Segregation, Wage Structure and the Gender Gap [1]

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Abstract

The main focus of this paper is the observation that male wages are higher than female wage, as has been documented in many empirical studies. Additional evidence, documented in a variety of studies, shows that the labor market is segregated between male and female jobs, and that there is increased investment in education by females. In several developed countries females now have more schooling than males. To explain these phenomena, the paper analyzes an economy composed of two kinds of jobs. The first kind is characterized by higher lifetime product but entails a fixed cost; the other kind generates a lower lifetime product. Due to the presence of the fixed cost, any employer will prefer to hire females for the second kind of job due to females' shorter expected tenure with the firm. The model offers two mechanisms that encourage employers to hire females. The first is a steeper wage-tenure profile for females, which reduces females' incentive to leave the firm. The second is for females to acquire a higher amount of schooling in order to raise their future product and, for this reason, to remain in the labor force. As a result of females' indifference between the two sectors and in some cases to be discussed later, the labor force is segregated.

1 Introduction

A great deal of empirical evidence exists pointing to the fact that male wages are higher than female wages. Additional evidence, documented in a variety of studies, shows that females axquire more human capital than males, the labor force is segregated, with some jobs dominated by males and others by females, and that females receive larger tenure and schooling premiums.

This paper constructs a model in which, in addition to accumulative human capital, the level of schooling serves as a signaling device to potential employers regarding an employee's expected rate of absenteeism from the labor force.

The model is based on two main assumptions. First, frequent absences reduce the amount of human capital that an individual acquires. Second, the rate of absenteeism is private information known only to each employee and his employer.

We show that an employer who incurs a fixed cost in hiring an employee offers females a steeper wage-tenure profile than males in order to screen the firm's potential female employees and hire only females whose expected rate of absenteeism is low. When the employer cannot commit to a rising wage-tenure profile, he does not hire females for a job that incurs a fixed cost due to females' higher rate of absenteeism. Consequently, females are forced to choose employers who can commit to an increasing wage-tenure profile or accept lower-paying jobs, resulting in a segregated labor force.

To obtain a higher-paying job, any female who internalizes the equilibrium described above may acquire a higher level of schooling than the optimal level (that chosen by males). Females use this strategy to signal to potential employers their intention of having a lower expected rate of absenteeism after giving birth. The employer of a female who has a high level of human capital is willing to bear the fixed cost and hire her. Note that a liquidity constraint may prevent females from acquiring such an extent of human capital. In the absence of a liquidity constraint the price of human capital is determines in such a way that makes females indifferent between the two sectors.

The model has a result which contradicts empirical evidence. It predicts that when males and females acquire the same amount of schooling, both receive the same lifetime wage. To overcome this result, we analyze an economy with a different setup. In this

economy, females may choose whether to exert an effort as well as whether to absent themselves from the market. The main result in this economy is that males generate a higher lifetime product and consequently receive a higher lifetime wage. The intuition behind this outcome stems from the additional choice of whether or not to exert an effort, whereas the only choice in the other setup analyzed is whether or not to be absent. This setup provides an intuition for an economy in which the choice of the rate of absenteeism (or effort) is continual rather than binary.

In a separate section of the paper, we analyze an economy that has no information asymmetry. We assume, however, that due to the higher cost to a female of exerting an effort, it is inefficient for employers to bear the fixed cost associated with hiring her.

Two forces generate the results of the paper. The first is information asymmetry; we assume that external employers cannot observe the amount of human capital acquired by every individual. The asymmetry results in a decrease in females' opportunity wages, which, in turn, allows females' current employers to reduce their current wages as well. We show later in the paper that the results are the same even when there is no information asymmetry. However, due to the higher cost of exerting effort for the female, it is inefficient to invest in her. The second force is the assumed fixed cost of hiring, which, as we show in the paper, needed only for the segregation result, and may be negligible without changing this result.

A main prediction of this paper is segregation within the labor force. Despite evidence of declining differences in the occupational distributions of males and females, the U.S. labor market is still highly segregated. Observation of occupations within establishments reveals even higher degrees of job segregation (Bielby and Barron, 1984). Blau (1977) finds that even within a given occupation males and females are employed in different firms.

Bayard, Hellerdtein, Neumark, and Troske (2003) find that although much of the sex gap in wages traces to the segregation of females into lower-paying occupations, industries, establishments, and occupations within establishments, another substantial part of the gap remains attributable to the individual's sex. Overall, their estimates indicate that approximately half of the sex-wage gap takes the form of wage differences between males and females within narrowly defined occupations within establishments.

Bronars and Famularu (1997) Find that the inclusion of employer fixed effects changes only female's return to education and tenure, while male return to education and tenure are identical across specifications. They also find that a sizable portion of the male-female wage differential for less educated and experienced workers is due to the concentration of female workers with low wage employers. They conclude that obtaining a job at a high wage employer is an important aspect of human capital investments for females.

Gronau (1988) and Sorensen (1990), using PSID data, find that females appear to have significantly steeper initial returns to tenure than males, with an earlier peak. Becker and Lindsay (1994) find little difference between the return to tenure by gender for individuals who left their jobs after less than five years of tenure but substantially larger differences by gender, favoring females, for those with more than five years of tenure in 1987. They assume that females have greater variance in the opportunity cost of their remaining with a firm and, for this reason, are more likely than men to separate inefficiently. By giving females a greater share of both the costs and the benefits of firm-specific human capital via a steeper wage–tenure profile, firms reduce undesirable turnover.

