On gender gaps and self-fulfilling expectations: 
Alternative implications of paid-for-training*

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ABSTRACT

This paper presents a simple model of self-fulfilling expectations by firms and households which generates multiplicity of equilibria in pay and housework time allocation for ex-ante identical spouses. Multiplicity arises from statistical discrimination exerted by firms in the provision of paid-for training to full-time male and female workers, rather than from incentive problems in the labour market. Employers’ beliefs about differences in spouses’ reactions to housework shocks lead to symmetric (ungendered) and asymmetric (gendered) equilibria. We find that: (i) the ungendered equilibrium tends to prevail as aggregate productivity in the economy increases (regardless of the generosity of family aid policies), (ii) the ungendered equilibrium could yield higher welfare under some scenarios, and (iii) gender-neutral job subsidies are more effective than gender-targeted ones in removing the gendered equilibrium. Empirical evidence based on time use surveys for three European countries yields support for some of these theoretical implications.

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Keywords: gender gaps, housework shares, multiple equilibria.

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1. Introduction

The recent literature on gender differences in the labour market has been mainly concerned with two issues. On the one hand, it has tried to explain the evolution of gender gaps in wages, labour market participation and working hours by building models in which initial differences in preferences or productivity across the sexes can be amplified by, say, adverse selection. The estimation and/or calibration of these models then allows us to understand to what extent the reduction in these gaps has been due either to changes in fundamentals, a reduction in some sorts of discrimination, or to the endogenous accumulation of human capital by women. On the other hand, a complementary stream of the literature has analyzed whether these gender gaps may persist even when exogenous differences across the sexes are of little importance or even absent. These studies tend to rely upon incentive problems in the labour market which lead to self-fulfilling prophecies about differences in gender roles without any initial comparative advantages. In this paper we consider an alternative mechanism based on statistical discrimination exerted by firms in the provision of paid-for training to male and female workers which also yields multiplicity of equilibria in the absence of moral hazard.

The basic idea in models on gender gaps and self-fulfilling prophecies is that employers’ beliefs about women’s lower attachment to the labour market lead to wage differentials in favour of men. Hence, since women face a lower expected opportunity cost, they end up devoting more time to housework, validating in this way firms’ beliefs. For example, Albanesi and Olivetti (2009) propose a model where firms are subject to incentive compatible constraints due to their imperfect monitoring of effort (a moral hazard problem) and hours of housework (an adverse selection problem). As a result, different types of labour contracts are offered to men and women. In a similar vein, Lommerud and Vagstad (2007) deal with a model where firms allocate workers to fast and slow track jobs, the former requiring a fixed investment cost. If women have

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2 See, e.g., Francois (1998), Engineer and Welling (1999), Albanesi and Olivetti (2009), Lommerud and Vagstad (2007), and the references therein.
3 Following the seminal work by Arrow and Phelps, there is a large literature on statistical discrimination leading to asymmetric treatment in equilibrium of ex ante identical groups. In particular, our model deals with some of the issues raised earlier by Moro and Norman (2003, 2004), namely, the interaction between an informational externality and general equilibrium effects. However, whereas their cross-group externalities stem from the marginal productivity in market work of one group being affected by the size of another group (say the ratio of black and white workers in a given occupation), ours relies upon household decisions on the division of housework interacting with firms’ decision on training.
traditionally exerted primary major responsibility at home and wages are non-contractible, they will predominantly follow a “mommy track” in equilibrium.

While incentive problems - often used to derive additional predictions on the structure of wages to be confronted with the data – are a useful modelling device, they could be somewhat restrictive. For instance, concerning the difficulty of perfectly monitoring effort, wage gaps should be negligible for routine tasks performed by less-skilled employees for whom effort and output should be easily observable. Yet, substantial gender gaps in hourly wages still remain in these categories even after removing differences in observable characteristics and in the overall wage dispersion (see, e.g., Blau and Kahn, 2000, Bassanini and Saint Martin, 2008, and de la Rica et al. 2008).

Our paper contributes to this literature by proposing an alternative mechanism which does not rely on moral hazard problems. We consider a two-period model in which firms choose how much to invest on workers’ paid-for training taking as given households’ choices about the allocation of housework between spouses when shocks affecting household tasks occur (e.g., unexpected need of housework or events that require parental leave, etc.). Both decisions interact because the housework decision determines whether a spouse works or quits after receiving training and the firm chooses the training without observing the housework allocation. Statistical discrimination arises in this setup as a result of firms’ prior beliefs about which of the spouses is more likely to fully quit the job. If wages are predetermined with respect to the unexpected changes in housework, asymmetric beliefs will induce differences in the provision of training across spouses and, as a result, gender pay differences will arise. Since spouses also form beliefs about their relative wages when allocating housework, this mechanism can lead to self-fulfilling prophecies and therefore to a multiplicity of equilibria. Indeed, under some plausible assumptions about the distribution of household shocks and the degree of diminishing returns to training, two types of equilibria arise: (i) an ungendered equilibrium, with a fully egalitarian division of housework and equal pay, and (ii) a gendered equilibrium, where one of the spouses (typically men) earns a higher wage and devotes less time to housework.

Our model is able to generate some novel predictions about the relationship between the division of housework and the gender wage gap relative to that stream of the literature which relies upon incentive problems or on the intensive margin. First, we find that, under plausible conditions (and abstracting from the availability of more
generous gender policies), the gendered equilibrium tends to vanish in economies with higher aggregate productivity (i.e., where training results in larger market productivity gains). Secondly, as regards the role of policies in reducing gender gaps, we find that gender-neutral policies tend to be more effective than gender-based policies. In particular, when a *gendered* equilibrium prevails, we show that job subsidies targeted at women can backfire by shifting the economy to an even more unequal equilibrium.\(^4\) Lastly, in contrast to most existing work using incentive problems (see, e.g., the discussion in Lommerud and Vagstad, 2007), we find that welfare could be higher in the symmetric than in the asymmetric equilibrium. The converse result is often found in the literature because an asymmetric equilibrium promotes some form of “efficient specialization” in the labour market. Although this channel is also present in our model, under the rather plausible assumption that the disutility of housework is minimized under an even split of these tasks between *ex-ante* identical spouses, this second effect can dominate in some scenarios (notably in *high-productivity* economies).

At this stage it is important to stress that there could be other mechanisms at play which are somewhat isomorphic to training. For example, higher training could be thought as a key ingredient for allocating workers to fast-track jobs, as in Lazear and Rosen (1990). Likewise, one could think of alternative setups where training plays a role, like the over-representation of women (with the same observable characteristics than men) in full-time jobs involving less training, or their segregation in college degrees with lower market returns (despite performing better than men in high school).\(^5\) Nonetheless, we opt for paid-for training not only because it provides as a simpler device to capture the interaction between employers’ and households’ decisions, but also because there is ample empirical evidence pointing out that the intensity of on-the-job training is lower for women than for men even in full-time jobs (see, inter alia, Altonji and Spletzer, 1991, Barron et al., 1993, Royalty, 1996, for the US, de la Rica et al., 2008, for Spain, and Puhani and Sonderhof, 2010, for Germany).

Some preliminary insight for the plausibility of our underlying mechanism can be drawn from aggregate cross-country correlations for ten European countries where

\(^4\) Moro and Norman (2003) examine a model of racial statistical discrimination with human capital investments and find that affirmative action may result in higher wage inequality across racial groups, in the spirit of Coate and Loury (1993)’s seminal work on the effects of this kind of policies.

\(^5\) For example, the fraction of female undergraduates in humanities degrees is much higher than in engineering or hard sciences. This may due to parents advising their daughters to choose less demanding degrees in view of future career interruptions s due to child bearing, etc. (see Machin and Puhani, 2003)
information is available on the three key variables in our model: wage and housework gaps, and differences in training intensity.\textsuperscript{6} Figure 1 displays the scatter plot of the (residual) male-female gross hourly wage gap\textsuperscript{7} (vertical axis) for full-time workers against the female share of total housework (horizontal axis). The reported wage gap is taken from the OECD Employment Outlook (2002, Ch. 2, Annex 2A, with data for the late 1990s and early 2000s). It is adjusted not only by the standard controls in mincerian wage equations, but also by country-specific wage dispersion (using Juhn \textit{et al.} (1993)'s approach) to improve comparability of pay gaps across countries with different degrees of overall wage inequality. The female housework share data, also for full-time couples, are obtained from the Multinational Time Use Survey (2003) and belong to the early 2000s (see Section 6 for a detailed discussion of this data source). The positive correlation (0.47) between both variables suggests that in those countries where women allocate more time to household work, the (unexplained) gender wage gap is greater.

According to our model, this positive correlation is driven by the correlations of the wage and housework gaps with training gaps. To check this, Figure 2 shows that the relationship between the female housework share (horizontal axis) and a measure of the male-female gap in the intensity of paid-for training in full-time jobs (vertical axis) in 2000-- available from the European Working Conditions Survey (2002)--\textsuperscript{8}, is strongly positive (0.87). Finally, Figure 3 displays the relationship between training and wage gaps, whose correlation is again positive (0.60).

\textsuperscript{6} These are Belgium, Finland, France, Germany, Italy, Norway, Poland, Spain, Sweden and the UK.

\textsuperscript{7} We choose residual wage gaps rather than raw gaps to get a closer match with our assumption of ex-ante identical individuals, except for gender. The amount of training received by the individual is not available in the data and hence was not included as a control.

\textsuperscript{8} Specifically, this variable is computed using information drawn from the Third European Working Conditions Survey (2002, Annex 3, q28a). It corresponds to the male-female differences (measured in percent) in the proportion of time that full-time workers report to have undergone paid-for training during the last month (i.e., the ratio between the proportion of hours of training and hours worked). For each country, the intensities are weighted by the incidence of training for each gender (i.e., the probability of being trained). Overall, this incidence is slightly higher for women than for men (27.1% vs. 25.3%), in agreement with the results in Arulampanam \textit{et al.} (2004). The joint evidence of higher incidence and lower intensity for women has also been found in the US (see, e.g., Altonji and Spletzer, 1991 and O’Halloran, 2008).
Figure 1: Relationship between (residual) wage gap and female share of housework

![Figure 1: Relationship between (residual) wage gap and female share of housework](image1)


Figure 2: Relationship between training intensity gap and female share of housework

![Figure 2: Relationship between training intensity gap and female share of housework](image2)


Figure 3: Relationship between training intensity gap and (residual) wage gap

![Figure 3: Relationship between training intensity gap and (residual) wage gap](image3)

Despite the very limited number of observations in the plots and interpretational problems due to omitted variables and reverse causality, this preliminary cross-country evidence can be considered as suggestive for the driving forces in our model. The above shortcomings, however, will be later partly circumvented in Section 6, where we re-examine some of this evidence using instead micro data from time-use surveys for a small but representative subset of the above-mentioned EU countries.

The rest of the paper is organised as follows. Section 2 lays out the model. Section 3 discusses the properties of the different equilibria. Section 4 deals with welfare analysis. Section 5 analyses the effects of using different policies to eliminate the asymmetric equilibrium. Section 6 provides detailed empirical evidence on some of the main predictions of the model using micro data from time-use surveys in three European countries (Norway, Spain and the UK). Finally, section 7 concludes. Further data descriptions and some algebraic derivations are relegated to two Appendices.

