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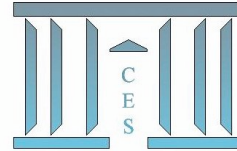
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Stereotypes upon Abilities in Domestic Production and Household Behaviour*

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Abstract

The collective model assumes that decisions taken inside the family are Pareto optimal. However, empirical studies cast doubts upon the efficiency assumption, especially on the production side of household decision making. In this paper, we present a model of household behavior including a stereotype about the ability of men and women in the production of domestic goods. At the beginning of couple formation, we assume that the distribution of abilities in domestic production of men and women is the same, but everybody believes that women are more able (the stereotype). One member of the couple is then chosen to make an investment in domestic production, which increases his/her productivity. Couples decide who will invest by maximizing the expected profit from domestic production, which depends on a signal and on the stereotype. Even though spouses aim at maximizing the household welfare, the resulting allocation is not Pareto efficient. This result leads to examine the role of public policies to restore the first best optimum, as well as equity.

Keywords: Stereotypes, household production, time allocation, household behavior, intra-household decision-making

JEL Classification: D13 – J16 – J22

Résumé

Le modèle collectif fait l'hypothèse de décisions intra-ménage préservant la Pareto-optimalité. Cependant, les résultats empiriques semblent contredire cette hypothèse, en particulier au niveau de la sphère production du ménage. Dans ce papier, nous présentons un modèle de comportement du ménage, incluant un stéréotype concernant la capacité des hommes et des femmes pour produire des biens domestiques. Au moment de la formation du couple, nous supposons que la distribution des compétences potentielles des hommes et des femmes dans la production domestique est la même, mais la croyance générale (le stéréotype) est que celles des femmes sont supérieures. Un des deux conjoints est ensuite choisi afin de réaliser un investissement en production domestique, lui permettant d'augmenter sa productivité. Les couples choisissent lequel des deux va investir en maximisant le profit espéré issu de la production domestique, dépendant d'un signal et du stéréotype. Même si les conjoints agissent dans le but de maximiser le bien-être du ménage, l'allocation des ressources résultant du processus de décision n'est pas efficace au sens de Pareto. Ce résultat conduit à examiner le rôle des politiques publiques afin de restaurer l'optimum de premier rang, de même que l'équité.

Mots-clés : Stéréotypes, production domestique, allocation du temps, comportement du ménage, prise de decision intra-ménage

Introduction

When analyzing intra-household decision-making, most models assume efficiency in the consumption and production side of the household. This departs with the models developed in the New Home Economics (Becker, 1965) and continues with cooperative models (Manser and Brown, 1980, McElroy and Horney, 1981) and collective models (Apps and Rees, 1988, 1997, Chiappori, 1988, 1992, 1997, Bourguignon and Chiappori, 1992). In the production side of the household, efficiency means that the partner with the lowest opportunity cost, so the lowest human capital, specializes more in domestic production. So an increase in female relative human capital leads to decrease woman domestic work time (Becker, 1981). However, serious doubts about the efficiency assumption can be expressed, especially on the production side of household decisions, i.e. household production which includes domestic tasks and child care.

Participation of women in the labour market has strongly increased during the second half of the century (Marchand & Thélot, 1991, Sofer, 2005). Today, women participate more and more in the labor market, but they are still in charge of the largest burden of domestic work inside the household. The sharing of time among men and women between market work and household work is still highly differentiated by gender (Goldschmidt-Clermont and Pagnossin-Aligisakis, 1995, Rizavi and Sofer, 2008). In particular, women in Europe spend roughly between 60 and 70% of their working time doing household work and between 30 and 40% working in the market, while men devote between 55% and 65% of their working time to market work and thus between 35% and 45% only in household work, with a total working time generally higher for women than for men (Winquist, 2004). For France, for example, the INED (The French National Institute for Demographic Studies) shows that French women contributed in 2009 to around 80% of the domestic tasks (Régnier-Loilier, 2009). In addition, they show that the presence of children increases specialization within the household. This relative specialization strongly interacts with women's situation in the labor market: it often results in differences in wage rates (through part time work), in large differences in earned income (through less work duration, as well as through flatter careers), which, in turn, has several negative implications for women, especially in case of divorce. In this latter case, they are evidently more exposed to a risk of income cut or even of poverty.

At first sight, it can be thought that the division of labour within the household might be explained by usual economic variables, as wages, education, or other measurable variables. But, in fact, these variables are far from completely driving the phenomenon (Hersch & Stratton, 1994, Anxo & Kocoglu, 2002, Aronsson et al, 2001, Rapoport and Sofer, 2005, Kalenkoski, Ribar and Stratton, 2009, Sofer and Rizavi, 2008). According to Sofer and Rizavi (2008), who use French data, women who invest a lot in their career do decrease their share of household work, which is substituted not only by men's household work but also often by external help. They show that when the woman earns a higher wage than her partner, which is the case for around 20% of households, there is no role reversal. However, her partner's

household work does increases and hers decreases but women still do the major part of household work even though they participate in the labour market with a strong intensity. These results challenge the assumption of Pareto-optimality of household decision making. In addition, several other studies (Udry, 1996, Duflo and Udry, 2004, Aguiar and Hurst, 2007) cast also some doubts about the efficiency assumption, especially on the production side of household decisions.

