On gender gaps and self-fulfilling expectations: Theory, policies and some empirical evidence*

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ABSTRACT

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

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1. Introduction

There is an extensive literature that analyses the joint determination of gender differentials in earnings and the division of labour within the household.[1] Most of these studies stem from Becker's (1985, 1991) observation that a small initial comparative advantage of women in household production (e.g., in bearing and nurturing children) can lead to full specialization over time through two amplification mechanisms: learning-by-doing and the increasing marginal disutility of market work caused by housework. However, as pointed out by several authors (see, e.g., Albanesi and Olivetti, 2007), huge improvements in medical and household technologies (plus less need of physical strength in most jobs) have increasingly rendered this comparative advantage unimportant and yet sizeable gender differences in both dimensions persist (see Bassanini and Saint Martin, 2008 for a recent review).

Several explanations for this persistence have been proposed in the literature without resorting to genetic differences or explicit prejudice against women. Instead, they often rely upon incentive problems in the labour market which lead to self-fulfilling prophecies about differences in gender roles in the absence of any initial comparative advantages. The basic idea is that firms´ beliefs about women´s lower attachment to the labour market lead to earnings differentials in favour of men. Hence, since women face a lower expected opportunity cost, they devote more time to housework, validating in this way firms' beliefs. For instance, Albanesi and Olivetti (2009) propose a model in which 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, they end up offering different types of labour contracts to men and women. In a similar vein, Lommerud and Vagstad (2007) analyse a model of job ladders where firms need to allocate workers to fast and slow track jobs, the former requiring a fixed investment cost. Hence, if women have been traditionally the gender exerting primary major responsibility at home and wages are non-contractible, they will predominantly follow a "mommy track" in equilibrium.

Our paper contributes to this literature in several ways. First, we propose an alternative mechanism, based on statistical discrimination in the provision of training by firms to male and female workers, which also yields multiplicity of equilibria in the

[1] See, e.g., Francois (1998), Engineer and Welling (1999), Albanesi and Olivetti (2009), Lommerud and Vagstad (2007), and the references therein.

absence of moral hazard problems.[2] 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, as regards 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 pay gaps 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). Likewise, regarding the substitutability of effort at housework and market work, one could argue that, since several homework activities are akin to running a "small firm", they may lead to better organizational skills which improve female performance in the marketplace rather than worsen it (see, e.g., Wolfers, 2006, for the case of successful female CEOs).

Specifically, statistical discrimination arises in our setup from firms´ asymmetric expectations about the allocation of time by husbands and wives when their households face disutility shocks (e.g., unexpected need of housework or events that require parental leave, etc.), once they have received paid-for training. If wages are predetermined with respect to these shocks, asymmetric beliefs will induce differences in the provision of training across genders and, as a result, pay differences will arise. Since households will also take these pay gaps parametrically when deciding upon the distribution of housework, this mechanism can lead to self-fulfilling prophecies and therefore to multiple equilibria. Indeed, under some assumptions about the distribution of disutility 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 household's members (typically men) earn higher wages than women and devote less time to housework.

At this stage it is important to stress that, although our model relies on paid-for training, we do not claim that gender differences in this type of training, especially in

[2] 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 before by Moro and Norman (2003, 2004), namely, the interaction between an informational externality and general equilibrium effects. However, whereas their cross-group externalities come from the marginal productivity of one group being affected by the size of another group in market work (say the ratio of black and white workers in a given occupation), ours relies upon household decisions on housework interacting with firms´ decision on training.

low-paid jobs, are the only explanation for gender gaps in pay and time allocation. There could be other mechanisms at work which are somewhat isomorphic to training. For example, higher training could be thought as input for fast-track jobs, as in Lazear and Rosen (1990). Alternatively, one could think of the high segregation of women in college degrees with lower market returns (see Machin and Puhani, 2003), possibly due family advice, [3]despite the fact that they often perform better than men in high school, or in temporary jobs involving less training, conditional on observed characteristics. In other words, training is used here as a simple modelling device not only because it facilitates analytically the joint study of firms´ 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 (see, inter alia, Altonji and Spletzer, 1991, Barron et al., 1993, and de la Rica et al., 2008).

In this fashion, we are able to generate some novel predictions about the relationship between the division of housework and gender wage gaps relative to the literature on this topic that relies upon incentive problems. For example, 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 labour productivity levels (e.g., where training results in larger productivity gains). Further, regarding 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, in the case where a *gendered* equilibrium prevails, 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. This effect is also present in our model. However, by allowing for a direct disutility of housework (which is minimized under an even split of housework) this second effect can dominate in some scenarios.

[3] For example, the fraction of female undergraduates in humanities 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.

[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.

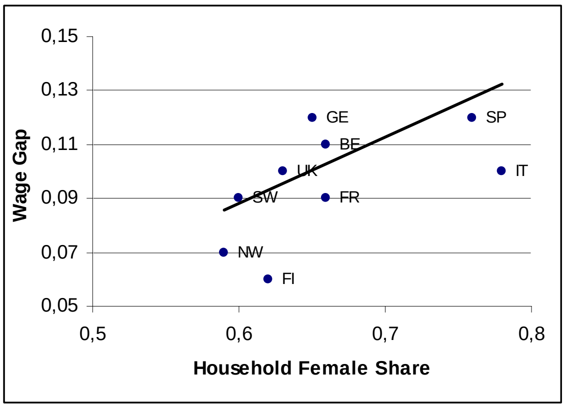
Some preliminary insight for the plausibility of our underlying mechanism can be obtained from a few scatter plots displaying aggregate cross-country correlations for ten European countries where information is available on all the key variables in our model, that is, wage and housework gaps, and differences in training intensity.[5] Figure 1 displays the scatter plot of the (residual) male-female gross hourly wage gap (vertical axis) 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 *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 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 theory, this positive correlation is driven by the correlations of the wage and housework gaps with training gaps. 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 (vertical axis) in 2000, which is available from the European Working Conditions Survey (2002).[6] As predicted, the correlation is strongly positive (0.87). Finally, Figure 3 displays the relationship between training and wage gaps, whose correlation is again positive (0.60). Therefore, in spite of the very limited number of observations in the plots and problems related to omitted variables and reverse causality, this preliminary evidence is consistent with the driving forces in our model. These shortcomings will be later addressed in Section 6, where we re-examine some of this evidence using micro data from time-use surveys for a small subset of the above-mentioned EU countries.

[5] These ten countries are Belgium, Finland, France, Germany, Italy, Norway, Poland, Spain, Sweden and the UK.