2. Modelling gender gaps

2.1 The basic setup: A training model

To account for the joint presence of gender gaps in wages and housework, we build a general equilibrium model of firms’ and households’ decisions which relies on the substantial available evidence about firms providing and paying for specific training investment for the workers (OECD, 2003). To simplify the analysis, we ignore issues about the provision of this paid-for training by firms to workers in frictional labour markets (Acemoglu and Pischke, 1998) and simply take this fact as given.9

The basic setup is as follows. Ex ante identical men and women live for two periods (1 and 2) each of which has time length normalized to unity. Each gender represents half of the overall population whose mass is also set equal to unity. In period 1, firms are randomly matched with just one worker of either gender who is assumed to be single. The firm invests an amount of (specific) training, on the worker, \( \tau \), whose cost is assumed to be linear, \( c(\tau) = \tau \). For simplicity, we assume that workers are not paid while being trained. Finally, there is free entry of firms in period 1 until the expected profits from training workers are driven down to zero.

At the start of period 2, individuals of each gender form couples (exogenously)

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9 Our results would not be affected if the firm paid for only part of the training and the worker for the rest. What is crucial is simply that the employer engages in statistical discrimination when choosing how much the firm finances.
and decide on how to split the household chores on the basis of their relative wages. These household tasks are assumed to involve two components which are assumed to require the same dedication: one which is known with certainty and another which is uncertain (stochastic). In the sequel, we will refer to the latter as a household *disutility* shock, \( \omega \). Before this shock occurs, each trained worker receives a predetermined wage offer, \( W \), by the firm. We assume that the shock induces a monetary loss \( \omega \) which is only borne by the individual if he/she decides to combine market and housework. Accordingly, monetary utility in period 2 becomes \( W - \omega \) if the worker remains in the firm, and zero otherwise. Hence, whenever \( W < \omega \) the trained worker will quit the job before production in period 2 takes place whereas production takes place and wages are subsequently paid by firms if \( W \geq \omega \).

The \( \omega \) shock is assumed to be an *i.i.d.* random variable with c.d.f. \( F(\omega) \), whose specific properties are discussed in subsection 2.3. Output per worker, denoted by \( a(\tau) \), depends on the level of training in period 1. The production technology is assumed to be \( a(\tau) = \beta \tau^{\alpha/2} \), where \( \beta > 0 \) is a shift factor capturing the productivity level in the economy (say, TFP) and \( 0 < \alpha < 1 \), so that \( a(\tau) \) is increasing and strongly concave.

Summing up, the timing of decisions can be graphically represented as follows:

\[
\begin{array}{cccccc}
\text{t=1} & & & & & \text{t=2} \\
\hline \\
\uparrow & \uparrow & \uparrow & \uparrow & \uparrow \\
\text{Training} & \text{Wage offer} & \text{Household decision} & \text{Disutility shock} & \text{Production} \\
\end{array}
\]

Firms move first by determining workers’ training investment in period 1 and the corresponding wage at the beginning of period 2, taking as given the household’s allocation of housework in period 2. It is important to note that the firm will not internalise the response of the household since it cannot affect the wage (and hence the time allocation decision of the spouse) of its own worker. At the start of period 2, spouses choose the division of the certain and uncertain component of housework. This choice is made before the disutility shock occurs and takes the wages offered by firms as *given*. Accordingly, workers will always get trained in period 1 and they will not quit in period 2 insofar as the value of staying with the firm is lower than the outside option, and they will quit otherwise. Next, the disutility shock is realized, participation decisions made, and production takes place by those who remain in employment.
2.2 Firms’ decisions

To solve for wages and the amount of training, we proceed by backward induction, first considering decisions in period 2 and later in period 1. To simplify the derivations, the distribution of shocks is assumed to be uniform, i.e., \( \omega \sim U[0, b_i] \) where \( b_i = \varepsilon \beta \) such that \( \gamma \geq 0 \), and \( 0 < \varepsilon \leq 1 \). The last two inequalities ensure that the time allocation induced by the shock never exceeds the unit time length available in period 2 even if \( \gamma = 0 \). The factor \( \beta \) appears in the upper bound of the support \( (b_i) \) to capture the possibility that the size of the shock may be affected by the productivity level. For example, it is conceivable that children’s minor health problems could be seen as a shock requiring parental time in richer economies (i.e., those with a higher value of \( \beta \)) but not in poorer ones. Thus, for \( \gamma = 0 \) the support of the shock, \( [0, \varepsilon] \), is independent of productivity, whereas \( \gamma > 0 \) implies a larger support in richer economies.

Under the assumption that the wage is announced to the worker before the disutility shock \( \omega \) is realized, firms will choose the wage \( W \) in period 2 to maximize expected gross profit in that period, \( \Pi \), taking into account that the worker may quit after being trained. This leads to the following optimization problem:

\[
\max_{w} \Pi = \max_{w} \int_{0}^{w} \left[ a(\tau) - W \right] \frac{1}{\varepsilon \beta} d\omega = \max_{w} \frac{a(\tau)W - W^2}{\varepsilon \beta},
\]

where the integral in the middle term of (1) captures the firm’s expected gross profit when the worker does not quit. Hence, the first-order condition (hereafter, f.o.c.) with respect to \( W \) implies that the wage paid in equilibrium, \( W^* \), satisfies:

\[
W^*(\tau) = \frac{a(\tau)}{2}, \tag{2}
\]

so that expected gross profit in period 2 becomes:

\[
\Pi(\tau) = \left[ a(\tau) - \frac{a(\tau)}{2} \right] \frac{W^*}{\varepsilon \beta} = \frac{a(\tau)^2}{4 \varepsilon \beta}, \tag{3}
\]

where the term \( W^*/\varepsilon \beta \) captures the probability of not quitting, i.e., \( \Pr(\omega \leq W) \).

Once the firm’s decision on the wage, conditional on training, has been established in (2), let us go back to period 1 when the firm chooses the level of training.

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10 This is just the average of the worker’s productivity and the outside wage, which is assumed to be zero. The weight \( \frac{1}{2} \) in the wage is due to the choice of the uniform distribution in the illustration. Alternative distributions will give rise to a weighted average with unequal weights.
by maximising net profits, given by \{\Pi(\tau) - \tau\}, with respect to \tau. Using (3), this yields \tau^* = (\alpha \beta^{2-\gamma} / 4 \epsilon \gamma)^{1/(1-\alpha)} so that the firm’s net profit evaluated at \tau^* becomes 
\((1-\alpha)\tau^* / \alpha > 0\). Since we are assuming free entry, other firms will offer a slightly higher amount of training and attract all workers until net profits are driven to zero due to decreasing returns to training. The zero-profit condition therefore pins down the equilibrium level of training in period 1, \tau^*, which is given by:
\[
\Pi(\tau^*) - \tau^* = 0.
\]

Hence, under the functional form assumed for \(a(\tau)\), \(\tau^*\) is chosen to be:
\[
\tau^* = \left( \frac{\beta^{2-\gamma}}{4 \epsilon} \right)^{\frac{1}{1-\alpha}}, \tag{5}
\]
which, when replaced into (2), yields the optimal wage:
\[
W^* = \frac{\beta}{2} \left( \frac{\beta^{2-\gamma}}{4 \epsilon} \right)^{\frac{\tau^*}{2(1-\alpha)}}. \tag{6}
\]

Equations (5) and (6) imply that, as the support of the disutility shock becomes larger (i.e., as \(b_1\) increases), workers face a higher probability of quitting in period 2 and, since this reduces expected profits, firms respond by lowering the amount of training and therefore wages. Note that our assumption that \(0 < \alpha < 1\) plays a crucial role in this result. If \(\alpha \geq 1\) (i.e., if there were weak diminishing returns in training) then the firm would respond to a higher probability of quitting by increasing the amount of training, raising the wage to offset the higher expected value of the shock. Our assumption of strong diminishing returns to training prevents this rather counterintuitive outcome.

From (6), both the probability of working \((P^* = \Pr(\omega \leq W^*) = W^* / \epsilon \beta^\gamma)\) and the expected wage \(P^*W^* = W^*^2 / \epsilon \beta^\gamma\) in equilibrium are given respectively by:
\[
P^* = \left( \frac{\beta}{2} \right)^{\frac{1}{1-\alpha}} \left( \frac{1}{\epsilon \beta^\gamma} \right)^{\frac{2-\alpha}{2(1-\alpha)}}, \tag{7}
\]
\[
P^*W^* = \left( \frac{\beta^{2-\gamma}}{4 \epsilon} \right)^{\frac{1}{1-\alpha}}. \tag{8}
\]

As before, a larger upper bound of the shock distribution, \(b_1 = \epsilon \beta^\gamma\), results in lower participation and a lower expected wage since \(\alpha \in (0, 1)\).

Further, the following assumption is made regarding parameter values:
Assumption 1: Let $b_2 \equiv (\beta^{2-\gamma}/4\varepsilon)^{1/\alpha}$. We suppose that the parameter $b_2$ verifies $b_2 \leq b_1$ and $b_2^{\alpha/1-\alpha} < 1/2$.

The first inequality, $b_2 \leq b_1$, ensures that the unit length of period 2 is not exceeded, namely, that $P^* \leq 1$. Since the inequality can be expressed as $\beta^{2(1-\gamma)+\alpha\varepsilon} \leq 4\varepsilon^{1-\alpha}$, it simply requires that the productivity of training ($\beta$) is not too large; otherwise, the resulting wage would be sufficiently high (relative to the shock) to lead to a corner solution for participation in the labour market. As will be seen later, the second inequality, $b_2^{\alpha/1-\alpha} < 1/2$, ensures that an interior solution exists in the household decision problem. It is equivalent to $\beta^{2-\gamma} \leq \varepsilon 2^{2-\alpha}$, and again requires that $\beta$ is not too large.

3. Household division of labour and multiplicity of equilibria

3.1 Household division of labour

The next step is to endogenize the household’s decision on time allocation at the beginning of period 2, once couples have been formed. We assume that there is a household good to be produced by the spouses, and that this good provides a fixed utility level denoted by $u$. There is no bargaining within the household. Instead, on the basis of their expected wages, the spouses decide jointly on how to split the responsibility for production of this good by choosing a fraction $s \in [0,1]$ of the household chores allocated to the wife and $1-s \in [0,1]$ to the husband.

As mentioned earlier, we assume that the production of the household good involves two utility costs. Part of the cost is perfectly known in advance, while the remaining component is uncertain (stochastic) and depends on the uniformly distributed disutility shock faced by the household in period 2. To give a specific example, suppose that the household good consists of raising children. Children have to be collected from school and ferried to their after-school activities every day, imposing a (known) utility cost to the parent in charge of this task, irrespective of whether he/she is employed or not. Additionally, there are shocks, such as a child falling sick and needing to stay home with a carer.\textsuperscript{11} The latter impose an opportunity cost only if the parent is working since they imply a reduction in the (monetary) utility derived from the job.

