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Household specialization and the labor-supply elasticities of women and men

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Household Specialization and the Labor-Supply Elasticities of Women and Men

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Abstract

This paper studies gender differences in the elasticity of labor supply in a model of household specialization. We show that household specialization implies larger Frisch elasticities for the partner that specializes in home production. Quantitatively, empirical time-use ratios alone imply differences in the Frisch elasticity between women and men of about 50%. Similar results are obtained for long-run elasticities. However, limited commitment within the household reduces the gender differences in long-run labor-supply elasticities. Our results imply that the elasticity of labor supply is not a deep parameter but can react on, e.g., gender-biased employment subsidies, public child care provision, and divorce laws.

Keywords: Labor-supply elasticity, gender, home production
JEL classification: J22, J16, D13

1 Introduction

The elasticity of labor supply is a key concept in many parts of economics including, next to labor economics, macroeconomics and optimal taxation theory. There is empirical consensus that labor supply is not equally elastic across the population (e.g., Francesconi 2002 and Keane 2011). Differences in labor-supply elasiticities have implications for the behavior of different population groups over the business cycle, for the effectiveness of employment subsidies, and for the distribution of optimal marginal tax rates.

This paper focusses on gender differences in labor-supply elasticities. There is strong empirical evidence that women's labor supply is in general more elastic than men's (Cogan 1981; Eckstein and Wolpin 1989; Bourguignon and Magnac 1990; van der Klaauw 1996; Francesconi 2002; Dechter 2013). Concerning the Frisch elasticity which governs short-run reactions to wage changes, empirical estimates are about twice as high for women than for men (Keane 2011).

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In a simple decision problem with continuous labor supply and without home production, the Frisch elasticity equals the inverse of the curvature of labor disutility. One may thus explain gender differences in the Frisch elasticity by gender differences in this parameter. Alternatively, one can relate the higher labor-supply elasticities of women at the macro level to the higher importance of the extensive margin for this group. In a heterogeneous-agents model with discrete labor supply, the labor-supply elasticity depends on the distribution of reservation wages rather than on the steepness of labor disutility (Chang and Kim 2006).

This paper gives an explanation for gender differences in the Frisch elasticity of labor supply in a model of household specialization. In the model, the partner that specializes in home production (traditionally, the wife) is predicted to have the higher Frisch elasticity of labor supply. This result does not rely on differences in preferences but is a result of specialization which also holds if men and women have identical preferences.

Generally, it is well known that home production increases the elasticity of labor supply as home produced goods are likely to be substitutes to market-purchased consumption goods (e.g., Cahuc and Zylberberg 2004 and Rogerson and Wallenius 2009). However, this argument applies symmetrically for both, women and men. Gender differences in the Frisch elasticity in our analysis are caused by different allocations of working time to home production and market work. In a model with home production, the Frisch elasticity of *market* labor supply is approximately equal to the elasticity of *total* work multiplied by the ratio of total to market work. The exact Frisch elasticity also contains the effects of substitution within home production and between home production and market consumption but these effects are likely rather small quantitatively.

Using this result, we can explain about half of the gender differences in empirical Frisch elasticities using time use evidence on household specialization (Ramey and Francis 2009). As, empirically, the ratio of total to market work is about 50% higher for women than for men, the model implied Frisch elasticities are - with equal preferences - roughly 50% bigger for women.

Our analysis further implies that labor-supply elasticity estimates are biased when home production is omitted from the estimated model. We demonstrate this by estimating a standard model with an artifical data set generated in a model with home production. There, we estimate pronounced gender differences in work preferences although the data-generating model features idential preferences. We also estimate two model versions (with and without home production) with real world data on gender-specific labor supply and earnings. There, we estimate very similar preferences for both genders in the model with home production. By contrast, when estimating the model without home production with the same data, results strongly reject the hypothesis of equal preferences.

We also analyze the implications of our model for long-run elasticities. As is known, home production can imply substantial long-run labor-supply elasticities even under balanced growth (e.g., Jones, Manuelli, and McGrattan 2003). Considering gender differences, we find that also long-run labor-supply elasticities tend to be higher for partners that specialize in home production. This has important policy implications as policy makers can expect rather strong effects of policies which change long-run earnings potentials of population groups that initially work much in home production. But, our model also implies that the labor-supply elasticity is not a deep parameter and is thus generally policy-variant. E.g., public provision or subsidizing of child care which reduce the amount of mothers' work at home can reduce the effectiveness of employment subsidies for women.

We further show that long-run labor-supply elasticities also depend on the degree of commitment between spouses. If permanent wage changes cause changes in bargaining positions and re-negotiations in the household, gender differences in the elasticity of labor supply are reduced. Consider, e.g., a relative wage rise for the wife which has two counteracting effects on her market hours. First, the household substitutes away from using the – now more expensive – time of the wife in home production. But, second, the household also puts a higher weight on leisure of the wife who has now more influence in household decision making due to improved outside options. The less spouses (can) commit to initial arrangements with their partners (e.g., because of loose divorce regulations, see Voena 2013), the stronger is this second effect and the lower – and more equal – are the labor-supply elasticities of both genders. Also this implies that the elasticity of labor supply is generally policy variant. The effectiveness of activating employment subsidies or optimal tax rates depend – among other things – also on divorce legislation.

This paper contributes to the literature on the non-preference determinants of labor-supply elasticities. Imai and Keane (2004) show that estimates of the Frisch elasticity are downward-biased when the estimated model omits the effects of on-the-job human capital accumulation. Similarly, Domeij and Floden (2006) demonstrate the importance of borrowing constraints for the Frisch elasticity. Most strongly related to our paper, Rogerson and Wallenius (2009) point to the relevance of home production for retiring decisions but do not consider gender differences. Concerning gender differences in the labor-supply elasticity, Ortigueira and Siassi (2013) stress the role of female labor supply as an insurance device. Our explanation is complementary to theirs as it works also under complete capital markets. However, when it comes to long-run wage changes, our explanation has substantially different implications than the argument of Ortigueira and Siassi (2013). In a model of household risk sharing with limited commitment, there is no transfer in the steady state. We demonstrate that this implies that spouses' long-run labor-supply elasticities in a model without home production equal the ones in a standard bachelor model with complete capital markets. Compatible with our predictions, the micro estimations of Kaya (2014) show that female labor-supply elasticities are particularly high for couples with young children (where home production is arguably important) and in situations where the degree of assortative mating is high (which increases the importance of household specialization, see Bredemeier and Juessen 2013).

The remainder of this paper is organized as follows. Section 2 presents the model set-up. Section 3 analyzes Frisch labor-supply elasticities. Section 4 studies long-run labor-supply elasticities. Section 5 concludes.

2 Model

A household consists of two spouses, a wife F and a husband M, who live forever. There are two commodities c and d. c is a usual consumption good which is produced and purchased on the market while d is a Beckerian home commoditiy that the household produces itself. Spouses face a joint budget constraint and engage jointly in home production. Each household chooses consumption quantities of the two commodities, hours worked n, and home production times h for both members.

The household's decision problem is to maximize the Lagrangean

$$\mathcal{L} = E_t \sum_{s=0}^{\infty} \beta^s \left[\begin{array}{c} \sum_{g=M,F} \mu_{g,t+s} \cdot u \left(\frac{c_{g,t+s}^{1-\sigma}}{1-\sigma} + \nu_d \frac{d_{t+s}^{1-\kappa}}{1-\kappa} - \nu_l \frac{(n_{g,t+s}+h_{g,t+s})^{1+\eta_g}}{1+\eta_g} \right) \\ +\lambda_{t+s} \left[\begin{array}{c} w_{F,t+s} n_{F,t+s} + w_{M,t+s} n_{M,t+s} + (1+r_{t+s}) k_{t+s} \\ +\pi_{t+s} - c_{M,t+s} - c_{F,t+s} - k_{t+s+1} \end{array} \right] \\ +\chi_{t+s} \left[A_{t+s} h_{F,t+s}^{\theta} h_{M,t+s}^{1-\theta} - d_{t+s} \right] \end{array} \right], \qquad (1)$$

where w are wage rates, k is physical capital, r the rental rate on it, and π summarizes dividends, taxes, transfers, and other lump-sum incomes or expenditures. A denotes TFP in home production, σ, ν_d, κ, ν_l, η_g, and θ are parameters, and λ and χ Lagrange multipliers. Note that we generally allow for gender differences in labor disutility.