Banzhaf (2005) finds that when the return to tenure is allowed to vary by unobserved heterogeneity, more educated males experience lower returns to tenure than less educated individuals, especially after three years of tenure. Also, the profiles are similar for more educated males and females.

Heckman and Willis (1977) analyzed the labor-force participation of married females and find evidence of considerable heterogeneity. Their sample yielded two groups of females: workers, whose participation probabilities verged on unity, and non-workers, whose participation probabilities were near zero. Relatively few females in the sample had probabilities approximating the mean participation rate of 40 percent. The authors argue that relationships estimated on aggregated cross-section data for the "reprehensive (or average) woman" will not convey information about the true relationship for every individual in the case of a heterogeneous population.

Goldin (1989) also finds heterogeneity among females. She identified two groups: worker and non-worker. She concludes, Current workers had more education than non-workers, were younger and began work at an older age.

The model presented combines two main theories to explain gender segregation in the

labor force and the gender wage gap: the human-capital theory and the "dual labor-market theory." We show the different incentives that males and females face in acquiring human capital. When employers prefer employees who have a low rate of the expected absenteeism, they prefer males over females. However, females can choose a higher amount of human capital or an increasing wage–tenure profile to signal their lower expected rate of absenteeism and, thus, to be able to join the primary sector.

Human capital theory predicts that individual variations in human capital implies differences in earning power through a variation of the individual's productivity. This paper proposes other sources of variance. A different amount of human capital, signal a different rate of the expected absenteeism.

Ben-Porath (1967) studied the path of investment in human capital. Weiss and Gronau (1981) analyzed gender differences in investment in human capital. The main differentiating feature between males and females is the interruptions (or expected interruptions) in their careers, associated with marriage or the birth of children.

Another supply-side explanation of the gender difference in occupational status centers on presumed differences between the sexes in taste for nonpecuniary job attributes (Filler, 1983).

The main difference between these models and the one presented here is the assumption that hiring an employee has a fixed cost that an employer is unwilling to bear when the individual may choose a positive rate of absenteeism. To convince a potential employer to hire a female, the female candidate may choose a steeper wage-tenure profile or a higher amount of schooling than a male.

A different approach to analyzing wage differences is the "dual labor-market theory," which analyzes the conditions under which an economy creates primary jobs with high wages and better conditions and secondary jobs that offer lower wages and poorer conditions. This paper proposes mechanisms that allow females to enter the primary sector.

The main findings of this paper are that, in contrast to previous studies, females acquire a higher amount of human capital than males and have a steeper wage–tenure profiles. Both conclusions stem from the need to signal potential employers that the agent expects a low rate of absenteeism via a raise in her future wage (the cost of absenteeism). Another prediction made by the paper is segregation in the labor force. This segregation

occurs in two cases: if there are employers who can commit to an increasing wage–tenure profile (even if the profiles are inefficient ex post), females accept jobs with them. Notably, government may serve as an example of this kind of employer. If the number of employers who can commit to an increasing wage–tenure profile is limited, females are indifferent between overinvestment in schooling and joining the higher paying sector or joining the lower paying sector and withdrawing from the labor force after giving birth.

Previous models that analyze the gender gap focused on the supply side (the labor supply of females), which differs from males in one fundamental aspect: giving birth induces interruptions in working life or periods in which higher production at home lessens the amount of effort that can be invested in work. The model presented here proposes a different approach focusing on the demand side. Thus, future interruptions lessen the willingness of employers to hire females and, therefore, generate the need for a mechanism that enables females to become more committed to the labor force, hence lower their rate of absenteeism. This paper proposes two mechanisms. The first is a steep enough wage–tenure profile that, by deferring wages, increases females' incentives to stay in the labor force. The second is a higher amount of schooling chosen by females than by males; this schooling advantages raises females' future productivity (hence wages) and increases their cost of absenteeism. The mechanisms differ in a profound way: the first is efficient if one assumes a perfect capital market but is not enforceable ex post; the second is enforceable ex post but inefficient due to overinvestment in schooling.

This paper makes several empirical predictions. The first is a steeper wage–tenure profile for females, in order to encourage them to stay within the labor force (Gronau, 1988; Sorensen, 1990; Becker and Lindsay, 1994). The second is segregation within the labor force (Orazen and Mattila, 1998; Bayard, Hellerdtein, Neumark, and Troske, 2003). Another prediction of the model is that the increase in females' schooling or their entrance into "male jobs" will change the distribution of females among the sectors of the economy but will not change females' relative income (Mulligan and Rubinstein, 2004).

The rest of the paper is organized as follows: the next section reviews the related literature; Section 3 describes the model and presents the main results; Section 4 discusses an economy without information asymmetry (in which it is inefficient to invest the fixed cost associated with hiring a female), Section 5 discusses the main outcomes and makes

a policy recommendation that may enhance the welfare of the economy, and Section 6 concludes the paper and proposes further areas of research.

2 Related literature

Lazear and Rosen (1990) show, using a model that has two kinds of jobs - one with higher productivity in the second period and the other with higher productivity in the first period—that any employer would rather place the female (who has a lower expected tenure with the firm) in the second job and the male in the first one. Thus, the results of their paper is characterized by different threshold levels for the promotion of males and females. Their model differs from ours in their assumption that females are heterogeneous and that the only difference between the assignments of females to different jobs originates in the variance of their expected output in the second period. In their model, if the female population was homogenous, all of the females were either promoted or not promoted for different parameters of the economy.