\textsuperscript{11} Note that the random shock need not be solely related to the presence of children in the household. Other examples could be the need to stay at home to undertake house repair, etc.
Consider a given division of housework such that the wife performs a share $s$ of both certain and uncertain chores whereas the husband performs $(1-s)$. This division of housework entails two costs. In the case of the wife, there is first the direct disutility (cost) of undertaking housework (of either certain or uncertain nature), which we assume to take the functional form $\left(0.5 \frac{s}{1-s}\right)$, so that the cost is increasing and convex in her share of housework, $s$, and tends to infinity when she bears the entire burden, i.e. as $s \uparrow 1$.\(^{12}\) Secondly, there is an opportunity cost of staying with the firm when the disutility shock occurs, so that the upper bound of the support of the shock distribution for females becomes $\varepsilon_f = s \varepsilon \beta^\gamma$. Likewise, the husband has a cost function given by $\left(0.5 \frac{(1-s)}{s}\right)$, which is again increasing and convex in his share, and tends to infinity if he bears the entire burden, i.e., as $(1-s) \uparrow 1$. The upper bound of the shock is given in this case by $\varepsilon_m = (1-s) \varepsilon \beta^\gamma$. The key feature of these household preferences is that costs tend to infinity as one of the household members specializes completely in housework, i.e., as $s=0$ or 1. As a result, they will always combine marketplace and housework activities. We adopt this assumption to mimic the evidence on time-use surveys in developed countries where strictly positive housework shares are reported by both partners (see Section 6).

In line with the literature on collective decision making models (see, e.g., Chiappori, 1988, 1997), we further suppose that there is full income sharing within the household and that its two members maximize the sum of utilities with respect to housework shares taking their respective wages as given. As mentioned earlier, the housework division implies that each of them is responsible for a certain fraction, $s \omega$ for women and $(1-s) \omega$ for men, so that the woman (man) will quit the firm if $W_f < s \omega$ (if $W_m < (1-s) \omega$). Thus, the expected net utility accruing to the unitary household, denoted by $V^H$, is given by

$$V^H = \pi + \left[ \int_0^{w_{u,1-s}} \frac{W_m}{\varepsilon \beta^\gamma} d\omega + \int_{w_{f,1-s}}^{w_f} \frac{W_f - s \omega}{\varepsilon \beta^\gamma} d\omega \right] - 0.5 \left[ \frac{1-s}{s} + \frac{s}{1-s} \right].$$

The first term in the RHS of this expression represents the fixed utility from the

\(^{12}\) The crucial assumption we are making here is that time not spent in the labour market is not necessarily leisure since it may be devoted to household production. See Rapoport, Sofer and Solaz (2010) on the implications of such a formulation.
household good, whereas the second and third terms capture, respectively, expected income (net of the random shock), conditional on participation (i.e., for shocks such that \((1-s)\omega \leq W_m\) and \(s\omega \leq W_f\)), and the direct cost from producing the household good. Integrating this expression yields

\[
V^H = \bar{u} + \frac{1}{2 e \beta'} \left[ \frac{W_m^2}{(1-s)^2} + \frac{W_f^2}{s^2} \right] - \frac{1}{2} \left[ \frac{1-s}{s} + \frac{s}{1-s} \right]. \tag{9}
\]

Under the previous assumptions, there are two factors that drive the household's choice of \(s\). On the one hand, there are the convex costs of housework - the last bracketed term in (9) - which have an equalizing effect as total disutility cost is minimized when housework is equally split \((s = 0.5)\). On the other hand, there is a participation effect which tends to lead to full specialization \((s = 0\) or \(1\)) since expected household income - the second bracketed term in (9) - is maximized when the member of the couple with the lower wage bears all the shock, the reason being that this ensures full labour market participation of at least one of the household members. Thus, the choice of \(s\) is driven by this trade-off between full specialization and equal share of housework.

Maximizing (9) with respect to \(s\) yields the f. o. c.:

\[
\frac{\partial V^H}{\partial s} = \frac{1}{2 e \beta'} \left[ \frac{W_m^2}{(1-s)^2} - \frac{W_f^2}{s^2} \right] + \frac{1}{2} \left[ \frac{1}{s^2} - \frac{1}{(1-s)^2} \right] = 0, \tag{10}
\]

which implies that the equilibrium share of housework, denoted by \(s^*\), is determined by equating the marginal rates of substitution between market and household work:

\[
\left( \frac{1-s^*}{s^*} \right)^2 = \frac{1}{1 - \frac{W_m^2}{W_f^2} e \beta'}. \tag{11}
\]

It can be easily shown that, for \(s^*\) to be a maximum, we require \(W_f^2 / e \beta' < 1\). Using (6), this is ensured by Assumption 1. As a result, \(ds^* / dW_f < 0\) and \(ds^* / dW_m > 0\), implying that a higher female (male) wage leads to a reduction (increase) of the female housework share. Moreover, when wages are equalised, i.e., \(W_f = W_m\), then \(s^* = 1-s^* = 0.5\). Note that this result is due to the symmetry assumption in the way in which we model the costs of housework (i.e., no comparative advantage of either gender), together with the specific choice of the cost functions which lead to total cost
minimization when housework is evenly split. Lastly, the partial equilibrium nature of the household’s decision in (11) leads to the following proposition

**Proposition 1:** Under Assumption 1, for given relative wages, an increase in the support of the shock \( b_i \equiv \varepsilon \beta^r \), induced by either a rise in \( \varepsilon \) and/or \( \beta \) decreases (increases) \( s^* \) whenever \( W_m > W_f \) (\( W_m < W_f \)).

The intuition for this partial-equilibrium effect in the household’s decision stems again from the first bracketed term in (9): the higher is the upper bound of the disutility shock, the lower is expected income and, as a result, the spouses will prefer to share housework more evenly in order to maximize \( V^H \). However, as will be shown below, the effect of \( \varepsilon \) on \( s \) in this partial equilibrium setup will change its sign once we move to a general equilibrium analysis. This different effect of \( \varepsilon \) on \( s \) in the two setups will become one of the main implications of the model tested in the empirical section.

### 3.2 Multiplicity of equilibria

Firms’ and households’ decisions are given by equations (6) and (11). In equilibrium expectations are fulfilled and hence the equilibrium values of wages and housework shares are jointly determined as the solution of the following system of equations:

\[
W_f = \left( \frac{\beta^{2-\alpha}}{4 \varepsilon^a s^a} \right)^{\alpha a}, \tag{E.1}
\]

\[
W_m = \left( \frac{\beta^{2-\alpha}}{4 \varepsilon^a (1-s)^a} \right)^{\alpha a}, \tag{E.2}
\]

\[
\left( 1 - s^* \right)^2 = \frac{1 - W_m^2}{\varepsilon \beta^r}, \tag{E.3}
\]

To analyse the equilibrium configurations, it is useful to substitute (E.1) and (E.2) into (E.3), so that the f.o.c. (11) can be rewritten as:

\[
\left( 1 - s^* \right)^2 = \frac{1 - b_2 (1-s^*)^{\frac{\alpha}{1-\alpha}}}{1 - b_2 (s^*)^{\frac{\alpha}{1-\alpha}}}, \tag{12}
\]

From (E.1) and (E.2), we can also define the gender wage and participation gaps as
follows:

\[ w = \frac{W_m}{W_f} = \left( \frac{s}{1-s} \right)^{\frac{a}{2(1-a)}} , \quad p = \frac{P_m}{P_f} = \left( \frac{s}{1-s} \right)^{\frac{2-a}{2(1-a)}} . \]  

(13)

To solve for \( s \) in (12), it is convenient to think of the following two functions:

\( f(s) \equiv \left[ (1-s)/s \right]^2 \), \( g(s) \equiv \left[ 1-b_2(1-s)^{-\alpha(0-a)} / [1-b_2s^{-\alpha(0-a)}] \right] \), whose intersection results in the equilibrium allocation of housework. On the one hand, \( f(s) \) (which is a monotonically increasing transformation of the disutility cost of housework for men) is decreasing and convex with a vertical asymptote at \( s = 0 \), such that \( f(0) = 0 \) and \( f(0.5) = 1 \). On the other, under Assumption 1, \( g(s) \) is increasing in the range \( s \in [0, b_2^{1/(\alpha^*)}] \) and decreasing when \( s \in \left[ \frac{1-a}{a}, 1 \right] \), with two vertical asymptotes, one at \( s = b_2^{1/(\alpha^*)} \), and another at \( s = 1 \), such that \( g(0) = 0 \), \( g(0.5) = 1 \) and \( g\left( 1-b_2^{\frac{1-a}{a}} \right) = 0 \). Lastly, \( g(s) \) has an inflection point within the range \( s \in \left[ \frac{1-a}{a}, 1-b_2^{\frac{1-a}{a}} \right] \). The non-monotonicity of \( g(s) \) is due to the fact that expected household income is a U-shaped function of \( s \); when men bear a high share \( (s < 0.5) \), expected income is higher the lower is \( s \), but when women bear a higher share \( (i.e. \ s > 0.5) \), expected income is increasing in \( s \) and maximized when there is full specialization.

The intersections of \( f(s) \) and \( g(s) \) are depicted in Figure 4 where the vertical axis represents the inverse of the wage gap in (13). As can be seen, there are three values of \( s \) that satisfy equation (12). In one of them, \( s_1^* = 0.5 \), while in the other two we have \( s_2^* \in \left[ 0.5, 1-b_2^{\frac{1-a}{a}} \right] \) and \( s_3^* \in \left[ 0, b_2^{\frac{1-a}{a}} \right] \). Corner solutions are ruled out by our assumption that disutility becomes infinite under complete specialization in housework.
Due to our assumption of *ex-ante* symmetry across genders, two possible asymmetric equilibria exist: one in which women bear a greater housework share and get a lower wage (G), and another in which the same outcomes apply to men (G'). In the sequel, we will solely focus on the historically more relevant case where women carry out a disproportionate share of the household chores, so that becomes the permitted domain of . This assumption therefore restricts the analysis to two possible interior equilibria, labelled respectively as the *gendered* equilibrium (denoted by G), where , and the *ungendered* equilibrium (denoted by U) where . Likewise, the gender wage gaps in these two equilibria are labelled as and . The following result summarises this discussion:

**Proposition 2:** Under Assumption 1 and with , there are two equilibrium solutions for the female share of housework and the wage gap: (i) an ungendered solution with and (ii) a gendered solution with and .

**3.3 The effect of the productivity level on equilibria**

Inspection of (12) and Figure 4 indicates that the system (E.1)-(E.3) may only exhibit a unique equilibrium. Indeed, the existence of multiple equilibria crucially depends on the size of the parameter. In effect, as increases, the range shrinks and, as a result, becomes steeper. This shifts the G-equilibrium to the left,
leading to a more even division of housework and a lower wage gap.

As depicted in Figure 5, there will be a unique U-equilibrium for sufficiently high values of $b_2$. Since $b_2 = \left(\beta^{2-\gamma} / 4\epsilon\right)^{1/\alpha}$, its value depends on $\beta$, $\gamma$, and $\epsilon$. Notice that the effect of $\beta$ can be ambiguous: when $\gamma = 2$, $b_2$ is independent of $\beta$, while for $\gamma < 2$ we have $\partial b_2 / \partial \beta > 0$, and for $\gamma > 2$, $\partial b_2 / \partial \beta < 0$. By contrast, $\partial b_2 / \partial \epsilon < 0$ holds unambiguously.

Figure 5: The effect of an increase in $b_2$ on equilibria

The previous discussion can be summarised in the following two propositions:

**Proposition 3a:** Under Assumption 1 and $s \in S$, the effect of the productivity level $\beta$ on the equilibrium gender gaps depends on the value of the parameter $\gamma$:

(i) For $\gamma < 2$, the higher the value of $\beta$, the lower are the equilibrium gender gaps. Moreover, economies with a sufficiently high value of $\beta$ will exhibit a unique ungendered equilibrium.