Importantly, the $\mu_{g,t+s}$ are utility weights which sum up to one. The first line in the square brackets in equation (1) describes the Pareto frontier, we are thus considering cooperative household decision making. However, we assume that couples are acting under limited commitment (as proposed by Ligon 2002). Spouses cannot commit themselves perfectly to an initial joint plan such that the utility weights can react to permanent changes in, e.g., relative wages of the spouses. By constrast, spouses are assumed to be able to commit themselves to an efficient sharing of the risk associated with transitory shocks. This implies that the utility weights do not react to short-run wage fluctuations.

We consider three variants of the model, one without home production and two variants that include home production. In the *model version without home production (variant 1),* we set the valuation of the home-produced good in the utility function to zero, $\nu_d = 0$. In the first model variant with home production, we assume that home production variables, $h_{M,t}$, $h_{F,t}$, and d_t have to be determined one period in advance. In this *model variant with pre-determined home production (variant 2)*, the household problem is to

$$\max \mathcal{L} \text{ over } \{c_{g,t+s}, n_{g,t+s}, h_{g,t+s+1}, d_{t+s+1}, k_{t+s+1}\}_{s=0}^{\infty}.$$

This model variant is supposed to be understood as a means of demonstration. It allows us to disentangle the effect of working in home production per se from substitution within home production. In the final model variant, we allow households to choose home production simultaneously with market labor supply. In this *model variant with simultaneous* *choice (variant 3),* the household problem is to

$$\max \mathcal{L} \text{ over } \{c_{g,t+s}, n_{g,t+s}, h_{g,t+s}, d_{t+s}, k_{t+s+1}\}_{s=0}^{\infty}.$$

This is the full model which features all effects that arise in reaction to wage changes.

The first-order conditions for $c_{M,t}$, $c_{F,t}, n_{M,t}, n_{F,t}, h_{M,t}, h_{F,t}, d_t, k_{t+1}, \chi_t$, and λ_t, respectively, are

$$\begin{aligned}
\mu_{M,t} c_{M,t}^{-\sigma} &= \lambda_t, & (2)\\
\mu_{F,t} c_{F,t}^{-\sigma} &= \lambda_t, & (3)\\
\mu_{M,t} \nu_l l_{M,t}^{\eta} &= \lambda_t w_{M,t}, & (4)\\
\mu_{F,t} \nu_l l_{F,t}^{\eta} &= \lambda_t w_{F,t}, & (5)\\
E_t \mu_{M,t(+1)} \nu_l l_{M,t(+1)}^{\eta} &= E_t \chi_{t(+1)} (1-\theta) A_{t+s} h_{F,t(+1)}^{\theta} h_{M(+1)}^{-\theta}, & (6)\\
E_t \mu_{F,t(+1)} \nu_l l_{F,t(+1)}^{\eta} &= E_t \chi_{t(+1)} \theta A_{t+s} h_{F,t(+1)}^{\theta-1} h_{M(+1)}^{1-\theta}, & (7)\\
\nu_d d_{t(+1)}^{-\kappa} &= E_t \chi_{t(+1)}, & (8)\\
\lambda_t &= \beta E_t \lambda_{t+1} (1 + r_t - \delta), & (9)\\
d_t &= h_F^{\theta} h_M^{1-\theta}, & (10)\\
c_{M,t} + c_{F,t} + b_{t+1} &= w_{M,t} n_{M,t} + w_{F,t} n_{F,t} + (1 + r_t) b_t + \tau_t, & (11)
\end{aligned}$$

where $l_{g,t} = n_{g,t} + h_{g,t}$ is total work of spouse $g = F, M$ and the $(+1)$ indicates the potential pre-determination of home production. Conditions (6), (7), (8), and (10) are, of course, irrelevant in the model variant without home production.

3 Frisch elasticities

3.1 Analytical results

How does the couple react to transitory wage changes? Formally, we consider an unanticipated change in $\widehat{w}_{M,t}$ or $\widehat{w}_{F,t}$, respectively. Considering the Frisch labor-supply elasticity, we hold the valuation of wealth, λ, constant. Further, there is no commitment problem associated with transitory wage changes in the short run, thus, the utility weights $\mu_{g,t}$ are constant. This implies that, to determine the Frisch elasticity, we only need to consider the first-order conditions (4) - (8) and (10). In order to calculate the Frisch elasticities, we consider the following log-linearized versions of these conditions:

$$\eta_M \frac{n_M}{l_M} \widehat{n}_{M,t} + \eta_M \frac{h_M}{l_M} \widehat{h}_{M,t} = \widehat{w}_{M,t}, \quad (12)$$

$$\eta_F \frac{n_F}{l_F} \widehat{n}_{F,t} + \eta_F \frac{h_F}{l_F} \widehat{h}_{F,t} = \widehat{w}_{F,t}, \quad (13)$$

$$\frac{\eta_M n_M}{l_M} E_t \widehat{n}_{M,t(+1)} + \left(\frac{\eta_M h_M}{l_M} + \theta \right) \widehat{h}_{M,t(+1)} - \theta \widehat{h}_{F,t(+1)} - E_t \widehat{\chi}_{t(+1)} = 0, \quad (14)$$

$$(\theta - 1) \widehat{h}_{M,t(+1)} + \frac{\eta_F n_F}{l_F} E_t \widehat{n}_{F,t(+1)} + \left(\frac{\eta_F h_F}{l_F} + 1 - \theta \right) \widehat{h}_{F,t(+1)} - E_t \widehat{\chi}_{t(+1)} = 0, \quad (15)$$

$$-\kappa\widehat{d}_{t(+1)} - E_t\widehat{\chi}_{t(+1)} = 0, \quad (16)$$

$$-(1-\theta)\,\widehat{h}_{M,t} - \theta\widehat{h}_{F,t} + \widehat{d}_t = 0, \quad (17)$$

where a hat "^" indicates percentage deviations from steady state. One of the key drivers of the results can be seen in the first two equations above. When agents work some time in home production, a one-percent increase in market hours, $\widehat{n}_{g,t}$, increases marginal labor disutility only by the curvature parameter η_g multiplied by the ratio of market to total work. This mechanically follows from the fact that a one-percent increase in market hours increases *total* working time by less than one percent. We now go through the three different model variants and calculate the Frisch elasticity.

In the model without home production, we can focus on the first two conditions (12) and (13) as the other four conditions (14) - (17) relate to home-production variables. Further, as spouses do not work in home production in this variant, $h_{g,t} = 0$, market work is equal to total work, $n_M/l_M = n_F/l_F = 1$. In matrix form, the system can thus be written as

$$\begin{pmatrix} \eta_M & 0 \\ 0 & \eta_F \end{pmatrix} \cdot \begin{pmatrix} \widehat{n}_{M,t} \\ \widehat{n}_{F,t} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix}.$$

It is solved by

$$\begin{pmatrix} \widehat{n}_{M,t} \\ \widehat{n}_{F,t} \end{pmatrix} = \begin{pmatrix} \eta_M & 0 \\ 0 & \eta_F \end{pmatrix}^{-1} \cdot \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix} = \begin{pmatrix} \frac{1}{\eta_M} & 0 \\ 0 & \frac{1}{\eta_F} \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix}.$$

Thus, in this model variant, we obtain the well-known standard result that the Frisch elasticity is constant and reflects the utility function's curvature in hours worked,

$$FLSE_g = \frac{1}{\eta_g}.$$

As a consequence, gender differences in the Frisch elasticity can only be generated by gender differences in preferences in this model variant without home production.

