Haverford College

Department of Economics

Senior Thesis

# Stuck for Life: A Firm-Specific Human Capital Explanation of the Male Marraige Premium

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**Abstract**

I argue that household specialization and investment in firm-specific human capital explain the male marriage premium. First I develop a model of human capital in which to-be-married men invest in human capital over two rounds. The promise of high returns to the *second* round of investment encourages firms to offer high wages before the *first* round, so that wages do not change upon marriage. The model has two other predictions, that among the self-employed wages should increase upon marriage, and that the cross-secional marriage premium should have declined over time. Using the Panel Study on Income Dynamics and the 2000 US Census, I find evidence in support of each of these predictions. Evidence from the self-employed suggests that marriage increases productivity by 20%, via the increased accumulation of human capital.

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# 1 Introduction

The male marriage premium is a robust finding of empirical labor economics: a regression of hourly wage against a host of demographic and human capital characteristics suggests that married men earn 10-20% more than their unmarried counterparts. This result has been documented at least since 1940, and continues until today (Loh, 1996). Initial theoretical explanations for the male marriage premium centered on the division of labor within the family. Since traditionally men specialize in market production while women work in the home, married men have a greater incentive to invest in human capital (specific to the market) and also more time for investing; therefore married men are more productive and have higher wages than do unmarried men (Becker, 1991).

Early empirical estimates of the male marriage premium are confounded by the endogeneity of marriage: even if earnings themselves do not increase the probability of marriage, then still marriage might be correlated with traits that are also associated with higher earnings, such as responsibility or loyalty. Studies that attempt to control for selection-into-marriage bias have produced mixed results, but by and large they call into question the notion that marriage enhances productivity; instead it merely signals productivity to econometricians. Although other explanations of the male marriage premium focus on how marriage and family formation might induce additional effort and therefore higher wages (see, e.g., Lundberg and Rose, 2002), these explanations cannot be correct, since the evidence from fixed-effects models largely suggests that wages do not increase upon marriage.

Labor economists have been content to take this finding as an explanation for the marriage premium: since marriage and wages are both correlated with unobserved characteristics, those characteristics explain the marriage premium. But this explanation does not follow from a careful development of the theory. In particular, if marriage improves productivity by providing incentives to invest in human capital, then lifetime income will increase, but income upon marriage will not. In the fixed effects specificaiton that implicitly equates wage with productivity, marriage will appear to have no impact on productivity.

In this thesis, I develop this approach to marriage and generate and test three predictions. First I predict that the return to marriage will be earned before and after marriage; second, that among the self-employed, the returns to marriag will be felt exclusively after marriage; and third, that the size of the average marriage premium depends positively on the average length of marriage and the degree of specialization within marriage. To test the first two hypotheses, I use the Panel Study of Income Dynamics. The PSID is advantageous because, as a panel data set, it tracks individuals over time. Also, unlike many other publicly available data sets, it contains information on the equity as well as the income of the self-employed. Its limitations are that it is relatively small and therefore it is difficult to determine whether the marriage premium as an independent phenomena declines over time, or whether it increases with age. To address this question, I use data from the 2000 Census and estimate within-age-cohort marriage premia.

The remainder of this paper is organized as follows. In section 2, I review the literature on the male marriage premium. I highlight specialization and selection as explanations for the premium, and show that the evidence in support of each explanation is only mixed. In section 3 I present the theory of human capital and the returns to marriage, and develop new predictions. In section 4 I review my data sources and their evidence. Section 5 concludes.

## 2 Literature Review

Becker (1991) develops a theory of the family predicting that husbands earn more than unmarried men. In his framework, individuals have a utility function U(.) evaluated on commodities $Z_i$. Each commodity requires some input of goods $x_i$, which are purchased at market price, and some input of time; they are produced and consumed within the household. Individuals can invest in two forms of human capital, for market and household production. The wage rate is proportional to the level of market capital, while investments in household capital reduce the amount of time required to make a single commodity, given the inputs, and therefore increase the return to a unit of time spent on home production.

Becker analyzes households with infinitely lived individuals; after a brief run up of capital acquisition, individuals will invest in new capital each year only to replace depleted capital. The cost of investing is foregone consumption. If individual members of a household have differing comparative advantages(differing initial stocks of market and household capital) then Becker shows that at most one member of the household will engage in both household and market production, and at most one member (the same one) will invest in both market and household capital (Theorems 2.1 and 2.2). Since traditionally men have worked in market activities while women have traditionally specialized in home production, marriage influences wages by enabling men to specialize in market production. The extra time spent on market production increases the return to investment in market capital, and therefore (taking marital status as exogenous) in the steady state husbands have higher levels of market capital than do single men. As wages increaes with to market capital, married men earn higher wages as well. Becker's theory of the family implies that the observed marriage premium is due to the productivity gains associated with higher investments in human capital.

Becker's work suggests that marital status introduces differences in the earnings of men and women, and therefore suggests that some of the gender gap may be due to the marriage premium. Some of the earliest explicit measures of the male marriage premium followed up on this insight.[1] In a cross section of 272 employees of a single firm in 1969 and 1970, Malkiel and Malkiel (1973) estimate a marriage premium of 15-18% for men, and zero for women. Oaxaca (1973) reports an 18% marriage premium for white men and a 9% premium for white women in a cross section drawn from the 1967 Survey of Economic Opportunity, controlling for education, occupation, industry and experience. Following up on Oaxaca's work, Neumark (1988) reports a male marriage premium of 15%, versus a female premium of zero, controlling for education, experience, age, and region of the United States, in a sample drawn from the 1980 wave of the National Longitudinal Survey of Young Men (NLSYM).

Although these studies persistently report a positive and large marriage premium, they are not concerned with validating marriage as an instrument for human capital or as a predictor of wage differentials. Hill (1979) provides one of the first attempts to measure a marriage premium. Using cross sectional data from the 1976 wave of the Panel Study of Income Dynamics (PSID), Hill finds a 29% marriage premium for white men, controlling for education, location, and potential experience and its square. In the same regression Hill estimates a premium of 3% per child under 18 living in the family unit, and a divorce premium of 26% for white men relative to never married men. The latter result might be taken to mean that married men invest more in human capital and, even

[1] Although I have been citing Becker's 1991 Treatise, he proposed many of the ideas on family formation and human capital acquisition in a pair of 1962 articles.

upon ending marriage, the investment remains. On the basis of these estimates, Hill concluded that marriage and presence of children both captured some aspect of human capital acquisition.