Of course, Pareto optimality in household decision-making could be restored under some auxiliary assumptions.

It could be that women are more productive than men in domestic production, with women's higher productivity more than compensating for wage differences when women's wage are higher. It is the assumption made by Becker (1981), based (besides "natural differences"?) on the different training received by girls and boys through "gendered" toys and games. But, today, in developed countries, at least, boys and girls are educated with the perspective that both genders in adulthood will participate in domestic tasks and work in the market. Moreover, though toys and games are still highly gendered, the skills necessary to perform domestic tasks are not really high any more, due to a large use of market substitutes to domestic goods, on the one hand (buying clothes has replaced sewing or knitting them) and household equipment in durable goods, on the other hand: it is not likely that women are better than men at pushing the button "on" of the washing machine! Moreover, most fathers are now involved in the caring of children of any age, including babies, so that, again, systematic productivity differences between genders do not seem likely to occur in the raising of children either, excluding the period, very limited in time, of pregnancy and, possibly, breastfeeding .

It could instead come from a difference in individual preferences, either in direct or indirect preferences. A direct difference in preferences would occur if women, on average, "liked" more than men performing domestic tasks. This would complicate the models above, as the production side of household decision-making would now have a consumption component. Non monetary costs (or advantages) should be added (or substracted) to monetary costs in the maximization of the profit from household production. In order to obtain the observed division of labor, again, the difference between men and women in those non monetary costs should be high enough to compensate for any difference in wages when women's wages are higher. We do not find this ad hoc assumption convincing either, among other reasons because, again, the skills necessary to perform most of domestic tasks are not very high: women would like using a vacuum cleaner while men don't?

A more convincing candidate for the explanation of a gendered division of labor is a difference in indirect preferences: the gender division of labour could instead come from a social norm. Social norms represent rules of behavior imposed to individuals by society, from which it is costly to deviate. For example, a social norm could be that women must specialize in domestic production while men must work mainly in the labor market. Social norms can be modeled as adding to the utility function a "cost of deviating" from the norm. "Gender

roles" would in that case impose or add a strong constraint leading households to deviate from the first best efficiency. Non cooperative household models including social norms have been developed by Carter and Katz (1997) and by Cudeville and Recoules (2009).

This will not be our assumption here. We shall rather develop another approach, based on the existence of a stereotype within the society. Stereotypes are beliefs grounded in the society. For example, and this will be our main assumption here, people could – wrongly – believe that in average, women are more talented than men concerning domestic work and child care. A model of discrimination in the labour market involving stereotypes has been developed by Coate and Loury (1993), who assume a stereotype upon a difference in the respective productivity of black and white workers. Black workers are (wrongly) believed to be on average, less able than white workers in the labor market. The result is that white workers will more often occupy skilled jobs than black workers. Similarly, in the model developed below, we show that women will more often be in charge of domestic production than the observed wage difference between men and women in the labor market would justify.

The decision-making process described below is that of a collective model with domestic production (Apps and Rees, 1997, Chiappori, 1997, Aronsson, Daunfeldt and Wickstrom, 1999, Bourguignon F. and M.C. Chiuri, 2005, Rapoport, Sofer and Solaz, 2011), adding a stereotype about the relative ability of men and women in domestic production using a methodology inspired by Coate and Loury (1993). The stereotype considered is the belief that women are more talented than men in domestic production, while, in reality, the distribution of talents between women and men is assumed to be the same.

The model developed is the following: at the beginning of marriage (or couple formation), a choice of relative specialization is made within the household. One of the two spouses will make an investment in domestic production, in order to improve his/her productivity. Therefore the first decision of the household consists in choosing which of the two spouses will invest. This decision depends on spouses' wages, which represent the costs of investment for each of them, the level of the specialization, and on their respective expected abilities in domestic production. However, abilities are assumed not to be known nor immediately observable by the spouses. The couple can only observe noisy signals about them. They choose which of them will invest in domestic production as the result of a program of optimization (maximizing the expected profit from household production), which depends on variables such as the ability signal emitted by each of them, on their wages, the level of specialization, but also on beliefs about the respective probabilities of abilities of each spouse. These beliefs depend on the signal which each spouse emits, but also on the stereotype running inside the society. Once the couple has chosen who invests, the investment is made and one spouse improves his/her productivity. Then they take daily household decisions in an optimal way, given that one spouse is more productive than the other. This implies that the couple maximizes a weighted sum of both couple members'

preferences under a full income constraint which includes the maximized profit from household production.

Decision process assumed here is similar to decision process assumed by Apps (1982): in a first stage, partners' specialization occurs: one member invests in order to specialize in the labor market, while the other invests in domestic production. Wage discrimination against women will bias the process. Then, in a second stage, labor supplies are determined according to this specialization (Apps, 1982). So the allocation of time is partly explained by wage discrimination, while in our model, specialization is partly determined by the stereotype.

