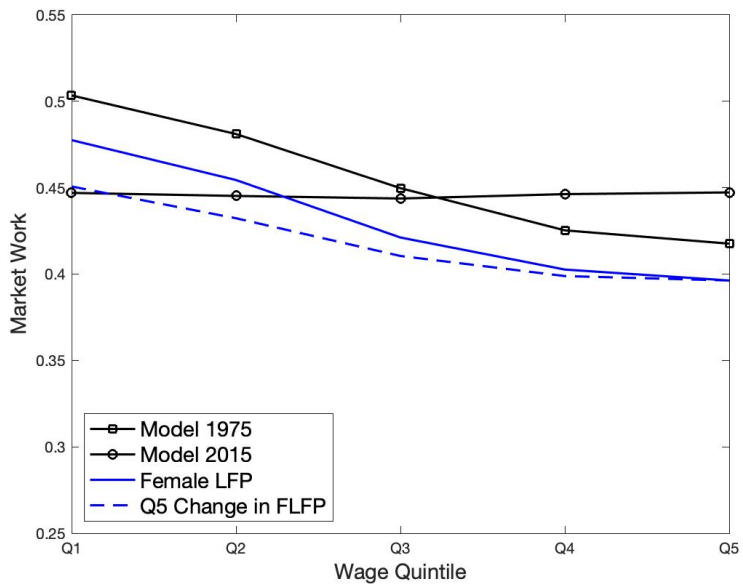
In this section, we document our findings for the UK and Spain. The particular reason why we are focusing on these two countries is that family channel in labor supply becomes prominent at different times. More specifically, the female labor force participation rate starts increasing first in the US then in the UK then in Spain (Figure 11). Hence, we expect the reversal of hours worked for rich vs. poor men to happen at different times. Consistent with our model, the data shows that the reversal of hours happen first in the US, then in the UK, then in Spain (Figure 12).

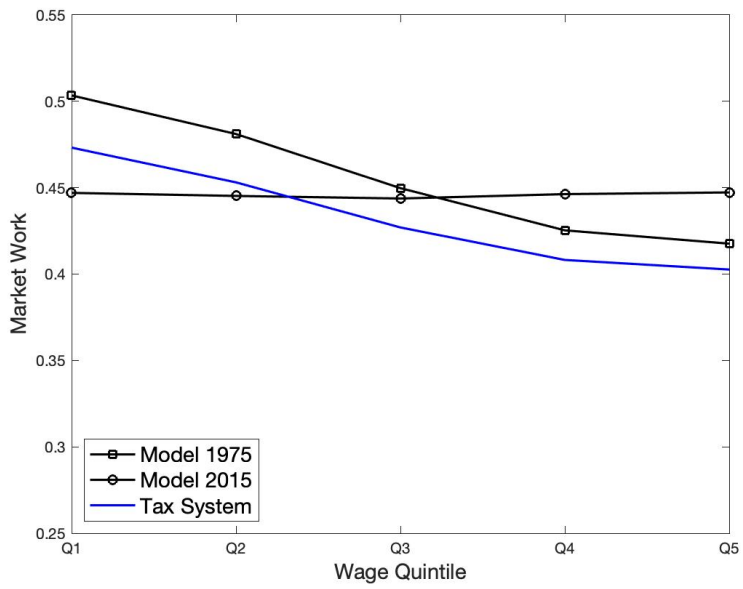
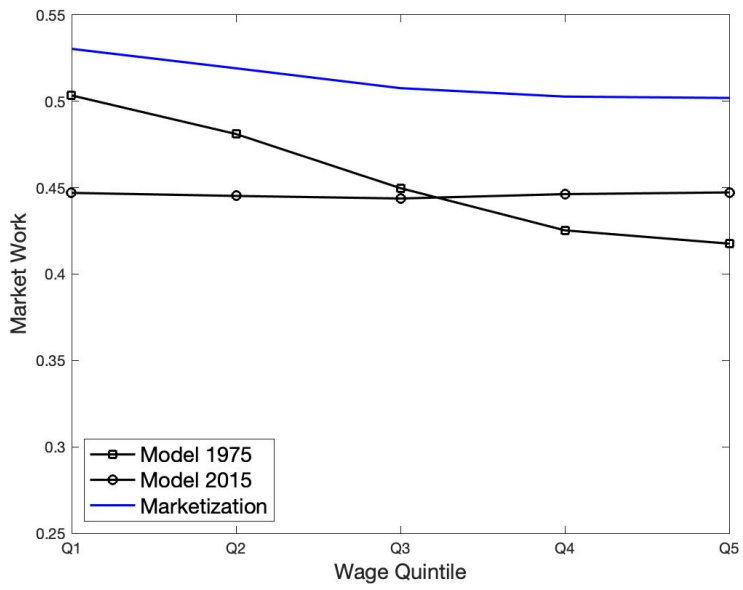
To analyze the UK hours, we combine data from the General Life Style Survey (formerly General Household Survey) for the period 1973-2004 and the EU-SILC data for the period 2005-2016. The EU-SILC data has been used to analyze hours worked in Spain for the sample years 2004-2016. We use the same sample restrictions as we use in CPS. Wage deciles have been calculated for the population ages 18-65, working full-time (20 hours a week). Hourly wages are calculated by dividing annual (or monthly labor income) to the corresponding hours worked variable⁹. Figure 12 shows that in the UK, poor workers used to work more in 1973 but by the mid-90's hours worked of rich surpassed hours worked of the poor. In other words, the correlation between hourly wages and hours worked switched from negative to positive. In the Spanish data, the contraction occurs primarily in the 2000s, with the correlation becoming effectively zero by 2016.