This work and the reported estimates are purely descriptive; they provide no explanation for the marriage premium. Although a positive coefficient on the marital status dummy variable provides evidence in support of Becker's specialization hypothesis, and more generally in support of Becker's theory of the family and the allocation of time, the cross sectional correlation between wages and marital status could be explained by a number of other factors. Before accepting the claim that marriage enhances productivity via specialization, we should evaluate the theory's specific predictions. The specialization hypothesis predicts that:

1. Married men should spend less time on housework than unmarried men, housework should have a negative influence on wages (assuming housework in previous periods is correlated with housework in the current period), and controlling for hours spent on housework should reduce or eliminate the observed, adjusted marriage premium.
2. Even controlling for time-invariant, unobserved characteristics, such as ability and interpersonal skills, the marriage premium should persist in some form or another, since married men will still have more time to invest in human capital.
3. Realizing that in the future they will work more hours, men who plan to get married should invest in more human capital at a younger age; married men should have faster wage growth after marriage, since they have more time for investing in HC. Never married men will earn less than ever-married men, even before the latter enter marriage.

Efforts to test these hypotheses have produced mixed results. Chun and Lee (2001) argue that since wives who work are less able to do the housework of their husbands, the presence of a wife who works ought to be negatively associated with wages. But one cannot regress wages against a dummy variable equal to one for employed wives, because wives of low-income husbands may be forced to work. Chun and Lee therefore adopt an instrumental variables approach. They construct an exogenous measure of wife's labor force participation by regressing hours worked against a number of explanatory variables, including two that they take to be exogenous: whether the couple lives with a relative and the labor force participation rate of women in the state. Chun and Lee estimate that the 14% cross-sectional marriage premium in the 1999 Current Population Survey is completely accounted for by two variables: whether the wife works and the number of hours that she works. Bardasi and Taylor (2005) also provide moderate support for the specialization hypothesis. In a fixed-effects specification, they show estimate a small marriage premium that decreases slightly upon controlling for household chores. The premia they estimate, however, are small and often statistically insignificant. With the full controls, it is equal to one percent and insignificant. Controlling for the number of children but not wife's chores, they estimate a premium of 3% with a t-value of 1.78 (which implies p=0.075).

Korenman and Neumark (1991) also provide strong evidence in favor of the specialization hypothesis, using two data sets. In a cross-sectional specification from pooled data from the 1976, 1978, and 1980 waves of the NLSYM, Korenman and Neumark report a male marriage premium of 11%, controlling for experience, schooling, region, and urban location. They also report a cross-sectional premium of 22% for a sample of employees working in a single firm. In a fixed effects specification, the marriage premium in the NLSYM sample falls to 6%. Arguing that the gains of marriage are unlikely to accrue to an individual upon uttering the words "I do," Korenman and Neurmark control for length of marriage and its square, however, and find that the gains of marriage

are purely quadratic (and concave down), with no intercept shift. They continue their analysis by studying the marriage premium in a single Massachusetts manufacturing firm. Multinomial logit regressions on the probability of promotion and positive evaluation within the firm, moreover, suggest that the marriage premium can be entirely decomposed into two effects: higher probability of promotion, and superior evaluations within job grade. As Korenman and Neumark note, their results suggest both that more productive men are selected into marriage, and that, even conditional on those characteristics, marriage is associated with faster earnings growth, since the premium persists in the fixed effects specialization using the NLSYM data set.

Using a similar design, Mehay and Bowman (2005) investigate the marriage premium among college-educated officers in the United States Navy. Their sample is drawn from officers who began their career between 1977 and 1985. Mehay and Bowman also find that marriage is strongly associated with the increased probabilities of promotion; they estimate a marginal impact of marriage on the probability of promotion equal to 5.5 percentage points. They find similar results for the probability of obtaining a favorable evaluation, and since job grade and evaluation entirely determine compensation, their results are consistent with Korenman and Neumark. To control for the possibility of selection into marriage biasing their results, they use an OLS framework to compare the wages of married men with those of men who will marry but have not yet done so. Men who will marry but have not yet done so earn 3.2 additional points on their evaluations than do men who will never marry; married men earn 10.3 more points. All three differences are statistically significant, and suggest that marriage has an independent impact on performance. This conclusion, as in Korenman and Neumark, depends on the hypothesis that supervisor evaluations reflect productivity.[2]

If it is problematic to assume that evaluators are not biased, then other ways of controlling for ability are necessary. The simplest procedure is to adopt a fixed effects specification, to compare workers to themselves before and after marriage. Stratton (2002) takes this approach to a sample drawn from the National Survey of Families and Households (NSFH). Using data from 1988-89 and 1992-1994, Stratton finds that the cross-sectional adjusted marriage premium of 10% persists despite controlling for fixed effects. Including a variable equal to one plus the log of number of years married, however, eliminates the intercept-shift component of the marriage premium and suggests that a one percent increase in the number of years married is associated with a 0.09 percent increase in wages, all else equal. Average marriage length in her sample, however, is 13.6 years; taken with her estimate of the yearly returns to marriage, the implied average marriage premium is 12.4%. Akerlof (1998), using the 1985-1993 waves of the NLSYM, estimates a cross-sectional marriage premium of 8.6% that reduces to 4.3% in a fixed effects specification, controlling for the usual culprits. Akerlof finds no evidence, however, that the returns to marriage increase overtime; rather he attributes the impact of marriage on wages to changes in behavior, the adoption of a more responsible life style.

In a somewhat different approach, Ginther and Zavodny (2001) attempt to quantify the impact of selection-into-marriage bias by examining the marriage premium following "shotgun weddings." Ideally, to understand the impact of marriage on wages, one would need an exogenous and random source of variation in marriage. Ginther and Zavodny suggest that marriage following unplanned pregnancy, a shotgun wedding, provides just such a source of variation, because shotgun weddings are by definition unplanned. Thus comparing the "shotgun wedding premium" to the traditional marriage premium indicates how much of the male marriage premium is due to selection. Estimating

[2]Korenman and Neumark are quick to aknowledge this, and provide evidence in favor of this assumption.

this difference, Ginther and Zavodny find that selection accounts for at most 10% of the male marriage premium.[3]

Antonovics and Town (2004) control for ability by comparing married and unmarried monozygotic twins. In their cross section, married twins interviewed in 1994 earned 19% more than unmarried twins in the sample, controlling for usual characteristics. Comparing married twins to their unmarried brothers, however, implies a 26% return on marriage, and thus lends strong support to the notion of marriage as productivity enhancing. Antonovics and Town;s sample is small, however, containing just 272 observations, of which 41 are married. Krashinsky (2004), also using a sample of twins, estimates a cross sectional marriage premium of 26% among the twins, but controlling for twin-specific genetic endowments (as in Antonovics and Town), find a statistically insignificant marriage premium of 7% (with a standard error of 6.1). In the same study, Krashinsky attempts to control for selection bias also by studying the marriage premium in the CPS using panel data and controlling for scores on the Armed Forces Qualifying exam, a measure of intelligence and ability. In both specifications, Krashinsky estimates a marriage premium that is not significantly different from zero. Loh (1996) also controls for genetic variation in ability significantly different from zero. Loh (1996) also controls for genetic variation in ability by comparing brothers to each other using the 1990 wave of the NLSY; between married and unmarried brothers, he finds no marriage premium.