In the model variant with predetermined home production, the household can not react to wage changes with changes in home production on impact. Formally, $E_{t-1}\widehat{\chi}_t = 0$ in conditions (14) - (16). It follows that $\widehat{h}_{M,t} = \widehat{h}_{F,t} = \widehat{d}_t = 0$. So, also in this model variant, we can focus on the first two conditions (12) and (13) when determining the impact reactions to wage changes. By contrast to the model variant without home production, spouses do work positive home hours such that the shares of steady-state working time devoted to market work, n/l, are below one. This model variant can thus be summarized as

$$\begin{pmatrix} \eta_M \cdot \frac{n_M}{l_M} & 0 \\ 0 & \eta_F \cdot \frac{n_F}{l_F} \end{pmatrix} \cdot \begin{pmatrix} \widehat{n}_{M,t} \\ \widehat{n}_{F,t} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix}.$$

The solution is

$$\begin{pmatrix} \widehat{n}_{M,t} \\ \widehat{n}_{F,t} \end{pmatrix} = \begin{pmatrix} \eta_M \cdot \frac{n_M}{l_M} & 0 \\ 0 & \eta_F \cdot \frac{n_F}{l_F} \end{pmatrix}^{-1} \cdot \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix} = \begin{pmatrix} \frac{1}{\eta_M} & 0 \\ 0 & \frac{1}{\eta_F} \cdot \frac{l_F}{n_F} \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix}.$$

Here, the Frisch elasticity is not a constant but depends on time use,

$$FLSE_g = \frac{1}{\eta_g} \cdot \frac{l_g}{n_g}. \tag{18}$$

Specifically, the absolute value of the Frisch elasticity decreases in the share of total labor that is devoted to market work. With household specialization, this translates into *higher* Frisch elasticities of the partner that specializes in home production – traditionally, the wife.

In the full model with simultaneous choice, we need to consider all six conditions (12) - (17). In matrix form, we write them as

$$\begin{pmatrix} \frac{\eta_M \cdot n_M}{l_M} & \frac{\eta_M \cdot h_M}{l_M} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\eta_F \cdot n_F}{l_F} & \frac{\eta_F \cdot h_F}{l_F} & 0 & 0 \\ \frac{\eta_M \cdot n_M}{l_M} & \frac{\eta_M \cdot h_M}{l_M} + \theta & 0 & -\theta & 0 & -1 \\ 0 & \theta - 1 & \frac{\eta_F \cdot n_F}{l_F} & \frac{\eta_F \cdot h_F}{l_F} + (1-\theta) & 0 & -1 \\ 0 & 0 & 0 & 0 & -\kappa & -1 \\ 0 & \theta - 1 & 0 & -\theta & 1 & 0 \end{pmatrix} \cdot \begin{pmatrix} \widehat{n}_{M,t} \\ \widehat{h}_{M,t} \\ \widehat{n}_{F,t} \\ \widehat{h}_{F,t} \\ \widehat{d}_t \\ \widehat{\chi}_t \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix} \cdot \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix}.$$

The solution of this model variant is

$$\begin{pmatrix} \widehat{n}_{M,t} \\ \widehat{h}_{M,t} \\ \widehat{n}_{F,t} \\ \widehat{h}_{F,t} \\ \widehat{d}_t \\ \widehat{\chi}_t \end{pmatrix} = \begin{pmatrix} \frac{1}{\eta_M} \cdot \frac{l_M}{n_M} + \frac{h_M}{n_M} \frac{(-1+\theta+\theta\kappa)}{\kappa} & \frac{-\theta h_M - \theta\kappa h_M}{\kappa n_M} \\ \frac{-\theta-\theta\kappa+1}{\kappa} & \frac{\theta+\theta\kappa}{\kappa} \\ \frac{-h_F+\theta h_F-\kappa h_F+\theta\kappa h_F}{\kappa n_F} & \frac{l_F}{n_F \eta_F} + \frac{h_F}{n_F} \frac{\kappa-\theta(1+\kappa)}{\kappa} \\ \frac{-\theta+\kappa-\theta\kappa+1}{\kappa} & \frac{\theta-\kappa+\theta\kappa}{\kappa} \\ \frac{1-\theta}{\kappa} & \frac{\theta}{\kappa} \\ 1-\theta & \theta \end{pmatrix} \begin{pmatrix} \widehat{w}_{M,t} \\ \widehat{w}_{F,t} \end{pmatrix}.$$

So, the Frisch elasticities in this full model are

$$FLSE_M = \frac{1}{\eta_M} \cdot \frac{l_M}{n_M} + \frac{h_M}{n_M} \cdot \frac{(1+\kappa)-1}{\kappa}, \tag{19}$$

$$FLSE_F = \frac{1}{\eta_F} \cdot \frac{l_F}{n_F} + \frac{h_F}{n_F} \cdot \frac{\kappa - \theta(1+\kappa)}{\kappa}. \tag{20}$$

Also here, the Frisch elasticties depend on time use. The Frisch elasticities in the full model contain the term $\frac{1}{\eta_g} \cdot \frac{l_g}{n_g}$ which we already know from the variant with predetermined home production. Here, a second term is added to the Frisch elasticity that describes substitution within home production (governed by the parameter θ) as well as substitution

Table 1: Summary of Frisch elasticties in the different model versions.

	Men	**Women**
without home production	$\frac{1}{\eta_M}$	$\frac{1}{\eta_F}$
predetermined home prod.	$\frac{1}{\eta_M} \cdot \frac{l_M}{n_M}$	$\frac{1}{\eta_F} \cdot \frac{l_F}{n_F}$
simultaneous choice	$\frac{1}{\eta_M} \cdot \frac{l_M}{n_M} + \frac{h_m}{n_M} \cdot \frac{(-1+\theta+\theta\kappa)}{\kappa}$	$\frac{1}{\eta_F} \cdot \frac{l_F}{n_F} + \frac{h_F}{n_F} \cdot \frac{\kappa-\theta(1+\kappa)}{\kappa}$

into or out of home production (governed by the parameter κ).

It is insightful to consider the special case where $\kappa \to 1$ and $\theta = 1/2$ such that we have log utility from the home good (a prerequisite for balanced growth as we will see below) and no ex-ante gender productivity differences in home production (specialization then originates in wage differences). In this special case the second terms in both Frisch elasticities (19) and (20) simplify to zero. We can thus conclude that the Frisch elasticities in the full model do not differ strongly from their counterparts in the model variant with predetermined home production when parameters do not differ too much from $\kappa \to 1$ and $\theta = 1/2$.

Table 1 summarizes the Frisch labor-supply elasticities in the three model variants. The main difference between the variant without home production and the two variants with home production is that in the latter ones, the Frisch elasticities depend on steady-state time use ratios. Differences between the two model variants with home production follow from substitution effects within home production and into or out of home productions. Quantitatively, however, these effects are likely to be rather small.

3.2 Quantitative Evaluation

Relation to time-use evidence. We have worked out that, in a model with home production, Frisch elasticities depend on the steady-state time-use ratios of women and men. We now consider which portion of empiricial gender differences in Frisch elasticities can be explained through observed differences in time use. Table 2 shows the weekly working times of individuals in prime working age (25-54) in the United States for 2005. The information stems from Ramey and Francis (2009). We see that differences in total labor are small, women work some three hours more per week than men. By contrast, there are pronounced differences between genders with respect to the allocation of total labor to market work and home production. Men devote about 68% of their labor to market work while, for women, this number is only about 46%.

Using these empirical numbers in our model-implied Frisch elasticities, we see that they imply substantial gender differences in the elasticity of labor supply even without gender

Table 2: Weekly time devoted to work activities of 25-54 years old in 2005, from Ramey and Francis (2009).

	Men	**Women**	**Gender ratio**
total labor l	54.1	57.2	0.95
market work n	36.8	26.1	1.41
home production h	17.3	31.1	0.56
share of market work n/l	0.68	0.46	1.49

differences in preferences. Equation (18) shows that women have Frisch elasticities which are about 50% higher than those of men in the model variant with predetermined home production. In the model with simultaneous choices on home production and labor supply, Frisch elasticities are similar if the calibration does not differ to much from log utility in home production and equal productivities of genders in the home. Many empirical studies suggest that the female share in opportunity costs is somewhat above 50%. Considering equations (19) and (20), this implies that the Frisch elasticity is somewhat larger for men and somewhat smaller for women than in the model with predetermined home production.

Given that empirical estimates of the Frisch labor-supply elasticity are about twice as high for women than for men (Keane 2011), we see that about half of these gender differences can be explained solely by the empirical gender differences in the fractions of working time devoted to home production and market work, respectively.[1]

Simulation/estimation exercise. In order to further evaluate the quantitative implications of our model results, we perform a simulation/estimation exercise with the model variants 1 and 3. We first simulate the full model with home production and simultaneous choice. Then, we use the artificial data from this simulation to estimate the model variant that does not include home production.