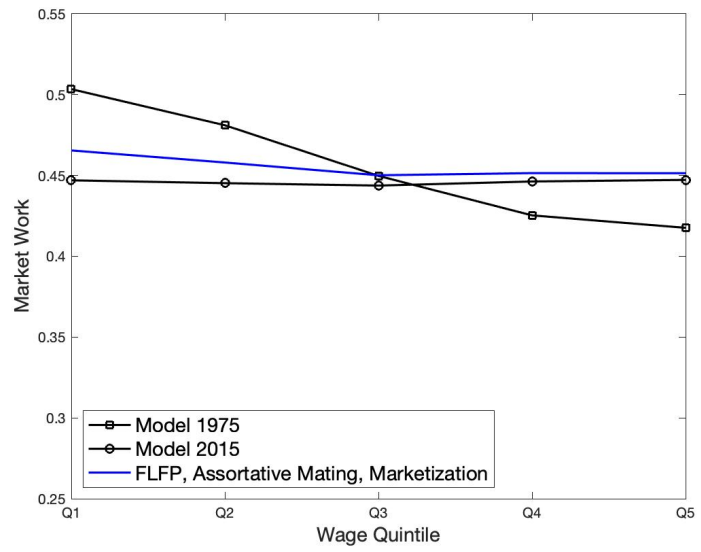
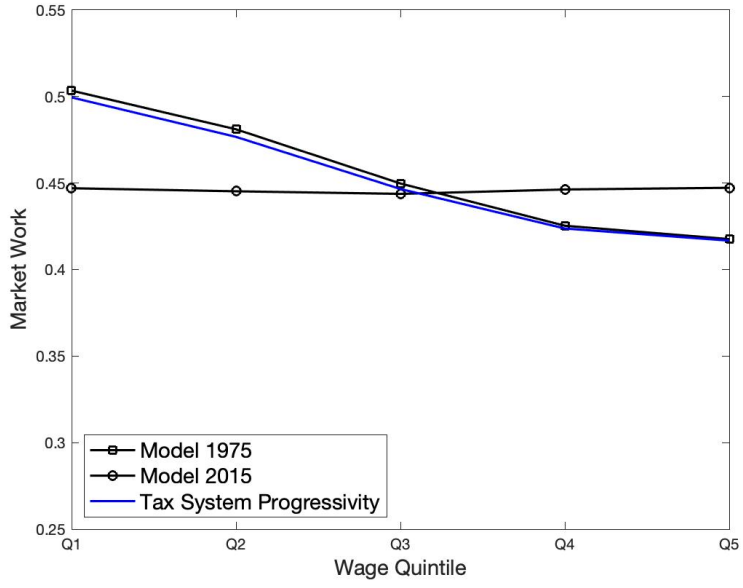
Figure 13 shows that the contraction of hours between rich and poor is particularly pronounced among married men, as we observe in the US. By contrast, Figure 14

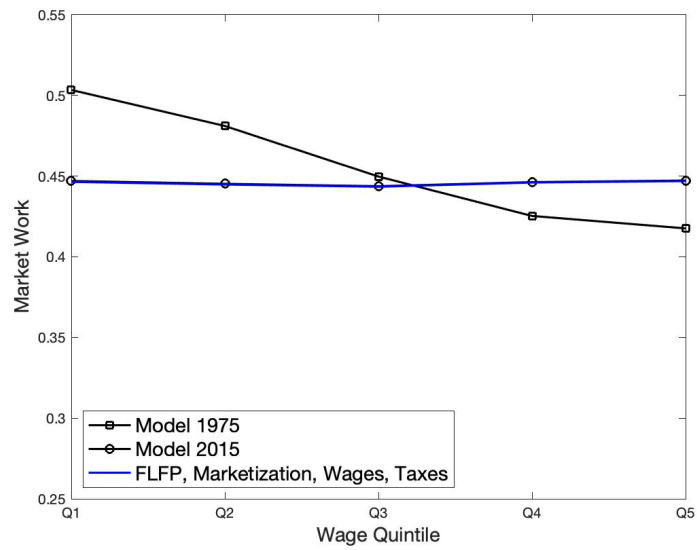
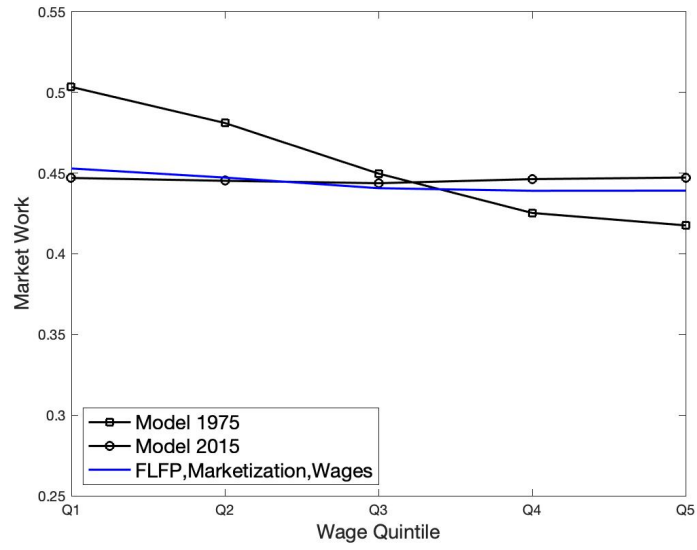
⁹The details of the variables and the estimation procedure have been explained in Appendix.











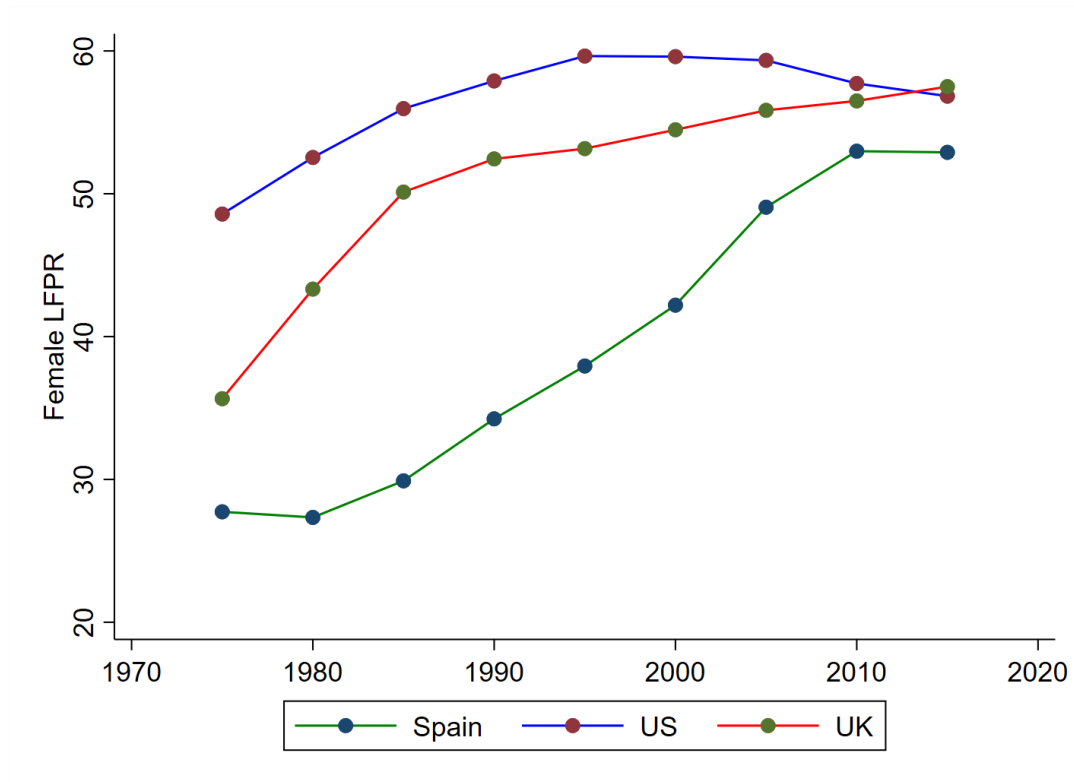


Figure 11: Female Labor Force Participation Rate

Note: IloStat data sources have been used for labor force participation rate of females 15+. Each data point represents 5 year averages (i.e.1975 is the average of 1975-1980)

shows that in Spain the contraction exists for all demographic groups, though it is sharper for married men.¹⁰

Figures 20 and 21 illustrate the patterns of total family hours in both the UK and Spain. As in the U.S., we see that the total family hours did not change much for poor families but increased for rich families. As a result, the difference between total family hours worked has converged between rich and poor. Family dynamics in terms of wages operate in the same way as in the US (Figure 22 and 23), i.e. men are out-earned by their wives among poor families, the opposite is true for rich families where the gender wage gap is big.