(ii) For $\gamma = 2$, the value of $\beta$ has no effect on the equilibrium gender gaps.

(iii) For $\gamma > 2$, the higher the value of $\beta$, the larger are the equilibrium gender gaps.

**Proposition 3b:** Under Assumption 1 and $s \in S$, a higher expected value of the disutility shock, driven by parameter $\epsilon$, increases the equilibrium gender gaps.

To understand the intuition behind Proposition 3a, consider the case with $\gamma = 0$, where the only effect of a rise in $\beta$ is to raise wages. The reason why productivity
matters is that it leads to an income effect. Recall the trade-off faced by a household between expected income and housework disutility: the former effect implies that income is higher with full specialization ($s=1$), while the latter effect induces an even allocation of housework ($s=0.5$). When wages are low ($\beta$ is small), the household is less willing to forgo expected income in order to reduce the utility cost. Hence, if firms offer different wages, housework will be unevenly allocated. By contrast, when wages are high ($\beta$ is large), the opposite holds, leading to a lower $s_g^*$. If wages are sufficiently high, the disutility effect dominates, making the housework division (almost) even when wages differ across genders. Yet, if $s$ is (close to) 0.5, then firms will pay similar wages to men and women. Hence the G-equilibrium cannot exist.

Consider now the more general case in which the support of the shock is affected by productivity. For given wages, a higher value of $\beta$ implies a larger expected shock, lower labour-market attachment and hence lower expected income for any division of housework. The resulting income effect would tend to foster specialisation and increase $s_g^*$. When $\gamma > 0$, there are two opposite effects: higher productivity increases wages but it also increases the support of the shock, reducing participation for given wages. Which of the two effects dominates depends crucially on the size of $\gamma$. For $\gamma < 2$, the wage effect dominates whereas for $\gamma > 2$, the participation effect does. Although, in principle, either of the two scenarios can be envisaged, we take $\gamma < 2$ as a more plausible setup since $\gamma > 2$ implies that higher productivity has a much larger effect on household shocks than on production and, from (6), it leads to the rather unintuitive result that higher productivity is associated with lower training.

Concerning Proposition 3b, notice that $\varepsilon$ unambiguously increases the equilibrium gender gaps under a general equilibrium approach implying the opposite result to that obtained in (11) under partial equilibrium of the household decision (for given wages), where a larger value of $\varepsilon$ lowered the gaps in the gendered equilibrium. The intuition for this contrasting result is that, under general equilibrium, an increase in $\varepsilon$ operates the same way as a decrease in $\beta$ (for $\gamma < 2$) and thus the gender gaps raise.

In sum, productivity plays a crucial role in determining the equilibrium gender gaps in wages and time allocation. It has been shown that, under the more plausible case of $\gamma < 2$, the gender gaps will be lower in the more productive economies.

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13 To see this simply let $b_2 \to \infty$ in equation (12), which makes its RHS equal to 1, implying that $s=0.5$. 
Interestingly, this result on its own suggests that, abstracting from the differences in the generosity of family-aid policies, the lower gender gaps reported in Figure 1a for the Nordic countries than for the Southern European countries could be solely explained by their higher aggregate productivity of the former economies.

4. Welfare analysis

In order to compare welfare in the two equilibria, let us consider the unitary-household problem faced by a planner who is allowed to choose the allocation of housework internalizing its effect on training and therefore on wages, while conditioning on firm’s optimal partial-equilibrium decisions. Since firms make zero expected profits due to the free-entry assumption, aggregate welfare in this economy, $W$, is simply equal to the welfare of the representative household taking into account that, in contrast to (9), the choice of $s$ is now allowed to affect wages through the amount of training provided by firms. Thus, substituting (E.1) and (E.2) into (9), yields the following unitary-household’s welfare function:

$$W^w = \bar{w} + \frac{1}{2} \left[ b_2 (1-s) \frac{1}{1-\alpha} + b_2 s \frac{1}{1-\alpha} \right] - \frac{1}{2} \left[ \frac{1-s}{s} + \frac{s}{1-s} \right], \quad (14)$$

We can now examine which of the two equilibria results in a higher level of welfare by substituting the f. o. c. (12) of the household’s decision into (14), which yields:

$$W^w(s^*) = 1 + \bar{w} - \frac{1 - b_2 s^* \frac{\alpha}{1-\alpha}}{2(s^*)^2}. \quad (15)$$

Then, differentiation of (15) implies:

$$\frac{dW^w(s^*)}{ds^*} = \frac{1}{2s^3} \left[ 2 - \frac{2 - \alpha b_2 s^* \frac{\alpha}{1-\alpha}}{1-\alpha} \right],$$

which may be positive or negative depending on the sign of the bracketed term. Hence, it is ambiguous whether welfare in the unitary-household problem is higher in the G-equilibrium or in the U-equilibrium, the reason being once more the trade-off between full specialisation and equal sharing of housework.

As before, the level of productivity $\beta$ is a key parameter determining which effect dominates. Since $b_2$ is increasing in $\beta$ when $\gamma < 2$, $s^*_G$ will decrease with the productivity level. Hence, $dW^w(s^*)/ds^* < 0$ for sufficiently high values of $\beta$. Because
$s_G^* > s_U^* = 0.5$, this implies higher welfare in the U-equilibrium.

This finding differs from the results in models that rely on incentive problems where it has been generally found that specialization results in higher welfare. The difference lies in both the symmetry in preferences and the fact that we assume an increasing and convex cost of housework for both spouses. Moreover, our analysis has the implication that the nature of the efficient equilibrium may change over time. Suppose that the productivity parameter grows exogenously. Initially, when $\beta$ is low, specialization delivers higher welfare. Yet, as productivity grows, the opportunity cost of sharing housework falls and the U-equilibrium becomes more efficient.

5. Policies

We next discuss which kind of gender policies could shift the economy from the G-equilibrium to the U-equilibrium. The literature on this issue has focused on two specific policies: affirmative action and subsidised family aid. In our setup, affirmative action would take the form of a law that prevents firms from engaging in statistical discrimination and offering differential training to men and women. Since men and women receive now the same amount of training, (2) implies that they also receive identical wages leading to equal sharing of housework tasks. Hence, the only possible equilibrium is $s = 0.5$, implying that it is optimal for the firm to offer the same amount of training to the household partners. In other words, since the reason for the existence of the U-equilibrium is a coordination problem, affirmative action will coordinate firms and households on the U-equilibrium in which firms would choose not to differentiate between genders even if they could.

There is an extensive debate on the effects of affirmative action policies. As discussed earlier, Coate and Loury (1993) show that an exogenous increase in the hiring probability reduces the educational effort of the minority. However, Moro and Norman (2003) find that this result depends crucially on assuming that the marginal product of labour is constant for each type of workers. By contrast, when the marginal products

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14 See Lommerud and Vagstad (2007) for a discussion of welfare in this type of models. In the statistical discrimination literature, however, there are examples where discrimination leads to lower welfare. For example, this is so in Coate and Loury (1993) because the discriminated group invests less than optimally in human capital. This is also the case in the racial discrimination model with exogenous posted wages proposed by Lang at al. (2005).

15 For analyses of how exogenous changes in productivity affect gender differences in the labour market, see Olivetti (2006) and Albanesi and Olivetti (2009).
depend on the relative supply of the two groups, general equilibrium effects imply that the wage changes resulting from affirmative action policies may induce minority workers to increase, rather than decrease, their educational investment. Our analysis illustrates how, even when there are no externalities, targeted policies towards statistically discriminated groups can have different effects. Thus, while affirmative action in the form of equal access to training increases wages but does not have a direct effect on participation (i.e., it generates no disincentive effects), our previous analysis points out that a subsidy that encourages female labour-market participation may induce a substitution effect that results in increased inequality across groups.

One problem with affirmative action policies is that they may be difficult to implement in many instances. This would be the case if the training that individuals receive is imperfectly observed by the policymaker or when there are differences in the ‘quality’ of training provided by firms. In this case, the standard tool left to affect the equilibrium is subsidized family aid whose effects are analyzed in the next subsections.

5.1 Subsidised family aid

5.1.1 Gender-based vs. Gender-neutral family aid

Consider the introduction of government-funded family aid subsidy. To start with, suppose that it is targeted on working women and that this subsidy, \( \kappa \), is proportional to the female wage in period 2. Thus, women will receive an income equal to \( W_f (1 + \kappa) \), where \( 0 < \kappa < 1 \), so that they will not quit in period 2 if \( W_f (1 + \kappa) - \omega \geq 0 \), whereas men, lacking any subsidy, will work if \( W_m - \omega \geq 0 \). For the time being, we focus on the partial equilibrium effect, postponing the analysis of the financing of the subsidy to the end of this section.

The same analysis of firms’ decisions as in section 2.2, but this time with the upper limit of the integral for women in (1) changed from \( W_f \) to \( W_f (1 + \kappa) \), yields the following optimal amount of training and wage chosen by the firm:

\[
\tau_f^{\kappa} = \left( \frac{(1 + \kappa)\beta^2}{4e_f} \right)^{\frac{1}{\alpha}}, \quad W_f^{\kappa} = \frac{\beta}{2} (\tau_f^{\kappa})^{\alpha/2},
\]

(16)

where the superscript \( \kappa \) is used to denote the equilibrium values under subsidies. Male workers are offered the training level and wage derived in (5) and (6). Note that the total income of women in period 2, \( Y_f^{\kappa} \), is now given by:
\[
Y_f^\kappa = (1 + \kappa)W_f^\kappa = \frac{\beta(1 + \kappa)}{2}(\tau_f^\kappa)^{\alpha/2}.
\] (17)

Not surprisingly, women fare better in the labour market when they are subsidised to stay in the job since \( \tau_f^\kappa > \tau_f^* \) and \( W_f^\kappa > W_f^* \),\(^{16}\) despite the fact that, for \( \kappa < (\epsilon_f - \epsilon_m)/\epsilon_m \) (i.e. if the subsidy is not too large), they will still receive less training and lower wages than men, that is, \( \tau_f^\kappa < \tau_m^* \) and \( W_f^\kappa < W_m^* \).\(^{17}\)

Abstracting from the household decision, (16) and (17) imply that the corresponding participation and wage gaps would be lower than without subsidies. However, this result changes once the division of housework is endogenized. In this case, each household chooses \( s \) to maximize the expected net utility given by:

\[
V^{H\kappa} = \bar{u} - 2 + \frac{1}{2\epsilon\beta\gamma} \left[ \frac{W_m^2}{1-s} + \frac{Y_f^{e2}}{s} \right] - \frac{1}{2} \left[ \frac{1-s}{s} + \frac{s}{1-s} \right].
\] (18)

The resulting f. o. c., once we have substituted for wages, yields the new equilibrium relationship:

\[
\left( \frac{1-s^e}{s^e} \right)^2 = \frac{1-b_2(1-s^e)^{\alpha-1}}{1-b_3s^{\kappa-1}},
\] (19)

where \( b_3 = b_2(1 + \kappa)^{1/\alpha} > b_2 \). The LHS of equation (19) is the same as in (12), while the RHS tilts upwards and takes a value greater than 1 when \( s=0.5 \). The new equilibrium is depicted in Figure 6.

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\(^{16}\) They may even get higher gross wages than men if the subsidy is sufficiently large but we ignore this possibility in the sequel.