We show that the stereotype is self-fulfilling, in the sense that at the end of the decision process, women become really more productive than men, given that women are more often than men chosen by couples to invest in domestic production. In addition, we show that even if a wife earns a higher wage than her husband, even though her husband has the same potential in domestic productivity, it is likely that the woman be chosen to invest in domestic production, though the first best optimal choice would have been to choose the husband in that case. Indeed, if the stereotype is strong in the society, the probability that the wife will be chosen to invest whatever her wage will be is high, and the wife will actually invest.

Our analysis proceeds as follows. Section 1, first presents the sequence of actions in the household decision process and then the definition of the stereotype. Section 2 is devoted first to a brief presentation of the collective model with household production, and then to household choices of who invests in domestic production. Then, in Section 3, we develop a comparative-static analysis, followed by a graphic analysis. In a third paragraph of section 3, we discuss the role of public policies. Finally, Section 4 concludes

1. **The framework**

1.1.   **Household Decision Process**

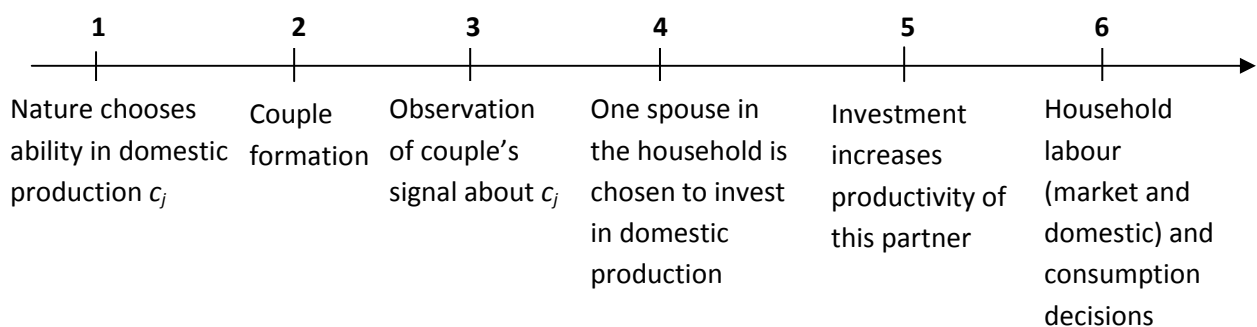| 1	2	3	4	5	6
Nature chooses ability in domestic production c_j	Couple formation	Observation of couple's signal about c_j	One spouse in the household is chosen to invest in domestic production	Investment increases productivity of this partner	Household labour (market and domestic) and consumption decisions

Figure 1 : Sequence of actions

Assume a population of couples, composed by a man and a woman. Men are indexed by *j=m* and women by *j=f*. There are two productivity levels in household production: low and high. The timing of decisions is summarized in Figure 1. Each member of the household has a certain level of ability in domestic production c_j, which corresponds to the capacity to make an investment in domestic production and reach the high level of productivity. Each individual in the population has a different level of ability c_j. The higher c_j, the more talented a priori the individual is to produce domestic goods, and the less his/her investment cost. We define by $(-c_j)$ the cost of investment in domestic production.

1.2.   The stereotype

A key assumption here is that before the investment made, all people, men as well as women, have the same distribution of ability in domestic production. However, at the beginning of marriage, nobody knows and can measure exactly one's own ability, nor that of one's spouse. Moreover, nobody knows that initially, the distribution of abilities is the same for men and for women. People (women as men) believe instead that, on average in the population, women are more able than men for domestic production. This is the stereotype. For simplicity, we shall assume that the stereotype shifts to the right the distribution of women abilities. We call c_f and c_m, true abilities in domestic production, and $\tilde{c}_f$ and $\tilde{c}_m$, the abilities imputed to the woman and to the man respectively, according to the belief in the society.
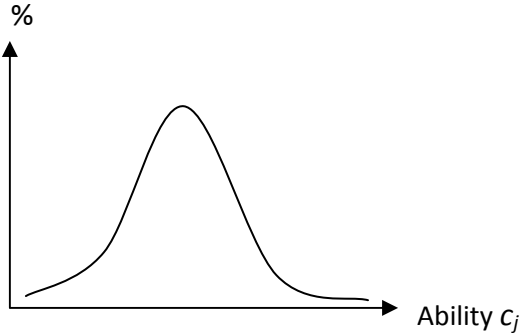

Figure 2: True distribution of ability in domestic production for men and for women, in the whole population
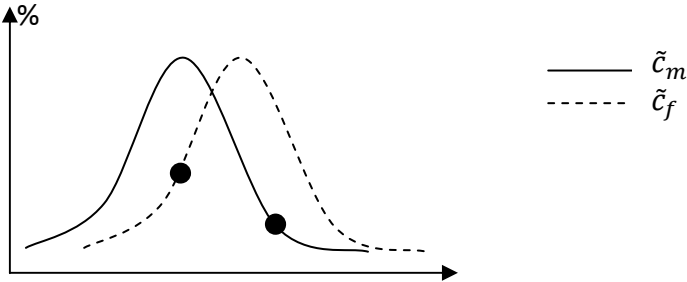

Figure 3: Imputed distribution of ability $\tilde{c}_f$ and $\tilde{c}_m$, according to the stereotype

Hence, on average, people believe that women are more able than men, but in a given household, the couple can (rightly) believe that the man is more able than the woman (cf the two points in Figure 3). All individuals believe that women's distribution of abilities is moved to the right in this way, that is why this belief can be called a stereotype.