To parameterize the full model, we use a combination of setting certain parameters and calibrating others. Most importantly, we set the parameters that determine the curvature of labor disutility equally to $\eta_M = \eta_F = 1.5$. We also set the other two preference parameters and use the values $\sigma = \kappa = 1$ which imply balanced growth, see Section 4 below. We set the time preference rate to $\beta = 0.995$ implying an annual interest rate of 2% as we interprete a period as a quarter. We use two independent AR(1) process for log wages of women and men with a long-run wage gap of $w_F/w_M = 0.8$ but equal persistence of 0.75. We then calibrate the remaining parameters to match the empirical time-use ratios in Table 2. This gives $\theta = 0.5899$ to match the gender ratio of home production time in steady state. The steady-state utility weights are calibrated to $\mu_M = 0.4239$ and $\mu_F = 0.5761$ to generate the empirical gender ratio of total working times. Finally, to generate the empirical ratios of home production to market work, we obtain $\nu_d = 0.8876$ and gender-specific utility weights on labor, $\nu_{lM} = 11.6263$ and $\nu_{lF} = 6.2954$.

[1] The model presented can of course explain also these long-run differences in time use between genders, see Section 5. Women are predicted to work a higher fraction of their total work in the household if they are more productive than men there and/or if they earn systematically lower wages in the market.

Table 3: Estimation results for the model variant without home production using artificial data stemming from a simulation of the full model.

	prior			posterior		
variable	distrib.	mean	std. dev.	mean	5% conf.	95% conf
η_M	gamma	1.500	1.000	12.4137	12.4096	12.4163
η_F	gamma	1.500	1.000	0.4198	0.4191	0.4202

From the simulation of the full model, we save time series of the cyclical components of male and female wages and market hours ($\widehat{w}_M$, $\widehat{w}_F$, $\widehat{n}_M$, $\widehat{n}_F$). Then, we use this artificial data to estimate the model variant without home production. Specifically, we estimate the labor disutility parameters η_M and η_F and the variances of the wage shocks taking the other parameters as given above (as long as they exist in the model variant without home production). We use a Bayesian estimation technique for dynamic stochastic equilibrium models and use a prior gamma distribution with mean 1.5 and variance 1 for both, η_M and η_F. The estimation results for η_M and η_F are given in Table 3. Although the data-generating model features no gender differences in preferences, the estimation results for the model without home production strongly reject the null hypothesis of equal preferences across genders. This indicates, that researchers may wrongly conclude that there are substantial gender differences in preferences when home production is omitted from the estimated model.

Estimation with real world data. In order to obtain some insights how the simulation results square with actual data, we also estimate the two above considered model variants 1 and 3 with real world data. Unfortunately, there is no perfectly fitting time-series data available at buiness-cycle frequency. While the model uses the hourly wage rate to predict hours worked, the BLS publishes gender-specific labor-market outcomes at quarterly frequency only for labor earnings of the full-time employed and the employment-to-population ratio. We use these data in seasonally adjusted and HP-filtered (1600) form for the time period 1979Q1-2012Q4.

Especially the earnings time series has a strong implication for our estimation results. As the earnings series are relatively volatile, models can generate the relatively low volatility of employment only with rather low Frisch elasticities. However, the estimation results confirm our result that home production is important for the identification of gender specific Frisch elasticities and work preferences. We estimate the preference parameters η_M and η_F as well as the parameters of the gender-specific wage processes. Again, we take the other parameters as given and use the values described above. The results are given in Tables 4 and 5. In the model with home production, we estimate rather similar preferences of women and men, see Table 4. By contrast, in the model without home production, the results strongly reject gender equality in preferences, see Table 5.

Table 4: Estimation results for the model variant with home production and simultaneous choice using real-world data.

variable	prior			posterior		
	distrib.	mean	std. dev.	mean	5% conf.	95% conf
η_M	gamma	1.500	1.000	15.1296	13.8172	16.0483
η_F	gamma	1.500	1.000	14.8703	12.8093	16.5941

Table 5: Estimation results for the model variant without home production using real-world data.

variable	prior			posterior		
	distrib.	mean	std. dev.	mean	5% conf.	95% conf
η_M	gamma	1.500	1.000	12.5689	12.5687	12.5695
η_F	gamma	1.500	1.000	0.8817	0.8792	0.8844

4 Implications for long-run elasticities

In this section, we consider the implications of our results for the long-run elasticities of labor supply. Empirical evidence suggests that also long-run elasticities differ substantially between genders. Uncompensated (Marshallian) long-run elasticities are usually estimated in a range of 0-0.3 for men while estimates for women lie around 0.6 (estimates for both genders in the US are reported by Hausman and Ruud 1984, Triest 1990, Devereux 2004, Eissa and Hoynes 2004, and Dechter 2013).

To determine the long-run elasticties in our model, we consider *permanent* wage changes. We thus consider the model in a non-growing steady state where the first-order conditions (2) - (11) simplify to

$$\mu_M c_M^{-\sigma} = \lambda, \tag{21}$$

$$\mu_F c_F^{-\sigma} = \lambda, \tag{22}$$

$$\mu_M \nu_l l_M^{\eta_M} = \lambda w_M, \tag{23}$$

$$\mu_F \nu_l l_F^{\eta_M} = \lambda w_F, \tag{24}$$

$$\mu_M \nu_l l_M^{\eta_M} = \chi \cdot (1-\theta) \cdot A_h h_F^{\theta} h_M^{-\theta}, \tag{25}$$

$$\mu_F \nu_l l_F^{\eta_M} = \chi \cdot \theta \cdot A_h h_F^{\theta-1} h_M^{1-\theta}, \tag{26}$$

$$\nu_d d^{-\kappa} = \chi, \tag{27}$$

$$d = A_h h_F^{\theta} h_M^{1-\theta}, \tag{28}$$

$$c_M + c_F = w_M n_M + w_F n_F + T, \tag{29}$$

$1 = \beta\,(1+r)$, and a function for the utility weights μ which may react to long-run changes due to imperfect commitment. $T = rb + \pi$ captures all non-labor income.

We consider the following linearized version of the steady-state conditions where x' denotes the change of variable x between two steady states:

$$\mu_M' - \sigma c_M' = \lambda', \tag{30}$$

$$\mu_F' - \sigma c_F' = \lambda', \tag{31}$$

$$\mu_M' + \eta_M \frac{n_M}{l_M} n_M' + \eta_M \frac{h_M}{l_M} h_M' - \lambda' = w_M', \tag{32}$$

$$\mu_F' + \eta_F \frac{n_F}{l_F} n_F' + \eta_F \frac{h_F}{l_F} h_F' - \lambda' = w_F', \tag{33}$$

$$\mu_M' + \eta_M \frac{n_M}{l_M} n_M' + \eta_M \frac{h_M}{l_M} h_M' = A' + \theta h_F' - \theta h_M' + \chi', \tag{34}$$

$$\mu_F' + \eta_F \frac{n_F}{l_F} n_F' + \eta_F \frac{h_F}{l_F} h_F' = A' - (1-\theta)\, h_F' + (1-\theta)\, h_M' + \chi', \tag{35}$$

$$-\kappa d' = \chi', \tag{36}$$

$$d = A' + \theta h_F' + (1-\theta)\, h_M', \tag{37}$$

$$\frac{c_M}{c} c_M' + \frac{c_F}{c} c_F' - \frac{y_M}{Y} n_M' - \frac{y_F}{Y} n_F' = \frac{y_M}{Y} w_M' + \frac{y_F}{Y} w_F' + \frac{T}{Y} T', \tag{38}$$

$$\mu_F' + \frac{\mu_M}{\mu_F} \mu_M' = 0, \tag{39}$$

$$\mu_F' - \mu_M' = \zeta w_F' - \zeta w_M'. \tag{40}$$

The last two conditions refer to the utility weights. Equation (39) mirrors that the sum of the utility weights is constant. Equation (40) is the assumption that utility weights react to long-run wage changes with an elasticity denoted by ζ. Note that the system of linearized steady-state conditions (30) - (40) contains changes in more exogenous variables than the short-run system (12) - (17). Here, we also consider changes in non-labor income, T', and changes in total factor productivity, A'. These are included for a balanced-growth evaluation in the model with home production. Further, there are also more changes in endogenous variables, as, in the long run, also the utility weights μ and the marginal valuation of wealth λ may change and with them the consumption levels c of both spouses.