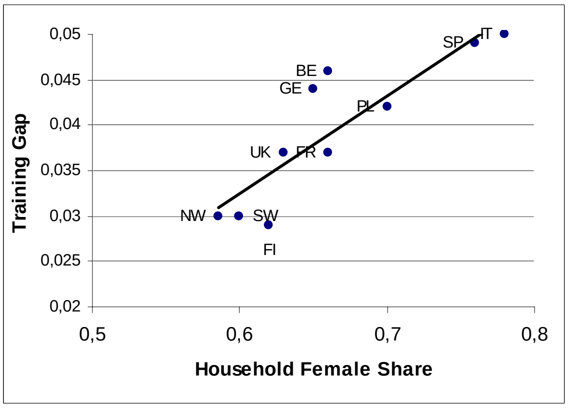
[6] Specifically, this variable is computed using information drawn from the Third European Working Conditions Survey (2002, Annex 3, q28a). It corresponds to the male-female differences (measured in percent) in the proportion of time that workers report to have undergone paid-for training during the 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 *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



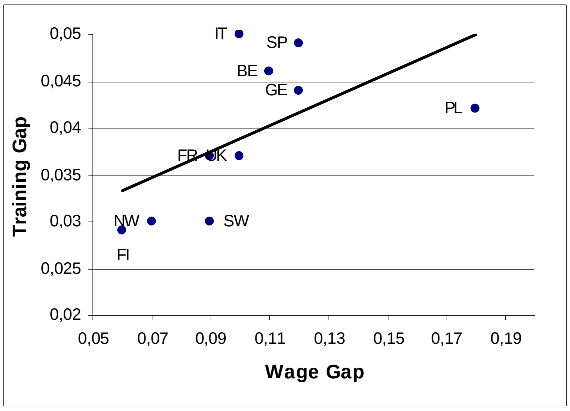
Source: OECD Employment Outlook (2002) (wage gaps) and
Multinational Time Use Survey (2003) (household share)

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



Source: Multinational Time Use Survey (2003)(household share) and
Third European Working Conditions Survey (2002) (training intensity)

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



Source : OECD Employment Outlook (2002) (wage gaps) and
Third European Working Conditions Survey (2002) (training intensity)

Finally, a caveat is in order. Our theory predicts that conditional on training men and women receive the same wages. As a result, if we could properly control for the amount of training that each gender obtains from the firm, gender wage gaps should disappear. Unfortunately, the lack of direct measures of workers' on-the-job training in data sets which simultaneously contain time allocation and wages implies that existing evidence tends to ignore this factor. Thus, the estimated (residual) pay gap could well be due to the fact that training is omitted from wage equations. There is, however, some evidence on this issue. For example, Barron et al. (1993), using the 'Employment Opportunity Pilot Project' database which includes detailed information on wages and on-the-job training access and duration (but not housework shares), report that women receive less training and that including this variable in wage equations reduces the gender wage gap observed in the sample by 27 percent.

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 pay and housework gaps, we build a general equilibrium model of firms´ and households´ decisions inspired by Acemoglu and Pischke (1998)'s partial equilibrium model of the provision of training by firms to workers in frictional labour markets. We adapt their model of training to a frictionless setup where exogenous household disutility shocks may induce differential job quits, as well as endogeneize households´ decisions on time allocation to provide a comprehensive explanation of all gaps.

The basic setup is as follows. *Ex ante* identical men and women live for two periods, each of which has a length normalized to 1. Each gender represents half of the overall population, whose size is also set equal to 1. In period 1, firms are randomly matched with just one worker of either gender who is assumed to be single. All individuals receive an amount of (specific) training, τ, provided by the firm which bear a linear training cost, $c(\tau)=\tau$. For simplicity, it is assumed 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.[7]

At the start of period 2, individuals of each gender form couples (exogenously) and decide on how to split the household chores on the basis of expected relative wages. Once this decision is taken, workers (ready to produce after being trained) are offered a wage, W, by the firm. After the wage has been announced, individuals suffer a disutility shock related to household tasks, ω, which may force them to quit the job before they start producing. The ω shock is an *i.i.d.* random variable with c.d.f. $F(\omega)$, whose specific properties are discussed below in subsection 2.3. Individuals then decide whether to work or to quit. In the first case, production takes place and wages are subsequently paid by firms. Output per worker, denoted by *a*, 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 ($a'(.)>0$) and *strongly* concave ($a''(.)<0$).

Since the amount of training determines workers' productivity, firms will decide how much training to provide in period 1 and the corresponding wage in period 2, taking as *given* the time allocation decisions of time within couples after the household shock takes place. Conversely, husbands and wives bargain over the division of housework at the start of period 2 before the disutility shock is realized, taking as *given* the expected wages offered by firms to each of the partners. Accordingly, workers will always get trained in period 1 and they will not quit in period 2 insofar as $W-\omega\geq 0$.

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

```
        t=1                 t=2
|-----------------|----------------------------------------------------|
     ↑          ↑                    ↑              ↑              ↑
  Training  Household decision   Wage offer   Disutility shock  Production
```

2.2 *Firms´ decisions*

To solve for wages and the amount of training, we proceed backwards in time, first

[7] Our results would not be affected if the firm paid for only part of the training and the worker for the rest. What is important is simply that the employer engages in statistical discrimination when choosing how much the firm finances.

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., $\omega \sim U[0, \varepsilon\beta^{\gamma}]$ with $\gamma \geq 0$, $0 < \varepsilon \leq 1$ and $0 < \varepsilon\beta^{\gamma} \leq 1$. The last two inequalities ensure that the time allocation induced by the shock never exceeds the unit time length available in period 2 even when $\gamma = 0$. Note that the factor β^{γ} appears in the upper bound of the support to capture the possibility that the size of the shock may be affected by the level of productivity. 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 β) 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 ω is realized, firms will choose the wage W in period 2 to maximize expected gross profit, Π, given the probability that the worker may quit after being trained. This leads to the following optimization problem:

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

where the integral in the middle of (1) captures the expected profit achieved by the firm 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:[8]

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

such that expected gross profit in period 2 becomes:

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

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

Free-entry of firms implies that expected profits at the beginning of period 1 are driven down to zero due to decreasing returns to training. The zero-profit condition therefore pins down the optimal level of training in period 1, τ^{*}, given by:

[8] This is just the average of the worker's productivity and the outside wage, which is assumed to be zero. The weight ½ 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.

$$\Pi(\tau^*) - \tau^* = 0\,. \qquad (4)$$

Hence, under the functional form assumed for $a(\tau)$, τ^* is chosen to be:

$$\tau^* = \left(\frac{\beta^{2-\gamma}}{4\varepsilon}\right)^{\frac{1}{1-\alpha}}, \qquad (5)$$

which replaced into (2), yields the optimal wage:

$$W^* = \frac{\beta}{2}\left(\frac{\beta^{2-\gamma}}{4\varepsilon}\right)^{\frac{\alpha}{2(1-\alpha)}}. \qquad (6)$$

Thus, (5) and (6) imply that, as the support of the disutility shock becomes larger (i.e., as $\varepsilon\beta^{\gamma}$ 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, using the resulting wage rise to offset the higher expected value of the shock. Hence, our assumption of strong diminishing returns to training prevents this rather counterintuitive outcome.