\(^{17}\) In equilibrium, since \( \epsilon_f = s\beta^e \) and \( \epsilon_m = (1-s)\beta^e \), this condition becomes \( \kappa < (2s-1)/(1-s) \).
The following proposition summarizes the main result.

**Proposition 4:** Under Assumption 1 and with \( s \in S \), a wage subsidy to female workers leads to a gendered equilibrium with \( s^* \in (0.5,1) \). The equilibrium division of household work implies a higher housework share for women, and hence larger wage and housework gaps, than in the absence of the subsidy.

The remarkable feature of (19) is that, with the subsidy in place, the U-equilibrium with \( s = 0.5 \) no longer exists. In other words, a gender-based subsidy policy only yields the G-equilibrium since the asymmetry in income induced by the subsidy prevents a symmetric equilibrium. In effect, suppose that households set \( s = 0.5 \). Then women have a lower probability of quitting than men (the combination of the same shock plus the subsidy) which implies that firms will offer them more training and a higher gross wage. But if female wages are different from men’s, then \( s = 0.5 \) cannot be a solution to the household’s problem. Hence, the U-equilibrium no longer exists. Moreover, it can be easily shown that the new G-equilibrium in Figure 6 lies to the right of the initial one in Figure 4, leading to a higher equilibrium value of \( s \).

Thus, gender-based job subsidies can backfire. For example, using our previous choice of parameter values but this time with \( \kappa = 0.1 \), yields \( s^* = 0.7299 > s^*_G = 0.7236 \).

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\( ^{18} \) To show this, denote the LHS of (19) as a function of \( s \) by \( g_\kappa(s) \). Then differentiating \( g_\kappa(s) \) with respect to \( s \) in a neighbourhood of its crossing with the LHS of (19), given by \( f(s) \), one gets that \( g_\kappa'(s) \) becomes more negative (steeper) for a higher value of \( \kappa \). Hence, since \( f(s) \) is the same as when \( \kappa = 0 \), the new gendered equilibrium must be to the right of the equilibrium without subsidies.
The intuition behind this seemingly puzzling result relies once again the trade-off faced by the household. Because the subsidy increases the probability of female labour participation, the unitary household can now afford to raise the probability of male participation by reducing men’s housework share. This result shares the spirit of the analysis of affirmative action policies in Coate and Loury (1993) where it is argued that an exogenous increase in the hiring probability faced by a minority would reduce their educational effort and hence increase the educational gap. Similarly, in our framework the exogenous increase in the probability of participation of women reduces their commitment to the labour market.

By contrast, consider now an alternative policy which offers the same subsidy to men and women. Following the same reasoning as above, this would yield the equilibrium relationship:

\[
\left(1 - s^{x}\right)^{2} = \frac{1 - b_{3}(1 - s^{x})^{\frac{-\alpha}{1 - \alpha}}}{1 - b_{3}s^{x\frac{-\alpha}{1 - \alpha}}},
\]

which again will narrow the range of values of \( s \in S \) for which the RHS of (20) is positive, since \( b_{3} > b_{2} \). The first implication is that the subsidy shifts the G-equilibrium to the left, reducing the value of \( s^{*}_{G} \). Moreover, if the subsidy is high enough (i.e. for sufficiently large values of \( b_{3} \)), equation (20) will yield a unique U-equilibrium, as depicted in Figure 5. Once more, the above-mentioned trade-off faced by the household underlies this result. The subsidy effectively increases expected income and hence reduces the opportunity cost of sharing housework. If the increase in income is large enough, the household will simply minimize the disutility associated with housework and choose an even allocation of domestic chores. Interestingly, this reasoning in favour of neutral-gender subsidies also echoes some of Saint-Paul (2007)’s recent arguments against gender-based taxation.

5.1.2 Financing of the subsidy

We next consider the financing of the subsidy. It is clear from the earlier discussion that a female wage subsidy financed by taxing men will lead to an asymmetry in the RHS of (19) eliminating therefore the U-equilibrium. Thus, only firms can finance the subsidy. Specifically, we suppose that they are taxed for their training expenditures in period 1 at
a proportional rate $t$. Under a balanced budget, this implies that $t(\tau_f + \tau_m) = \kappa (W_fP_f + W_mP_m)$.

In this tax-subsidy scheme, denoted by the superscript $TS$, participation is given by $P_{TS_i}^T = (1+\kappa)W_{TS_i}^T/\varepsilon_i$, and firms offer the wage $W_{TS_i}^T(\tau_i) = a(\tau_i)/2$, implying that gross profits now become:

$$\Pi(\tau_i) = \frac{a(\tau_i)^2}{4\varepsilon_i} (1 + \kappa),$$

while the zero-profit condition for firms yields:

$$\Pi(\tau_i) - (1 + t)\tau_i = 0. \quad (22)$$

Noticing that we can write $\Pi(\tau_i) = P_iW_i$, this condition is simply equivalent to $\tau_i(1 + t) = P_iW_i$, which can be replaced into the budget constraint to obtain the equilibrium relation between the tax and the subsidy rates, i.e., $t = \kappa/(1 - \kappa)$. The zero-profit condition, together with this value of $t$, yields the optimal level of training:

$$\tau_i^{TS_T} = \left[ \frac{\beta^2 1 + \kappa}{4\varepsilon_i (1 + t)} \right]^{1/\alpha} = \left[ \frac{\beta^2}{4\varepsilon_i} (1 - \kappa^2) \right]^{1/\alpha}. \quad (23)$$

Equation (23) implies lower training and wages than without subsidies as a result of the labour tax paid by firms. Participation, given by $P_{TS_i}^T = (1 + \kappa)W_{TS_i}^T/\varepsilon_i$, may be higher or lower than under laissez-faire due to the opposite effects of the subsidy and the lower wage. The former tends to increase participation while the latter tends to reduce it.

As regards the household decision on $s$, a similar argument as before yields the following f.o.c.:

$$\left( 1 - s_{TS_s} \right)^2 = \frac{1 - b_4 (1 - s_{TS_s})^{-\alpha}}{1 - b_3 s_{TS_s}^{-\alpha}}, \quad (24)$$

where $b_4 = b_4 h(\kappa)$ with $h(\kappa) = [(1-\kappa)\alpha(1+\kappa)]^{1/\alpha}$. Then, $h(0) = 1$ and $h'(\kappa) > 0$ if and only if $\kappa < (1-\alpha)/(1+\alpha)$. Thus, for not too high values of $\kappa$, $h(\kappa)$ is increasing and therefore $b_4 > b_3$. Hence, this tax-subsidy scheme makes the $g(s)$ function steeper, implying that the equilibrium value of $s$ will decrease and, potentially, a unique U-
equilibrium could be achieved. Indeed, for the G-equilibrium to disappear, we also need
that there is a unique intersection, which will be the case if $1 - b_4^{(1-\alpha)/\alpha} \leq 0.5$, that is, if
$(1 + \kappa)(1 - \kappa)^{\alpha} \geq 2^{3-2\alpha} \varepsilon / \beta^2$. Hence, the following result holds.

**Proposition 5:** Under Assumption 1 and with $s \in S$, if $\kappa$ is not too large, i.e.,
$(1 + \kappa)(1 - \kappa)^{\alpha} \geq 2^{3-2\alpha} \varepsilon / \beta^2$, an equal wage subsidy to male and female workers
financed through a proportional tax on training expenditures by firms in period 1 will
reduce gender gaps and may even lead to an ungendered equilibrium with $s^{TS^*} = 0.5$.

The intuition for this result relies on the two conflicting effects affecting
participation: a direct effect from the subsidy which tends to increase participation, and
an indirect one, operating through the reduction in training induced by the tax paid by
firms, which tends to reduce participation. The condition $(1 - \alpha)/(1 + \alpha) > \kappa$ is easy to
interpret since, from (24), a low value of $\alpha$ implies a low elasticity of training with
respect to the subsidy. This means that the wage does not decrease by much, implying
that the direct effect dominates, leading to higher expected income for any given
division of housework. As in section 3.3, a higher income implies that couples can
afford to reduce the utility cost of housework, thereby choosing an even split.

5.2. Asymmetric economies
Our framework makes the strong assumption of complete symmetry between men and
women which is precisely what allows for the existence of U-equilibria. In this section
we briefly examine how results are modified when we assume that there is an
(exogenous) asymmetry associated to gender.

There are many ways of allowing for asymmetries, ranging from differences in
comparative advantage in home/market production to the structure of intra-household
bargaining. In line with our assumption that the former are absent, we focus on the latter
and assume that men’s utility have a higher weight in the household’s objective
function, so that household utility can be expressed as:

$$V^H = \pi + \frac{1}{2} \beta^\varepsilon \left[ \frac{(1 + \eta) W_m^2}{s} + \frac{(1 - \eta) W_f^2}{s} \right] - \frac{1}{2} \left[ \frac{(1 + \eta)(1 - s)}{s} + \frac{(1 - \eta)s}{1 - s} \right],$$

with $\eta \in (0,1)$. The resulting f. o. c. and the expressions for wages in (2) imply that
equilibrium is given by:

\[
\left( \frac{1-s^*}{s^*} \right)^2 = \frac{1-\xi b_2 (1-s^*) \frac{\alpha}{1-\alpha}}{\xi - b_2 (s^*) \frac{\alpha}{1-\alpha}},
\]

(25)

where the relative utility weight \((1+\eta)/(1-\eta)\) is denoted by \(\xi > 1\). The LHS of this expression is the same as in the symmetric case, while the RHS, i.e. the \(g(s)\) function, shifts upwards when compared to equation (12). As a result, when \(s=0.5\), \(g(s)\) takes a value greater than 1, implying that the U-equilibrium cannot exist. Because the household gives greater weight to the husband’s disutility, even when wages are the same across genders, wives will end up doing more than half of the housework. But as women are bearing a greater fraction of the shock, firms will offer them lower wages. Hence only the G-equilibrium exists.

Under this asymmetric case, not surprisingly a wage subsidy targeted to women can work. In effect, a subsidy equal to \(W_f\) paid to participating women yields the following f. o. c.:

\[
\left( \frac{1-s^{\kappa,\eta}}{s^{\kappa,\eta}} \right)^2 = \frac{1-\xi b_2 (1-s^{\kappa,\eta}) \frac{\alpha}{1-\alpha}}{\xi - b_2 (s^{\kappa,\eta}) \frac{\alpha}{1-\alpha}},
\]

(26)

where the superscript \((\kappa,\eta)\) denotes the case with asymmetric power and subsidies, and \(b_2 = b_2 (1+\kappa)^{\frac{2-\alpha}{1-\alpha}}\). Thus, one could choose \(\kappa\) so as to make the right-hand-side of (26) equal to 1 when \(s=0.5\), yielding:

\[
(1+\kappa) = \left( \xi + \frac{\xi-1}{b_2 2^{\frac{2-\alpha}{1-\alpha}}} \right)^{\frac{1-\alpha}{2-\alpha}},
\]

whereby the f. o. c. in (26) becomes:

\[
\left( \frac{1-s^{\kappa,\eta}}{s^{\kappa,\eta}} \right)^2 = \frac{1-\xi b_2 (1-s^{\kappa,\eta}) \frac{\alpha}{1-\alpha}}{1-\xi b_2 (s^{\kappa,\eta}) \frac{\alpha}{1-\alpha} + (\xi-1) \left( 1-(2s^{\kappa,\eta}) \frac{\alpha}{1-\alpha} \right)},
\]

(27)

Comparison of (27) and (12), using the same reasoning as in (24), implies that the U-equilibrium becomes more likely. Whether it is a unique equilibrium or not hinges on the sizes of \(\xi\) and \(b_2\), which in turn depend upon \(\eta\) and \(\beta\) (for given values of \(\alpha\) and \(\varepsilon\)). This result echoes the argument made by Alesina et al. (2011) in their proposal of
different taxation for men and women. In their reasoning, the asymmetry across genders arises from women have higher elasticity of labour supply than men. Thus, according to the Ramsey principle of optimal taxation, the former should have lower taxes than the latter. In our setup, the asymmetry arises from different bargaining power but the policy implication is similar. Notice, however, that (27) also implies the novel result that, as long as \( \gamma < 2 \) and for given \( \eta \), this gender-based taxation scheme is bound to be more effective in achieving the U-equilibrium in more productive economies (those with higher \( \beta \)) than in less productive ones.