Then couples form, and household members do not observe their true ability to make an investment in domestic production, but only noisy signals about it. At the beginning of couple formation, a relative specialization occurs between spouses: one spouse specializes more in the labor market, and the other specializes more in domestic production. In order to proceed to this specialization, one of the two household members is chosen to make an investment in domestic production, and this investment allows him/her to increase his/her productivity in domestic production. So finally, one spouse becomes more productive than the other. This investment may be thought as spending a lot of time in household production and developing habits. We assume that there exist two levels of productivity to produce domestic goods among all the population: *a high level* and *a low level*. The high level is the level of productivity of the household member who has invested in domestic production, and the low level is the level of productivity of the spouse who has not invested. All spouses in the society who have invested have the same productivity, and all partners in the population who have not invested have the same lower productivity. What differs between all individuals is the ability (c_j) to reach the high level of productivity. The higher the initial individual ability, the lower the investment costs in order to reach the post-investment productivity.

As household members do not observe their true ability to make this investment, but only signals about it, these signals, wages, and beliefs about abilities help them to determine who invests.

The framework used here is a household general equilibrium model, in which the household profit from household production is maximized. Hence, the model below can be part of a collective model with household production (Apps et Rees 1997, Chiappori 1997, Aronsson, Daunfeldt and Wikstrom 2001, Bourguignon F. and M.C. Chiuri 2005, Rapoport, Sofer and Solaz 2011), or of a Nash bargaining model (Mc Elroy et Horney, 1981, Manser and Brown, 1980, Lunberg and Pollak, 1993), adding household production.

Once the choice of which partner invests and once the investment made, individual domestic times, leisure and consumption decisions are taken optimally, according to a household model with domestic production, given that one partner has increased his/her productivity.

2. Household choices

2.1. General Household Behavior

The general model, according to a collective model extended to household production, can be written in the following way, in which the household maximizes a generalized weighted utilitarian household welfare function:

$$\max_{L_f C_f Y_f L_m C_m Y_m} \left(\mu_f(.)U_f\left(L_f, C_f, \boldsymbol{Y_f}, \boldsymbol{z}\right) + \mu_m(.)U_m(L_m, C_m, \boldsymbol{Y_m}, \boldsymbol{z}) \right)$$

$$subject\ to \quad C_f + C_m + \boldsymbol{p}Y_f + \boldsymbol{p}Y_m + L_f w_f + L_m w_m \leq T w_f + T w_m + y + \pi(w_{f,} w_m, \boldsymbol{p})$$

L_j represents leisure, C_j, the consumption of private goods, and **Y** the vector of domestic goods, with $\boldsymbol{Y} = h(t_f, t_m; \boldsymbol{z})$. t_j is member j's household work devoted to household production, T the total time available, **z** represents part of the individual heterogeneity, y the household's non-labour income, w_m and w_m are the wage rates, and $\mu_j = \mu_j(w_f, w_m, y, \boldsymbol{z})$ are weighting factors contained in [0,1], with $\mu_m + \mu_m = 1$. $\pi(w_{f,} w_m, \boldsymbol{p})$ is the profit function from the household production.

The household maximization program could be thought of as decentralized in three steps. In a first stage, the household would maximize the profit from household production:

$$\max_{t_f, t_m} \pi = pY - w_f\, t_f - w_m t_m$$

This allows to determine t_f and t_m, domestic work times.

In a second stage, spouses agree on the sharing of full income. Full income contains household non labor income and profit from household production. Each spouse receives the share Ψ_j.

In the third stage, the man and the woman separately maximizes their own utility function, under their own budget constraint, in order to determine quantities of leisure L_j and consumption C_j.

$$\max_{L_j, C_j, Y_j} U_j\left(L_j, C_j, Y_j, z\right)$$
$$C_j + pY_j + L_j w_j \leq \Psi_j + w_j h_j$$
$$L_j + h_j + t_j = T$$

where h_j represents the time spent by individual j in the labor market.

In what follows, we concentrate only on the first step: profit maximization from household production. The other steps are straightforward from the standard model. Here, the uncertainty about abilities c_j and hence, the beliefs about the difference between men and women in that respect prevail in the first step of the household decision process. Rather than maximizing the known profit from household production by choosing adequate

domestic times, the household will maximize an expected profit, given that nobody knows true spouses' abilities. Once the investment in domestic production is made by one partner accordingly, the chosen partner becomes more productive than the other. This has direct consequences on the determination of t_f and t_m in stage 1, and hence on subsequent stages.