In the steady state, we distinguish between only two model variants, one without home production ($\nu_d = 0$) and one with home production. Of course, the distinction between predetermined home production and simultaneous choice is irrelevant in steady state.

4.1 Model variant without home production

In this model variant, it is imporant to notice that gains from marriage arise from insurance over the business cycle. The model can also be written as the two spouses acting subject to individual budget constraints with an endogenously determined transfer between them (e.g., Ligon 2002). However, it is an important result in these models that the steady-state transfer reflects differences in wage uncertainty (thus, the insurance value of marriage for each spouse) but not on the wage levels of the two spouses (which are not equalized).

Thus, spouses effectively act subject to distinct budget constraints in the steady state. For each of them, the problem simplifies to

$$\begin{pmatrix} c'_g \\ n'_g \\ \lambda' \end{pmatrix} = \begin{pmatrix} -\sigma_g & 0 & -1 \\ 0 & \eta_g & -1 \\ 1 & -\frac{Y-T}{Y} & 0 \end{pmatrix}^{-1} \begin{pmatrix} 0 & 0 \\ 1 & 0 \\ \frac{Y-T}{Y} & \frac{T}{Y} \end{pmatrix} \begin{pmatrix} w'_g \\ T'_g \end{pmatrix}$$

$$= \begin{pmatrix} \frac{\left(1+\eta_g\right)(T-Y)}{Y\left(\sigma_g+\eta_g\right)-T\sigma_g} & \frac{\eta_g T}{Y\left(\sigma_g+\eta_g\right)-T\sigma_g} \\ \frac{(\sigma_g-1)Y-\sigma_g T}{Y\left(\sigma_g+\eta_g\right)-T\sigma_g} & -\frac{\sigma_g T}{Y\left(\sigma_g+\eta_g\right)-T\sigma_g} \\ \frac{\sigma_g\left(1+\eta_g\right)(Y-T)}{Y\left(\sigma_g+\eta_g\right)-T\sigma_g} & -\frac{\sigma\eta_g T}{Y\left(\sigma_g+\eta_g\right)-T\sigma_g} \end{pmatrix} \begin{pmatrix} w'_g \\ T'_g \end{pmatrix}.$$

The Marshallian labor-supply elasticity in this model variant is

$$MLSE_g = \frac{(\sigma_g - 1)\,Y - \sigma_g T}{Y\,\left(\sigma_g + \eta_g\right) - T\sigma_g} \overset{T=0}{=} \frac{\sigma_g - 1}{\eta_g + \sigma_g}$$

where the latter equality refers to the case where non-labor income in the steady state is zero. The long-run cross-wage elasticity is zero. The results imply that also gender differences in long-run labor-supply elasticities can only be due to gender differences in preferences in this model variant without home production. Next to differences in the curvature of labor disutility (η_g), also the risk aversion parameter σ_g plays a role for long-run labor-supply elasticities. Some experimental evidence (Borghans, Golsteyn, Heckman, and Meijers 2009) suggest that women are more risk averse than men are which might explain their higher long-run labor-supply elasticities. However, this model variant is compatible with balanced growth only under $\sigma_M = \sigma_F = 1$. But, then, labor supply is completely independent of wages in the long run such that both genders' Marshallian elasticties are zero and thus independent of η_g.

4.2 Model with home production

We now turn to the full model with home production. We simplify the system (30) - (40) and express it in matrix form as

$$BX' = MZ' \iff X' = B^{-1}MZ' = SZ' \tag{41}$$

with

$$X = \left(c'_M\, c'_F\, n'_M\, n'_F\, h'_M\, h'_F\, \lambda'\right)^T,\ Z\prime = \left(w'_M\, w'_F\, T'\, A'\right)^T,$$

$$M = \begin{pmatrix} -\zeta & 1 & 0 & -\zeta\mu_F & \zeta\mu_M & n_M w_M \\ \zeta & 0 & 1 & \zeta\mu_F & -\zeta\mu_M & n_F w_F \\ 0 & 0 & 0 & 1-\kappa & 1-\kappa & 0 \\ 0 & 0 & 0 & 0 & 0 & T \end{pmatrix}^T,$$

and

$$B = \begin{pmatrix} -\sigma & \sigma & 0 & 0 & 0 & 0 \\ \sigma & 0 & \frac{\eta_M n_M}{l_M} & 0 & \frac{\eta_M h_M}{l_M} & 0 \\ 0 & \sigma & 0 & \frac{\eta_F n_F}{l_F} & 0 & \frac{\eta_F h_F}{l_F} \\ 0 & 0 & \frac{\eta_M n_M}{l_M} & 0 & \frac{\eta_M h_M}{l_M} + \theta + \kappa(1-\theta) & -(1-\kappa)\theta \\ 0 & 0 & 0 & \frac{\eta_F n_F}{l_F} & -(1-\kappa)(1-\theta) & \frac{\eta_F h_F}{l_F} + 1 - \theta + \kappa\theta \\ c_M & c_F & -w_M n_M & -w_F n_F & 0 & 0 \end{pmatrix}.$$

4.2.1 Simplified model version

Before we turn to evaluation the complete model for realistic parameters, we study a simplifying special case to understand basic mechanisms of the model in the long run. Specifically, we consider the special case where $\sigma = \kappa = \eta_F = \eta_M = \nu_d = 1$, $T = 0$ and $\nu_l = 2$. We further assume here that initial wages are equal and normalize them to 1. We finally assume that inital utility weigths are equal, $\mu_M = \mu_F = 1/2$. In this special case, the steady state of the household problem is $n_M = \theta$, $h_M = 1-\theta$, $n_F = 1-\theta$, $h_F = 1-\theta$, and $c_M = c_F = 1/2$. See appendix for a derivation of these steady-state results. Applying these reults in (41), we can write the model as

$$\begin{pmatrix} -1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & \theta & 0 & 1-\theta & 0 \\ 0 & 1 & 0 & 1-\theta & 0 & \theta \\ 0 & 0 & \theta & 0 & 1+1-\theta & 0 \\ 0 & 0 & 0 & 1-\theta & 0 & 1+\theta \\ 1/2 & 1/2 & -\theta & -(1-\theta) & 0 & 0 \end{pmatrix} \begin{pmatrix} c'_M \\ c'_F \\ n'_M \\ n'_F \\ h'_M \\ h'_F \end{pmatrix} = \begin{pmatrix} -\zeta & \zeta & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ -\frac{1}{2}\zeta & \frac{1}{2}\zeta & 0 \\ \frac{1}{2}\zeta & -\frac{1}{2}\zeta & 0 \\ \theta & 1-\theta & 0 \end{pmatrix} \begin{pmatrix} w'_M \\ w'_F \\ A' \end{pmatrix}$$

Multiplying the inverse of the matrix on the left-hand side from the left, we obtain the solution

$$\begin{pmatrix} c'_M \\ c'_F \\ n'_M \\ n'_F \\ h'_M \\ h'_F \end{pmatrix} = \begin{pmatrix} \frac{1}{2} + \frac{1}{2}\zeta & \frac{1}{2} - \frac{1}{2}\zeta & 0 \\ \frac{1}{2} - \frac{1}{2}\zeta & \frac{1}{2} + \frac{1}{2}\zeta & 0 \\ \frac{1}{\theta} - \frac{1}{2} - \frac{1}{2}\frac{\zeta}{\theta} & -\frac{1}{\theta} + \frac{1}{2} + \frac{1}{2}\frac{\zeta}{\theta} & 0 \\ -\frac{1}{1-\theta} + \frac{1}{2} + \frac{1}{2}\frac{\zeta}{1-\theta} & \frac{1}{1-\theta} - \frac{1}{2} - \frac{1}{2}\frac{\zeta}{1-\theta} & 0 \\ -\frac{1}{2} & \frac{1}{2} & 0 \\ \frac{1}{2} & -\frac{1}{2} & 0 \end{pmatrix} \begin{pmatrix} w'_M \\ w'_F \\ A' \end{pmatrix}. \tag{42}$$