Traditionally, females have had the main responsibility for the upbringing of children. If employers expect this to be the case also in the future, they will place female in jobs which can be combined with child care responsibilities. Given that female disproportionately can be found on jobs which allow them to take care of their children, with men over-represented on the fast track, the rational choice from a family viewpoint is that the male spends the most effort in the labor market while the female has the main responsibility for child care. The employer expectations have become self confirming. Lommerud and Vagstad (2000).

Breen and Garcia-Pensola (2002) propose a different mechanism to explain different career choices of females. They show that gender segregation in occupations may be the result of a case-based decisions about the difference in the probabilities of males' and females' success in different type of jobs. Their main finding is that this segregation may persist even when the probabilities are the same. In their model, agents have imperfect information about their probability of success in different occupations and base their career choices on prior beliefs about these probabilities, which are updated according to Baye's rule, implying that past gender differences in preferences of occupations affect the

beliefs of the current generation.

Salop and Salop (1976) show that a firm can discourage high turnover individuals from applying and encourages low turnover workers to apply for employment by increasing an employee's wage with his tenure at the firm, in their model the firm has recruiting cost and hence an advantage of hiring a low turnover workers. They show that, competition among the identical firms ensures that all the gains from sorting accrue to the scarce sector - low turnover workers.

Lazear (1979) provides a different model that predicts an increasing wage–tenure profile. He shows that it is optimal for firms and workers to have a payment scheme that pays workers less than their marginal product when they are young and more than their marginal product when they are old. By implication, there is some date at which the firm is no longer willing to pay the worker his current wage. When that date comes around, the worker is forced to retire. Such an agreement may be beneficial to both parties if it creates a mechanism that provides the worker with an incentive not to cheat his or her employer. The optimal wage structure for the inducing of effort will differ commensurate with the expected term of employment. As this period lengthens, flatter wage–tenure profiles will suffice to induce optimal effort. If the expected tenure within a firm is shorter for females, the wage–tenure profile will be steeper (Hersch and Reagan, 1997).

Weiss and Gronau (1981) analyzed male and female differences in investment in human capital. The main feature that makes a difference between males and females are the interruptions (or expected interruptions) in their careers associated with marriage or the birth of children. These interruptions do not merely result in the loss of current earnings; they also affect investment in human capital. The differences in the earning profiles of a male and a female prior to the interruption can be ascribed to differences in their anticipations while the difference after the interruption can be ascribed to the differences in their history. Thus, the differences between the earnings of males and females reflect both the loss of human capital due to past interruptions and the lower accumulation of human capital due to expected future interruptions

Hashimoto (1979, 1981) presents a model that predicts an increasing wage–tenure profile due to human -capital investment in the form of specific firm training. The model shows that due to the existence of transaction costs, both the firm and the employee share

the costs and benefits of an investment in specific human capital in order to reduce the likelihood of terminating the relationship (which occur if the firm fires the employee or the employee finds a better job), according to the variance of their alternative options. Under the assumption that females have a higher variance, due to their alternative of staying at home, as well as finding a new job, they have a steeper wage–tenure profile.

A different approach to the analysis of wage differences is the "dual labor-market theory." It explains the variance in employee wages and benefits in various sectors of the economy. The theory claims that an economy tends to create primary jobs with high wages and better conditions and secondary jobs that offer lower wages and poorer conditions. This theory differs from the human-capital theory in its assumption that employees are identical and that the discrepancy is created by excess demand for positions in the primary sector (Bullow and Summers, 1986). Our study claims that while employers prefer to hire males for the primary sector due to their higher expected tenure with the firm, females may join the primary sector if they signal their intention of staying in the labor force. They can do this in two ways: by establishing a steep wage–tenure profile and by obtaining a high level of schooling. Both devices guarantee their remaining in the labor force, in order to gain the future wage, which exceeds the value of their staying at home.

An explanation of the increase in female's participation rate and investment in acquiring of human capital is the introduction of the pill. The pill has altered female's career and marriage choices. Because up-front, time-intensive career investments are difficult for females with child care responsibilities, the pill encouraged female's careers by virtually eliminating the risk of unwanted pregnancy. Access to the pill have strong positive and statistically impact on the movement of collage females into careers like lawyers and medical doctors, professional careers requiring long-term investments. Goldin and Katz (2000), (2002). Buckles (2005) used Ben-Porath model of human-capital accumulation to provide a theoretical background for the study of the timing of career interruptions and career outcomes.

In the presented model, unlike other models, we develop a theoretical model that focuses on the demand side, i.e. the incentives employers are facing when having to choose between hiring male or female. The model enables us to explain that females acquire higher amount of schooling than males in the past few years, segregation between

male and female jobs and that females receive a higher tenure and schooling premium.

3 The Model

The presented model analyzes the demand size of an economy that consists of two sectors. An individual employed in the primary sector has a higher lifetime product but his employer entails a fixed cost; an individual employed in the secondary sector produces a lower lifetime product.

There are two kinds of agents in the economy: males with no home product and females who have a positive home product in the period after giving birth. The higher home product of females increases their incentive to absent themselves from the labor force. This rate of absenteeism may take the form of extended absenteeism but may also take the form of a divided effort between home and the market.

We assume that in the period after giving birth, every female has to choose her rate of absenteeism (which we refer to as a binary choice in this section). The rate of absenteeism from the labor force determines both her product in that period—the period after giving birth—and whether she accumulates additional human capital during that period.

The main assumption of the model is that the rate of absenteeism is private information known only to the female and her current employer. Consequently, the alternative wage of a female who has accumulated additional human capital is lower than her product. This external wage allows a female's current employer to lower her wage and diminishes her incentive to choose a zero rate of absenteeism. This assumption will be relaxed later.