2.2. Which of the two partners will invest ?

Each household must choose the man or the woman, in order to make an investment in domestic production. The objective of the household is to choose the partner who will bring the highest profit from household production. The error would be to choose one partner, while the other would have allowed to obtain a higher profit. However, the couple cannot measure correctly levels of abilities.

The profit if the man invests in domestic production is the following:
$$r_m = p^* h\left(t_f^{ni}, \rho t_m^i\right) - w_f t_f^{ni} - w_m t_m^i - (-c_m)$$
The profit if the woman invests in domestic production is the following:
$$r_f = p^* h\left(\rho t_f^i, t_m^{ni}\right) - w_f t_f^i - w_m t_m^{ni} - (-c_f)$$

w_f and w_m are respective wages of f and m, and p^*, the implicit price of domestic production. c_j is the measure of j's initial ability in domestic production. $(-c_j)$ represents the cost of investment in domestic production. The higher c_j, the less costly it is for an individual to acquire the high level of productivity. We index t_j by t_j^{ni} for the partner who has not invested in domestic production (*ni: no investment*), and t_j^i for the spouse who have invested in domestic production (*i: investment*). $h\left(\rho t^i, t^{ni}\right)$ is the household production function, assumed to be the same for all households. Domestic time spent by the spouse who has invested is multiplicated by $\rho > 1$, corresponding to the productivity gain resulting from the investment. ρ is the same across all households.

In the following, we assume for simplicity that there exist only two levels of t^i and t^{ni} in the population. It means that all partners who have invested perform the same amount of domestic work t^i and all partners who have not invested spend t^{ni} units of time making domestic tasks. Consequently, $h\left(\rho t^i, t^{ni}\right)$ is the same across all households, whoever was chosen to invest. We also assume that p^* is the same for all couples. Hence, what differs among couples are wages w_f and w_m, and abilities c_f and c_m.

The objective of the household is to obtain the highest profit from household production. So household's choice should be made by comparing r_m and r_f. If r_m is higher than r_f, the net benefit from household production is higher when the man invest rather than when the woman invests, hence the man should be chosen to invest.

The man should be chosen if and only if

$$r_m > r_f$$
$$\Leftrightarrow p^* h\big(t_f^{ni}, \rho t_m^i\big) - w_f t_f^{ni} - w_m t_m^i - (-c_m) > p^* h\big(\rho t_f^i, t_m^{ni}\big) - w_f t_f^i - w_m t_m^{ni} - (-c_f)$$

As $p^* h\big(t_f^{ni}, \rho t_m^i\big) = p^* h\big(\rho t_f^i, t_m^{ni}\big)$,

$$r_m > r_f$$
$$\Leftrightarrow -w_f t_f^{ni} - w_m t_m^i + c_m > -w_f t_f^i - w_m t_m^{ni} + c_f$$
$$\Leftrightarrow c_m - c_f > w_m(t_m^i - t_m^{ni}) + w_f\big(t_f^{ni} - t_f^i\big)$$

As $t_m^{ni} - t_m^i = t_f^{ni} - t_f^i = t^{ni} - t^i$, and $t^{ni} - t^i$ is a constant,

$$r_m > r_f$$
$$\Leftrightarrow (t^i - t^{ni})(w_m - w_f) < c_m - c_f$$

In order for the man to be chosen to invest, the difference c_m- c_f should be larger than $(t^i - t^{ni})(w_m - w_f)$. However, the couple does not know the true values of c_m and c_f. They only observe noisy signals about c_m and c_f: θ_f and θ_m. Note that the distribution of $\theta_m - \theta_f$ depends on the true distribution $c_m - c_f$, and not on the stereotype. The stereotype acts through the perceived distribution of abilities, $\tilde{c}_f$ and $\tilde{c}_m$. Intuitively, the stereotype, by moving the distribution of capacities of women to the right, leads to a decrease of $c_m - c_f$, according to the belief of couples. Hence, the inequality $\big[(t^i - t^{ni})(w_m - w_f) < c_m - c_f\big]$ is less likely to be satisfied.

2.3. The formal decision process

We formally define the couple decision process below.
In the following, we denote the couple wage differential $(w_m - w_f)$ by W, the (true) ability differential $(c_m - c_f)$ by C, the signal differential $\theta_m - \theta_f$ by θ and the time differential $(t^i - t^{ni})$ by T. The correct inequality for an investment by the man becomes: $TW < C$

Let $F_q(\theta)$ $[F_u(\theta)]$ be the probability that signal differential of the couple does not exceed θ, given that $TW < C$ $[TW > C]$ and let $f_q(\theta)$ and $f_u(\theta)$ be the related density functions. Define $\varphi(\theta) \equiv f_u(\theta) / f_q(\theta)$, to be the likelihood ratio at θ. We assume that $\varphi(\theta)$ is nonincreasing, which implies $F_q(\theta) \leq F_u(\theta)$ for all θ. So higher values of signals θ are more likely if $TW < C$, and for a given prior, the posterior likelihood that $TW < C$ is larger if couple signal θ takes a higher value.