Now, we consider the Marshallian labor-supply elasticities of both spouses which are given by entries $(3, 1)$ and $(4, 2)$ of the matrix above. As their short-run counterparts, we can also express the long-run labor-supply elasticities as functions of initial steady-state time-use ratios. Using that $h_F/l_F = \theta$ and $h_M/l_M = 1-\theta$, we obtain

$$MLSE_g = \frac{l_g}{h_g} - \frac{1}{2} - \frac{1}{2} \cdot \zeta \cdot \frac{l_g}{h_g}. \tag{43}$$

In general, there are two counteracting effects of the inital share of working time devoted to home production: First, there is a standard substitution effect. A higher wage induces substitution of leisure against consumption. This induces the agent to work more after a wage rise. As in the short run (see Section 3), this effect is the stronger, the more the agent initially worked in home production. The intuition is the same as in the short run. Furthermore, there is a re-negotiation effect in the long run. A higher wage potentially (i.e., if $\zeta > 0$) leads to a higher weight of this spouse in the household target function. This, ceteris paribus, induces the spouse to consume more leisure and work less after a wage rise. We can see in equation (43) that also this second effect is the stronger, the more the agent initially worked in home production. It follows that stark re-negotiation after changes in relative wages counteract the effects of initial specialization on the long-run labor-supply elasticities. However, as long as $0 \leq \zeta < 2$, the spouse which specializes in home production has the higher Marshallian elasticity as we can write $MLSE_g = -1/2 + (1 - \zeta/2)\, l_F/h_F$. The empirical evidence of Lise and Seitz (2011) suggests that ζ is about one. We can thus be relatively confident that the first effect dominates and that long-run labor-supply elasticities are increasing in the initial time share devoted to home production.

Home production also implies non-zero cross-wage elasticities of labor supply in the long run. In this simplified model variant, the cross-wage elasticities are equal to the own-wage elasticities with opposite sign. Both effects discussed above occur symmetrically also in the cross-wage elasticities. The importance of the re-negotiation effect for the cross-wage elasticities is discussed by Knowles (2013). We contribute here that the strength of this effect depends on the initial degree of specialization within married couples.

Finally note that this model variant is compatible with balanced growth. We can easily see this, by setting $\begin{pmatrix} w'_M \, w'_F \, A' \end{pmatrix}^T$ in (42) to $\begin{pmatrix} 1 \; 1 \; 1 \end{pmatrix}^T$ and performing the matrix multiplication to obtain $\begin{pmatrix} c'_M \, c'_F \, n'_M \, n'_F \, h'_M \, h'_F \end{pmatrix}^T = \begin{pmatrix} 1 \; 1 \; 0 \; 0 \; 0 \; 0 \end{pmatrix}^T$, i.e. no changes in time use. A model with home production can thus be compatible with balanced growth and still have substantial non-zero long-run labor-supply elasticities. This property differentiates models with home production (e.g., also the one used in Jones, Manuelli, and McGrattan 2003) from models without home production (see Section 4.1) even when the latter can have substantial richness in the short-run labor-supply elasticities (like, e.g., the model of Ortigueira and Siassi 2013).

4.2.2 General model

Do the insights obtained in the model version above rely on the simplifying parameter restrictions imposed? To answer this question, we now turn to describe long-run labor-supply elasticities in the general model as described by (30) - (40). As we consider long-run wage changes, we restrict ourselves to parameter constellations that ensure balanced growth. In the appendix, we show that the model fulfills balanced growth if and only if

$$\sigma = \kappa = 1.$$

Under this condition, we can write the Marshallian elasticity of spouse g as

$$MLSE_g = \left(\Omega_g + \zeta \Upsilon_g\right)/\Gamma_g \tag{44}$$

where

$$\begin{aligned}
\Gamma_g &= \gamma \cdot n_g, \\
\gamma &= \eta_{-g}\eta_g + l_{-g}w_{-g}\eta_g + l_g w_g \eta_{-g} + h_{-g}w_{-g}\eta_{-g}\eta_g + h_g w_g \eta_{-g}\eta_g, \\
\Omega_g &= \left(c\eta_{-g} + h_{-g}w_{-g} + h_g w_g + l_{-g}w_{-g} - l_g w_g\right)\left(l_g + h_g\eta_g\right), \\
\Upsilon_g &= \mu_g \left(\left(\frac{h_{-g}}{l_{-g}}\eta_{-g} - \frac{h_g}{l_g}\eta_g\right) l_g l_{-g} w_{-g} + c l_g \eta_{-g}\right) - \left(c l_g \eta_{-g} + l_{-g} l_g w_{-g} + h_{-g} l_g w_{-g} \eta_{-g}\right)
\end{aligned}$$

(see appendix for a derivation). We see that the effects discussed in the simplified model version above also operate here although they are less easily visible. For a given total workload l_g, we can state the following relations between home production h_g and the components of the Marshallian elasticity. First, Ω_g increases in home-production share which tends to generate a *positive* relation between the home-production share and the Marshallian elasticity. Second, Γ_g decreases in the home-production share which tends to generate a *positive* relation between the home-production share and the Marshallian elasticity (note that γ is independent of gender). Third, Υ_g - which captures the re-negotiation effect - likely decreases in the home-production share which tends to generate a *negative* relation between the home-production share and the Marshallian elasticity (note that h_g/l_g further is a decreasing function of w_g and an increasing function of w_{-g}). So, as in the simplified model version, the re-negotiation effect counteracts the effect of home production on the Marshallian elasticities. But also here, small values of ζ ensure that this effect is dominated.

To strengthen our understanding of the substitution and re-negotiation effects on the long-run labor-supply elasticities, Table 6 shows the Marshallian labor-supply elasticities of both spouses for different values for the labor disutility parameters η_g and the strength of the re-negotiation ζ. The remaining parameters of the model have been calibrated to match the time-use ratios in Table 2 with a gender wage gap of $w_F/w_M = 0.8$ for any triplet (η_M, η_F, ζ).

The first block in Table 6 shows results for a relatively high number of $\eta_g = 10$ for both spouses implying an Frisch labor-supply elasticity of 0.1 in a model without home production. We can see that our model with home production implies long-run labor-supply elasticities of 0.25 to 0.9 with these preferences (as a comparison, remember that the Marshallian elasticities are zero in a model without home production under balanced growth). Two results catch the eye in the first block of the table. First, long-run labor-supply elasticities are considerable higher for women. The gender difference amounts to about factor 2.5 to 3 which arises - since preferences are equal - from initial specialization within the household (which in turn results from the gender wage gap and the productivity

Table 6: Long-run labor-supply elasticities for different labor-disutility parameters and strengths of re-negotiation.

	η_M	η_F	ζ	$MLSE_M$	$MLSE_F$
1	10	10	0	0.3523	0.8987
2	10	10	0.5	0.3070	0.8527
3	10	10	1	0.2616	0.8067
4	1.5	1.5	0	0.7806	1.6166
5	1.5	1.5	0.5	0.5274	1.2536
6	1.5	1.5	1	0.2742	0.8907
7	1.5	0.5	0	0.9400	2.5886
8	1.5	0.5	0.5	0.6067	1.8556
9	1.5	0.5	1	0.2734	1.1225

Notes: other parameters calibrated to match the time-use ratios in Table 2 for a gender wage gap of $w_F/w_M = 0.8$. This implies $\theta = 0.59$ independent of η_g and ζ. Further, $\mu_M = 0.31$ for $\eta_M = 10$ and $\mu_M = 0.42$ for $\eta_M = 1.5$.

difference in home production). Second, both gender's Marshallian elasticities decrease in the degree of re-negotiation after long-run wage changes. This effect is of about equal size for both genders.

In the second block of the table, we consider a substantially lower value for η_g, implying higher Frisch elasticities. We observe that this leads to higher labor-supply elasticities also in the long run eventhough the effect of lowering η_g is very small when $\zeta = 1$. In this block, we also observe substantially higher Marshallian elasticities for women than for men and a reduction in Marshallian elasticities as ζ increases.