From (6), one can also easily derive the probability of working $(P^* = \Pr(\omega \leq W^*) = W^*/\varepsilon\beta^{\gamma})$ and the expected wage $(P^*W^* = W^{*2}/\varepsilon\beta^{\gamma})$ in equilibrium, which are given by:

$$P^* = \left(\frac{\beta}{2}\right)^{\frac{1}{1-\alpha}}\left(\frac{1}{\varepsilon\beta^{\gamma}}\right)^{\frac{2-\alpha}{2(1-\alpha)}}, \qquad (7)$$

$$P^*W^* = \left(\frac{\beta^{2-\gamma}}{4\varepsilon}\right)^{\frac{1}{1-\alpha}}. \qquad (8)$$

As before, a larger upper bound of the shock distribution, $\varepsilon\beta^{\gamma}$, results in both lower participation and expected wage since $\alpha \in (0,\ 1)$. Further, the following assumption ensures that the unit length of period 2 is not exceeded, i.e., that $P^* \leq 1$:

Assumption 1: *The following inequality holds:* $\left(\beta^{2-\gamma}/4\varepsilon\right)^{\frac{1}{1-\alpha}} \leq \varepsilon\beta^{\gamma} \leq 1$.

This assumption simply requires the productivity of training (β) cannot be too large since, otherwise, the resulting wage would be sufficiently high (relative to the shock) to lead to excessive participation in the labour market. In what follows, to simplify notation, we will denote $(\beta^{2-\gamma}/4\varepsilon)^{\frac{1}{1-\alpha}}$ by the parameter b_1 which verifies $b_1 \leq 1$ by Assumption 1 and, as a result implies that $W^* = \sqrt{\varepsilon\beta^{\gamma} b_1} \leq 1$.

3. Household division of labour and multiplicity of equilibria

3.1 Household division of labour

The next step is to endogenize the time allocation decision within the household at the beginning of period 2, once couples are 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 $\bar{u}$. The couple jointly decides 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 $1-s$ to the husband.

We suppose 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 shock faced by the household in period 2. To give an 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 becoming sick and needing to stay home with a carer.[9] These impose an opportunity cost only if the parent is working since they imply a reduction in the (monetary) utility derived from the job.

Consider a given division of household chores such that the wife performs a share s of both certain and uncertain chores. This division of housework entails two costs for the woman. First, there is the disutility of undertaking housework, which we assume to take the form $s/(1-s)$. That is, disutility is increasing and convex in the share of housework done, and tends to infinity when the woman has the entire burden, i.e. $s \uparrow 1$. Second, the woman bears a fraction s of the shock received by the household, implying that the upper bound of the support of the shock distribution for females is $\varepsilon_f = s\varepsilon\beta^{\gamma}$. In a symmetric way, a male who performs a fraction (1-s) of housework has

[9] Note that the random shock need not be solely related to the presence of children in the household. Another example could be the need to stay at home waiting for a plumber to fix a leak, etc.

a disutility of $(1-s)/s$ -which again is increasing and convex in his share, and tends to infinity as $(1-s)\uparrow 1$ - and faces a shock with an upper bound of $\varepsilon_m = (1-s)\varepsilon\beta^{\gamma}$. The key aspect in these preferences is that if the wife (husband) performs a share $s=0$ ($s=1$) then her (his) disutility tends to infinity. As a result, their time allocation will be such that they never fully specialize in either marketplace or housework activities, in line with the evidence on time-use surveys in developed countries where strictly positive housework shares are reported by both partners (see Section 6).

Following 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 partners maximize the sum of utilities with respect to s taking their respective wages as given. Thus, the expected utility accruing to the household (net of costs), denoted by V^H, is given by:

$$V^H = \bar{u} + \left[\int_0^{W_m/(1-s)} \frac{W_m - (1-s)\omega}{\varepsilon\beta^{\gamma}} d\omega + \int_0^{W_f/s} \frac{W_f - s\omega}{\varepsilon\beta^{\gamma}} d\omega\right] - \left[\frac{1-s}{s} + \frac{s}{1-s}\right],$$

Where we have adopted the subscripts m for males and f for females, so that the two wages are W_f and W_m. Integrating this expression becomes

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

The first term in the RHS of (9) represents the fixed utility from the household good, whereas the second and third terms capture, respectively, expected income (net of the random shock), and the utility cost from producing the household good.

Under our assumptions, there are two factors that drive the choice of s. On the one hand, there are the convex costs of housework - the last term in (9) - which have an *equalizing effect* as total disutility is minimized when housework is equally split $(s=0.5)$. On the other, there is a *participation effect* which tends to lead to full specialization ($s=0$ or 1) since expected household income - the second 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.:

$$\frac{\partial V^H}{\partial s} = \frac{1}{2\varepsilon\beta^\gamma}\left[\frac{W_m^2}{(1-s)^2} - \frac{W_f^2}{s^2}\right] + \left[\frac{1}{s^2} - \frac{1}{(1-s)^2}\right] = 0, \qquad (10)$$

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

$$\left(\frac{1-s^*}{s^*}\right)^2 = \frac{1-\dfrac{W_m^2}{2\varepsilon\beta^\gamma}}{1-\dfrac{W_f^2}{2\varepsilon\beta^\gamma}}. \qquad (11)$$

Assumption 1 ensures that $W_i^2 / 2\varepsilon\beta^\gamma < 1$.[10] 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 $s^* = 1 - s^* = 0.5$. This last 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 fact that the convexity of the cost function implies that the total utility cost is minimized when household chores are 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 ($\varepsilon\beta^\gamma$), induced by either a rise in ε and/or β (for $\gamma > 0$) decreases (increases) s^* whenever $W_m > W_f$ (i.e., the case we will focus on), and conversely when $W_m < W_f$.*

The intuition for this effect can be found again in the first-bracketed term in (9): the higher is the upper bound, 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 ε on s in this partial equilibrium setup will change its sign once a general equilibrium analysis is undertaken and this will become one of the model implications tested in the empirical section.

[10] The fact that $W_i^2 / 2\varepsilon\beta^\gamma \leq 1$ also ensures that the second-order condition for a maximum is satisfied.

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 are housework shares are jointly determined as the solution of the following system of equations:

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

$$W_m = \left(\frac{\beta^{2-\alpha\gamma}}{4\varepsilon^{\alpha} (1-s)^{\alpha}} \right)^{\frac{1}{2(1-\alpha)}} \tag{E.2}$$

$$\left(\frac{1-s^*}{s^*} \right)^2 = \frac{1 - \frac{W_m^2}{2\varepsilon\beta^{\gamma}}}{1 - \frac{W_f^2}{2\varepsilon\beta^{\gamma}}}, \tag{E.3}$$

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:

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

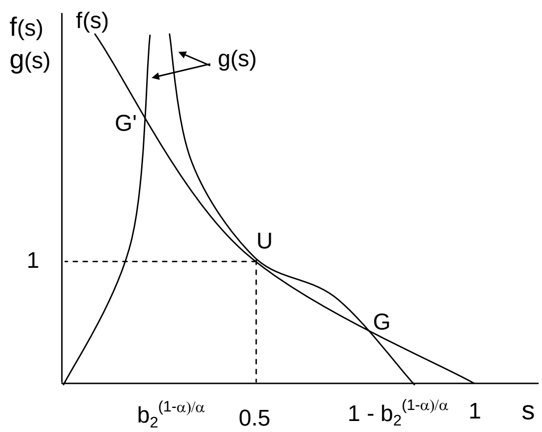
with $b_2 \equiv \left(\beta^{2-\gamma} / 4\varepsilon\right)^{\frac{1}{(1-\alpha)}} / 2 < 0.5$, by Assumption 1. From (E.1) and (E.2), we can also define the gender wage and participation gaps as follows:

$$w = \frac{W_m}{W_f} = \left(\frac{s}{1-s} \right)^{\frac{\alpha}{2(1-\alpha)}}, \; p = \frac{P_m}{P_f} = \left(\frac{s}{1-s} \right)^{\frac{2-\alpha}{2(1-\alpha)}}. \tag{13}$$

To solve for s in (12), it is convenient to think of the following two functions: $f(s) \equiv [(1-s)/s]^2$, $g(s) \equiv (1 - b_2 (1-s)^{\frac{-\alpha}{1-\alpha}}) / (1 - b_2 s^{\frac{-\alpha}{1-\alpha}})$, whose intersection results in the equilibrium allocation of housework. On the one hand, $f(s)$ (which is a monotonically increasing transformation of the disutility of housework for men) is decreasing and convex with a vertical asymptote at s=0, such that $f(1) = 0$ and $f(0.5) = 1$. On the other, $g(s)$ is increasing in the range $s \in [0, b_2^{\frac{1-\alpha}{\alpha}})$ and decreasing when $s \in (b_2^{\frac{1-\alpha}{\alpha}}, 1)$, with two vertical asymptotes, one at $s = b_2^{\frac{1-\alpha}{\alpha}}$, and another at $s = 1$, such that $g(0) = 0$, $g(0.5) = 1$ and $g(1 - b_2^{\frac{1-\alpha}{\alpha}}) = 0$. Lastly, under Assumption 1, it can be checked that $g(s)$ has an inflection point within the range $s \in (b_2^{\frac{1-\alpha}{\alpha}}, 1 - b_2^{\frac{1-\alpha}{\alpha}})$. The nonmonotonicity of $g(.)$ 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 s is, but when women bear a higher share (i.e. $s > 0.5$) expected income is increasing in s and maximized when there is full specialisation.

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 solutions we have $s_2^* \in (0.5,\ 1 - b_2^{\frac{1-\alpha}{\alpha}})$ and $s_3^* \in (0,\ b_2^{\frac{1-\alpha}{\alpha}})$. Note that corner solutions are ruled out by our assumption that disutility becomes infinite under complete specialization in housework.

Figure 4: Gendered and ungendered equilibria



Due to the assumption of symmetry across genders, two possible asymmetric equilibria exist: one in which women bear a greater housework share and get a lower wage (point G), and another in which the same outcomes apply to men (point 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 the permitted domain of the $g(s)$ function becomes $s \in (b_2^{\frac{1-\alpha}{\alpha}}, 1) \equiv S$. This restricts the analysis to two possible equilibria, labelled respectively as the *gendered* equilibrium (denoted by G), where $s_G^* > 0.5$, and the *ungendered* equilibrium (denoted by U) where $s_U^* = 0.5$. Likewise, the gender wage gaps in these two equilibria are labelled as w_G^* and w_U^*. The following result summarises this discussion:

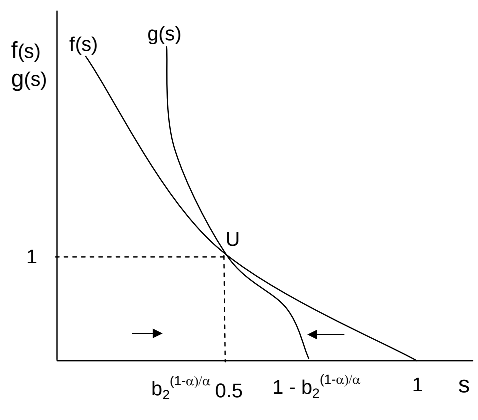
Proposition 2: *Under Assumption 1 and with* $s \in S$, *there are two equilibrium solutions for the female share of household work and the wage gap: (i) an ungendered solution with* $s_U^* = 0.5$ *and* $w_U^* = 1$ *and (ii) a gendered solution with* $s_G^* \in (0.5, 1 - b_2^{(1-\alpha)/\alpha})$ *and* $w_G^* > 1$.

To gauge how different these equilibria could be, let us consider the following numerical example. Using the parameter values $\alpha = 0.5$, $\varepsilon = 1$, $\gamma = 0$, and $\beta = 2^{3/4}$, which jointly satisfy Assumption 1, the roots of equation (12) become $s_G^* = 0.7236$ and $s_U^* = 0.5$. The G-equilibrium leads to a wage gap in favour of men of 62%, illustrating that the differences in the outcomes of the two equilibria can be very large.

3.3 The effect of the productivity level on equilibria

Inspection of (12) and Figure 4 indicates that the system in (E.1)-(E.3) may only exhibit a single equilibrium. Indeed, the existence of multiple equilibria crucially depends on the size of the b_2 parameter. In effect, as b_2 increases, the range $s \in \left(b_2^{(1-\alpha)/\alpha}, 1 - b_2^{(1-\alpha)/\alpha}\right)$ becomes narrower and, as a result, $g(s)$ becomes steeper. This shifts the G-equilibrium to the left with a more even division of housework, and hence a lower wage gap.

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



As depicted in Figure 5, there will be a unique U-equilibrium for sufficiently high values of b_2, Since $b_2 = 0.5\left(\beta^{2-\gamma}/4\varepsilon\right)^{\frac{1}{(1-\alpha)}}$, its value depends on three parameters: the productivity factor β, its power γ, and the upper bound parameter ε. Notice that the effect of β can be ambiguous: when $\gamma = 2$, b_2 is independent of β, while for $\gamma < 2$ we have $\partial b_2 / \partial \beta > 0$, and for $\gamma > 2$, $\partial b_2 / \partial \beta < 0$. By contrast, $\partial b_2 / \partial \varepsilon < 0$ holds unambiguously. These results are summarised in the following two propositions:

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

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

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

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

Proposition 3b: *Under Assumption 1 and with $s \in S$, a higher expected value of the disutility shock, driven by parameter ε, 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 β 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 (β 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 (β 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.[11] 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 β implies a larger expected shock, lower labour-market attachment and hence lower expected income for any division of

[11] To see this simply let $b_2 \to \infty$ in equation (12), which makes its RHS equal to 1, implying that *s*=0.5.

housework. The resulting income effect would tend to foster specialisation and increase s_G^*. When $\gamma > 0$, the overall income effect has two elements: higher productivity increases wages but it also increases the shock and reduces participation for given wages. Which of the two effects dominates depends crucially on the size of γ. For $\gamma < 2$, the wage effect dominates whereas for $\gamma > 2$, the participation effect does. A larger value of β then implies lower expected income and results in greater household specialisation and larger gender gaps. Although, in principle, either of the two scenarios can be envisaged, we take $\gamma < 2$ as a more plausible case. In effect, note that $\gamma > 2$ requires a very strong effect: since output increases linearly with β, it implies that higher productivity has a much larger effect on household shocks than on production. Moreover, from equation (6), it also implies the rather extreme result that that higher productivity is associated with lower training.