Krashinsky's and Loh's estimates militate against the notion that marriage improves productivity; rather the marriage premium may reflect the correlation between productivity and marriage. Cornwell and Rupert (1997) find similar evidence in the NLSYM, using the same waves as Korenman and Neumark (1991), but also more recent data. They note that the majority of marital status changes in the Korenman and Neumark sample are either divorces or remarries, and therefore there is little within person variation in marital status among those who get married at all. Expanding the sample to include the 1971 data as well as the later years and re-estimating the fixed effects equations, Cornwell and Rupert find a marriage premium of 5-7%, consisting only of an intercept shift and no differences over time. This result is much more believable: although Cornwell and Rupert fail to note it, Korenman and Neumark's estimates imply that the returns to marriage are maximized after 11.46 years (in the fixed effects specification), and that after 24.2 years of years of marriage, a married man should expect his wages to decline relative to a comparable unmarried man. That result, though possible, is not in any sense predicted by theory and could be an artifact of Sanders and Neumark's restrictive functional form and their small sample, in which the mean marriage length is 7 years.[4]

In a more recent sample, Hersch and Stratton (1997), using the same data as Stratton (2002), find that, on average, married men spend 17.95 hours on housework while unmarried men spend 18.31 hours on housework. Fixed effects regression confirm that the differences in housework are too small to account for the marriage premium: controlling for time spent on housework suggests a marriage premium of 8.7% that does not vary with time. Although time spent on housework is associated with lower wages, including it in the regression does not imply a marriage premium of zero.

[3]One might well wonder about the validity of this instrument. Akleroff, Yellen, and Katz (1996) show that between the 1960s and 1990s, shotgun weddings as an actual institution essentially vanished. Although couples might choose to marry soon after conception, the perceived social necessity of doing so had largely disappeared, thanks in large part to the prevalence of abortion.

[4]If the quadratic is the wrong form, then it is possible that the marriage premium could be felt mostly over time, despite Cornwell and Rupert's contrary evidence.

Thus the evidence in favor of Becker's specialization hypothesis is mixed. The observation that married men spend any time at all on housework ought to cast doubt on the specialization hypothesis. Yet while housework appears to have an impact on wages, the hypothesis predicts that the impact of marriage will persist in specifications that control for individual fixed effects, and it predicts that the marriage premium should rise with years married. Neither of these predictions is uniformly borne out. Estimates suggest that controlling for selection-into-marriage bias reduces or nearly eliminates the marriage premium. It is worth emphasizing, however, that the estimates reported here have varied over time, and are lowest in the most recent studies.

Indeed, there is growing evidence that the marriage premium has fallen over time. Using data from the decennial Census, Loh (1996) shows that the marriage premium held steady near 20% from 1939 through 1969, and then declined in 1979 to 10%. Gray (1997) using early (1976-1980) and late (1989-1993) waves from the NLSYM, finds a marriage premium of 8.6% in the early sample after controlling for fixed effects, but no premium at all under the same specification in the later premium. Lundberg and Rose (2002) report similar results obtained from every wave of the PSID between 1967 and 1991. Dividing their sample into cohorts, those born before 1950 and those born after, Lundberg and Rose find a cross-sectional marriage premium of approximately 14% for each cohort. Controlling for fixed effects, however, they estimate a marriage premium of 8.6% for the first cohort, however, and 4.6% for the second. [5] Bardasi and Taylor (2005) echo the claim that among younger cohorts, the marriage premium is explained by selection bias. Using the 1991-2001 waves of the British Household Panel Survey, they find a cross sectional marriage premium that ranges between 9 and 18%, depending on the specification. Controlling for fixed effects, however, implies a premium of between 1 and 3%, which is only marginally statistically significant.

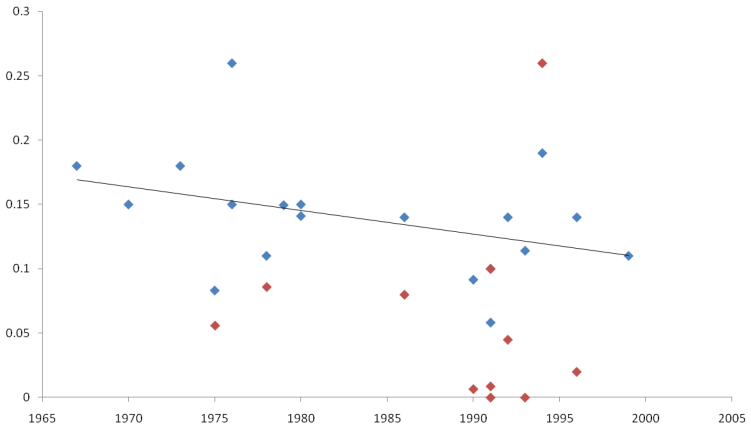


Figure 1: Estimates of the marriage premium over time. Blue points are cross-sectional estimates, while red points are fixed effects estimates. The trend line shows the OLS fit of cross-sectional estimates.

Figure 1 depicts estimates of the marriage premium using cross sectional and various fixed effects specifications, drawn from reports. Estimates based on the pooling of multiple years of data are charted at the midpoint of the first and last years pooled. The chart confirms the impression

[5] Although Lundberg and Rose do not test whether the implied difference is statistically significant, I estimate that it is not, with p = 0.15, using a t-test of the null hypothesis that the mean of the difference is zero.

developed in this review, that the marriage premium has fallen since the late 1960s, and that, with one exception, estimates of the marriage premium that account for selection bias are lower than estimates that do not. (The exception is Antonovics and Town's study of twins; recall that Krashinsky provides contradictory evidence.) This time impact could be due to a secular decline in the marriage premium. To see why, assume for a moment that, in fact, the marriage premium exists in some causal sense, and that it has been declining over time; in particular suppose that men born earlier experience higher marriage premiums, on average, than do men born sooner. Any single data set will contain men with varying marriage tenure, so that some will be married longer than others. If the marriage premium for men of a particular cohort is fixed within cohorts, but declining across them, then estimating the relationship between length of marriage and wages will imply that the returns to marriage increase with tenure.

So far, I have reviewed the two main explanations for the marriage premium, specialization and selection bias, and reviewed the mixed evidence supporting each claim. I have also shown the declining quantitative importance of marriage on husbands' wages over the period 1970-2000. Even if selection bias explained the current marriage premium, it clearly does not explain the observed premium of the 1970s and earlier. But the exact mechanism between wages, marriage, and unobserved characteristics remains to be uncovered. Indeed, it is unclear whether marriage enhances productivity, or merely signals it; whether the impact of marriage, if it exists, is felt over time or all at once. To address these questions, I review the theories of human capital accumulation and wage dynamics to develop more precise predictions, and then I present evidence on the impact of marriage on productivity, and on the timing and incidence of this impact.