We define $\Phi \in (0,1)$, the probability that in a representative couple $TW < \tilde{C}$, according to the belief in the population about C, and before the observation of signals.

The true probability that $TW < C$ is $P(TW < C)$.

This probability distorted by the stereotype is $\Phi = P(TW < \tilde{C})$.

In other words, Φ is the prior probability that the profit is higher when the man invests, so that the man be chosen to invest, in a representative household, and according to the belief. This probability depends on four distributions: the distributions of w_m, w_f, and the distributions of $\tilde{c}_m$ and $\tilde{c}_f$, in the whole population. Note that it also depends on the level of specialization, through T. Hence, Φ is a distribution of probability, and not a parameter, because it depends on specific wage values of the household. But all people have the same belief about the gap between c_m and c_f (the stereotype). So the stereotype intervenes through this probability Φ. Signals do not act on this probability, because it is defined anterior to signals observation.

Now for a given couple, if it "emits" the signal $\theta = \theta_m - \theta_f$ then, using Bayes' Rule, the couple's posterior probability that $TW < C$ is the number $\xi(\Phi, \theta_m - \theta_f)$ given by

$$\xi(\Phi, \theta_m - \theta_f) = P\left(TW < \tilde{C} \mid \theta_m - \theta_f\right)$$

$$\equiv \frac{\Phi f_q(\theta_m - \theta_f)}{\Phi f_q(\theta_m - \theta_f) + (1-\Phi) f_u(\theta_m - \theta_f)}$$

$$= \frac{1}{1 + \frac{1-\Phi}{\Phi}\varphi(\theta_m - \theta_f)}$$

This posterior probability (posterior to the observation of signals) depends on prior probability Φ and on couple's signal.

The stereotype is defined by the shift in the distribution of abilities of women compared to men. To make it clear on an example, according to our assumption, the true probability that $TW < C$, given that $w_m = w_f$ is equal to ½.

$$P(TW < C | w_m = w_f)$$
$$= P(0 < C)$$
$$= P(c_f < c_m)$$
$$= 0{,}5$$

Now, according to the stereotype (measured by S), this probability becomes lower, for example 0,3.

$$S = P(TW < \tilde{C} | w_m = w_f)$$
$$= P(\tilde{c}_f < \tilde{c}_m)$$
$$= 0{,}3$$

In the example above, everybody in the society believes that the likeliness that a man randomly drawn in the population is more able than any woman drawn randomly is only 30%. A probability of 0,2 corresponds to a stronger stereotype, while a probability of 0,4 corresponds to a weaker stereotype.

The stereotype is defined on beliefs about abilities, $\tilde{c}_f$ and $\tilde{c}_m$, but the couple decision is based not only on both imputed abilities $\tilde{C}$, but also on wage differential W, and on the level of specialization, T.

Now, how does a household decide which partner is the most appropriate to make this investment? For a given household, wage difference W is known, and T is the same for all households. We denote Φ_W, the probability Φ for a given couple, hence for a given W. Φ_W is a scalar. We also denote $\varphi_W(\theta_m - \theta_f)$, the likelihood ratio φ for the same given value of W.

The man will be chosen to invest iff $\xi(\Phi_W, \theta_m - \theta_f) > \frac{1}{2}$, because it means that the posterior probability that the profit is higher when the man invests $\xi(\Phi_W, \theta_m - \theta_f)$, is superior in that case to the posterior probability that the profit is higher if the woman invests $(1 - \xi(\Phi_W, \theta_m - \theta_f))$.

$$\xi(\Phi_W, \theta_m - \theta_f) > \frac{1}{2}$$

$$\Leftrightarrow \quad \frac{1}{1 + \dfrac{1 - \Phi_W}{\Phi_W}\varphi_W(\theta_m - \theta_f)} > \frac{1}{2}$$

$$\Leftrightarrow \quad \frac{1 - \Phi_W}{\Phi_W}\varphi_W(\theta_m - \theta_f) < 1$$

$$\Leftrightarrow \quad \varphi_W(\theta_m - \theta_f) < \frac{\Phi_W}{1 - \Phi_W}$$

So the decision process of the household is the following:

The man invests if and only if

$$\varphi_W(\theta_m - \theta_f) < \frac{\Phi_W}{1-\Phi_W} \qquad\qquad (1)$$

As a result, the household combines the stereotype, signals, wages and the level of specialization in society in order to take its decision.

3. **The results**

3.1. **Comparative-Static Analysis**

- **For a given couple:**

		$\dfrac{\Phi_W}{1-\Phi_W}$	$\varphi_W(\theta_m - \theta_f)$	Investment of the man
Increasing of	Φ_W	+	$\emptyset$	*more likely*
	w_f	+	$\emptyset$	*more likely*
	w_m	−	$\emptyset$	*less likely*
	θ_f	$\emptyset$	+	*less likely*
	θ_m	$\emptyset$	−	*more likely*
	T	− for W>0, + for W<0	$\emptyset$	*less likely* *more likely*

Table 1: Comparative-static analysis

It can be seen from Table 1 that if the woman's wage w_f increases, it leads to a decrease of $w_m - w_f$, hence the probability Φ_W that $TW < \tilde{C}$ is higher. Consequently, inequality (1) becomes easier to be satisfied and the man is more likely to be chosen. The opposite stands if the man's wage increases.