As regards Proposition 3b, notice that, under a general equilibrium approach, the unambiguously increasing effect of ε on the equilibrium gender gaps implies the opposite result of what was obtained before in (11), under a partial equilibrium analysis (i.e., for given wages), in which a larger value of ε led to lower gaps. The intuition for this result is similar to that found for the effect of β when $\gamma > 2$.

In sum, productivity plays a crucial role in determining the equilibrium gender gaps in wages and time allocation. It has been shown that a higher value of β can increase or reduce these gaps. However, in the more plausible case of $\gamma < 2$, the gender gaps will be lower in the more productive economies. 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 productivity of the former economies.

4. Welfare analysis

In order to analyze the welfare implications of the two above-mentioned equilibria, let us consider the problem faced by a social planner who chooses the allocation of housework internalizing its effect on wages. Since firms make zero expected profits due to the free-entry assumption, aggregate welfare, denoted by V^W, is simply equal to the welfare of the representative household. Thus, substituting (E.1) and (E.2) into (9), yields the following social planner's welfare function:

$$V^W(s) = \bar{u} + \left[b_2 (1-s)^{-\frac{1}{1-\alpha}} + b_2 s^{-\frac{1}{1-\alpha}} \right] - \left[\frac{1-s}{s} + \frac{s}{1-s} \right]. \qquad (14)$$

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 into (14), which yields:

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

Then, differentiation of (15) implies:

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

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

Once more, the level of productivity β is a key parameter determining which effect dominates. Since b_2 is increasing in β in the more realistic case where $\gamma < 2$, s_G^* will decrease with the productivity level. Hence, $dV^W(s^*)/ds^* < 0$ for sufficiently high values of b_2 driven by a rise in β. Because $s_G{}^* > s_U{}^* = 0.5$, this leads to higher welfare in the U-equilibrium. To illustrate this result, consider again the previous numerical example with the two equilibria given by $s_G^* = 0.7236$ and $s_U^* = 0.5$. If we further assume that $\bar{u} = 10$ then, substituting the chosen parameter values into (15), we obtain a level of welfare in the G- equilibrium, $V^W(s_G^*) = 3.2$, which is lower than in the U-equilibrium, $V^W(s_U^*) = 4.1$. Conversely, it can be easily shown that lower values of β (yet satisfying Assumption 1) would yield the opposite welfare ranking.

This finding contrasts with the results in models with multiple equilibria relying upon incentive problems, where it has been generally found that specialization by gender results in higher welfare.[12] The difference lies in both the symmetry in preferences and the fact that we assume an increasing and convex disutility of housework for both males and females. Moreover, our analysis has the implication that

[12] 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).

the nature of the efficient equilibrium may change over time. Suppose that the productivity parameter grows exogenously. Initially, when β is low, specialization delivers higher welfare. Yet, as productivity grows, the opportunity cost of sharing housework falls and the U-equilibrium becomes more efficient.[13]

5. Policies

We next discuss which type 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 crucially depends on assuming that the marginal product of labour is constant for each type of workers. By contrast, when the marginal products depend on the relative supply of the two groups, general equilibrium effects imply that the changes in wages resulting from an affirmative action policy may induce minority workers to increase, rather than decrease, their educational investment. Our analysis illustrates how, even in the case where these externalities are absent, 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 the labour-market participation of women may induce a substitution effect that results in increased

[13] For analyses of how exogenous changes in productivity affect gender differences in the labour market, see Olivetti (2006) and Albanesi and Olivetti (2009).

inequalities across groups.

The problem of affirmative action policies is that they may, in many instances, be difficult to implement. This would be the case if the training that individuals receive is difficult to observe by the policymaker or if the 'quality' of the training can vary. In this case, the tool left to affect the equilibrium is subsidized family aid. We consider this 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, κ, is proportional to the female wage in period 2. Thus, wives 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 husbands, lacking any subsidy, will work if $W_m-\omega\geq 0$. For the time being, we concentrate on the partial equilibrium effect, ignoring the financing of the subsidy, an issue which will be re-examined at the end of this section.

Following the same analysis about firms' behaviour as in section 2.2, but this time with the upper limit of the integral for women in (1) changed from W_f to $W_f(1+\kappa)$, it follows that firms will choose the amount of training and wages given by:

$$\tau_f^{\kappa *}=\left(\frac{(1+\kappa)\beta^2}{4\varepsilon_f}\right)^{\frac{1}{1-\alpha}},\quad W_f^{\kappa *}=\frac{\beta}{2}(\tau_f^{\kappa *})^{\alpha/2}, \tag{16}$$

where the superscript κ 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:

$$Y_f^{\kappa *}=(1+\kappa)W_f^{\kappa *}=\frac{\beta(1+\kappa)}{2}(\tau_f^{\kappa *})^{\alpha/2}. \tag{17}$$

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 $W_f^{\kappa *}>W_f^*$, [14] despite the fact that, for $\kappa<(\varepsilon_f-\varepsilon_m)/\varepsilon_m$ (i.e. if the subsidy is not too large), they will still receive less

[14] They may even get higher gross wages than men if the subsidy is sufficiently large but we ignore this possibility in the sequel.

training and lower wages than men, that is, $\tau_f^{\kappa *} < \tau_m^*$ and $W_f^{\kappa *} < W_m^*$.[15] .

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 does not hold once the division of housework is endogenized. In effect, each household chooses *s* to maximize the expected net utility given by:

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

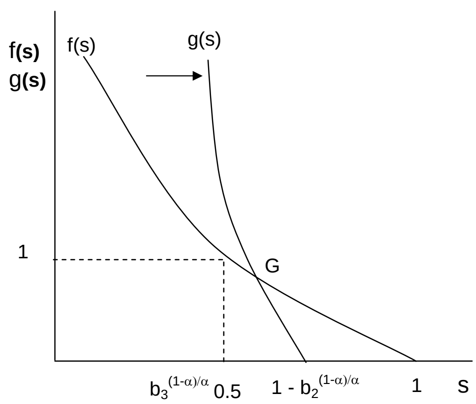
The resulting f. o. c., once we have substituted for wages, yields the new equilibrium relationship:

$$\left(\frac{1-s^{\kappa^*}}{s^{\kappa^*}}\right)^2 = \frac{1-b_2(1-s^{\kappa^*})^{\frac{-\alpha}{1-\alpha}}}{1-b_3 s^{*\kappa \frac{-\alpha}{1-\alpha}}}, \qquad (19)$$

where $b_3 = b_2(1+\kappa)^{\frac{2-\alpha}{1-\alpha}} > b_2$. 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 and can be summarised as follows:

Proposition 4: *Under Assumption 1 and with* $s \in S$ *, a wage subsidy to female workers leads to a gendered equilibrium with* $s^{\kappa^*} \in (0.5,1)$. *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.*

Figure 6: The effect of a subsidy to women



[15] In equilibrium, since $\varepsilon_f = s\beta^{\gamma}\varepsilon$ and $\varepsilon_m = (1-s)\beta^{\gamma}\varepsilon$, this condition becomes $\kappa < 2s-1$.