¹⁰Note that Euro Crisis hit Spanish labor market badly. Asymmetric labor market outcomes according to skill and gender groups are likely to happen as a result of the crisis. However, the hours worked seem to converged to a plateau after the crisis. Hence we expect the contraction not to be the result of the crisis only, but also the result of long run trend as we see from smooth decline in hours worked of married men.

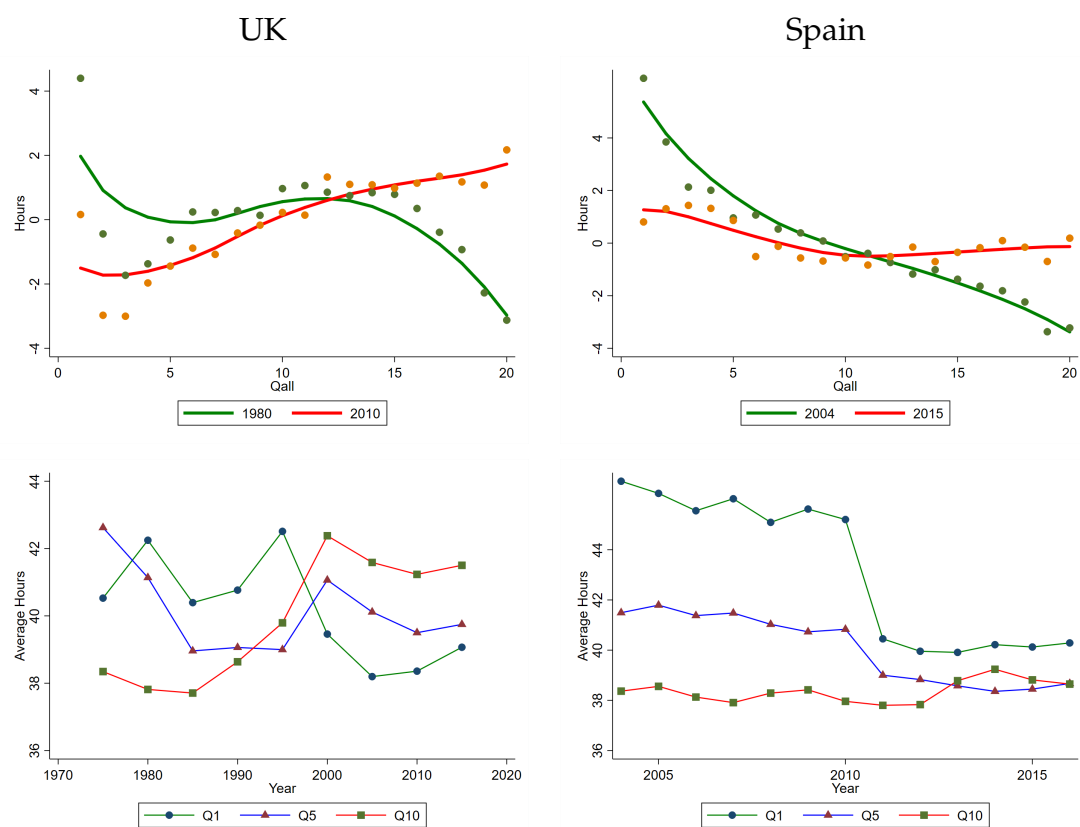


Figure 12: Time Trend in Hours Worked (UK and Spain)

Note: Upper figures represent deviations of each decile from the mean hours worked for the UK (left) and Spain (right). Bottom figures represent average hours worked of each decile for the UK (left) and Spain (right). Data Source: EU-SILC for Spain, General Household Survey and EU-SILC for the UK. The reason for the decrease in the UK hours in 80's has been discussed in Appendix

There are three main lessons that we learn from the international data. First, that the reversal of hours worked for poor and rich people is not unique to the US. Second, in Spain and the UK it appears that the family channel operates in the same way as in the US, i.e. the contraction is more pronounced among married men, total family hours did not change for poor families and increased for rich, relative wage (wife/husband) is bigger than 1 among poor families and less than 1 among rich families. Third, the timing of the reversal in the correlation between hours and wages is significantly correlated with the timing of female labor force participation – as the family channel would predict. Overall, we believe that international evidence ends further credence to the significance of the family

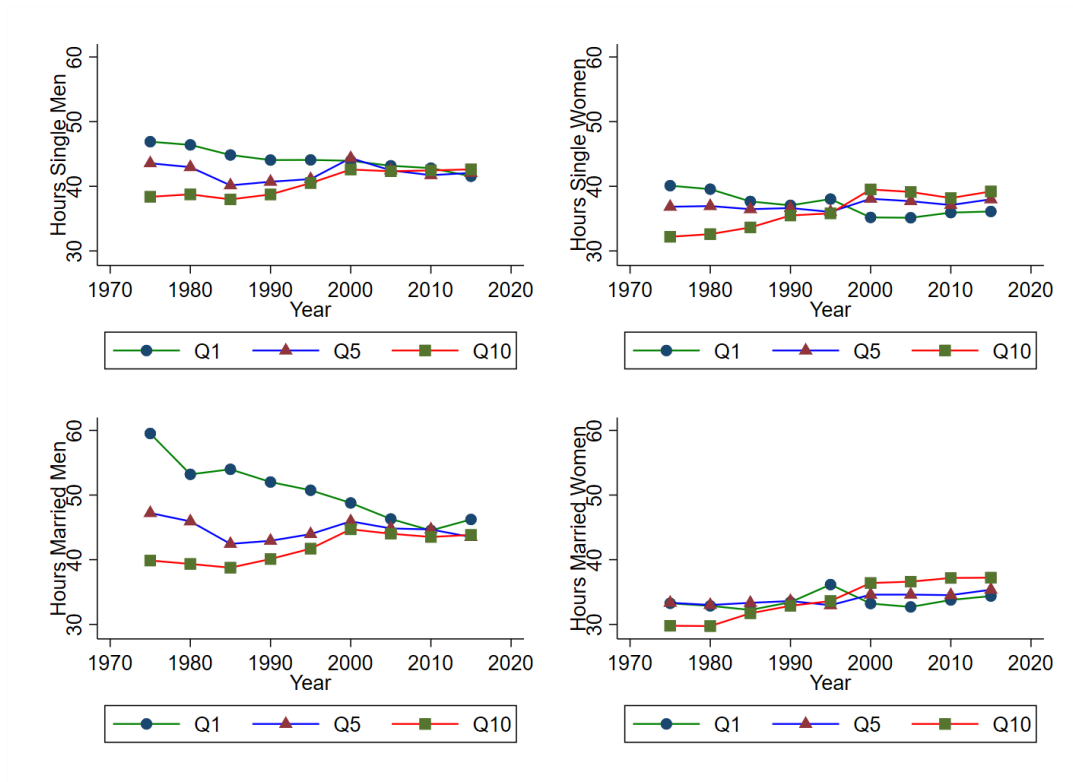


Figure 13: UK Panel
Data Source: General Household Survey

channel in explaining the recent stylized facts on wages and hours.