Finally, we consider gender differences in preferences in the third block of the table where we set the curvature of labor disutility to 0.5 for women. This would induce gender differences in the Frisch elasticity also in a model without home production. This variation in η_F increases the women's Marshallian elasticity - and (except for $\zeta = 1$) also slightly men's. However, without re-negotitation ($\zeta = 0$) the introduction of gender differences in preferences has only a very small effect on the gender difference in the Marshallian elasticity. Comparing lines 4 and 7 of Table 6, the ratio $MLSE_F/MLSE_M$ increases from 2.07 to only 2.75. In other words, only one fourth of the gender difference in the Marshallian elasticity is caused by gender differences in preferences. The importance of preference differences in even somewhat lower when re-negotiations are strong.

5 Conclusion

This paper has demonstrated that gender differences in the elasticity of labor supply can be explained as a result of household specialization. While empirical gender differences in Frisch elasticities are estimated to be about factor 2, empirical time-use ratios alone imply differences of somewhat below factor 1.5. The importance of home production for labor-supply elasticities can bring about biased estimates in models without home productions. We have further demonstrated that long-run elasticities are also affected by household specialization and that models with home production can have substantial non-zero long-run elasticities and still be compatible with balanced growth. Under limited commitment, re-negotiation effects of long-run wage changes can also affect labor-supply elasticties. The policy implications of our results include potentially larger effects of employment subsidies for groups that initially specialize in home production but also a non-constancy of labor-supply elasticities that policy makers should take into account.

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Appendix

Simplified Model version: initial steady state

We use $\sigma = \kappa = \nu_d = \eta_M = \eta_F = w_M = w_F = 1$, $\mu_M = \mu_F = 1/2$, and $T = 0$ in the model (21)-(29). We then use conditions (27) and (28) in conditions (25) and (26) to write the system as

$$
\begin{aligned}
c_M &= (2\lambda)^{-1}, \\
c_F &= (2\lambda)^{-1}, \\
\nu_l l_M &= 2\lambda, \\
\nu_l l_F &= 2\lambda, \\
\nu_l l_M &= 2(1-\theta)\, h_M^{-1} \\
\nu_l l_F &= 2\theta h_F^{-1} \\
c_M + c_F &= n_M + n_F.
\end{aligned}
$$

We now use the first and second condition in the final condition and combine the third and fourth condition which imply $l_M = l_F = l$ to obtain

$$
\begin{aligned}
\nu_l l &= 2\lambda \Leftrightarrow \lambda^{-1} = 2l^{-1}\nu_l^{-1}, \\
\nu_l l &= 2(1-\theta)\, h_M^{-1}, \\
\nu_l l &= 2\theta h_F^{-1}, \\
(2\lambda)^{-1} + (2\lambda)^{-1} &= \lambda^{-1} = n_M + n_F.
\end{aligned}
$$

We now use the first condition in the fourth and re-arrange all equations to obtain.

$$
\begin{aligned}
\nu_l l &= 2(1-\theta)\, h_M^{-1} \Leftrightarrow \nu_l l\,(l - n_M) = \nu_l l^2 - \nu_l n_M l = 2(1-\theta), \\
\nu_l l &= 2\theta h_F^{-1} \Leftrightarrow \nu_l l\,(l - n_F) = \nu_l l^2 - \nu_l n_F l = 2\theta, \\
2l^{-1}\nu_l^{-1} &= n_M + n_F \Leftrightarrow 2 = \nu_l n_M l + \nu_l n_F l.
\end{aligned}
$$

Using the first two conditions in the last condition gives

$$
\begin{aligned}
2 &= \nu_l l^2 - 2(1-\theta) + \nu_l l^2 - 2\theta = 2\nu_l l^2 - 2 \\
&\Leftrightarrow l = \sqrt{2/\nu_l}.
\end{aligned}
$$

Now using $\nu_l = 2$, we can derive the solution as

$$
\begin{aligned}
l &= 1, \\
\nu_l l &= 2(1-\theta)\, h_M^{-1} \Leftrightarrow 2 = 2(1-\theta)\, h_M^{-1} \Leftrightarrow h_M = 1-\theta, n_M = \theta, \\
\nu_l l &= 2\theta h_F^{-1} \Leftrightarrow h_F = \theta, h_F = 1-\theta, \\
c_M &= c_F = (2\lambda)^{-1} = (\nu_l l_M)^{-1} = 1/2.
\end{aligned}
$$

General model: balanced growth and Marshallian elasticities

Calculating $S = B^{-1}M$ with B and M defined as in (41), we can determine the Marshallian labor-supply elasticity, the cross-wage elasticity, the elasticity to home productivity, and the elasticity to non-labor income for the husband and the wife as $S_{3,1}$, $S_{3,2}$, $S_{3,3}$, and $S_{3,4}$ and $S_{4,2}$, $S_{4,1}$, $S_{4,3}$, and $S_{4,4}$ respectively. Balanced-growth requires that

$$S_{j,1} + S_{j,2} + S_{j,3} + S_{j,4} = 0 \text{ for } j = 3, 4 \tag{45}$$

Define $j(g)$ with $j(M) = 3$ and $j = (F) = 4$ and θ_g with $\theta_F = \theta$ and $\theta_M = 1 - \theta$. Functionally, the elasticities read as

$$\begin{aligned}
MLSE_g &= S_{j(g),j(g)-2} = (\Omega_g + \zeta\Upsilon_g)/\Gamma_g \\
MLSE_g^{cross} &= S_{j(g),j(-g)-2} = \left(\Omega_g^{cross} + \zeta\Upsilon_g^{cross}\right)/\Gamma_g \\
LSE_g^A &= S_{j(g),3} = (1-\kappa)\cdot\Lambda_g/\Gamma_g \\
LSE_g^T &= S_{j(g),4} = T\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right)/\Gamma_g
\end{aligned}$$

where

$$\begin{aligned}
\Gamma_g =& \kappa c_{-g}n_g\eta_{-g}\eta_g + \kappa c_g n_g\eta_{-g}\eta_g + \kappa\sigma l_{-g}n_g w_{-g}\eta_g + \kappa\sigma l_g n_g w_g\eta_{-g} \\
&+\sigma h_{-g}n_g w_{-g}\eta_{-g}\eta_g + \sigma h_g n_g w_g\eta_{-g}\eta_g, \\
\Omega_g =& n_g w_g\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right) + \kappa c_{-g}l_g\eta_{-g} + \kappa c_g l_g\eta_{-g} + \kappa\sigma l_{-g}l_g w_{-g} \\
&+c_{-g}h_g\eta_{-g}\eta_g + c_g h_g\eta_{-g}\eta_g + \sigma l_{-g}h_g w_{-g}\eta_g - \theta_{-g}c_{-g}h_g\eta_{-g}\eta_g - \theta_{-g}c_g h_g\eta_{-g}\eta_g \\
&+\theta_{-g}\sigma h_{-g}l_g w_{-g}\eta_{-g} + \kappa\sigma h_{-g}l_g w_{-g}\eta_{-g} - \theta_{-g}\sigma l_{-g}h_g w_{-g}\eta_g + \theta_{-g}\kappa c_{-g}h_g\eta_{-g}\eta_g \\
&+\theta_{-g}\kappa c_g h_g\eta_{-g}\eta_g - \theta_{-g}\kappa\sigma h_{-g}l_g w_{-g}\eta_{-g} + \theta_{-g}\kappa\sigma l_{-g}h_g w_{-g}\eta_g + \sigma h_{-g}h_g w_{-g}\eta_{-g}\eta_g, \\
\Upsilon_g =& \mu_g\left(\sigma h_{-g}l_g w_{-g}\eta_{-g} - c_g h_g\eta_{-g}\eta_g - c_{-g}h_g\eta_{-g}\eta_g - \sigma l_{-g}h_g w_{-g}\eta_g\right) \\
&-\left(\kappa c_{-g}l_g\eta_{-g} + \kappa\sigma l_{-g}l_g w_{-g} - c_g h_g\eta_{-g}\eta_g + \sigma h_{-g}l_g w_{-g}\eta_{-g}\right), \\
\Omega_g^{cross} =& n_{-g}w_{-g}\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right) - \kappa\sigma l_{-g}l_g w_{-g} - \sigma l_{-g}h_g w_{-g}\eta_g \\
&+\theta_{-g}c_{-g}h_g\eta_{-g}\eta_g + \theta_{-g}c_g h_g\eta_{-g}\eta_g - \theta_{-g}\sigma h_{-g}l_g w_{-g}\eta_{-g} - \kappa\sigma h_{-g}l_g w_{-g}\eta_{-g} \\
&+\theta_{-g}\sigma l_{-g}h_g w_{-g}\eta_g - \theta_{-g}\kappa c_{-g}h_g\eta_{-g}\eta_g - \theta_{-g}\kappa c_g h_g\eta_{-g}\eta_g \\
&+\theta_{-g}\kappa\sigma h_{-g}l_g w_{-g}\eta_{-g} - \theta_{-g}\kappa\sigma l_{-g}h_g w_{-g}\eta_g - \sigma h_{-g}h_g w_{-g}\eta_{-g}\eta_g, \\
\Upsilon_g^{cross} =& \left(\kappa c_{-g}l_g\eta_{-g} + \kappa\sigma l_{-g}l_g w_{-g} - c_g h_g\eta_{-g}\eta_g + \sigma h_{-g}l_g w_{-g}\eta_{-g}\right) \\
&-\mu_g\left(\sigma h_{-g}l_g w_{-g}\eta_{-g} - c_g h_g\eta_{-g}\eta_g - c_{-g}h_g\eta_{-g}\eta_g - \sigma l_{-g}h_g w_{-g}\eta_g\right), \\
\Lambda_g =& \sigma h_{-g}l_g w_{-g}\eta_{-g} - c_g h_g\eta_{-g}\eta_g - c_{-g}h_g\eta_{-g}\eta_g - \sigma l_{-g}h_g w_{-g}\eta_g.
\end{aligned}$$