A noticeable 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), implying that firms will offer women 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*.[16] For example, using our previous choice of parameter values but this time with $\kappa = 0.1$, yields $s^{\kappa^*} = 0.7299$ $> s_G^* = 0.7236$. The intuition behind this seemingly counterintuitive result relies once again the trade-off faced by the household. Because the subsidy increases the probability of female labour participation, the household can now afford to raise the probability of male participation by reducing their 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:

$$\left(\frac{1-s^{\kappa^*}}{s^{\kappa^*}}\right)^2 = \frac{1-b_3(1-s^{\kappa^*})^{\frac{-\alpha}{1-\alpha}}}{1-b_3 s^{*\kappa\frac{-\alpha}{1-\alpha}}}, \tag{20}$$

which will again 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

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[16] To show this, denote the LHS of (20) 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 (20), given by $f(s)$, one gets that $g_\kappa^{'}(s)$ becomes more negative (steeper) for a higher value of κ. Hence, since $f(s)$ is the same as when $\kappa = 0$, the new gendered equilibrium must be to the right of the one without subsidies.

sufficiently large values of b_3), equation (20) will yield a unique U-equilibrium, as depicted in Figure 4. Once more this is the result of the above-mentioned trade-off faced by the household. 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*.[17] Under a balanced government budget, this implies that $t\left(\tau_f + \tau_m \right) = \kappa\left(W_f P_f + W_m P_m \right)$.

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

$$\Pi(\tau_i) = \frac{a(\tau_i)^2}{4\varepsilon_i}(1+\kappa), \qquad (21)$$

whilst the zero-profit condition for firms yields:

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

Noticing that we can write $\Pi(\tau_i) = P_i W_i$, this condition is simply equivalent to $\tau_i(1+t) = P_i W_i$, 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:

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

Equation (23) implies lower training and wages than without subsidies as a result of

[17] We have also examined the case where the tax is lump-sum in the first period. This case yields similar results though the calculations are somewhat more cumbersome.

the labour tax paid by firms. Participation, given by $P_i^{TS^*} = (1+\kappa)W_i^{TS^*}/\varepsilon_i$, 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.:

$$\left(\frac{1-s^{TS^*}}{s^{TS^*}}\right)^2 = \frac{1-b_4(1-s^{TS^*})^{\frac{-\alpha}{1-\alpha}}}{1-b_4 s^{TS^*\frac{-\alpha}{1-\alpha}}}, \qquad (24)$$

where $b_4 \equiv b_2 h(\kappa)$ with $h(\kappa) \equiv [(1-\kappa)^\alpha (1+\kappa)]^{\frac{1}{1-\alpha}}$. Then, $h(0)=1$ and $h'(\kappa)>0$ if and only if $\kappa < (1-\alpha)/(1+\alpha)$. Thus, for not too high values of κ, $h(\kappa)$ is increasing and therefore $b_4 > b_2$. 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* κ *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 α 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, and it is precisely this assumption that allows for the existence of U-equilibria. In this section we briefly examine how results get 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. For simplicity, we focus on the latter and assume that men have higher bargaining power in the household decision-making process, denoted by η, so that household utility can be expressed as:

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

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

$$\left(\frac{1-s^*}{s^*}\right)^2 = \frac{1-\xi\, b_2(1-s^*)^{-\frac{\alpha}{1-\alpha}}}{\xi - b_2(s^*)^{-\frac{\alpha}{1-\alpha}}}, \tag{25}$$

where the relative bargaining power $(1+\eta)/(1-\eta)$ 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, a wage subsidy targeted to women can work. In effect, a subsidy equal to κW_f paid to participating women yields the following f. o. c.:

$$\left(\frac{1-s^{\kappa,\eta*}}{s^{\kappa,\eta*}}\right)^2 = \frac{1-\xi\, b_2(1-s^{\kappa,\eta*})^{-\frac{\alpha}{1-\alpha}}}{\xi - b_3(s^{\kappa,\eta*})^{-\frac{\alpha}{1-\alpha}}} \tag{26}$$

where the superscript (κ,η) denotes the case with asymmetric power and subsidies, and $b_3 = b_2(1+\kappa)^{\frac{2-\alpha}{1-\alpha}}$. Thus, one could choose κ so as to make the right-hand-side of

(26) equal to 1 when s=0.5, yielding:

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

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

$$\left(\frac{1-s^{\kappa,\eta*}}{s^{\kappa,\eta*}}\right)^2=\frac{1-\xi\, b_2(1-s^{\kappa,\eta*})^{-\frac{\alpha}{1-\alpha}}}{1-\xi\, b_2(s^{\kappa,\eta*})^{-\frac{\alpha}{1-\alpha}}+(\xi-1)\left(1-(2s^{\kappa,\eta*})^{-\frac{\alpha}{1-\alpha}}\right)}. \tag{27}$$

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 ξ and b_2, which in turn depend upon η and β (for given values of α and ε). This result echoes the argument made by Alesina et al. (2007) 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, for given η, this gender-based taxation scheme is bound to be more effective in achieving the U-equilibrium in more productive economies (those with higher β), as long as $\gamma < 2,$ 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, given that wages and housework shares are simultaneously determined in equilibrium, analysing aggregate cross-country data in more detail would involve having to tackle serious endogeneity problems with a scarce number of observations. In order to ameliorate these problems, we focus solely on the empirical modelling of the household's time allocation decision ignoring firms′ decisions since, lacking matched employer-household data, information is missing on how paid-for training policies impinge on wages, and therefore on housework decisions (see however, de la Rica et al., 2008, for supportive evidence on our statistical discrimination mechanism using wage and training data for Spain). Nonetheless, despite the limitation of adopting a partial equilibrium approach, we will show that it is still possible to test several interesting theoretical predictions from our model. For that, we make use of micro data at the household level (with two-earner couples) drawn from time use surveys for several European countries. The idea is that since, at the individual level, it seems reasonable to assume that, when households decide upon time allocation, the spouses´ wages are taken as parametric, this will allow us to interpret wages as predetermined variables to the spouses´ choice of heir respective housework shares.

More specifically, 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. Given that external researchers have limited access to disaggregate information of this dataset, empirical evidence will only be presented for a subset of 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)[18], (ii) Norway, capturing the generous family-aid policies typical of the Nordic area (data is available for 2000)[19], and (iii) the UK, a country in a somewhat intermediate situation (data is also available for 2002-03)[20].

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

[18] Italy could have been another representative of South-Mediterranean countries. However, MTUS does not contain information on wages for this country.