# 3 Theories of Human Capital

Investigators of the marriage premium, focusing on whether marriage raises productivity, often estimate the "within" impact of marriage: using a fixed effects specification, researchers estimate how much wages change for a man when he gets married, controlling for experience, location, and sector. These specifications nearly always imply a marriage premium somewhat smaller than the marriage premium obtained in cross-sectional estmates; often the "within" premium is small and not statistically significant. Researchers conclude that the male marriage premium is due in part or entirely to selection-into-marriage bias, and not to the productivity-boosting impact of marriage on wage. If marriage improved productivity, they reason, then it would also improve wages.

This syllogism, central to the analysis of the male marriage premium, is false; many labor market models predict that wages need not equal marginal product. Monopsony power leads to a differential between wages and productivity, for example. Numerous researchers find pervasive evidence of monopsony, for example Acemoglu and Pishke (1998) on seniority, or studies of the impact of the minimum wage on employment (e.g. Stewart, 2004, Dickens et al., 1999). Even without any market imperfection, Lazear (1981) shows that it is optimal for employers to offer wages below productivity early in an employee's tenure, and wages above productivity late in tenure, in order to minimize shirking. That is, even if employers perfectly detect shirk, and always fire workers who shirk, age-earings profiles must slope upwards to induce optimal effort. More central to the marriage premium however, are theories of human capital acquisition. Becker (1962) in his pioneering work on human capital showed that except in the case of perfectly general human capital, the acquisition of human capital will introduce a differential between wages and marginal productivity. The differential occurs because specific human capital enhances productivity only

in a single firm, so that firm can offer wages below the marginal productivity but still above the worker's opportunity wage. In other words, the extra productivity implies wage setting, and therefore monopsony power, for the firm to which the human capital is specific.

In the human capital story of the male marriage premium, there is a second market imperfection. Although labor markets are competitive in the sense of large numbers of actors, with free entry, and although Becker (1991) does not consider the implications of firm-specific human capital, his theory of household production implies that markets are incomplete. This market failure is central to the marriage premium. Because markets are incomplete, to-be-married men cannot borrow against future earnings and use that income to expand current consumption of household goods, even though credit markets are perfect. The missing market for household goods forces them to work fewer hours and therefore reduces the optimal level of investment in human capital before marriage. As a result to-be-married men, unlike never-married men, will invest in two rounds of human capital, once upon entering the labor force and again upon marriage. As I show below, in the context of employment in a firm, this implies the to-be-married men will earn more than never-married men even before marriage, and that upon marriage, their earnings will not necessarily increase, and neither must the earnings differential.

### 3.1 General Theory

This subsection is due to Becker (1962) and it concerns the investment in human capital as undertake by firms and individuals. I follow Becker's exposition closely. Although Human Capital refers to the "embedding of resources" (Becker 1962, 10) that affect future consumption and productivity in people, to simplify I concentrate on on-the-job training. I assume competitive labor markets, credit markets, and product markets.

In a competitive labor market, equilibrium is given by

$$MP = W \tag{1}$$

where $MP$ is the marginal product, and $W$ is the wage rate. Unless marginal product equals outlays by firms, firms will either go out of business or earn excess profit. Free entry and exit thus requires (1). More generally, however, workers and firms will contract over multiple periods, so that (1) generalizes to

$$MP_t = W_t \tag{2}$$

where t is the time period. Free mobility of labor, as well as entrace and exit, ensures that these equalities hold over all periods.

Now consider the decision to invest in human capital. Since human capital improves productivity over the entire career, it will be optimal to invest in human capital as soon as possible. Hence I assume investment only occurs in the first period. Investment in human capital requires explicit outlays, $k$, as well as foregone production, because employees cannot produce while training. Since wages vary from year to year, and now a firm's outlay decision depends on the wages, (2) no longer necessarily describes an equilibrium. Instead we require that recepits equal outlays in present discounted value. That is,

$$MP_0 + \sum_{t=1}^{n} \frac{MP_t}{(1+i)^t} = w_0 + k + \sum_{t=1}^{n} \frac{w_t}{(1+i)^t}, \tag{3}$$

where $t$ indexes time and $i$ is the discount rate. Outlays in the initial period, the wage rate paid then as well as training expenses, plus all future outlays, equal in present discounted value the marginal product in the initial period, plus all future marginal products. Denote the return to the firm on the investment in human capital by

$$G = \sum_{t=1}^{n} \frac{w_t - MP_t}{(1+i)^t}.$$

Since $G$ gives the present discounted value of the difference in every period between productivity and the outlay, it represents the return to the firm on the investment. Then equation (3) simplifies to

$$MP_0 + G = w_0 + K. \tag{4}$$

The total economic cost of investment, however, is not given by $k$, since the cost involves both outlays and foregone production, $MP'$. Economic cost $C$ is equal to $k + MP' - MP$, because $MP' - MP$ gives the opportunity cost of production. Then equation (4) implies that

$$\begin{aligned} MP'_0 + G &= w_0 + K + MP'_0 - MP_0 & (5) \\ MP'_0 + G &= w_0 + C. & (6) \end{aligned}$$

This equation is a generalization of equilibrium in capital markets, since it implies that marginal cost of investing equals the marginal return.

To continue the discussion, it is helpful to distinguish between general and specific human capital. General human capital refers to those investments that can be used in any firm, or in any firm in a particular industry. Specific human capital, by contrast, influences productivity only for the firm in which it is acquired.

### 3.1.1 General Human Capital

Investments in general human capital raise productivity equally for all firms. Competition implies that $w_t = MP_t$ and hence $G = 0$. Thus equation (6) reduces to

$$MP_0 - w_0 = C.$$

That is, workers bear the entire cost of investing in general human capital.

In the extreme case, there are just two levels of income: before the investment and afterwards. In reality, however, workers may not be able to invest in as much human capital in a particular period as they would like, since they need to be able to pay for their basic expenses. Although perfect capital markets imply that workers can borrow against their future earnings, as Becker (1991) suggests, workers may not be able to invest enough *time* because of such constraints as needing to eat. The greater the opportunity to specialize, moreover, the more rapid will be the investment in human capital, since the foregone production of home goods will be lessened. Investment over multiple periods, paid for by foregone earnings, implies a concave shape for those who invest, as opposed to the flat line depicted for workers who do not invest in human capital.