6 Conclusions

[To be written]

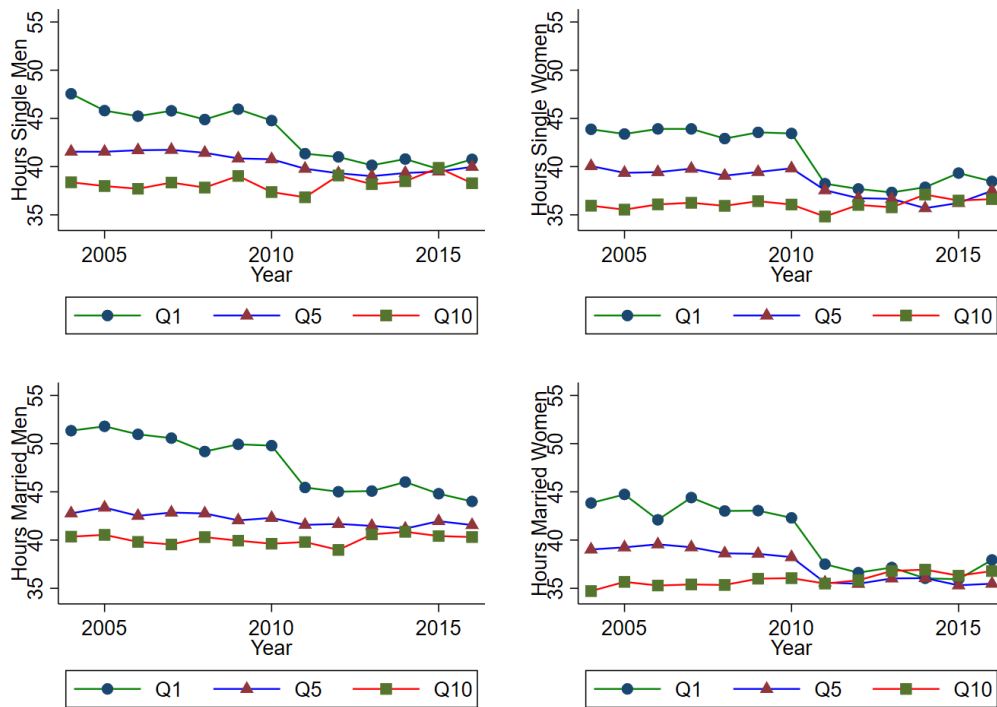


Figure 14: Spain Panel
Data Source: EU-SILC Spain

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Appendix

Figures

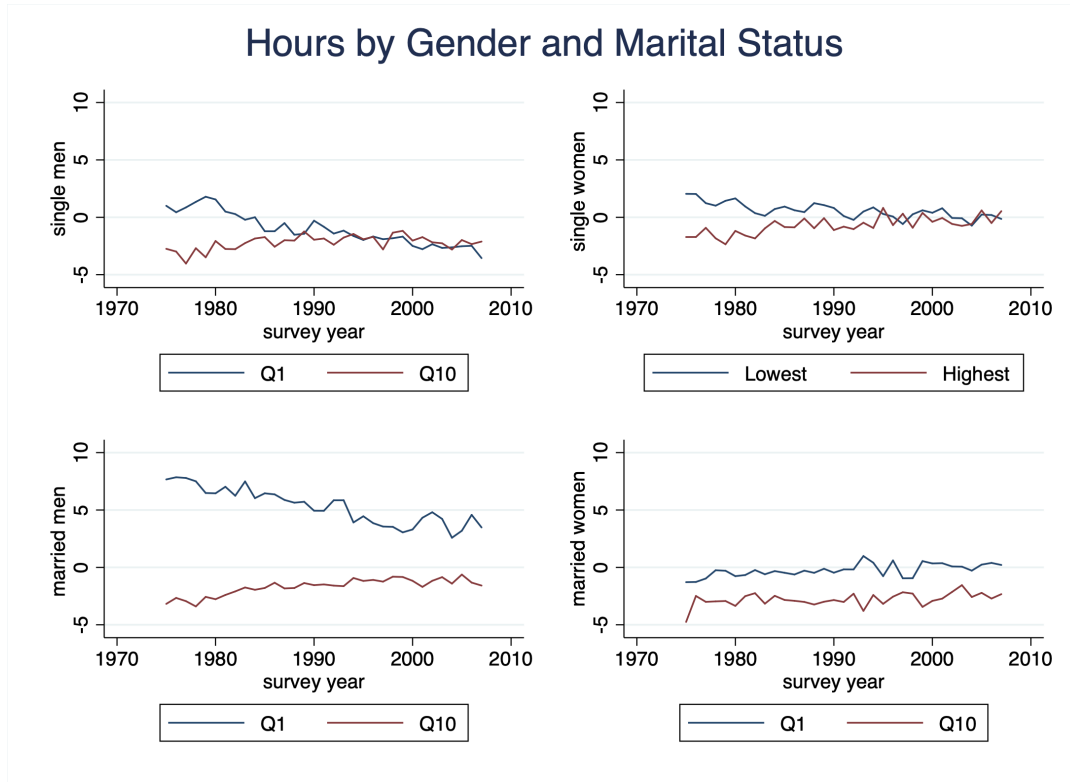


Figure 15: Residual hours worked by gender and marital status. Residual hours correspond to usual weekly hours worked purged of fixed effects for 5 education categories, detailed census industry and occupation categories, detailed census race and ethnicity categories, and age effects. Fixed effects are estimated separately for each gender along with year effects.