Thus, the balanced-growth condition (45) can be written as

$$\Omega_g + \zeta\Upsilon_g + \Omega_g^{cross} + \zeta\Upsilon_g^{cross} + (1-\kappa)\Lambda_g + T\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right) = 0 \tag{46}$$

As $\Upsilon_g = -\Upsilon_g^{cross}$, see above, we can thus simplify the balanced-growth condition (46) to

$$\Omega_g + \Omega_g^{cross} + (1-\kappa)\,\Lambda_g + T\left(-\kappa\sigma l_g \eta_{-g} - \sigma h_g \eta_{-g}\eta_g\right) = 0.$$

Using the functional forms of Ω_g and Ω_g^{cross}, we obtain

$$\begin{aligned}
&\Omega_g + \Omega_g^{cross} + (1-\kappa)\,\Lambda_g + T\left(-\kappa\sigma l_g \eta_{-g} - \sigma h_g \eta_{-g}\eta_g\right)\\
&= n_g w_g\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right) + \kappa c_{-g} l_g \eta_{-g} + \kappa c_g l_g \eta_{-g} + \kappa\sigma l_{-g} l_g w_{-g} + c_{-g} h_g \eta_{-g}\eta_g\\
&\quad + c_g h_g \eta_{-g}\eta_g + \sigma l_{-g} h_g w_{-g}\eta_g - \theta_{-g} c_{-g} h_g \eta_{-g}\eta_g - \theta_{-g} c_g h_g \eta_{-g}\eta_g + \theta_{-g}\sigma h_{-g} l_g w_{-g}\eta_{-g}\\
&\quad + \kappa\sigma h_{-g} l_g w_{-g}\eta_{-g} - \theta_{-g}\sigma l_{-g} h_g w_{-g}\eta_g + \theta_{-g}\kappa c_{-g} h_g \eta_{-g}\eta_g + \theta_{-g}\kappa c_g h_g \eta_{-g}\eta_g\\
&\quad - \theta_{-g}\kappa\sigma h_{-g} l_g w_{-g}\eta_{-g} + \theta_{-g}\kappa\sigma l_{-g} h_g w_{-g}\eta_g + \sigma h_{-g} h_g w_{-g}\eta_{-g}\eta_g\\
&\quad + n_{-g} w_{-g}\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g \eta_{-g}\eta_g\right) - \kappa\sigma l_{-g} l_g w_{-g} - \sigma l_{-g} h_g w_{-g}\eta_g + \theta_{-g} c_{-g} h_g \eta_{-g}\eta_g\\
&\quad + \theta_{-g} c_g h_g \eta_{-g}\eta_g - \theta_{-g}\sigma h_{-g} l_g w_{-g}\eta_{-g} - \kappa\sigma h_{-g} l_g w_{-g}\eta_{-g} + \theta_{-g}\sigma l_{-g} h_g w_{-g}\eta_g\\
&\quad - \theta_{-g}\kappa c_{-g} h_g \eta_{-g}\eta_g - \theta_{-g}\kappa c_g h_g \eta_{-g}\eta_g + \theta_{-g}\kappa\sigma h_{-g} l_g w_{-g}\eta_{-g} - \theta_{-g}\kappa\sigma l_{-g} h_g w_{-g}\eta_g\\
&\quad - \sigma h_{-g} h_g w_{-g}\eta_{-g}\eta_g + (1-\kappa)\,\Lambda_g + T\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right)\\
&= \left(n_g w_g + n_{-g} w_{-g}\right)\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right) + (1-\kappa)\,\Lambda_g + T\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right)\\
&\quad + \kappa c_{-g} l_g\eta_{-g} + \kappa c_g l_g \eta_{-g} + c_{-g} h_g\eta_{-g}\eta_g + c_g h_g \eta_{-g}\eta_g\\
&= \kappa c l_g \eta_{-g} + c h_g \eta_{-g}\eta_g - \kappa\sigma n_{-g} l_g w_{-g}\eta_{-g} - \kappa\sigma l_g n_g w_g \eta_{-g} - \sigma n_{-g} h_g w_{-g}\eta_{-g}\eta_g\\
&\quad - \sigma h_g n_g w_g \eta_{-g}\eta_g + (1-\kappa)\,\Lambda_g + T\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right)\\
&= \kappa\left(w_g n_g + w_{-g} n_{-g}\right)\left(h_g + n_g\right)\eta_{-g} + \left(w_g n_g + w_{-g} n_{-g}\right) h_g \eta_{-g}\eta_g - \kappa\sigma n_{-g}\left(h_g + n_g\right) w_{-g}\eta_{-g}\\
&\quad - \kappa\sigma\left(h_g + n_g\right) n_g w_g \eta_{-g} - \sigma n_{-g} h_g w_{-g}\eta_{-g}\eta_g - \sigma h_g n_g w_g \eta_{-g}\eta_g\\
&\quad + (1-\kappa)\,\Lambda_g + T\left(\left(h_g + n_g\right)\eta_{-g} + h_g\eta_{-g}\eta_g - \kappa\sigma l_g \eta_{-g} - \sigma h_g \eta_{-g}\eta_g\right),
\end{aligned}$$

where we used $c_g + c_{-g} = c = w_g n_g + w_{-g} n_{-g} + T$ and $l_g = n_g + h_g$. For this to be zero independent of T we need

$$l_g\eta_{-g} + h_g\eta_{-g}\eta_g - \kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g = (1-\kappa\sigma)\, l_g\eta_{-g} + (1-\sigma)\, h_g\eta_{-g}\eta_g = 0$$

Which is, for general $l_g, h_g, \eta_{-g}, \eta_g$, only fulfilled if $\kappa = \sigma = 1$. Is this necessary condition also sufficient? We set $\kappa = \sigma = 1$ and obtain

$$\begin{aligned}
&\Omega_g + \Omega_g^{cross} + (1-\kappa)\,\Lambda_g + T\left(-\kappa\sigma l_g\eta_{-g} - \sigma h_g\eta_{-g}\eta_g\right)\\
&= \left(w_g n_g + w_{-g} n_{-g}\right)\left(h_g + n_g\right)\eta_{-g} + \left(w_g n_g + w_{-g} n_{-g}\right) h_g\eta_{-g}\eta_g - n_{-g}\left(h_g + n_g\right) w_{-g}\eta_{-g}\\
&\quad - \left(h_g + n_g\right) n_g w_g \eta_{-g} - n_{-g} h_g w_{-g}\eta_{-g}\eta_g - h_g n_g w_g \eta_{-g}\eta_g = 0.
\end{aligned}$$

This implies that

$$\kappa = \sigma = 1$$

is a necessary and sufficient condition for balanced growth. Under this condition, Γ_g, Ω_g, and Υ_g simplify to the terms expressed in Section 4.2.2 of the main text.