### 3.1.2 Firm-Specific Human Capital

Not all forms of training and education increase productivity equally in all firms. In this section I develop the ideal notion of specific human capital: an investment that increases producity in exactly one firm. In reality it is difficult to point to more than a handful of examples, most of them by now hackneyed. Lazear (2003), noting the difficulty of finding instances of specific human capital, derives identical predictions for a model in which different firms draw on different types of skill in different proportions; the imlications are are the same. Regardless of the approach employed, if the returns to investments in human capitl vary across firms, then the results developed below will hold.

As before, equation (6) describes equilbrium. Since the investment in human capital is specific to a single firm, the wage that firm offers in a given period, $w_t$, may differ from the outside wage option $w^*$, which does not depend on $t$ because the outside marginal productivity is constant and equal to $MP^*$, which since labor markets are competitive, must equal $w^*$. Hence the firm may offer a wage of $w^*$, to maximize the difference between $MP_t$ and outlays, and thus maximize the return on their investment. Hence $w_0 = w^* = MP'_0$, so equation (6) reduces to

$$G = C.$$

That is, the firm pays for the entirety of investments in specific human capital and gain the full rewards.

The analysis is incomplete, however, without discussion of quitting. Since labor is mobile, workers may leave the firm during training or after completing it. If a worker leaves the firm, the company loses the entirety of their investment. Although firms can choose a level of investment to maximize income conditional on quits (maximizing the expected return), they can do even better if they recognize that quit rates depend on relative wages. Offering $w_t > w^*$ will reduce the quit rate. Thus if quitting the theory of specific human capital implies that firms will pay the cost of investment, and that they will pay a premium wage in order to recoup the full value of their investment. In the case of perfectly specific human capital, firms may pay only an arbitrarily small premium in order to retain their investment. More realistically, however, some of the human capital may benefit production in other firms, as well. We would expect that as the returns to human capital in other firms increase, so too does the wage that the firm offers. We may think of the total investment in human capital as consisting of some part that is perfectly general and some part that is perfectly specific. If the analysis is correct, then we would expect firms to pay for specific part and reap all its benefits, while workers would pay for the general component and repeat all of its benefits.

To capture this situation more formally, we denote by $G'$ the return on specific investment recouped by employees (in the form of higher wage) and $G''$ the total return. Then let $a$ denote the fraction of returns collected by the firm. By construction, $G = aG''$, and in equilbrium $G'' = C$, because marginal cost must equal marginal return for both general and specific human capital. Thus

$$\begin{aligned} MP' \quad & +aC = w_0 + C \\ MP' \quad & -w_0 = (1-a)C. \end{aligned}$$

The fraction of the cost of specific human capital that employees pay equals the fraction of the return to capital. Note that this equation generalizes our earlier result ($a = 0$ and $a = 1$ give

the extreme cases). As Becker concludes, firms pay employees with general human capital exactly as much as they would earn in outside employment, and they pay employees with specific human capital more than they would earn in outside employment.

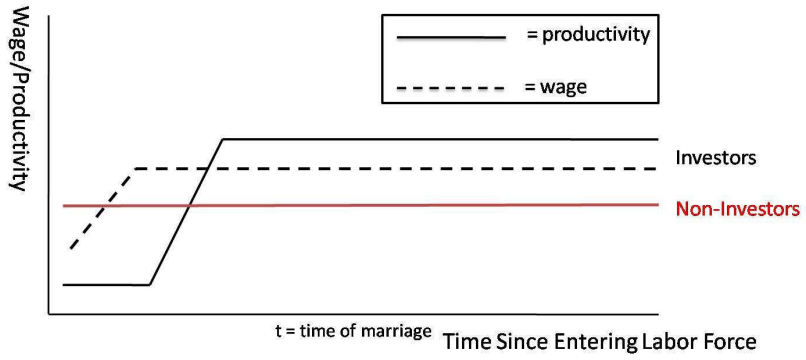


Figure 2: Wages and productivity for those who do and do not invest in human capital.

I illustrate the situation graphically in figure 2. Those who do not invest earn constant income and have constant marginal productivity. Investors in general human capital at first pay by foregone wages, and then earn high wages. Investors in specific capital bear some of the cost of investing, and earn some of the returns, and hence earn intermediate wages.

### 3.2 Returns to HC and Labor Force Commitment

The possibility of employee quits forces firms to share the returns, and also the costs, of investment in specific human capital. The key hypothesis is that the quit rate depends on the wage rate offered by the firm, relative to the alternative wage rate. Conditional on a probability of quitting, $p$, the return to the firm on an investment in human capital is a random variable equal to 0 with probability $p$ and equal to $G$ with probability $1-p$. Firms choose $a$, the proportion of the returns to the investment that accrue to them, to maximize the expected return on investment, $\mathbb{E}(G)$.

Recall the definition of $G$, the return to the firm on the investment:

$$G = \sum_{t=1}^{n} \frac{MP_t - w_t}{(1+i)^t}$$

The return on investment is the present discounted value of the difference between marginal product and wage in every period. Firms may dismiss employees at will; if $MP_t < w_t$ then it is not optimal to continue employment. Hence for all $t, MP_t - w_t \geq 0$. Thus $G$ is strictly increasing in $t$, the length of time over which the investment affects productivity. Moreover it is not difficult show that $a$ does not depend on $G''$, the total size of the investment. Suppose the probability of not quitting is given by some function so that $p = f(a)$, where $\frac{\delta f}{\delta a} < 0$. Then the firm chooses $a$ to maximize the expected return on income, $p * (G) = f(a) * aG''$. Then differentiating and setting expected profits equal to zero implies that

$$\begin{aligned} \frac{\delta f}{\delta a} a G'' + f(a) G'' &= 0 \\ -\frac{\delta f}{\delta a} &= \frac{f(a)}{a}. \end{aligned}$$

Firms choose $a$ so that the marginal increase in probability associated with $a$ is equal to the actual probability divided by $a$.[6] Critically, the optimal level does not depend on the size of the total return, $G''$. These result implies that the longer a worker works, the greater the marginal return to his investment, for both the firm and the worker; the total investment will increase with expected duration of the investment. Hence tenure increases wages in each period as well as lifetime labor income.

### 3.3 Marriage

Becker (1991) notes that unmarried men who will marry later in life, upon entering the labor market, are constrained in the amount of human capital that they can acquire, because of the necessity of engaging in household production. Knowing that they will work more hours in the future, they would like to invest in additional human capital now, but cannot beause they lack the time to do so. This section explores the dynamics of wage for to-be-married men (implicitly, relative to never-married men).