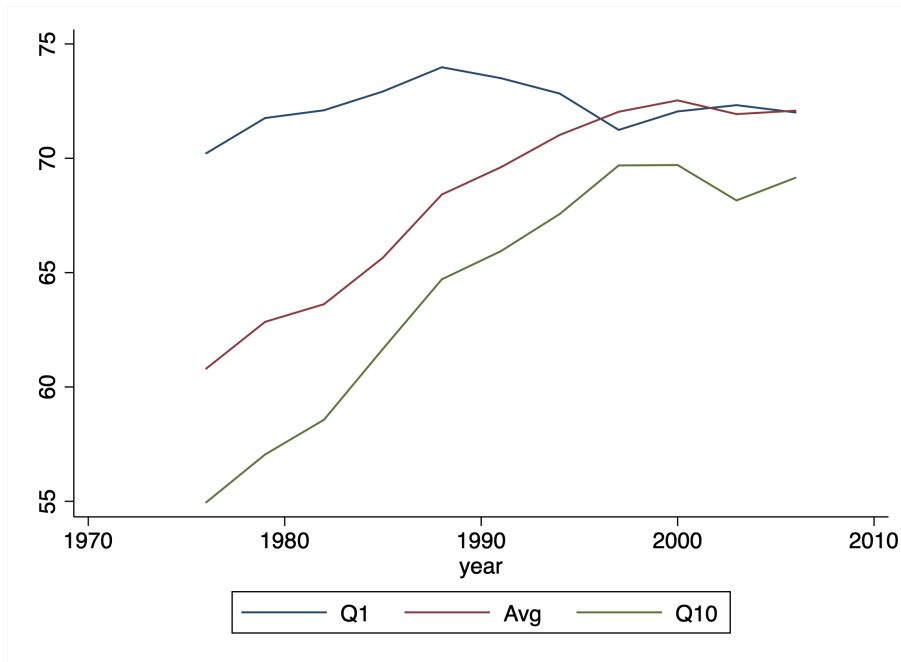


Figure 16: Family labor supply, including extensive and intensive margins for wife labor supply.

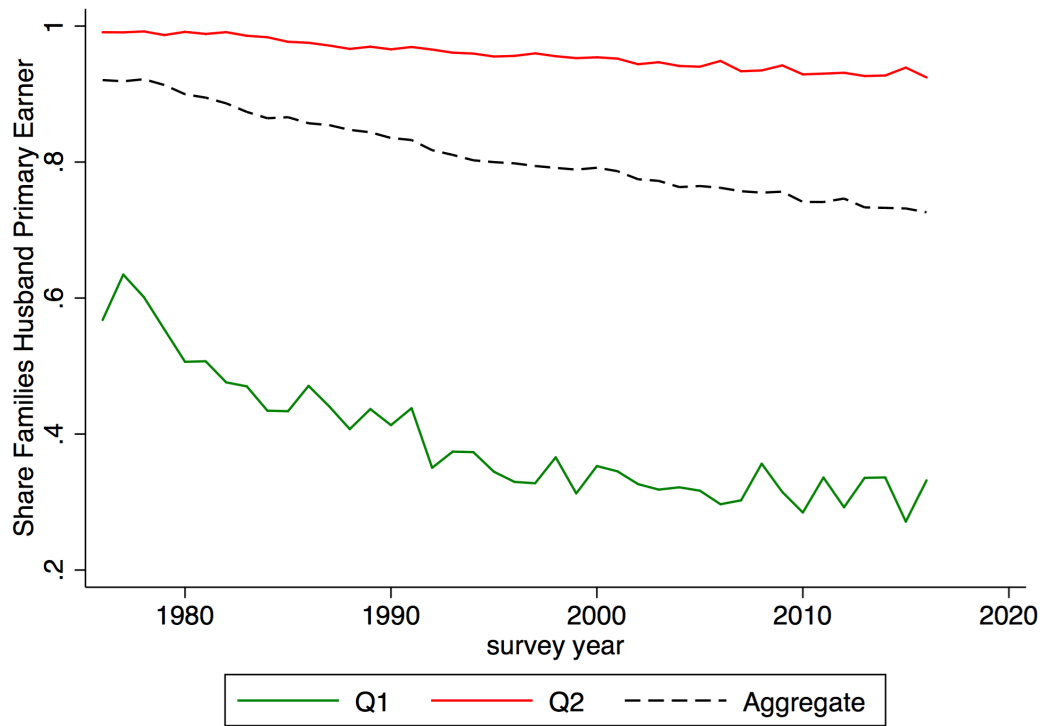


Figure 17: Share of households by husband wage decile where husbands out-earn their wives.

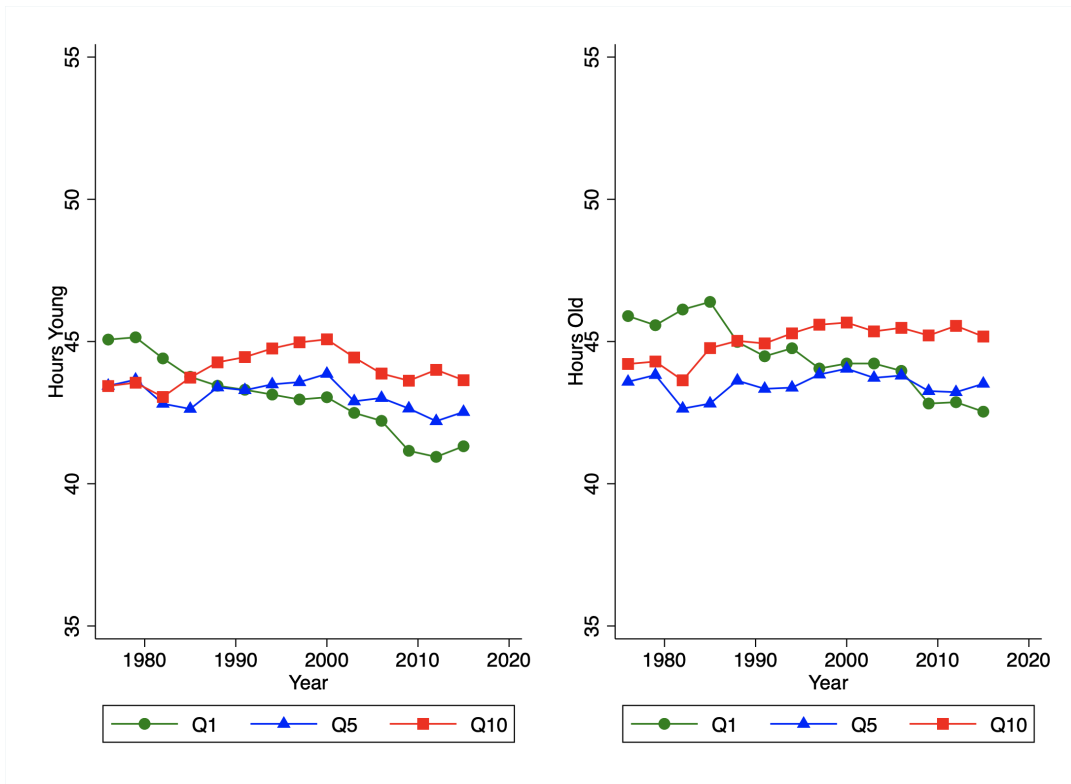


Figure 18: Hours worked by age. Young corresponds to workers age 25-35. Old corresponds to workers age 45-55.