3.1 The Economy

There are two kinds of agents in the economy: males and females, with a lifetime of T periods. We assume that home productivity takes the value of 0 prior to t_1, a value of C between t_1 and t_2, and a value of 0 between t_2 and T. To simplify matters, we assume that for males, $C = 0$. Any individual may choose his rate of absenteeism. An individual can choose a positive rate of absenteeism (and exert effort both at home and in the market) or exert effort only in the market. The cost of a positive rate of absenteeism

is lower production in the market and a lower investment in acquiring human capital at that period.

There are two kinds of firms in the economy, A and B. A Type A firms incur a fixed cost when hiring a new employee, Type B firms do not incur a fixed cost but each of their employees produces a lower lifetime product.

The timing of the model is as follows: each individual may go to school and the duration of his schooling is denoted by s. After finishing school, he joins either Sector B or Sector A. An individual who chooses Sector A joins a training program for a fixed duration - t_3. After the training program, his product rises. Females give birth at date t_1 and have a home product of C until period t_2. To simplify matters, we assume that for the optimal amount of schooling, s^*, $t_2 < t_3 + s^*$.

An individual who is employed in Sector A and produces only in the market (i.e., does not choose a positive rate of absenteeism) produces $\delta_2 e^{gs}$ ($\delta_2 > 1$) after the training period. An individual who chooses a positive rate of absenteeism produces $\delta_1 e^{gs}$ ($\delta_1 < 1$) during the period of absenteeism and $e^{g_A s}$ afterward. Where g denotes the marginal product of schooling.

The main assumption of the model presented is that the information about the rate of absenteeism is private and known only to the employee and his current employer. Consequently, external employers do not observe the rate of absenteeism that an individual chooses and, in turn, do not observe an individual product. Because this information is private, employers do not pay females wages that are equal to their product ex post (after the training period), females choose a positive rate of absenteeism, and employers who anticipate this will not pay the fixed cost associated with employing a female.

The intuition of this setup is this: Many jobs provide for an internship (or training) period. This period has two main attributes: timing (after schooling and before being hired for a professional position) and brevity. The paper analyzes an economy in which the date of giving birth giving falls within the internship period. As a result, the cost of exerting an effort during the internship period is higher for females than for males, or the cost of absenteeism is lower for males than for females. If external employers do not observe the rate of absenteeism chosen by females, females have an incentive to increase their rate of absenteeism. The results of this section are robust for an economy in which

the cost of exerting an effort is higher for females than for males at the start of their working life.

The assumed fixed cost is a basic assumption in the presented model, one can think of this cost as the employers cost of search or training a new employee. We will show later on the paper that it can be negligible without changing the qualitative results of the paper.needed only for the segregation result, and may be negligible without changing this result.

The production function of job j for an individual who does not choose a positive amount of absenteeism is given by

$$TP_j(s) = \mathrm{Re}^{sg}\left(\int_s^{t_3} e^{-rt}dt + \delta_j \int_{t_3}^{T} e^{-rt}dt\right) - FC_j \tag{1}$$

where s denotes the amount of schooling, $TP_j(s), j \in (A,B)$ denotes the total productivity of a Type j job, R denotes the price of a unit of human capital, r denoted the intrest rate and g denotes the marginal product of schooling. We assume that $\delta_A > \delta_B = 1, FC_A > FC_B = 0$.

We denote by s_j the amount of schooling chosen by an individual who plans a full working life. By differentiating equation (1) with respect to s, one can show that the optimal s_j is given by

$$s_A = T + t_3 + \frac{Ln\left(\frac{r-g_A}{e^{rT}g_A(\delta-1)-e^{rt_3}g_A\delta}\right)}{r} \tag{2}$$

$$s_B = \frac{\ln\left(e^{rT}(g_B - r)\right)}{r} \tag{3}$$

We assume that individuals care about the present value of their wage stream over their lifetime and plan a lifetime earning and participation program under conditions of certainty, competitive labor market and a perfect capital market.

Males enjoy a wage of Re^{sg} in a Type B job and a wage of $R\delta_2 e^{sg}$ in a Type A job during the period following the training period, since this is both their spot-market wage and their marginal product, and a wage of $\frac{e^{sg}\int_s^{t_3} e^{-rt}dt - FC_A}{\int_s^{t_3} e^{-rt}dt}$ during the training period in a Type A job, in which their wage smoothes.

Notice that the assumption regarding a competitive labor market is needed in order to generate the incentives which are necessary in order to produce the efficient investment in schooling. As a result, from this assumption, each worker receives his net productivity despite the fixed cost. Notice that any contract that smooth wage in the training period is both ex post and ex ante efficient, the fixed cost is carried out once and after that any worker gains a higher wage than his alternative and any firm receives a positive profit, and therefore self enforced.

Females' enjoy a wage of Re^{sg} in a type B job, since this is both their spot-market wage and their marginal product. Due to the private information regarding whether they acquired additional human capital, females' alternative wage in the period following t3, the end of the training period, is given by Re^{sg}. Note that females have the same alternative wage whether they acquired additional human capital or not.

Note that all the females who join sector A will choose a positive rate of absenteeism. This result stems from females' future wage; females enjoy the same alternative wage following the training period (t_3) whether they choose a positive or a zero rate of absenteeism. Hence, due to the cost of a positive rate of absenteeism all females will choose a zero rate of absenteeism.

We assume that if employers luck a way to commit to the entire wage-tenure profile they pay females their alternative wage.