Before continuing, a few words on household production are needed. In the male marriage premium literature, it has been customary to think of household production as household *chores*, cleaning and cooking and tending to children. This notion, however, is incorrect. Recall that household production refers to the production of commodities, $Z_i$, which take as inputs both market goods $x_i$ and also time, $t_i$. The $Z_i$, and not the $x_i$, are the inputs of the utility function. Although a clean house and a hot meal may be the basic arguments of happiness, it is unlikely that more fundamental goods are not also consumed. Becker, for example, enumerates "children, prestige and esteem, health, altruism, envy, and pleasure of the senses" (1991, p. 24). Many of these goods are essentially social; they involve standing relative to others and perhaps also interaction with others.From the list it should be clear that the kind of household production the theory envisions is not at all the division of chores from labor market activities. When surveys ask respondants about the number of hours they spend on chores, it is unlikely that they are measuring the division of labor within the household that this theory posits.

We shall procede as though these household goods can be produced for another person (at least within the household), so that specialization can occur. It may be difficult to see how one can produce "pleasures of the senses" for another's consumption. If, for example, seeing a movie counts as pleasure of the senses, then surely one cannot produce movie viewing for another's pleasure. This line of reasoning would be particularly problematic if marriage did not change social behavior; but social behavior changes dramatically upon marriage. Akerlof (1998) reports that, controlling for inter alia, education and location, married men are more likely to work, less likely to quit, and less likely to report either having had six drinks on one occasion in the past month or having smoked marijuana in the past year. One interpretation of these facts is that substance usage is a substitute for family life. If time is used more intensively in the production of substance usage

[6] $a = 0$ is also an extrema; clearly, however, choosing to keep none of the returns to investment minimizes the value of the investment to the firm.

than in the production of family life, then marriage will allow for greater specialization between household production and the market place.

Let us now consider the impact of that specialization on wages. Suppose that the human capital acquired upon entering the labor force, and upon marriage, is not totally general; the cost and benefits are shared. Suppose, additionally, that firms know which of their new hires will marry and when these employees will marry. This assumption is grossly unrealistic; marriage is difficult to predict and the timing of it, even more so. As we will see, however, this hypothesis will be analytically essential. Below I provide some evidence for it.

Recall that firms set $a$ to maximize $G$, the present discounted value of the difference between marginal product and wages. A married man, at time $t'$, invests for a second time in firm-specific human capital. We may write

$$G = \sum_{t=1}^{t'} \frac{MP - w_t}{(1+i)^t} + \sum_{t=t'+1}^{n} \frac{MP' - w_t}{(1+i)^t},$$

with $MP < MP'$, reflecting the addition of human capital. Again the firm's goal is to choose $a$ to maximize $\mathbb{E}(G)$. The choice of $a$ depends on the value to the firm of the investment and on the outside wage rate; the higher the outside wage rate, the less $a$ must be to dissuade workers from quitting. But the worker's objective is to maximize lifetime income, $\sum_{t=1}^{n} \frac{w_t}{(1+i)^t}$, not just period-specific income, $w_t$. The introduction of a second period of human capital investment complicates the preceeding analysis. Now workers know that, upon marriage, they can quit and work for another firm and invest in human capital specific to that firm; the effective outside wage rate thus rises; clearly $a$ must fall. But we have already seen that $a$ is equal both to the return to the employee of the investment, and the fraction of the cost of the investment born by the employee. Thus the wage rate must increase prior to marriage.

Upon making the second round of investment, however, $a$ and $w_t$ do not change. Prior to the investment, the firm chooses the maximum $a$ possible to induce the worker to stay with the firm. Upon making the investment, the worker is locked into his current firm, because he can no longer switch firms and look forward to the extra income from his second round of investment. Despite the worker's higher productivity, firms will not offer increase wages, since the worker is already earning more than his outside option. The firm cannot cut wages, however, since then the worker *would* find it profitable to switch employment and reinvest in human capital.[7]

The situation is depiced graphically in figure 3. The productivity of to-be-married men equals that of never-married men until marriage. To-be-married men earn a premium based on their expected future productivity, but upon attaining that productivity, do not experience an additional increase in income.

One might think it silly to suppose that firms know which workers will marry and which will not. Theory predicts, however, that two workers who differ only in their timing or incidence of marriage, may upon entering the labor force acquire different levels of human capital. Knowing that he will be married in the future, the to-be-married worker invests at a high level, supposing that the constraint of home production is not binding for the never-married worker (otherwise they will invest at the same level). The differential in initial investment provides one way to distinguish

[7]In fact this is not quite true: as the worker remains with the firm, his expected labor force tenure decreases, which decreases the returns to reinvestment. A myopic firm might attempt to cut wages, but for reasons that Lazear (1981) makes clear, a firm that reneges on its contracts will quickly find it hard to hire new labor.

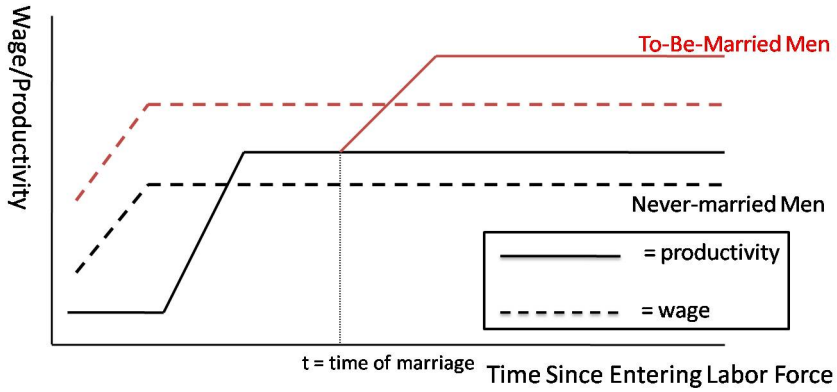


Figure 3: Wages and productivity for to-be-married and never-married men investing in specific human capital.

to-be-married workers from never-married ones. Using the Census data described below, I estimate the following equation via the probit procedure:

$$P(Marriage_i = 1) = f(ln(wage_i), years\_education_i, race_i),$$

For the entire population the probability of marriage is 65.7%. The average number of years of education is 13.8, with a standard deviation of 2.4. The results imply that a single standard deviation increase in years of education is associated with a one percentage point increase in the probability of marriage, conditional on income and race. The relationship is not large, but it is nontrivial and statistically significant.[8]

### 3.4 The Self-Employed

In the previous analysis, two market failures give rise to the difference between marginal product and wage. On the one hand, the firm-specific productivity improvement gives firms monopsony power. On the other hand, the embodiment of the firm's investment in its workers, whose objective functions do not coincide with that of the firm, implies a principle-agent problem: workers would choose to quit even when it is not optimal for the firm if they do so.[9]

The self-employed thus differ from those employed in regular employment in two critical ways, as far as the theory of human capital is concerned. First, there is no monopsony power and no principle-agent problem. I define the self-employed to be residual claimants, in the sense of Alchian and Demsetz (1972). The self-employed capture all of the profit of their operation. The self-employed face correct incentives, in that they will provide effort until the marginal return on effort equals the marginal cost of providing it. By definition, then, the compensation of the self-employed is equal to their marginal product. This is also the second difference between those employed in regular employment and the self-employed. Because the self-employed only earn income

[8]The estimated coefficient on years of education is 0.0027 with a standard error of 0.00015.