[19] Access to MTUS micro-data from other Nordic countries, such as Finland or Sweden, is restricted. Regarding Denmark, the last year for which availability of the micro-data is provided is 1987.

[20] Results for Germany (available upon request) were similar to those for the UK, and hence are not reported.

labour-market characteristics of the respondents. We restrict our sample to two-earner couples where both partners (living in the same household) have a full-time job,[21] 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.

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 (see however the informal discussion in subsection 6.3) and, on the other, we may suffer from omitted variables bias because the productivity parameter (β) at the individual level is likely to be correlated with aggregate productivity level at the region of residence and also with the availability of domestic help. Fortunately, some information about these missing variables could 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 is not available in the corresponding domestic surveys of Norway and UK, only for the case of Spain we will be able to later extend the analysis including these extra variables.

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 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) 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%

[21] We exclude part-time workers since working hours (taken as fixed in our model) are jointly determined with hours of housework and this would create a bias. Moreover, the decision by firms on the intensity of training received by workers is likely to depend on whether their labour contract is full time or part time.

receive some form of family-aid subsidies.

<u>Table 1</u> - Descriptive Statistics (Demographic and Labour-Market Characteristics)

Full -Time Working couples (25-64 years of age)

Var./ Country	**Spain**		**Norway**		**United Kingdom**	
	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Wages						
Hourly Wage, Husband	8.34	4.00	169.22	131.13	8.07	4.75
Hourly Wage, Wife	6.51	3.48	143.72	55.03	6.43	3.10
Average Log Wage Gap (H-W)	0.22	0.47	0.15	0.42	0.20	0.58
Education						
% Primary Education, Husband	0.11	0.31	0.04	0.19	0.31	0.43
% Primary Education, Wife	0.09	0.29	0.04	0.19	0.32	0.41
% Secondary Educ., Husband	0.52	0.49	0.46	0.49	0.37	0.44
% Secondary Educ. Wife	0.49	0.50	0.46	0.49	0.36	0.42
% University Educ. Husband	0.37	0.49	0.50	0.47	0.31	0.43
% University Educ. Wife	0.40	0.50	0.50	0.48	0.29	0.41
Age						
Average Age, Husband	42.9	8.29	40.81	11.8	40.7	10.7
Average Age, Wife	40.6	8.64	40.89	11.7	40.3	11.2
Children						
% Couples with no child	0.57	0.49	0.11	0.39	0.40	0.49
% couples with child <5 years	0.12	0.32	0.51	0.5	0.22	0.41
% couples with child>5 years	0.31	0.48	0.38	0.4	0.38	0.46
Household aid (*)						
% with family aid income	0.04	0.21	--	--	--	--
% with domestic service	0.26	0.45	--	--	--	--
No. obs. (couples)	2915		397		799	

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).

<u>Table 2</u>: Average Female Housework Share

Country/Share	**Spain**		**Norway**		**UK**	
	Housework Duties	Housework & Childcare	Housework Duties	Housework &Childcare	Housework Duties	Housework & Childcare
Average	0.80 (0.28)	0.76 (0.26)	0.60 (0.35)	0.59 (0.26)	0.71 (0.32)	0.72 (0.30)
By Couple's Education Level						
Less-ed.	0.82 (0.27)	0.78 (0.27)	0.61 (0.36)	0.60 (0.29)	0.75 (0.32)	0.71 (0.30)
Highly-ed.	0.75 (0.30)	0.70 (0.27)	0.57 (0.34)	0.58 (0.28)	0.68 (0.31)	0.72 (0.28)
By Woman's Age						
25-30	0.74 (0.34)	0.70 (0.31)	0.62 (0.35)	0.63 (0.23)	0.69 (0.34)	0.72 (0.32)
31-40	0.78 (0.29)	0.72 (0.25)	0.60 (0.35)	0.58 (0.30)	0.71 (0.33)	0.69 (0.30)
41-50	0.81 (0.26)	0.79 (0.26)	0.57 (0.37)	0.56 (0.34)	0.75 (0.29)	0.75 (0.28)
51-64	0.87 (0.23)	0.87 (0.23)	0.69 (0.27)	0.65 (0.23)	0.78 (0.31)	0.78 (0.31)

Source: MTUS Data. Data for Spain and the UK is for 2002-2003. Data for Norway is for 2000.
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.

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, we find that 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 is consistent provides somewhat support for the result in Proposition 3a about the effect of productivity on gender gaps.

6.2. Testable implications

Since MTUS data refers to households´ decisions, our empirical application focuses on the structural equation given in (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 can be taken as parametric by the household, could be estimated by OLS (with heteroskedasticity-robust standard errors).[22] This approximation yields (see Appendix 2):

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

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: $\theta_1 > \theta_2 > 0$, $\theta_3 < 0$, and $\theta_4 < 0$ (see Appendix 2). Thus, as expected, the impact of the male wage (given by θ_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, θ_2 is predicted to be smaller in those economies where gender gaps are closer to the *ungendered* equilibrium, that is, $\theta_2 \to 0$ as $s^* \to 0.5$, insofar as there is symmetric bargaining in the household.

[22] However, it could be argued that male and female wages might be endogenous for the female housework share if unobserved individual characteristics are positively correlated with wages, thus creating spurious correlation between these covariates and the error term. We have tried to instrument the wage gap and the female wage in (28) with third-order polynomials in age and education as in Mroz (1987). However, the correlations between these variables and the logged wages are rather weak, preventing them from being used as suitable instruments. Unfortunately, MTUS does not contain any other variables that can be used as adequate instruments for wages.

Otherwise, $\theta_2 > 0$ and the restriction $\theta_1 > \theta_2$ need not hold (see Appendix 2). Thus, testing whether $\theta_1 > \theta_2$ will serve as a first-pass check on whether asymmetric bargaining/discrimination play a role in explaining the gap. Finally, $\theta_3 < 0$, and $\theta_4 < 0$ are the predictions of Proposition 1.

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 bargaining the wage gap will emerge as the relevant explanatory variable. 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:

$$\ln\left(\frac{s}{1-s}\right) = \phi_0 + \phi_1 \ln\beta + \phi_2 \ln\varepsilon, \qquad (29)$$

where Proposition 3b about the general equilibrium effects of β and ε 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 $\phi_1 < 0$ when estimating (29), this result would confirm that $\gamma \in (0,\ 2)$ 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 implies the opposite sign of θ_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, β. 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 capita 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 ε 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

Dependent Variable: ln[s / (1-s)]