6. Some empirical micro evidence

6.1. Data and descriptive statistics

Simple cross-country correlations were presented in the Introduction to motivate our modelling approach. However, since wages and housework shares are simultaneously determined in equilibrium, analyzing aggregate cross-country data in more detail would require tackling serious endogeneity problems with a scarce number of observations. In order to partially circumvent these problems, we use of micro data at the household level (with two full time-earner couples) drawn from time use surveys for some European countries to test some implications of the model for the relationship between wages and housework shares. In particular, our focus lies exclusively in the empirical modelling of the household’s time allocation decision since we are not aware of the availability of either time-use surveys reporting information about paid-for training received by workers or firms’ databases reporting time use of their workers. Therefore, rather than modelling sequentially how firms’ decisions on their paid-for training policies impinge on wages, and later how wages affect housework decisions, we focus on testing some implications of the paid-for training channel for the choice of housework shares conditional on wages. Since, it seems reasonable to assume that at, the individual level, spouses take their hourly wages in full-time jobs as parametric, this approach will allow us to interpret wages as predetermined variables in the choice of housework shares. Once more, it is important to stress that our analysis will focus on full-time workers so that hourly wages (times the number of fixed working hours) are equal to the income each spouse earns. If households were allowed to choose how many

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\(^{20}\) de la Rica et al., 2008, provide supporting evidence on our statistical discrimination mechanism using hourly wage and training data for Spanish full-time workers but do not deal with household decisions.
hours each spouse works, labour income would be endogenous.

The data comes from the Multinational Time Use Survey (MTUS, see below for details) which contains information on the use of time by households living in a variety of countries and that has been recently used to examine the labour supply decisions of men and women (see, for example, Rapoport, Sofer and Solaz, 2010). Empirical evidence will be presented for three European countries which have been selected on the basis of exhibiting rather different characteristics regarding gender gaps and the availability of policies reconciling family and market-work life: (i) Spain, as a representative of Southern-European economies with less generous family-aid policies (data available for 2002-03), (ii) Norway, capturing the generous family-aid policies typical of the Nordic area (data is available for 2000), and (iii) the UK, a country in a somewhat intermediate situation (data is also available for 2002-03).  

MTUS contains harmonized data on how much time each individual devotes to a wide range of activities (41 in total) on a representative day. For each 10-minute interval (and during 24 hours), respondents are required to keep a diary recording which are their primary and secondary activities during this period of time. These are coded according to a list provided in Table A1 in Appendix.1. Housework time is defined as the number of minutes reported in the diary that each individual devotes to categories AV7 (housework) as primary activity. Likewise, this definition can be extended to include time devoted to childcare (housework plus childcare), in which case AV7 and AV11 are lumped together. The partners’ shares of household work within each couple are therefore computed for each of these two definitions.

In addition to time use, MTUS provides information on basic demographic and labour-market characteristics of the respondents. To mimic our modelling assumptions, we restrict our sample to two-earner couples where both partners (living in the same household) have a full-time job, belong to the 25-64 age bracket, and report complete information on housework share, wages and the remaining controls. Notice that the fact that part-time rates are much higher in Norway and the UK than in Spain implies that our sample sizes of full-time working couples are quite smaller in the first two economies.

Our choice of countries has been driven by data availability. Italy could have been another representative of South-Mediterranean countries, however MTUS does not contain information on wages for this country. Access to MTUS micro-data from other Nordic countries, such as Finland or Sweden, is restricted, while for Denmark, the last year for which the micro-data is available is 1987. Potential candidates for countries in an ‘intermediate situation’ were the UK and Germany. We have focused on the UK but results for Germany (available upon request) were similar and hence are not reported.
One important limitation of MTUS is that it lacks information on the availability of family-aid subsidies, domestic service and the region of residence of the households. This can be restrictive since, on the one hand, we will not be able to test predictions about the different effects of family-aid, depending on whether it is gender-targeted or neutral and, on the other, we may suffer from omitted variables bias because the productivity parameter ($\beta$) at the individual level is likely to be correlated with the aggregate productivity level at the region of residence and also with the availability of domestic help. Fortunately, some information about these missing variables can be retrieved from the larger questionnaire used in the Spanish Time Use Survey (STUS), which is the domestic survey in Spain from which the MTUS harmonized data for this country is drawn. Since this information, however, is not available in the corresponding domestic surveys of Norway and UK, we will only be able to include these extra variables for Spain.

Table 1 - Descriptive Statistics (Demographic and Labour-Market Characteristics)

<table>
<thead>
<tr>
<th>Var./ Country</th>
<th>Spain</th>
<th>Norway</th>
<th>United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>St. Dev</td>
<td>Mean</td>
</tr>
<tr>
<td>Wages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hourly Wage, Husband</td>
<td>8.34</td>
<td>4.00</td>
<td>169.22</td>
</tr>
<tr>
<td>Hourly Wage, Wife</td>
<td>6.51</td>
<td>3.48</td>
<td>143.72</td>
</tr>
<tr>
<td>Average Log Wage Gap (H-W)</td>
<td>0.22</td>
<td>0.47</td>
<td>0.15</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Primary Education, Husband</td>
<td>0.11</td>
<td>0.31</td>
<td>0.04</td>
</tr>
<tr>
<td>% Primary Education, Wife</td>
<td>0.09</td>
<td>0.29</td>
<td>0.04</td>
</tr>
<tr>
<td>% Secondary Educ., Husband</td>
<td>0.52</td>
<td>0.49</td>
<td>0.46</td>
</tr>
<tr>
<td>% Secondary Educ. Wife</td>
<td>0.49</td>
<td>0.50</td>
<td>0.46</td>
</tr>
<tr>
<td>% University Educ. Husband</td>
<td>0.37</td>
<td>0.49</td>
<td>0.50</td>
</tr>
<tr>
<td>% University Educ. Wife</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Age, Husband</td>
<td>42.9</td>
<td>8.29</td>
<td>40.81</td>
</tr>
<tr>
<td>Average Age, Wife</td>
<td>40.6</td>
<td>8.64</td>
<td>40.89</td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Couples with no child</td>
<td>0.57</td>
<td>0.49</td>
<td>0.11</td>
</tr>
<tr>
<td>% couples with child &lt;5 years</td>
<td>0.12</td>
<td>0.32</td>
<td>0.51</td>
</tr>
<tr>
<td>% couples with child&gt;5 years</td>
<td>0.31</td>
<td>0.48</td>
<td>0.38</td>
</tr>
<tr>
<td>Household aid (*)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% with family aid income</td>
<td>0.04</td>
<td>0.21</td>
<td>--</td>
</tr>
<tr>
<td>% with domestic service</td>
<td>0.26</td>
<td>0.45</td>
<td>--</td>
</tr>
<tr>
<td>No. obs. (couples)</td>
<td>2915</td>
<td>397</td>
<td>799</td>
</tr>
</tbody>
</table>

Source: MTUS. Data for Spain and for the UK is for 2002-2003. Data for Norway is for 2000. (*) denotes the percentage of couples who receive some type of state-funded family aid and of those who have domestic service; information on these two variables is only available for Spain (STUS, 200-03).

Table 1 presents descriptive statistics of the demographics (education levels and presence of children) and wages of the individuals in our sample, in addition to the extra
variables available for Spain. Net hourly wages, expressed in the countries’ respective currencies, have been computed from reported net monthly wages and (four times) weekly working hours.

The average (log) hourly wage gap is higher in Spain, closely followed by the UK and substantially lower in Norway. As regards gender differences in spouses’ educational attainments, they are small in the three countries, whilst the proportion of individuals with a college degree is higher in Norway and Spain than in the UK. Next, the fraction of households with no children is found to be larger in Spain and smaller in Norway than in the UK, a ranking which matches the observed fertility rates in these countries. Lastly, 26% of the Spanish households in our sample have domestic service and 4% receive some form of family-aid subsidies.

Table 2 reports the female shares using the two above-mentioned definitions of household work. Spain exhibits the highest shares (80% and 76%) whereas Norway has the lowest (60% and 59%), and the UK (72% and 71%) is in between. By age and education, the shares are lower for younger and more educated women, especially in Spain and the UK. To the extent that younger and highly-educated individuals tend to receive better training, this result somewhat provides support for the result in Proposition 3a about the effect of productivity on gender gaps.

<table>
<thead>
<tr>
<th>Country/Share</th>
<th>Spain</th>
<th>Norway</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Housework Duties</td>
<td>Housework &amp; Childcare</td>
<td>Housework Duties</td>
</tr>
<tr>
<td>Average</td>
<td>0.80 (0.28)</td>
<td>0.76 (0.26)</td>
<td>0.60 (0.35)</td>
</tr>
<tr>
<td>By Couple’s Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less-ed.</td>
<td>0.82 (0.27)</td>
<td>0.78 (0.27)</td>
<td>0.61 (0.36)</td>
</tr>
<tr>
<td>Highly-ed.</td>
<td>0.75 (0.30)</td>
<td>0.70 (0.27)</td>
<td>0.57 (0.34)</td>
</tr>
<tr>
<td>By Woman’s Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-30</td>
<td>0.74 (0.34)</td>
<td>0.70 (0.31)</td>
<td>0.62 (0.35)</td>
</tr>
<tr>
<td>31-40</td>
<td>0.78 (0.29)</td>
<td>0.72 (0.25)</td>
<td>0.60 (0.35)</td>
</tr>
<tr>
<td>41-50</td>
<td>0.81 (0.26)</td>
<td>0.79 (0.26)</td>
<td>0.57 (0.37)</td>
</tr>
<tr>
<td>51-64</td>
<td>0.87 (0.23)</td>
<td>0.87 (0.23)</td>
<td>0.69 (0.27)</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses. The definition of less-educated couples is that both partners have less than a college degree, while highly-educated couples are those where both partners have a college degree.
6.2. Testable implications

Since MTUS data refers to households’ decisions, our empirical application focuses on equation (11), describing the decision of how to allocate housework within the household, using the two above-mentioned definitions of housework shares. To obtain an estimable regression model, we use a log-linearization of (11) around a generic (possibly gendered) equilibrium value which, under the assumption that wages are taken as parametric by the household, can be consistently estimated by OLS (with heteroskedasticity-robust standard errors). This approximation, which is derived in Appendix 2, yields:

\[
\ln\left(\frac{s}{1-s}\right) = \theta_0 + \theta_1 (\ln W_m - \ln W_f) + \theta_2 \ln W_f + \theta_3 \ln \beta + \theta_4 \ln \varepsilon, \quad (28)
\]

where the logit transformation of the dependent variable is always feasible since \(s\) is never equal to 0 or 1 in any of the three samples.