[9]As Hashimoto (1981) points out, the Coase theorem bears on this situation: although property rights are misaligned, in the absence of transactions costs, firms and individuals can contract an optimal allocation of human capital.

via production, they cannot earn wages above productivity when they invest in human capital. When investing, it may be optimal for the self-employed to borrow against future income, so that consumption will be identical in periods of investment and non-investment. However in surveys, this consumption smoothing will not affect reported income. Whereas the theory of firm-specific human capital suggests that, for those employed in regular employment, the marriage premium will occur before and after marriage, for the self-employed it can only occur after marriage.

### 3.5 Secular Declines

The male marriage premium depends on the return to investment in human capital: the greater the return to the second round of investment, the more the firm will have to share in the returns to the first round of investment in order to keep the to-be-married man from leaving for another firm. The return to the investment, as we have seen, depends on the timing of it. The earlier one invests, the longer one works with a greater stock of human capital, and therefore the greater the total return. Finally, because the extent of household specialization determines the timing and extent of investment in human capital, the marriage premium should also be correlated with the level of specialization within the household.

Taken together, these three propositions imply that the male marriage premium has been steadily declining from the 1960s until today, because there has been a steady rise in the age at which men first marry, and a steady decline in the extent of specialization. These trends have been documented extensively; Akerlof, Yellen, and Katz (1996) and Akerlof (1998) report the changing trends in marriage rates and timing. Goldin and Katz (2002) also describe changing marital dynamics and the increase in labor force participation. In every story, the rise of birth control plays a central part. These trends both imply a decline in the marriage premium, particularly from 1960 onward. If the theory is true, then we should see that for a particular cohort, the marriage premium will be constant, but in the cross-section, it will rise with age.

## 4 Empirical Tests

My empirical strategy is to test the three implications set forth in §3.5, §3.6, and §3.7: that among males there is a cross-sectional marriage premium but not a marriage premium in a fixed effects specification for the whole population; that the self-employed do enjoy a marriage premium even in fixed effects specifications; and that the marriage premium has declined since the generation that came of age in the 1960s. To test the first two predictions, I use a longitudinal data set, the Panel Study on Income Dynamics; to test the third, I use the much larger cross-sectional data, the 5% Public Use Microdata part of the Census.

### 4.1 Panel Study of Income Dynamics

I use data drawn from the 1999, 2001, 2003, and 2005 waves of the Panel Study of Income Dynamics. Described more fully in Hill (1991) and Brown, Duncan and Stafford (1996), the PSID is a longitudinal data set that tracks family units over time. It contains household-level observations with detail about household expenditures and consumption, and demographic and economic information on heads of household and their spouses. (Whenever a male is present, the head of household is male.)The economic data include measures of compensation along multiple contract types; for example, income from commission as opposed to tips or salary. The PSID also contains

individual-level data on every family member. Since the data set was designed to track entire families, whenever a family member leaves a household to start her own home, the new household is also included. Whenever a head leaves a household and does not become head of a new household, however, he may be lost.

Conceived in 1968, the PSID was designed to study the impact of poverty on family's, with an emphasis on both economic and socio-psychological factors. Consequently its initial samples had a subsample of families earning less than 150 percent of the federal poverty line. Since its initial five year run ended in 1972, however, the sample has expanded to include individuals of all income levels. The PSID enjoys a very high re-interview rate: over the period between 1991 and 1996, between 97% and 98% of applicants interviewed in one year were interviewed in the next year. Because the PSID tracks families from the late 1960s onward, with an emphasis on poorer families, it does not represent the national population, particularly with regard to race and geographic location.[10]

**Table 1: PSID Frequency Statistics, by Year**

| Observations | 1999 | 2001 | 2003 | 2005 | Total |
|---|---|---|---|---|---|
| 1. Total | 899 | 1094 | 2108 | 1800 | 5901 |
| 2. Enter Marriage | – | 28 | 48 | 32 | 108 |
| 3. Leave Marriage | – | 21 | 78 | 53 | 152 |
| a) Of Which, Divorced | – | 9 | 39 | 26 | 74 |
| 4. Enter Self-Employment | – | 24 | 51 | 54 | 129 |
| 5. Leave Self-Employment | – | 19 | 29 | 50 | 98 |

Statistics refer to a sample drawn from the 1999-2005 waves of the PSID.

I restrict my attention to employed men for whom the relevant data are available. I have 5901 total observations on 2720 individuals. Because data can, and sometimes must, be recovered from previous years, observations from the first two years were much more likely to be incomplete than were observations from the first two year; comparability issues also presented a problem. Table 1 displays, by year, the number of observations, as well as the number of marriage formations and dissolutions. I identify a marriage formation by identifying those individuals who were single in one year and married in the next. Likewise a marriage dissolution occurs when a married individual becomes divorced, widowed, or separated. (By construction, I cannot identify marriage events in 1999.)

The PSID reports yearly earnings as well as income from numerous particular sources: wages, tips, commission, salary, bonus, and for the unincorporated self-employed, profit. To calculate hourly wages, I first compute the hourly income from each source, and then calculate a total hourly income. This includes all forms of compensation, but does not include extra earnings from overtime (nor do overtime hours worked enter into the denominator). The unincorporated self-employed report only the profit or loss from their business, which presents a special problem since

[10]Sample weights are available so that one may make representative estimates. I do not use these weights for two reasons: first, since I only report regression results, they are not necessary; and second, as Brown, Duncan and Stafford (1996) note, using the weights in multiple regression analysis is computationally quite taxing and of dubious value.

profit represents the return to both labor and capital. To adjust for this, I compute the five year average return of the S&P 500 for the five years prior to each of my sample years; this gives me a risk-adjusted return on capital, r.[11] The PSID asks business owners, "If you sold your business and paid off all debts, how much would you realize¿'[12] The answer to this question may be interpreted as the company's equity, $E$. Thus if yearly profit is $P$, I calculate labor's share as $P - rE$. Of course, it is possible that a business will turn a loss, particularly after subtracting out capital's share. Because of limited liability, however, it is likely impossible to earn negative income, so I treat all negative income as zero, and exclude the 21 individuals who earn negative income from the analysis (since I use a log specification throughout). Robustness checks using a measure of negative income, however, suggest that this exclusion has no qualitative impact on my results.