Var./ Country	Spain		Norway		UK	
	Housework Duties	Housework & Childcare	Housework Duties	Housework & Childcare	Housework Duties	Housework & Childcare
Log. Wage Gap	0.23***	0.27***	0.31**	0.30*	0.11**	0.15**
	(0.07)	(0.08)	(0.16)	(0.16)	(0.05)	(0.07)
Log. Fem Wage	0.07***	0.06***	-0.03	-0.04	0.03**	0.05**
	(0.02)	(0.02)	(0.07)	(0.06)	(0.02)	(0.03)
Age gap (H-W)	0.02***	0.02***	0.12**	0.14***	0.12**	0.12***
	(0.01)	(0.01)	(0.05)	(0.04)	(0.06)	(0.05)
Education (ref. Mixed ed. couples)						
High-ed. couples	-0.02	-0.10*	-0.15*	-0.23***	-0.17	-0.38**
	(0.08)	(0.06)	(0.09)	(0.09)	(0.17)	(0.18)
Less-ed. couples	0.35***	0.43***	0.12	0.13	0.43**	0.58***
	(0.10)	(0.09)	(0.09)	(0.09)	(0.19)	(0.18)
Child Status (ref. No child)						
Children<5 yrs.	-0.40***	-0.58***	-0.26*	-0.30**	-0.33*	-0.60***
	(0.11)	(0.09)	(0.15)	(0.14)	(0.21)	(0.23)
Children>5 yrs.	-0.12*	-0.35***	-0.16*	-0.18**	-0.26*	-0.46***
	(0.08)	(0.09)	(0.10)	(0.09)	(0.21)	(0.21)
R-squared	0.07	0.15	0.08	0.10	0.04	0.06
N. obs. (couples)	2915		397		799	

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).[23] 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 (θ_1) are always larger than the coefficients on the female wage (θ_2), and that both tend to be positive, is consistent with symmetric bargaining and implies that the effect of the female wage on the female share is negative whereas the effect of the male wage is positive, as predicted by our model. 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 share. Finally, the female 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: Estimates of the Reduced- Form Household´s Decision on Time Allocation

Dependent Variable: ln[s / (1-s)]

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.

Table 4 provides estimation results for the reduced- form equation (29). Two findings stand out. First, the signs of the coefficients on the variables capturing $\ln\beta$

[23] 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, $\partial s/\partial \ln W_f = [\partial s/\partial \log(s/1-s)]0.27 = s(1-s)0.27$. 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.

remain the same as in (28), indicating that $\gamma \in (0,2)$ is the most plausible range of values in the three countries, as we 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 5: Estimates of the Structural Household´s Decision on Time Allocation.

(Spain) Dependent Variable: ln[s / (1-s)]

Variables	Housework Duties	Housework & Childcare
Log. Wage Gap	0.26***	0.33***
	(0.09)	(0.08)
Log. Fem Wage	0.09**	0.17**
	(0.02)	(0.08)
Age gap (H-W)	0.02**	0.03***
	(0.01)	(0.01)
High-ed. couples	-0.06***	-0.06
	(0.02)	(0.06)
Less-ed. couples	0.21***	0. 26***
	(0.09)	(0.10)
Children<5 yrs.	-0.26***	-0.28***
	(0.10)	(0.11)
Children>5 yrs.	-0.09	-0.15**
	(0.07)	(0.08)
Dummy rich regions	- 0.08**	-0.11**
	(0.04)	(0.05)
Dummy domestic service	-0.09**	-0.11***
	(0.04)	(0.04)
Dummy family aid	-0.04	0.02
	(0.04)	(0.05)
R-squared	0.09	0.16
N.obs. (couples)	2915	2915

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

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, there is no evidence on family-aid effects is inconclusive since the coefficient on this dummy is statistically insignificant. One possible reason for this last result 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 can cancel out.

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.

6.3. *Female share of housework and family-aid policies*

The empirical predictions of the proposed model regarding the effects of a subsidy are not clear-cut: in asymmetric households where men have more bargaining power than women, a subsidy targeted at working women can shift the G- equilibrium to the U one. However, in a symmetric household, the U-equilibrium can only be achieved through a neutral-gender subsidy targeted at both members of the household. As already mentioned, this empirical prediction cannot be tested with the available data since MTUS lacks information on this issue and the STUS does not report whether the husband, wife or both members of the household receive family-aid. Given these shortcoming, all we can report is some very basic descriptive evidence on the correlation between the female share of housework for the MTUS participant countries in Figures 1 to 3 and the percentage of GDP spent on family aid expenditure in those economies.[24] Figure 7 shows a very negative correlation (-0.88) between both variables: countries which devote a greater share of the GDP to family aid are those where the female share of housework is lower, and vice versa. This preliminary evidence may be interpreted in terms of our discussion in section 5.3 about asymmetric economies with different bargaining power in the household or in terms of our

[24] It includes cash transfers, services and tax breaks towards family; see www.oecd.org/els/social/family /database.

collective household decision model if targeted aid received by one of the spouses becomes neutral through within-household redistribution. However, clearly more research needs to be done in order to clarify the channels through which these subsidies affect household decisions.

Figure 7: Correlation between Expenditure on Family Aid and Housework share

Notes: (X-axis) Female Housework Share (from MTUS).
(Y-axis) Family Aid Expenditures as a percentage of GDP (OECD, 2001).

7. Conclusions

We have proposed a simplified 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 of our main theoretical predictions concerning the relationship between wages and the sharing of household tasks, as well as the role of 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.

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). Properly examining what drives this pattern of wage gaps would require an analysis of statistical discrimination in training over the worker's lifecycle. This remains in our future research agenda.

Appendix 1

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

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

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, $\overline{X}$, recall that $f(X) \approx f(\overline{X})[1+\eta\, x]$, where $x = \ln X - \ln \overline{X}$ and $\eta \equiv [(\partial f(\overline{X})/\partial \overline{X}) \cdot (\overline{X}/f(\overline{X})]$. Now, write the inverse of (11) as

$$\left(\frac{s}{1-s}\right)^2 = \frac{1-a_f}{1-a_m}, \quad \text{(A.1)}$$

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

$$\ln\left(\frac{s}{1-s}\right) = 0.5\left(\frac{a_m^*}{1-a_m^*}(\ln a_m - \ln a_f) + \frac{a_m^* - a_f^*}{(1-a_m^*)(1-a_f^*)}\ln a_f\right). \quad \text{(A. 2)}$$

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

$\theta_1 = \dfrac{a_m^*}{(1-a_m^*)} > 0,\ \theta_2 = \dfrac{(a_m^* - a_f^*)}{(1-a_f^*)(1-a_m^*)} > 0,\ \theta_3 = -0.5\gamma\theta_2 < 0,$ and $\theta_4 = -0.5\theta_2 < 0$.

Under Assumption 1 ($i.e.$, $a_i^* < 1$) and with $s \in S$, it can be easily checked that $\theta_1 > \theta_2 > 0$ since $\theta_1 / \theta_2 = [(a_m - a_m a_f)(a_m - a_f)] > 1$ Further, since θ_2 is proportional to $(a_m^* - a_f^*)$, it should be smaller for countries whit gender gaps closer to the ungendered equilibrium, in which $a_m^* = a_f^*$. Note that this is not the case for θ_3 and θ_4 since γ and the coefficients on the covariates used to proxy $\ln\beta$ and $\ln\varepsilon$ 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 bargaining (see subsection 5.3), yielding

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

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 $a_m^* = a_f^*$, and that the coefficient on the gender wage gap need not be larger than the coefficient on the female wage.

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