Considering now signals, if the signal of the man increases, $\varphi_W(\theta_m - \theta_f)$ decreases because $\varphi_W(\theta_m - \theta_f)$ is decreasing with $\theta_m - \theta_f$. Inequality (1) logically becomes easier to be satisfied.

What's the impact of a lightening of the stereotype, and consequently an increasing of Φ_W? $\dfrac{\Phi_W}{1-\Phi_W}$ increases, so the right hand of inequality (1) increases. Consequently, inequality (1) is easier to be satisfied, and the man will be more likely to be chosen.

We conclude that if the stereotype is strong inside the society, for a couple who emits the signal $\theta_m - \theta_f$, it will be more difficult that condition (1) be realized, and as a result, the woman will invest more often. The stereotype decreases the right hand of condition (1). Hence, in order for the man to be chosen, $\varphi_W(\theta_m - \theta_f)$ must be weak. Since $\varphi_W(\theta_m - \theta_f)$ is a decreasing function of $\theta_m - \theta_f$, the couple will need to observe a θ_m sufficiently high relative to θ_f in order to believe that the man is really as, or more able than his wife and is the right person for the investment which will be made.

Finally, the impact of the level of specialization, $t^i - t^{ni}$ depends on the sign of W. When $w_m - w_f > 0$, a higher level of specialization (a higher difference $t^i - t^{ni}$) decreases the likeliness that the man will be chosen. The opposite stands if $w_m - w_f < 0$. As in all

societies, on average, men's wages are higher, more often, a high level of specialization tends to further decrease the chances that men will be chosen for household production.

- **For the whole population:**

In a given household, the beliefs about difference of abilities between men and women, together with market wages and signals, determine which partner will be chosen to invest in domestic production. Considering now all couples in the society, this will, in turn, determines the fraction of men who become qualified, and, hence, who specialize in domestic production.

On average, according to empirical evidence on aggregate data, women earn lower wages than men. So on average, wage differences and stereotype effects reinforce each other to finally result in much more women than men be chosen to invest in the population.

The stereotype is defined by the deformation of distribution about abilities and can be measured by the probability: $P(TW < \tilde{C}|w_m = w_f)$.

Let us note G(W, θ, Φ) the proportion of men in the society who are chosen to invest.

Assume $w_m = w_f$ on average in the population, then

$$G(W, \theta_m - \theta_f, \Phi) = P(TW < \tilde{C}|w_m = w_f) = S$$

According to the definition of the stereotype S, (see above), the case where $w_m = w_f$ on average in the population, corresponds to a situation in which the stereotype is self-fulfilling: a belief of households members about the difference of abilities between men and women will be self-confirmed as households will induce men to invest at precisely the rate postulated by the beliefs. This is precisely the case when W is 0 in average in the population, hence if wages have no effect in the decision process.

In this case,

$$S = P(TW < \tilde{C}|w_m = w_f) = \frac{\% \text{ of men who invest}}{100}$$

Two important results can be drawn from there. Given that in average, women earn lower wages than men (according to empirical evidence on aggregate data), efficiency implies that a majority of women are chosen to invest in domestic production. The stereotype reinforces this effect, so that furthermore, even if a woman earns a higher wage than her husband, and true abilities of the two partners are equal, the couple will very often choose the wife to invest in domestic production, though efficiency would have implied to choose the husband. Finally, very few men are chosen to invest in domestic production, and the resulting resource allocation is Pareto inefficient. By introducing inertia in household decisions, the stereotype creates a second best Pareto inefficiency. Negative prior beliefs about ability of men will bias the assignment process.

3.2.   A graphic analysis

Figure 4 below illustrates the analysis graphically, in the whole population. The horizontal axis measures the average value of the posterior probability of men's investment in the population $\xi_P(\Phi_W, \theta_m - \theta_f)$, while the vertical axis measures the proportion of men believed to be at least as able as the average woman, S, according to the stereotype, as well as the proportion of men who finally invest in the whole population, G(ξ_P). The upward-sloping curve EE is the graph $\{(\xi_P, S)|\xi_P = \xi_P(S)\}$, depicting posterior probability-stereotype pairs consistent with optimal household behavior. Indeed, when then stereotype is strong in the society (Φ decreases), ξ_P decreases. The upward-sloping curve WW is the graph $\{G(\xi_P)\}$, which represents 'posterior probability-proportions of men investing' pairs consistent with optimal household behavior. Indeed, when ξ_P is high, many men invest in domestic production. The figure assumes G(.) to be continuous.