Females who plan to join Sector A and choose a positive amount of absenteeism maximize

$$\mathrm{Re}^{sg_i}\int_s^{t_1} e^{-rt}dt + (C+\delta_1\,\mathrm{Re}^{sg_A})\int_{t_1}^{t_2} e^{-rt}dt + \mathrm{Re}^{sg_A}\int_{t_2}^{T} e^{-rt}dt - FC_j \tag{4}$$

We denote by s_{wA} the solution to equation (4) . Differnting equation (4) with respect to s_j, one can show that

$$s_{wA} = T + t_1 + t_2 + \frac{Ln\left(\frac{g_A - r}{g_A\left(e^{r(t_1+t_2)} + \left(e^{r(T+t_1)} - e^{r(T+t_2)}\right)(\delta_1 - 1)\right)}\right)}{r} \tag{5}$$

Using equation (1) ,one can show that

$$TP_A\left(s_{wA}\right) < TP_B\left(s_B\right) \tag{6}$$

As a result of the inequality captured in equation (6), females who cannot receive wages equal to their product with a Type A firm join Sector B.

We now add the assumptions that

$$\left(C + \delta_1 \operatorname{Re}^{s_A g_A} \int_{t_1}^{t_2} e^{-rt} dt\right) + \operatorname{Re}^{s_A g_A} \int_{t_2}^{T} e^{-rt} dt > \operatorname{Re}^{s_A g_A} \int_{t_1}^{T} e^{-rt} dt \tag{7}$$

Therefore, even though females generate a larger total product during the rest of their lifetime than their product at home, it is not "high enough," due to the assumed private information about whether an individual has acquired additional human capital or not, in order for a female not to choose a positive rate of absenteeism after she gives birth. Given this assumption, there is no efficient ex post contract and, for this reason, no enforcement contract, that can generate the incentives that are necessary to induce females to invest in the s_A amount of human capital. Note that when the inequality (7) is reversed, the economy can generate the right incentives to induce both types of agents to choose Type A jobs.

The assumption regarding a constant C and t_2 is made in order to simplify the algebra and characterize the value of home product and the period in which it is optimal for females to stay at home. Weiss and Gronau (1981) assumed that C decreases with time and, therefore, that females' return to the labor force is determined endogenously. In our model, one can analyze a case in which t_2, the date after which the value of home product equal C, is different in a Type A job than in a Type B job. This assumption does not affect the qualitative results of this paper. Alternatively, one may refer to C as the cost of daycare.

Therefore, we can conclude:

Conclusion 1: Males enjoy a raising wage-experience profile.

Conclusion 2: When the firm can commit to the entire wage contract it chooses a raising wage-tenure profile for females in order to recruite them.

Conclusion 3: When the firm cannot commit to the entire wage contract the labor market is segregated: females choose a type B job and males choose a type A job.

The paper assumes that males and females differ in one profound way: females cannot signal to external employers whether or not they acquired additional human capital after giving birth. This inability encourages females not to acquire additional human capital.

The equilibrium is characterized by males employed in Type-A jobs and females employed in a Type B jobs or employed by employers who can commit to a rising wage-tenure profile.

Orazem and Mattila (1998) find a higher percentage of females in governmental jobs. Conclusion 2 predicts that females who do invest in schooling would rather be employed by firms that can commit to the entire wage contract. Assuming that it is easier for government to commit than for a competitive firm, females would rather be employed in a governmental job. Previous explanations regarding different job characteristics, such as more flexible hours in government work, cannot explain females' behavior in governmental jobs in fields such as nursing.

Notice that the force generating these results is the assumption captured in equation (7). This assumption can be maintain regardless of the fixed cost. As a result of this assumption the firm must offer an increasing wage tenure profile. For example, let us assume that $FC = 0$ but the firm cannot commit to an increasing wage tenure profile. In this case, all females choose a positive rate of absenteeism and any female who internalizes it chooses an amount of schooling of s_B. Thus, this result is attained even when the firm can choose an amount of FC and not take it as exogenous. The only result which we need a positive fixed cost in order to obtain is the result of segragat labor force.

3.2 Schooling as a signaling device

In this section we assume that firms do not have a way to commit to a contract that cannot be enforced ex post. Therefore, in the previous setup, employers lack a way to commit to a wage profile that induces females not to choose a positive rate of absenteeism in the period after they give birth. Firms and females internalize this and the economy forces females into Type-B jobs. To overcome this inefficient scenario, females need to increase their future productivity in order to raise the cost of absenteeism.

The presented model suggests another way of increasing future wage. By choosing to increase their amount of schooling, females increase their future productivity and, in turn, their wages. As a result, the cost of absenteeism rises. The higher future productivity of females allows employers to design a contract that is efficient ex post and hence self enforced, thus allowing them to recruit females for Type A jobs. Females who over invest

in schooling generate a higher lifetime product in Type A jobs than in Type B jobs and, as a result, enjoy a higher lifetime wage.

To generate a contract that is enforceable, females need to acquire the amount of schooling that is necessary for the right and left side of equation (7) to be equal. Notice that this is a larger amount of schooling than that of males who choose the optimal amount of schooling.

Therefore female choose s^{com} such that

$$\mathrm{Re}^{s_{com}g}\left(\int_{t_1}^{t_2} e^{-rt}+\delta_2\int_{t_2}^{T} e^{-rt}\right)=\left(C+\delta_1\,\mathrm{Re}^{s_{com}g}\right)\int_{t_1}^{t_2} e^{-rt}dt+\delta_2\,\mathrm{Re}^{s_{com}g}\int_{t_2}^{T} e^{-rt}dt \quad (8)$$

One can show that

$$e^{s^{com}g}=\frac{C}{R\left(1-\delta_1\right)} \quad (9)$$

This amount of schooling (The amount of schooling that females need in order to increase their future productivity) gives females an incentive not to choose a positive rate of absenteeism after giving birth. As a result, employers are willing to recruit females for type A jobs and to bear the fixed cost.