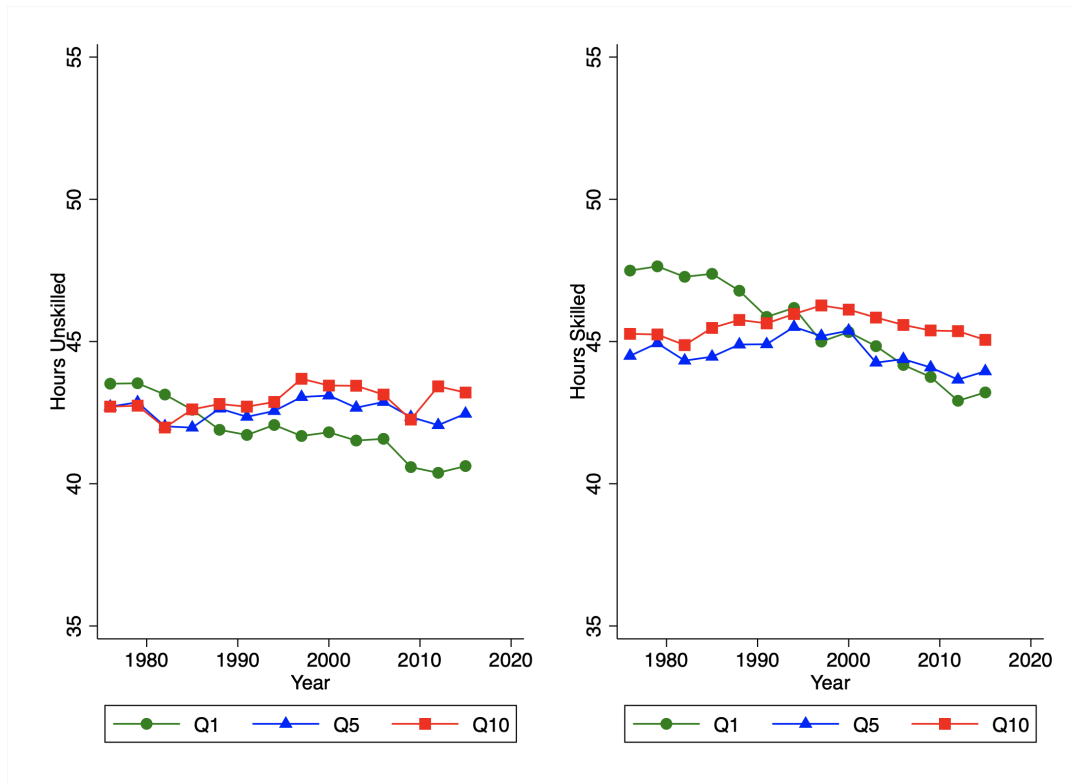


Figure 19: Hours worked by education. Skilled workers are those with a BA degree or more. Unskilled are those with some college or less.



Figure 20: UK Total Family Hours (both working)

Note: Data source is General Household Survey and EU-SILC. Income deciles are determined based on husband wage.



Figure 21: Spain Total Family Hours (both working)

Note: Data source is EU-SILC. Income deciles are determined based on husband wage.

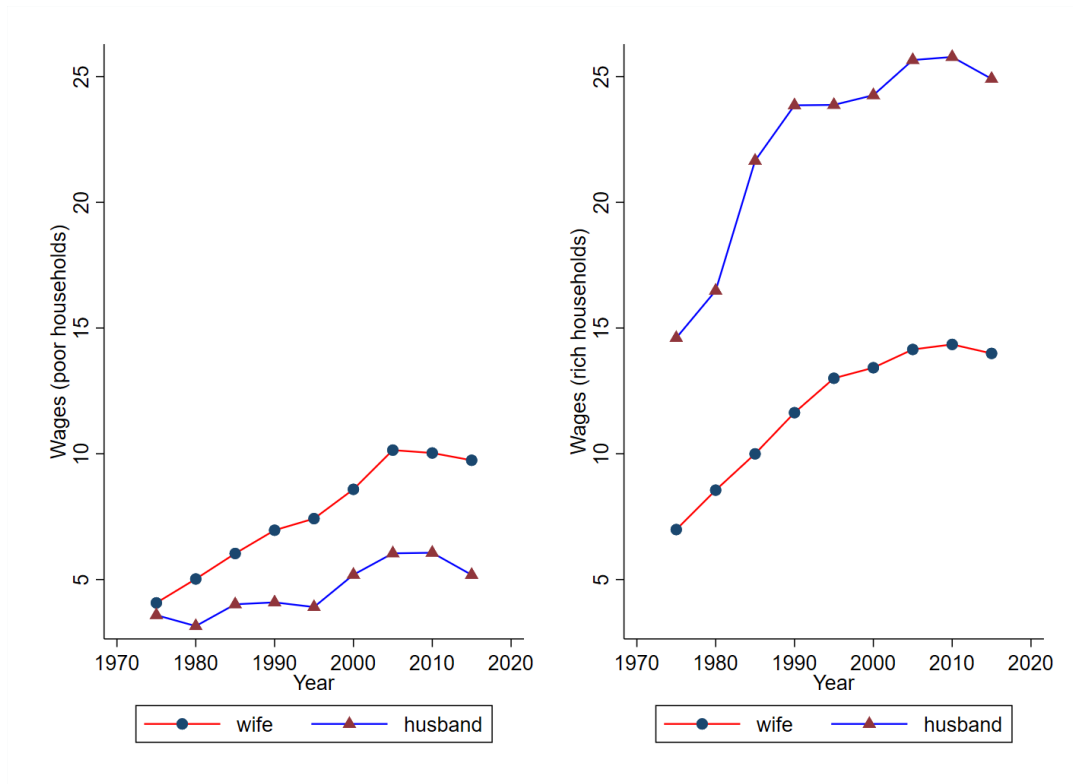


Figure 22: UK Wages

Note: Data source is General Household Survey and EU-SILC. Wages are adjusted with CPI and are in 2015 British Pound.