Wages are not represented in the graph, but they implicitly determine the gap between EE and WW. In figure 4, $w_m > w_f$, on average. Hence EE is above WW, which implies that the proportion of men investing (given by WW) is lower than the proportion of men believed to be more able than their wife in domestic production (given by EE).
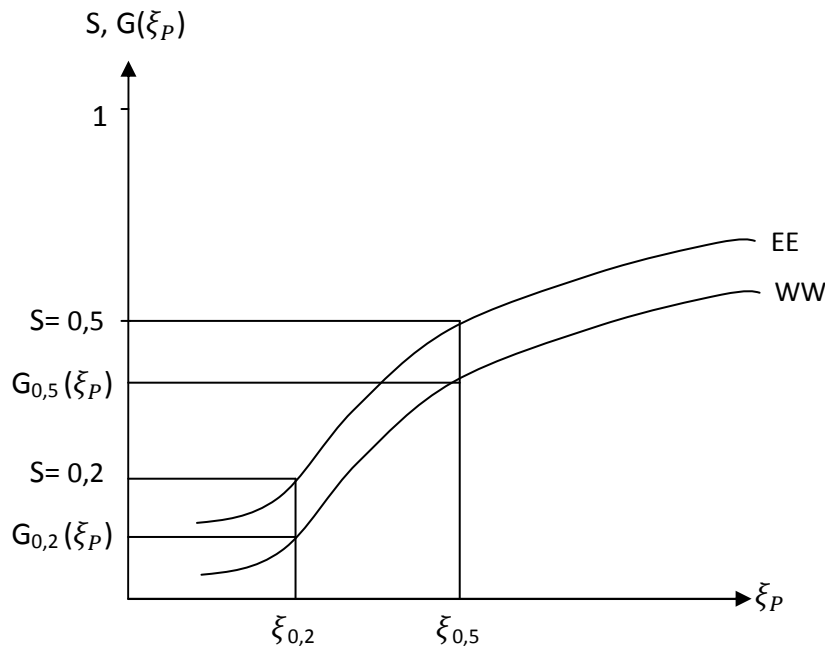

Figure 4: Different levels of the stereotype, for $w_m > w_f$, on average

Figure 4 shows different situations, according to the prevalence of the stereotype. Two levels of the stereotype are represented here. In the first situation, the stereotype is strong because people think that only 20 % of men have a higher ability than the average women (S=0,2), while in the second situation, the stereotype disappears since half of the men are

believed more talented than the average woman (S=0,5). On average, $\xi_{0,5}$ is higher than $\xi_{0,2}$, and more men are chosen to invest when S=0,5.

If, women's wages and men's wages were equal on average, curves EE and WW would merge and the stereotype would be self-fulfilling for any value of S.

3.3.   **Public policies implications**

The above inefficiency result raises the question of public policies and of the role that they might play to restore the first best optimum and promote gender equality at the same time. Can public policies have an influence upon a stereotype of the kind depicted above, and can they improve the allocation of time within the household?

First, public policies have an influence on wages, and, more precisely, on wage equality between men and women. As the choice of the investor in the household depends on wage inequalities, wage policies promoting wage equality would lead men and women to share household tasks more equally. Men would then have a higher probability to be chosen to invest and to increase their household productivity. This increase in men's investment should have in turn an effect upon beliefs: as more men become productive in household production, more people realize that their initial belief about the difference of ability between men and women is false, and the stereotype becomes less prominent. However, the stronger the stereotype at the beginning, the less effective wage policies are in changing household allocation decisions, as well as the specialization of partners in market and household activities.

Apart from wage equality, which is already targeted in most developed countries, the objective of public policies could be to increase the revealing of true abilities: paternity leaves, as well as strong incentives for a sharing of parental leave between mother and father (as in some Northern countries, for example) would result in decreasing the strength of the stereotype by showing to both parents that, in fact, their abilities in household production are much often more similar than what they initially believed. At the same time, this would decrease (-c_m), the cost of investment in domestic production for men.

Another types of political measure could directly act on the stereotype, as broadcasting advertisements promoting a better sharing of tasks between partners (advertisements showing men performing domestic tasks for instance), or encouraging little boys to play with the usual toys for girls connected with domestic tasks (dolls, dolls' tea sets, etc.).

Finally, firms could also be encouraged to recognize and promote fathers' role by family friendly policies addressing men (no meeting late in the evening, tolerating sick leave in case of a child's illness, etc…)

4. <u>Conclusion</u>

We show that, even if men and women are equally endowed ex ante, a negative stereotype upon the capacity of men in reaching a high productivity level in household production can result in a situation in which households (correctly) perceive the groups to be unequally productive, ex post. The stereotype reinforces the effect of wage differences in the labor market, leading only a very small minority of men to (partly) specialize in domestic production while efficiency, as well as equity, would have implied less segregation in gender roles. We also show that this effect is still stronger, the higher the specialization level. We finally discuss a few policy measures aiming at restoring efficiency and equity. Besides policies targeting wage equality between men and women, policies directly targeting beliefs should have a positive impact, as well as policies promoting a more equal sharing of household production within couples. Note that an unequal division of labor within the family strongly interacts with women's situation in the labor market: it is very unlikely that wage and income equality can be attained without an equal sharing of household production.

These results open the way to empirical developments, through experimentation, on the one hand, and through simulations, on the other hand.

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