We denote

$$TP_A\left(s^{com}\right)-TP_B\left(s_B\right)\equiv\pi$$

Thus, π represents a difference in lifetime productivity between the two kinds of jobs. Notice that due to the observation that $s^{com}>s_A$, π is not necessarily positive.

We can conclude:

conclusion 5: When $\pi>(<)\ 0$ females choose an amount of schooling of $s^{com}\left(s_B\right)$

Proof. Straightforward, using equation (8) ■

When $\pi>0$ this amount of schooling generates a surplus which allows females to commit not to choose a positive rate of absenteeism and exert effort only at the market after giving birth.

conclusion 6: $TP_m>TP_f$

Proof. Straightforward, using equation (8) ■

Intuitively, females maximize their productivity without restrictions while males do so without any restrictions.

There is an obvious inefficiency stemming from Conclusion 6: females choose a higher amount of schooling, decreasing their lifetime productivity in order to generate a higher productivity later in life. This inefficiency reduces females' lifetime wage.

What are the properties of the mechanism that assign females to different jobs? Three such mechanisms exist. The first is random; if the number of firms that can commit to a raising wage–tenure profile is limited, price reductions cannot change this number. Even though changing prices cannot generate more jobs in which firms can commit, the firm can reduce wages in these kinds of jobs, making them less appealing to males. This kind of mechanism appears in Bullow and Summers (1986). One way to extend our model is to add heterogeneity ability and conclude a different ability threshold necessary to be employed in a Type A job for members of a different sex; this kind of mechanism appears in Lazear and Rosen (1990). Notice that, in the absence of a liquidity constraint or heterogeneity, R is determined in such a way that females are indifferent between the two sectors or that make each gender prefer a different sector. The parameters that make females indifferent between the two sectors satisfies the following:

$$R = \frac{C\int_{t_1}^{t_2} e^{-rt} + FC}{e^{s^{com}g}\int_{s^{com}}^{s^{com}+t_3} e^{-rt} + \delta e^{s^{com}g}\int_{s^{com}+t_3}^{T} e^{-rt} - e^{s_B g}\int_{s_B}^{T} e^{-rt}} \tag{10}$$

where s_B is given by the equation (5).

The model has two equilibria. In the first equilibrium, females are indifferent toward overinvestment in schooling (s^{com}) and being employed in Sector A or investing $\left(s^B\right)$ and being employed in Sector B. Males invest $\left(s^A\right)$ and are employed in Sector A. The price of human capital in this equilibrium is R and the amount of schooling chosen by females who join Sector A is s^{com}, which is jointly determined by both equations (9) and (10). The second equilibrium is characterized by males employed in Sector A and females employed in Sector B. In this equilibrium, like in Ben-Porath (1967), R is exogenous and can be found within a general equilibrium framework. Note that firms have zero profits in both equilibria.

By using a comparative static, one can show that an increase in T or in g reduces s^{com}, in contradiction to the standard human-capital theory. An increase in C causes s^{com} to increase. Intuitively, g determines an individual's product and the cost of choosing a

positive rate of absenteeism. The price of a positive rate of absenteeism is a function of T as well, due to the assumption that it determines the length of the period in which females produce less due to lower investment in human capital.

One of the basic premises of the model is that the date of giving birth is exogenous. We now relax this assumption and allow females to choose the date they give birth.

We use $COST$ to denote the cost of postponing the date of giving birth from t_1 to $s + t_3$, and $deff = TP_A\left(s^{com}\right) - TP_B\left(s^B\right)$.

conclusion 7: Females postpone their birthgiving date to $s_{tr} + t_3$ and behave like males (females do not postpone the date of giving birth to $s_{tr} + t_3$ and behave like females) when $deff > COST$ ($deff < COST$)

Intuitively, if females give birth at the end of the training period, there is no private information; females have acquired the additional human capital and there is no need to signal the fact to external employers. Note that in the economy analyzed, due to the assumed binary technology (an individual either acquires additional human capital or does not), neither females nor employers have an incentive problem. As a result, females can commit to the date of giving birth.

The paper's main results can be reached using only schooling and general training. A setup that contains specific on-the-job-training can produce the same outcome as well. The properties of such a contract is described in the appendix.

4 Choice of effort

This section of the paper analyzes an economy in which the cost to females of exerting an effort at the start of their working life is higher than males'. The main result of this section is that employers who internalize it would prefer to hire males as their interns than to hire females. This increases males' human capital via better training. As a result, males generate a larger lifetime product and, in turn, receive higher wages.

In the standard analysis of human-capital acquisition, the investment is made at a decreasing rate. Thus, in a model containing different jobs that provide different quantities or qualities of training, the training an individual receives early in working life is crucial in gaining a higher lifetime wage. An individual who cannot be employed at a job that

provides training has less of an incentive to acquire human capital earlier in life. An employer of an individual who may withdraw from the labor force later internalizes the employee's lower incentive of acquiring human capital and, as a result, is unwilling to train and invest in this kind of employee.

In this section we assume that each individual who is employed in Sector A can join a training program (or take an internship) for fixed duration t_3. During the training program, an individual who exerts an effort of $1(0)$ produces $p\,\mathrm{Re}^{sg}$ $(q\,\mathrm{Re}^{sg})$ $(1>p>q)$. Following the training program an individual who exert an effort of $1\,(0)$ pwe^{sg} (qwe^{sg}) $(w>\delta_2)$ in the reminder of his or her working life.