The first set of testable implications relates to the signs and relative sizes of some of the parameters in (28) which satisfy the following restrictions: \(\theta_1 > \theta_2 > 0, \theta_3 < 0, \text{ and } \theta_4 < 0\) (see Appendix 2). As expected, the impact of the male wage (given by \(\theta_1\)) on the relative share is positive, i.e., a rise in \(W_m\) increases \(s\), whereas the corresponding impact of the female wage (given by \(\theta_2 - \theta_1\)) is negative, i.e., a rise in \(W_f\) decreases \(s\). Moreover, \(\theta_2\) is predicted to be smaller in those economies where gender gaps are closer to the ungendered equilibrium, that is, \(\theta_2 \to 0\) insofar as there is a unitary-household decision model with equal weights. Otherwise, if men were to have larger bargaining power, it is also shown in Appendix 2 that \(\theta_2 > 0\) and therefore the restriction \(\theta_1 > \theta_2\) need not hold. Thus, testing whether \(\theta_1 > \theta_2\) will serve as a first-pass check on whether asymmetric bargaining/discrimination play a relevant role in explaining the gap. Finally, according to Proposition 1, \(\theta_3 < 0, \text{ and } \theta_4 < 0\).

Summing up, we predict that, in economies with sizeable gender gaps in favour of men, there will be an asymmetric effect of the spouses’ wages on \(\ln(s/(1-s))\) whereas in economies with low gender gaps and symmetric household’s decision model, the wage gap will emerge as the relevant explanatory variable in (28).

A second testable prediction relates to comparing the sizes of the coefficients in the two above-mentioned definitions of household work. In effect, since it is plausible that disutility shocks are likely to be more frequent in households with children, we
would expect the estimated coefficients in (28) to be more sizeable for the definition of housework that contains childcare.

Finally, the third testable implication relies on comparing the signs of the estimated coefficients on the variables capturing $\ln \varepsilon$ in (28) with those obtained in a reduced-form specification where wages are omitted from the list of covariates in (28). The latter specification could be interpreted along the lines of a similar log-linearization of (12) around a generic reference value of $s$, once the spouses’ wages have been properly endogenized as a result of firms’ beliefs. This yields the following equation:

$$\ln \left( \frac{s}{1-s} \right) = \phi_0 + \phi_1 \ln \beta + \phi_2 \ln \varepsilon,$$

where Proposition 3b about the general equilibrium effects of $\beta$ and $\varepsilon$ on $s$ implies that $\phi_1 \leq 0$ (if $0 \leq \gamma < 2$) or $\phi_1 > 0$ (if $\gamma > 2$) and $\phi_2 > 0$. If we find that $\phi_1 < 0$ in (29), this result would confirm that $\varepsilon \in (0, 2)$ and thus that higher productivity on its own can lead to the reduction of gender gaps. Regarding $\ln \varepsilon$, notice that $\phi_2 > 0$ in (29) under general equilibrium (Proposition 3b) implies the opposite sign of $\theta_4 < 0$ in (28) under partial equilibrium. Thus, checking whether this coefficient changes from being negative in (28) to being positive in (29) constitutes our last testable prediction.

Before discussing the results, the issue of how we measure the covariates $\ln \beta$ and $\ln \varepsilon$ in (28) and (29) must be addressed. Indeed, both are unobservable variables that require observable counterparts (proxies) to estimate the models. In the cross-country comparisons, we use two education-level dummy variables, one for highly and another for less-educated couples (mixed-education couples are the reference category) to proxy the productivity level, $\beta$. The idea is simply that, for given training, more educated workers are bound to be more productive than less educated ones. As mentioned earlier, in the Spanish case we will also be able to use a dummy variable of whether the household lives in a region with high productivity (with GDP per employee above the national mean in the 2000-03) as a possibly more reliable proxy for $\ln \beta$, as well as introduce two additional dummy variables capturing the availability of domestic service and family aid. Lastly, individual heterogeneity in the upper bound $\varepsilon$ is captured by children age status (household without children are the reference category).
6.3. Results

OLS results of the common specification (28) used for the three countries are presented in Table 3.

Table 3: Estimates of the Structural Household’s Decision on Time Allocation

<table>
<thead>
<tr>
<th>Var./ Country</th>
<th>Spain</th>
<th>Norway</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Housework Duties &amp; Childcare</td>
<td>Housework Duties &amp; Childcare</td>
<td>Housework Duties &amp; Childcare</td>
</tr>
<tr>
<td>Log. Wage Gap</td>
<td>0.23*** (0.07)</td>
<td>0.31*** (0.16)</td>
<td>0.11*** (0.05)</td>
</tr>
<tr>
<td>Log. Fem Wage</td>
<td>0.07*** (0.02)</td>
<td>-0.03 (0.07)</td>
<td>0.03*** (0.02)</td>
</tr>
<tr>
<td>Age gap (H-W)</td>
<td>0.02*** (0.01)</td>
<td>0.12*** (0.05)</td>
<td>0.12*** (0.06)</td>
</tr>
<tr>
<td>Education (ref. Mixed ed. couples)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-ed. couples</td>
<td>-0.02 (0.08)</td>
<td>-0.15* (0.09)</td>
<td>-0.17 (0.17)</td>
</tr>
<tr>
<td>Less-ed. couples</td>
<td>0.35*** (0.10)</td>
<td>0.12 (0.09)</td>
<td>0.43** (0.19)</td>
</tr>
<tr>
<td>Child Status (ref. No child)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children&lt;5 yrs.</td>
<td>-0.40*** (0.11)</td>
<td>-0.26* (0.15)</td>
<td>-0.33* (0.21)</td>
</tr>
<tr>
<td>Children&gt;5 yrs.</td>
<td>-0.12* (0.08)</td>
<td>-0.16* (0.10)</td>
<td>-0.26* (0.21)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.07</td>
<td>0.15</td>
<td>0.04</td>
</tr>
<tr>
<td>N. obs. (couples)</td>
<td>2915</td>
<td>397</td>
<td>799</td>
</tr>
</tbody>
</table>

Note: Heteroskedasticity-robust standard errors. *, **, *** mean significantly different from zero at 10%, 5% and 1% levels, respectively. Age gap is defined as age of the man minus age of the woman. The definition of less-educated couples is that both partners have less than a college degree, while highly-educated couples are those where both partners have a college degree.

Regarding the first set of predictions, our evidence points out that the strongest response of the relative housework share with respect to the female wage takes place in Spain while the weakest impact is found for Norway (indeed the estimated coefficient in this case is incorrectly signed, yet highly insignificant). This result agrees with the prediction that the coefficient on the female wage should be smaller in economies with lower observed gender gaps, as in Norway. Moreover, the finding that the estimated coefficients on the wage gap \( \theta_1 \) are always larger than the coefficients on the female wage gap \( \theta_2 \).

---

22 The estimated coefficients in Table 3 can be used to compute the percentage-points change in the female housework share, \( s \), corresponding to a change of x% in each of the spouses’ wages. For example, in the case of Spain, using the definition of housework which includes childcare, the coefficient on the male wage is 0.27. Thus, \( \frac{\partial s}{\partial \ln W_f} = \frac{[\partial s / \partial \log(s/(1-s))]0.27 = s(1-s)0.27}{s} \). Using the average value of \( s \) in Table 1 (0.76) an increase of 10% in the husband’s wage yields a rise of 0.5 percentage points in \( s \). Similar calculations imply that a 10% point increase in the wife’s wage leads to a reduction of 0.38 percentage points in \( s \).
wage ($\theta_j$), and that both mostly positive, is consistent with the symmetric household decision model, implying that the effect of the female wage on the female share is negative whereas the effect of the male wage is positive. In general, we also find that either a higher education of the spouses or a lower age gap gives rise to a reduction in the female housework share. Finally, this share tends to be larger in households with no children, as predicted by our partial equilibrium analysis. As for the second testable implication, we find that the estimated impacts of the different covariates tend to be larger when the extended definition of housework is used.

Table 4 provides the estimation results for the reduced-form equation (29). Two findings stand out. First, the signs of the coefficients on the variables capturing $\ln \beta$ remain the same as in (28), indicating that $\gamma \in (0,2)$ is the most plausible range of values in the three countries, as it was conjectured before. Secondly, and in sharp contrast with the results in Table 3, having children in the household now leads to a rise of the female housework share rather than to a reduction, in line with the different predictions of the model under partial and general equilibrium.

| Table 4: Estimates of the Reduced-Form Household’s Decision on Time Allocation  |
|-------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Var./ Countries                         | Spain  | Norway | UK               |                 |                 |
|                                          | Housework Duties | Housework & Childcare | Housework Duties | Housework & Childcare | Housework Duties | Housework & Childcare |
| Age gap (H-W)                           | 0.03*** | 0.04*** | 0.12* | 0.09*** | 0.05** | 0.06*** |
|                                          | (0.01) | (0.01) | (0.06) | (0.04) | (0.01) | (0.02) |
| Education (ref. Mixed ed. couples)      |       |       |       |       |       |       |
| High-ed. couples                        | -0.23* | -0.27** | -0.53*** | -0.58*** | -0.13* | -0.18** |
|                                          | (0.14) | (0.13) | (0.13) | (0.12) | (0.07) | (0.07) |
| Less-ed. couples                        | 0.14*  | 0.23** | 0.26** | 0.33*** | 0.11  | 0.17   |
|                                          | (0.08) | (0.09) | (0.13) | (0.12) | (0.16) | (0.16) |
| Child Status (ref. No child)            |       |       |       |       |       |       |
| Children<5 yrs.                         | 0.15*  | 0.19** | 0.17* | 0.18  | 0.20* | -0.06  |
|                                          | (0.09) | (0.09) | (0.23) | (0.20) | (0.11) | (0.13) |
| Children>5 yrs.                         | 0.05   | 0.13*  | 0.07* | 0.12* | -0.04 | -0.06  |
|                                          | (0.06) | (0.07) | (0.07) | (0.08) | (0.12) | (0.13) |
| R-squared                               | 0.05   | 0.13   | 0.05  | 0.08  | 0.03  | 0.04   |
| N. obs. (couples)                       | 2915   | 377    | 799   |       |       |       |

Note: As in Table 3.

Lastly, Table 5 presents further results regarding the estimation of (28) for Spain, where the three new indicator variables, only available for this country, have been added to the list of covariates included in Table 3. The first one is a dummy variable that captures residence in a region with high aggregate productivity. Using
indexes of regional labour productivity in 2002-03, the indicator takes a value of 1 for couples living in one of the five regions with the highest GDP per employee (Balearic Islands, Cataluña, Madrid, Navarra and the Basque Country) out of the seventeen regions in which Spain is divided. The remaining two dummy variables take a value of 1 for households with domestic help, and for those receiving family-aid subsidies, respectively.

Our main finding here is that this extended specification has the same qualitative features of the one reported in Table 3 for this country. Regarding the dummy variables, we find that living in a high-productivity region reduces the female share, as it is also the case of having domestic help. However, the evidence on family-aid effects is inconclusive since the coefficient on this dummy is statistically insignificant. One possible reason for this inconclusive finding is that family-aid in Spain is often means-tested and is hence capturing the fact that the household is low income. Since family-aid would tend to reduce the female share but lower income tends to increase it, the two offsetting effects may cancel out.