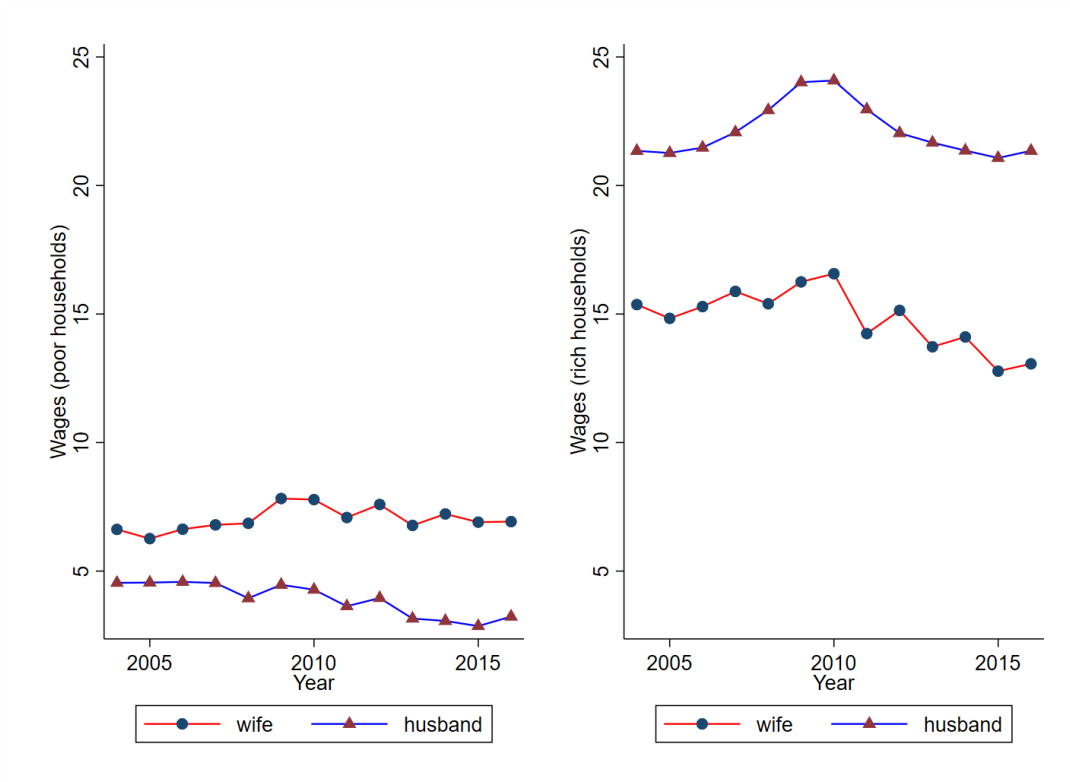


Figure 23: Spain Wages

Note: Data source is EU-SILC. Wages are adjusted with CPI and are in 2015 Euros.

Robustness Checks with PSID

To make sure that the facts we document in section ?? are robust, we repeat our main analysis for the US using PSID. We construct our PSID sample by only restricting our analysis to married male heads of households and their wives as the hours worked information is only available for this group. “Annual total hours worked” and “annual labor income” variables have been used to construct hourly wages. We calculate hourly wage deciles only for married male heads of households, then we analyze their wives’ labor market outcomes based on husband’s wage decile. We deflate wages by using CPI (total all items, 2015 Dollars). Same sample restrictions have been used in terms of age (18-65) and full-time work (at least 20 hours a week and 40 weeks a year). To plot consistent figures as in CPS, we convert annual hours to weekly hours (in Figure 24). Moreover, we report 5-year averages.

First, we observe same trends in hours worked for married men and women in PSID, consistent with CPS results (Figure 24), both at the individual level and family level. Second, we document real wages and relative wages in families (Figure 25). Real wages of men in the first and medium deciles are stagnant, whereas real wages of rich men is increasing. Although, there is some increase in real wages of women at all deciles, it is more pronounced among the wives of rich men. When we focus on within family dynamics, i.e. relative wage (husband/wife) of couples, it is decreasing for poor and middle earner families but increasing for rich families. Hence, men are out-earned by their wives in poor families but the gender gap is big and increasing in rich families. Taking into account the extensive margin, i.e. differences in participation rates of women among different family types (Figure 26), then define inverse relative wage (wife/husband), we observe increase for all family types but it is more pronounced among poor families. Finally, Figure 26 documents wife’s labor force participation rate and relative housework done within family. Where wives of rich men used to participate less than wives of poor men in 1969, they have the same participation rate in 2006. By the increase in labor market participation of wife among all family types, men do more of housework as a fraction of housework done by wife.

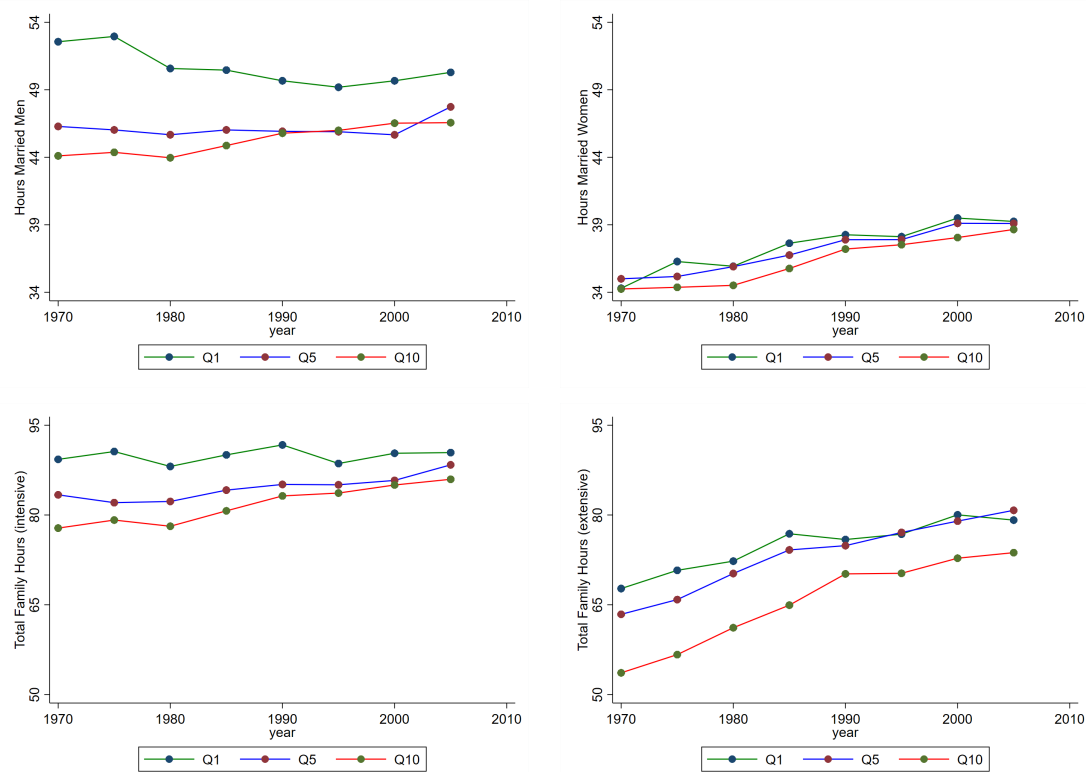


Figure 24: Hours

Note: Upper figures represent average hours worked for married men (only heads of households) and their wives who work full-time. Bottom left figure is total family hours conditional on both working, bottom right figure is total family hours conditional on husband working full-time (hours are zero for wives who do not work). Source: PSID

Description of PSID Data

Consistent income and hours worked information is only available for household heads and their wives in PSID. A household head by definition can be single or married, male or female. However, since the majority of household heads are male, we restrict our analysis to household heads who are male and married, aged 18-65, and to their wives.