Hence, an individual who plans to join the training program and exert an effort of $1(0)$ produces

$$p\left(e^{gs}\int_{s}^{s+t_3}e^{-rt}dt+we^{gs}\int_{s+t_3}^{T}e^{-rt}dt\right)-FC_A \tag{11}$$

$$q\left(e^{gs}\int_{s}^{s+t_3}e^{-rt}dt+we^{gs}\int_{s+t_3}^{T}e^{-rt}dt\right)-FC_A \tag{12}$$

where s denotes the amount of schooling.

By differencing equation (11) with respect to s, one can show that the optimal s, denoted by $s_{tr}\,(eff)$, is given by

$$\begin{aligned}0=&-(1-p)\,e^{s_{tr}g_A+r(s+t_3)}+\frac{e^{g_As-r(s+T+t_3)}\left(e^{rT}-e^{r(s+t_3)}\right)(1-p)\,(g-r)}{r}+\\&p\left(\frac{e^{gs-r(s+t_3)}\left(e^{rt_3}-1\right)(g-r)}{r}-we^{g_As+r(s+t_3)-r(s+T+t_3)}+\frac{we^{g_As_{tr}-r(s+T+t_3)}\left(e^{rT}-e^{r(s+t_3)}\,(g-r)\right)}{r}\right)\end{aligned} \tag{13}$$

We use $TP_{tr}\,(s_{tr},eff)$ to denote the lifetime product of an individual who join the training program. $eff\in(0,1)$ denotes whether the individual would exert an effort (1) or did not exert an effort (0). We denote by $V_m\,(0)$ $(V_f\,(0))$ and by $V_m\,(1)$ $(V_m\,(1))$ the disutility of effort of male (female).

We add the following assumptions:

$$V_m\,(0)=V_f\,(0)<V_m\,(1)<V_f\,(1) \tag{14}$$

$$TP_{tr}(s_{tr},1) - V_f(1) < TP_A(s_A) < TP_{tr}(s_{tr},1) - V_m(1) \tag{15}$$

The first equation captures the assumption that a female incurs a higher cost for exerting an effort due to her childraising cost. The second equation captures the main assumption, i.e., it is inefficient for the economy to generate the incentives that are needed to encourage females to exert effort in the training program and males generate a larger product if they join the training program than if they do not. The result of this assumption is that males always join the training program.

Conclusion 7: When $TP_{tr}(s_{tr},0) - V_m(0) < TP_A(s_A)$, males join the training program, exert effort of 1, and receive a wage of $\frac{pe^{gs}\int_0^{t3} e^{-rt}dt - FC_{tr}}{\int_0^{t3} e^{-rt}dt}$ during the training period and a wage of pwe^{gs}, folowing the training period. Due to their lower product within the training program, females do not join those programs.

Conclusion 8: When $TP_{tr}(s_{tr},0) - V_f(0) > TP_{tr}(s_{tr},1) - V_m(1)$, both males and females join the training program, do not exert an effort, and receive a wage of $\frac{qe^{gs}\int_0^{t3} e^{-rt}dt - FC_{tr}}{\int_0^{t3} e^{-rt}dt}$ during the training period and a wage of qwe^{gs}, folowing the training period.

Conclusion 9: When $TP_{tr}(s_{tr},1) - V_m(1) > TP_{tr}(s_{tr},0) - V_f(0) > TP_A(s_A)$, both males and females join the training program. Males exert effort of 1; females do not exert an effort. Males receive a wage of $\frac{pe^{gs}\int_0^{t3} e^{-rt}dt - FC_{tr}}{\int_0^{t3} e^{-rt}dt}$ during the training period and females receive $\frac{qe^{gs}\int_0^{t3} e^{-rt}dt - FC_{tr}}{\int_0^{t3} e^{-rt}dt}$. After the training period, males receive a wage of pwe^{gs} and females receive a wage of qwe^{gs}.

Proof. Straightforward, using equations (14) and (15). ■

Notice that, in the economy analyzed, males and females who join Sector A do not have an incentive problem. Both choose the optimal amount of effort, which may be either 1 or 0.

In the economy analyzed in this section, we assume that there are parameters within which it is inefficient to incur the fixed cost associated with hiring a female. Because this is assumed, females have a lower incentive to invest in human capital. This section also offers an intuition for an economy in which employees do not choose whether to have a positive rate of absenteeism or not but do choose the rate of absenteeism Under this

setup, one may think of the rate of effort 0 as the optimal effort for a female and rate of effort 1 as the optimal amount for a male.

5 Discussion

The model presented here proposes a different approach to analyzing the well documented observation that males' wages surpass females'. It shows that when firms cannot commit to the entire wage–tenure profile, they cannot produce a contract that can maintain a female working full time after she gives birth. Notably, under the assumption of a perfect capital market when firms can commit to the entire wage contract the outcome is Pareto optimal and females acquire the optimal amount of human capital.

If there is no way for the firm to commit to the entire wage–tenure profile, the outcome is no longer efficient. Females overinvest in schooling in order to convince potential employers to hire them by making a commitment to a low rate of absenteeism after giving birth. In other words, if the firms lack a way to commit, the economy cannot opt for the first best solution and must shift to the second-best one. This solution is characterized by overinvestment in human capital by females. Thus, it facilitates an inefficient way to commit.