Table 5: Estimates of the Structural Household’s Decision on Time Allocation. (Spain)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Housework Duties</th>
<th>Housework &amp; Childcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log. Wage Gap</td>
<td>0.26***</td>
<td>0.33***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Log. Fem Wage</td>
<td>0.09</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Age gap (H-W)</td>
<td>0.02**</td>
<td>0.03***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>High-ed. couples</td>
<td>-0.06***</td>
<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Less-ed. couples</td>
<td>0.21***</td>
<td>0.26***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Children&lt;5 yrs.</td>
<td>-0.26***</td>
<td>-0.28***</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Children&gt;5 yrs.</td>
<td>-0.09</td>
<td>-0.15**</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Dummy rich regions</td>
<td>-0.08***</td>
<td>-0.11**</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Dummy domestic service</td>
<td>-0.09**</td>
<td>-0.11***</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Dummy family aid</td>
<td>-0.04</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.09</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note: As in Table 3. STUS is the source for the last three dummy variables.

Additional specifications of (28) have been tried without altering the previous
main qualitative results. For example, neither the inclusion of quadratic terms in the partners’ wages (to account for previous evidence on the existence of a convex effect in the impact of relative earnings on the relative housework due to social norms; see, e.g., Bittman et al., 2003) - nor interactions of the education dummies and the age gap with the wages led to statistically significant coefficients on those terms.

7. Conclusions

We have proposed a model of self-fulfilling prophecies in which statistical discrimination results in both wage and housework time differences across ex ante generically identical individuals, except for gender. In contrast to a large strand of this literature, our model does not rely on either moral hazard due to unobservable effort, efficiency wages in some sectors or adverse selection problems. In our setup, employers would provide identical training to ex ante equally-able men and women in the absence of uncertainty. However, under uncertainty, they form different expectations about the burden of household disutility shocks (unexpected need of household work) that each of the spouses would face once they have been trained for their jobs. If firms believe that women are more likely to quit than men when shocks arise, they will offer them less training leading to a gender wage gap. Conversely, couples make decisions about the division of household tasks taking future wages as parametric. If they believe that male wages would be higher, wives would devote relatively more time to housework than husbands would do, validating in this way both sets of beliefs.

The model gives rise to two types of equilibria -gendered and ungendered- leading to several novel policy implications which are harder to obtain in other type of models. First, in contrast to most of the literature relying on incentive problems, welfare in the symmetric equilibrium can be greater than in the asymmetric one. The reason for this result is that having one member of the household specializing in home production has two opposing effects: on the one hand, it leads to larger expected household income, as it is standard in the existing literature; on the other, the disutility of housework is minimized when this task is evenly shared amongst household members. Which effect dominates depends crucially on the level of productivity: the ungendered equilibrium results generally in higher welfare in highly productive economies, while the opposite holds in less productive ones. One immediate implication of this result is that the desirability of policy intervention may not be the same in all economies. In particular,
we have shown that a gender-targeted policy (e.g., wage subsidies targeted to married women) may not only fail to achieve a symmetric equilibrium but could also worsen the prior gender wage gap. By contrast, we show that a gender-neutral subsidy (i.e., targeted to both members of the couple) could be more efficient in achieving an ungendered equilibrium, and that such policy works better in more productive economies.

Empirical evidence using micro data from time-use surveys for Spain, Norway and the UK yields some support to our main predictions concerning the relationship between the gaps in hourly wages and housework division for full-time earner couples, as well as the role of aggregate productivity. However, more empirical work is clearly needed in order to test other implications, notably the effect of alternative tax-subsidy policies whose effects cannot be identified with the datasets at hand.

Finally, our model also raises questions about the time profiles of gender wage gaps. In our set-up, men and women have the same (zero) wage when they enter the labour market, but differential training implies faster wage growth for males than females. This result is in line with recent evidence on gender gaps and wage growth that shows that there are no gender wage differences at entry level but a gap appears shortly afterwards and grows up to at least age 40-45; see Manning and Swaffield (2008). As pointed out in the Introduction, there is a recent literature analyzing the role played by on-the-job learning and out-of-employment spells in explaining the lower wage growth for women. Yet, as this paper points out, it is possible that, unless beliefs change because of aggregate productivity or specific policies, statistical discrimination leading to persistent gender gaps in training over the worker’s lifecycle may remain deeply entrenched. Addressing this issue in more depth remains in our future research agenda.
Appendix 1

Table A1 – List of Activities coded in the Multinomial Time Use Survey

<table>
<thead>
<tr>
<th>MTUS Variable Name</th>
<th>Variable Label</th>
<th>MTUS Variable Name</th>
<th>Variable Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV1</td>
<td>Paid work</td>
<td>AV21</td>
<td>Walking</td>
</tr>
<tr>
<td>AV2</td>
<td>Paid work at home</td>
<td>AV22</td>
<td>Religious activities</td>
</tr>
<tr>
<td>AV3</td>
<td>Paid work, second job</td>
<td>AV23</td>
<td>Civic activities</td>
</tr>
<tr>
<td>AV4</td>
<td>School, classes</td>
<td>AV24</td>
<td>Cinema or theatre</td>
</tr>
<tr>
<td>AV5</td>
<td>Travel to/from work</td>
<td>AV25</td>
<td>Dances or parties</td>
</tr>
<tr>
<td>AV6</td>
<td>Cook, wash up</td>
<td>AV26</td>
<td>Social clubs</td>
</tr>
<tr>
<td>AV7</td>
<td>Housework</td>
<td>AV27</td>
<td>Pubs</td>
</tr>
<tr>
<td>AV8</td>
<td>Odd jobs</td>
<td>AV28</td>
<td>Restaurants</td>
</tr>
<tr>
<td>AV9</td>
<td>Gardening</td>
<td>AV29</td>
<td>Visit friends at their homes</td>
</tr>
<tr>
<td>AV10</td>
<td>Shopping</td>
<td>AV30</td>
<td>Listen to radio</td>
</tr>
<tr>
<td>AV11</td>
<td>Childcare</td>
<td>AV31</td>
<td>Watch television or video</td>
</tr>
<tr>
<td>AV12</td>
<td>Domestic travel</td>
<td>AV32</td>
<td>Listen to records, tapes, cds</td>
</tr>
<tr>
<td>AV13</td>
<td>Dress/personal care</td>
<td>AV33</td>
<td>Study, homework</td>
</tr>
<tr>
<td>AV14</td>
<td>Consume/personal services</td>
<td>AV34</td>
<td>Read books</td>
</tr>
<tr>
<td>AV15</td>
<td>Meals and snacks</td>
<td>AV35</td>
<td>Read papers, magazines</td>
</tr>
<tr>
<td>AV16</td>
<td>Sleep</td>
<td>AV36</td>
<td>Relax</td>
</tr>
<tr>
<td>AV17</td>
<td>Free time travel</td>
<td>AV37</td>
<td>Conversation</td>
</tr>
<tr>
<td>AV18</td>
<td>Excursions</td>
<td>AV38</td>
<td>Entertain friends at home</td>
</tr>
<tr>
<td>AV19</td>
<td>Active sports participation</td>
<td>AV39</td>
<td>Knit, sew</td>
</tr>
<tr>
<td>AV20</td>
<td>Passive sports participation</td>
<td>AV40</td>
<td>Other leisure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AV41</td>
<td>Unclassified or missing activities</td>
</tr>
</tbody>
</table>

The two housework share variables used in the empirical analysis are:

1) AV7: Housework, which includes the following activities: Washing clothes, hanging washing out to dry, bringing it in, Ironing clothes, Making, changing beds, Making, changing beds, Dusting, hovering, vacuum cleaning, general tidying, Outdoor cleaning, Other manual domestic work, Housework elsewhere unspecified, Putting shopping away.

2) AV7+AV11, where AV11 is childcare, and includes the following activities: Feeding and food preparation for babies and children, Washing, changing babies and children, Putting children and babies to bed or getting them up, Babysitting (i.e. other people’s children), Other care of babies, Medical care of babies and children, Reading to, or playing with babies and children, Helping children with homework, Supervising children, Other care of children, Care of children and babies – unspecified.

Appendix 2: Log-linearization of household’s time allocation decision

To log-linearize a function \( f(X) \), with \( X > 0 \), around a reference value, \( \bar{X} \), recall that

\[
 f(X) \approx f(\bar{X})[1 + \eta \cdot x], \text{ where } x \equiv \ln X - \ln \bar{X} \text{ and } \eta \equiv [\partial f(\bar{X})/\partial \bar{X}] \cdot (\bar{X}/f(\bar{X})].
\]

Now, write the inverse of (11) as
\[
\left( \frac{s}{1-s} \right)^2 = \frac{1-a_f}{1-a_m}, \tag{A.1}
\]

where \( a_i = W_i^2 / 2e \beta \gamma, (i = f, m) \). Then, using the previous result, log-linearization of (A.1) around the reference values \((s/1-s)^*\) and \(a^*_i\) yields

\[
\ln\left( \frac{s}{1-s} \right) = 0.5 \left( \frac{a_m^*}{1-a_m^*} (\ln a_m - \ln a_f) + \frac{a_m^* - a_f^*}{(1-a_m^*)(1-a_f^*)} \ln a_f \right). \tag{A.2}
\]

Since \( \ln a_i = 2 \ln W_i - \ln 2 - \gamma \ln \beta - \ln \epsilon \), we get equation (28) in the main text, where

\[
\theta_1 = \frac{a_m^*}{(1-a_m^*)} > 0, \quad \theta_2 = \frac{(a_m^* - a_f^*)}{(1-a_f^*)(1-a_m^*)} > 0, \quad \theta_3 = -0.5 \gamma \theta_2 < 0, \quad \text{and} \quad \theta_4 = -0.5 \theta_2 < 0.
\]

Under Assumption 1 (i.e., \( a^*_i < 1 \)) and with \( s \in S \), it can be easily checked that

\[
\theta_1 > \theta_2 > 0 \quad \text{since} \quad \theta_1 / \theta_2 = [(a_m^* - a_m^*)(a_m^* - a_f^*)] > 1.
\]

Further, since \( \theta_2 \) is proportional to \( (a_m^* - a_f^*) \), it should be smaller for countries with gender gaps closer to the ungendered equilibrium, where \( a_m^* = a_f^* \). Note that this does not hold for \( \theta_3 \) and \( \theta_4 \) since \( \gamma \) and the coefficients on the covariates which proxy \( \ln \beta \) and \( \ln \epsilon \) could differ in size across countries.

Lastly, one can also log-linearize a similar f.o.c. to (11) but this time obtained from maximizing household utility under asymmetric weights (see subsection 5.3), yielding

\[
\ln\left( \frac{s}{1-s} \right) = 0.5 \left( \frac{a_m^* \xi}{1-a_m^* \xi} (\ln a_m - \ln a_f) + \frac{a_m^* \xi - a_f^* \xi}{(1-a_m^* \xi)(\xi-a_f^*)} \ln a_f \right), \tag{A.3}
\]

where \( \xi = (1+\eta)/(1-\eta) > 1 \). It is again straightforward to check that, in contrast to the symmetric bargaining case, the coefficient on the female wage will not be zero, even if \( a_m^* = a_f^* \) (where it is positive since \( \xi > 1 \)), and that the coefficient on the gender wage gap need not be larger than the coefficient on the female wage.
References