We use yearly family files from 1968 to 2015 and individual file (1968-2015). Variables we use from the individual file are yearly family interview numbers, yearly relation to head and person number. We rename yearly family interview numbers as in family files. We define individual identifier by multiplying 68 family

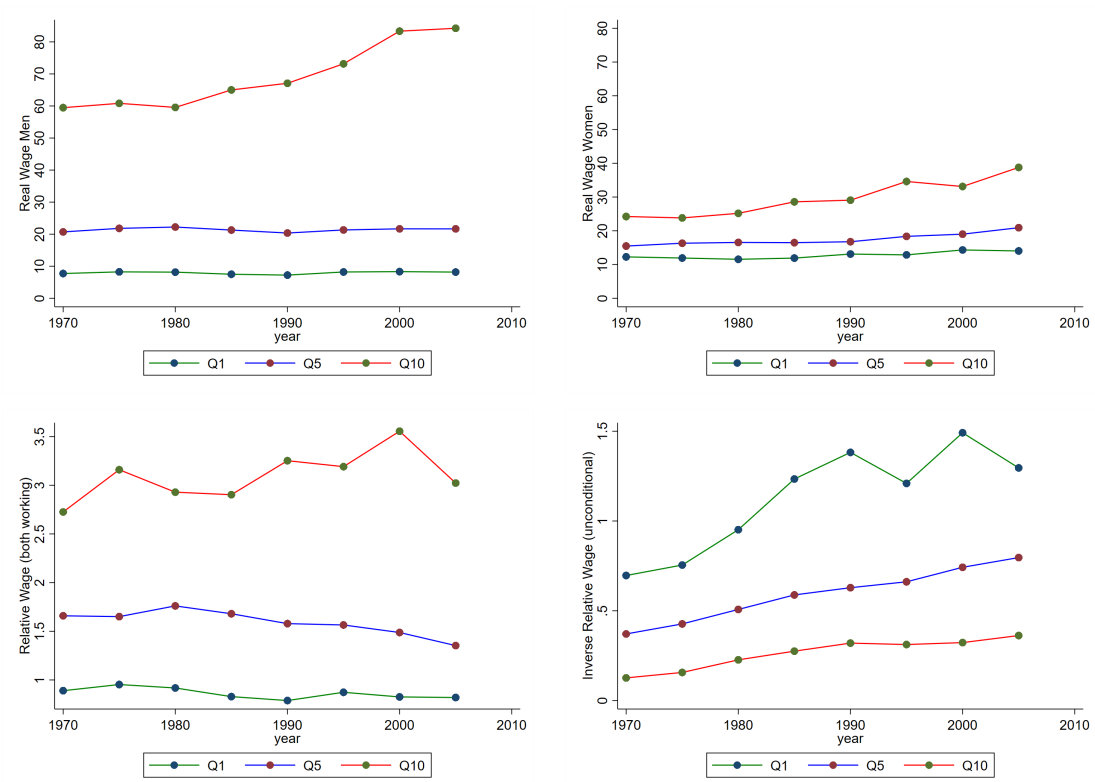


Figure 25: Wages

Note: Real wages are in 2015 Dollars. CPI (total all items) has been used as deflator. Bottom left figure represents husband/ wife wage conditional on both working full time (20 hours a week). Bottom right figure represents wife/ husband wage conditional on husband working (wages are zero for wives who do not work). Source: PSID

interview number by 1000 and adding person number. Individual identifier is important when following a person over the years. We then repeatedly match each family file with the individual file using family interview number. This procedure creates yearly files containing all individuals in the family. Family variables becomes attached to all individuals in the family. We rename all the variables to be used in a consistent way across yearly files. We keep only heads of households. After producing yearly individual-family matched files from 1968-2015, we append all the matched yearly files. The last step produces the panel data of all household heads.

Since the income and hours worked variables are asked for the previous year (how much your income was last calendar year?), we redefine the year as the previous

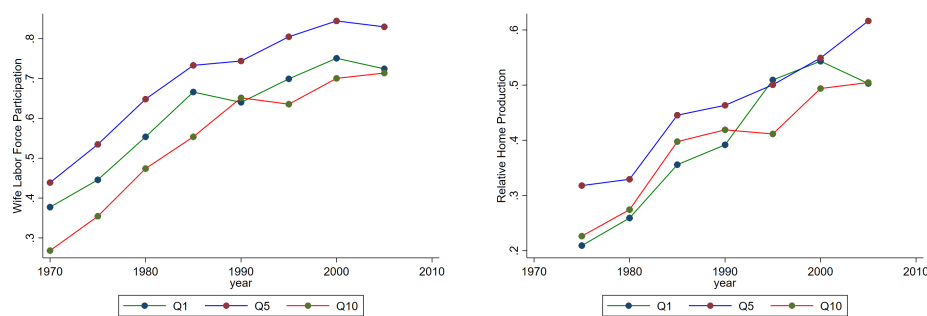


Figure 26: Participation and Home Production

Note: Left figure represents wives' labor force participation rate of males who work full-time. Right figure represents the fraction of housework done by husbands. Source: PSID

year by also correcting the age of head and wife. Then we merge the PSID dataset with CPI (total, all items, 2015\$). Note that correcting the time is crucial when deflating the income variables with the CPI. We make income of head and wife undefined if income exceeds 9999990 (not available code). Moreover, we make hours worked undefined if annual hours exceeds 5000 or is between 0 and 1000 (part-time). To define hourly wage of head and wife, we divide deflated annual labor income to annual hours for those who work positive hours. To address possible reporting errors, we make hourly wage of head and wife undefined if it exceeds 400\$ or is between 0 and 2\$. These restrictions are commonly used in the literature.

The figures reported in this paper are based on following further restrictions. We only keep married males, aged 18-65, who work at least 40 weeks a year, 1000 hours a year and whose hourly wage is greater than 2\$. The income distribution has been calculated based on this sample. We define the wife as working if she works at least 1000 hours a year, 40 weeks a year, earns at least 2\$ per hour. A non-working wife is defined as the wife who works zero annual hours and earns zero hourly income. Note that this definition rules out women who work in an irregular way, hence we only focus on wives who either works full-time or who are not in the labor force.

Description of EU-SILC and GHS

We use EU-SILC cross-sectional person files to construct the dataset for Spain from 2004 to 2016. Main variables that we use are “yearly net income” and “usual hours worked per week”. We define annual hours by multiplying usual hours by 52 and we calculate hourly wage by dividing annual net income to annual hours. We restrict our analysis to people who work full-time (at least 9 months a year, at least 20 hours a week). Furthermore, to address possible reporting errors, we restrict the sample to people whose hourly wage is between 1 and 30 in 2015 Euros.

We use General Life Style Survey for the period 1973-2004, EU-SILC for the period 2005-2016 for the UK. We harmonize hours and income variables across years in the following way. GLS does not report harmonized income variables in all sample years. In order to increase accuracy, we use all available variables (when the main income variable is missing) which is reported as gross weekly earnings for employees and gross profit for self-employed. In sample years 1983-1991, for around 15% of the defined sample, the survey is incomplete i.e. hours worked are defined but not the income. This subgroup has significantly high hours worked than the rest of the sample. Hence, being not able to include them, decreases average hours, especially more for poor group. The lack of smoothness between 1983-1991 is due to this data restriction that we are aware of. However, given that our total sample expands to 1973-2016 period, we are confident on the results describing the trend from 70’s towards 2000’s.

We restrict our sample to the population aged 18-65, who work at least 20 hours a week, who earn between 1 and 30 an hour (in 2015 British Pound). Finally, we define income deciles based on samples explained and report the hours worked of each subgroup according to their ranking in the aggregate income distribution.