Another result of this paper is that, as long as the parameters are such that the product of females after giving birth is lower than their home product, females have a steeper wage tenure profile than males, and as long as firms cannot commit to the entire wage contract, females will choose to acquire more schooling than males do. This results is inefficiency and lower females' lifetime product and wage. Females invest in acquiring human capital and enjoy a tenure (or experience) wage profile similar to males when the value of home product (C) is lower than their market product at t_1. Note that C may be a function of g as well (via spouse's wage).

The main policy device that may enhance females' attachment to the labor force and encourage them to acquire the optimal amount of schooling is one that permits to firms or workers to commit to a long-term employment contract. Even if this inefficient ex post, one way to induce such a mechanism is to encourage unions in female-dominated sectors, another way is to lower mother's income tax. Another is to subsidize daycare, especially

daycare provided by firms, which lowers C while increasing females' attachment to their employers. A third way is to raise females' retirement age. These mechanisms generate a Pareto improvement that enhances females' utility as well as firms' profits. Another policy device is to subsidize the acquisition of human capital by females so that females with liquidity constraint can increase they investment in human capital and allow them to commit to a long working contract.

6 Conclusion

The paper presented highlights a different approach to the analysis of the gender gap. The paper contrasts employer's incentives for hiring females to their incentives for hiring males. This different approach elicits new insights on females' incentives in choosing occupations and amounts of schooling. We show that when employers cannot commit to a wage structure that is not efficient ex post, or when females face a liquidity constraint, the workforce is segregated. To counter the segregation, females may overinvest in schooling and thereby signal their intention of a low rate of absenteeism.

The difference between males' and females' wages is a well documented empirical observation valid across countries and time. Additional evidence documents a steeper wage–tenure profile of females than of males. This paper argues that this steeper wage profile may serve as a signaling device to potential employers as to females' expected rate of absenteeism. Any female who is indifferent between the two sectors can, due to a liquidity constraint, choose the secondary sector (type B job) and when she has the opportunity to overcome the liquidity constraint, she may choose the second sector. Therefore, a rise in income that allows females to overcome the liquidity constraint may move them to switch sectors.

The main empirical prediction of our model is that the more schooling a female has, the higher her return to tenure. Another promising direction for further research is to augment the model with additional abilities and to find a different amount of schooling chosen by individuals as a function of both their abilities and their gender.

7 Appendix A

This appendix shows that the results of the paper can be achieved in a continuous setup that allows for on-the-job training.

Let us assume that training has both firm -specific and general aspects. An individual's lifetime product, is given by

$$TP_A = \int_0^T (\alpha k (1 - x_t))\, dt - FC \tag{16}$$

$$\dot{k} = \beta_0 (kx)^{\beta_1} - \delta x \tag{17}$$

where x denotes the share of time devoted to training and k denotes the individual's human capital.

The individual's alternative (his product if he chooses a positive rate of absenteeism) is given by

$$TP_{abs} = \gamma \int_{t_2}^T k (1 - x)\, e^{-rt} \tag{18}$$

where $\gamma < 1$.

Notice that we allow training in these jobs as well.

Males problem is given by maximizing equation (16), subject to equation (17).

Notice that the accumulation of human capital enhances the individual's alternative as well as his or her product within the firm. Thus, a contract that smoothes wage is not enforceable ex post if γ is high enough. In this setup, any individual enjoys a rising profile of wage tenure (or experience) even if the firm can commit to the entire wage contract.

We define P_m as the male "demand price" of human capital.

$$P_m (t) = \int_t^T \alpha_0 k (t)\, e^{-rt} d\tau \tag{19}$$

We denote by $X_m (t)$ the optimum path of a male's investment in training, which is given by equating P_m to the marginal cost of training, expressed as

$$MC (k, t) = ak_t \tag{20}$$

One can show that $X_m(t)$, as well as the female's investment in the period following t_1, which is given by

$$\left(\frac{k^{1-b_1}(r+d)}{(1-d)\,b_0 b_1\left(1-e^{(r+d)(T-t)}\right)}\right)^{\frac{1}{b_1-1}} = x \tag{21}$$

In the period before t_1, females maximize equation (16) subject to the following constraint, which ensures their future participation after birthgiving:

$$\int_{t_1}^{T} k(1-x)\,e^{-rt} \geq \int_{t_1}^{t_2} \left(C+\gamma_1 k(1-x)\right)e^{-rt} + \gamma \int_{t_1}^{T} k(1-x)\,e^{-rt} \tag{22}$$

where $\gamma_1 k(1-x)$ is the product of an individual who choose a positive rate of absenteeism at the period of absenteeism.

We use Kt_1 to denote the amount of human capital that solves equation (22). The additional female constraint can be given by

$$k(t_1) \geq Kt_1 \tag{23}$$

The female problem is given by:

$$H = \alpha k(1-x_t) + \lambda\left(\beta_0 (kx)^{\beta_1} - \delta x\right) \tag{24}$$

Therefore, $\dot{\lambda}$ is the same as the corresponding parameter for males. Hence, λ rises by a fix amount in each period. In this setup, for any given k and t the cost of acquiring additional human capital is the same for both males and females but the benefits are higher for females before t_1 due to their need to acquire a constant amount of human capital by date t_1. In the function selected, one may show that

$$\alpha k = -\dot{\lambda} + \alpha(x-1) \tag{25}$$

Therefore, for any given t individuals invest more in training in order to attain a higher k. As a result, females invest more in training both before and after t_1 and acquire more training than males acquire. Consequently, females amass less total life product than males and receive a lower lifetime wage. However, females' alternative wage later in life surpasses that of males. Thus, their firms should pay them a higher wage later in life in order to retain them.

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