**Table 2: PSID Summary Statistics**

| | All | Married | Unmarried | Self Employed |
|---|---|---|---|---|
| Wage | 27.1 | 29.17 | 21.41 | 47.38 |
| Weeks Worked | 48.26 | 48.7 | 47.06 | 48.986 |
| Hours/Week | 45.14 | 45.61 | 43.84 | 46.2726 |
| Years work | 17.71 | 18.62 | 15.2 | 19.91 |
| Self Employed | 0.12 | 0.14 | 0.08089 | N/A |
| Ever Self-Employed | 0.19 | 0.2 | 0.152 | N/A |
| Age | 44.43 | 46.32 | 39.2121 | 47.238 |
| At least one Child | 0.49 | 0.58 | 0.2235669 | 0.488 |
| Ever Married | 0.81 | N/A | N/A | 0.884 |
| Marriage | 0.73 | N/A | N/A | 0.826 |
| Marriage Length | 16.58 | 22.59 | N/A | N/A |
| Housework | 7.34 | 7.05 | 8.16 | 7.12 |
| Bachelors | 0.21 | 0.24 | 0.16 | 0.25 |
| Masters | 0.05 | 0.049 | 0.03 | 0.06 |
| PhD | 0.01 | 0.01 | 0.003 | 0.01 |
| JD | 0.01 | 0.01 | 0.003 | 0.02 |
| MD | 0.01 | 0.01 | 0.002 | 0.03 |
| White | 0.76 | 0.21 | 0.62 | 0.89 |
| Black | 0.2 | 0.17 | 0.31 | 0.08 |
| Observations | 5901 | 4331 | 1570 | 730 |

Statistics refer to a sample drawn from the 1999-2005 waves of the PSID.

Table 2 presents summary statistics for the entire sample and four subsamples: those who are married, those are or will be married, those who are self-employed, and those who are or will be self-employed. 73% of the sample is married, and 81% are married for at least one observation.

[11] The returns are: prior to 1999: 21.39%; 2001: 16.47%; 2003: -1.94%; 2005: -3.78%.

[12] The actual wording of the question, from the 2005 codebook, is "If you sold all that and paid off any debts on it, how much would you realize on it¿' (ER26544) The preceding question asks "Do you (or anyone in your family living there) own part or all of a farm or business¿'

Married men, on average, earn a 7.76 dollars more per hour, and work 1.77 more hours per week and 1.64 weeks per year than do the unmarried men men. Married men also do slightly less housework, 1.11 fewer hours per week. They are older, more likely to have had a child, and somewhat better somewhat better educated. Each of these differences is significant at the 0.01 level, except the differences in JD and PhD attainment, which are significant at the 0.05 level. The self-employed are older, better educated, and more likely to be white and more likely to be married. They earn much higher wages and work slightly more weeks and longer hours. They have more work experience. Each of thse differences is significant at at least the 0.05 level, except for differences in master's degree attainment, which is not statistically significant.

### 4.1.1 OLS Estimates

In this section, I estimate the following equation:

$$ln(Wage_{i,t}) = \alpha + \beta_0 marriage_{i,t} + \beta_1 \hat{marriage}_{i,t} + \beta_2 X_{i,t} + \beta_3 Y_{i,t} + \epsilon_{i,t}, \quad (7)$$

where $marriage_{i,t}$ is a vector of marriage characteristics, $X_{i,t}$ is a vector consisting of variables usually thought to influence wages, $Y_{i,t}$ is a vector of proxies for the ability to invest in human capital, $\hat{marriage}_{i,t}$ is the same vector of marriage characteristics, but equal to zero if individual $i$ is not self-employed, and $\epsilon_{i,t}$ is an individual and time-specific randomly distributed error term. These specifications closely resemble those employed in the literature to identify the male marriage premium. Note that I do not include controls for length of marriage. For reasons that will be made clear later, that specification is not appropriate.

**Table 3: OLS Estimates of the Marriage Premium, Dependent variable: log of real wage**

| dep. var = ln(rl wage) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Marriage | 0.221*** | 0.220*** | 0.222*** | 0.223*** |
| | (0.018) | (0.018) | (0.018) | (0.018) |
| Marriage (SE) | | | 0.198** | 0.202** |
| | | | (0.056) | (0.056) |
| Housework | | -0.001 | -0.001 | 0.001 |
| | | (0.00108) | (0.001) | (0.001) |
| Housework (SE) | | | | -0.01** |
| | | | | (0.004) |
| N | 5901 | 5901 | 5901 | 5901 |
| Adjusted R2 | 0.2934 | 0.2933 | 0.2932 | 0.2942 |

Estimated using the 1999-2005 waves of the PSID. Other controls are years of experience and its square, and dummy variables for race (four dummies), education (six), sector of employment (four), region of the country (three) and urban workers. Standard errors are given in parentheses.

* Significant at the 0.1 level.

** Significant at the 0.05 level.

*** Significant at the 0.01 level.

Table 3 presents the results of estimating equation (5) in succession. In the first column I include only a dummy variable for marriage. It indicates that without additional controls, married men earn 22% more than unmarried men, all else equal. In the next column I introduce a term equal to the number hours spent on housework. It is miniscule and insignificantly different from zero. Including it decreases the marriage premium slightly. The result suggests that housework and wages are not correlated.

Columns 3 and 4 report the results of including an interaction term between self-employment and marriage. In the table, however, I report the implied marriage premium for the self-employed (equal to $\beta_1 + \beta_2$), rather than the differential between that premium and the marriage premium for the general population. The standard error reported, however, is the standard error of $\beta_2$. I estimate a marriage premium of 19.79% among the self-employed, which is not significantly different from the 22.19% marriage premium in the general population. In column 4 I include an interaction term between self-employment and housework. Doing so reduces the estimated self-employment marriage premium to 18.82%, which is not significantly different from the average premium of 22.32%. The estimates imply that for every additional hour the self-employed spend in housework per week, their wage falls by 1%, which is significantly different from the impact of housework on wages in general population, which is quite small.

The large cross-sectional marriage premium provides prelimary although by no means decisive evidence in favor of the firm-specific human capital explanation of marriage. I also estimate that there is at best a weak relationship between hours spent on housework and wages; this too is consistent with the theory, since we expect that "housework" type questions are a poor proxy for the degree of specialization within the household. Moreover the marriage premium persists despite controlling for this kind of specialization.

#### 4.1.2 Fixed Effects

If unobserved, time-invariant characteristics $Z_i$ are correlated with both marriage and with wages, or even if marriage is determined in part by wages, then the estimates of equation 5 are biased. To address this bias, I estimate a fixed-effects specification of the marriage-earnings regression, given by:

Since the $Z_i$ are not observed, we must use a fixed effects framework to estimate (6). That is, we re-write equation (6) by summing over all individuals $i$ and dividing by time periods $n$ to average all characteristics across time:

$$\begin{aligned}\frac{\sum_{i=1}^{n} Wage_{i,t}}{n} = \alpha &+ \beta_0 \frac{\sum_{i=1}^{n} marriage_{i,t}}{n} + \beta_1 \frac{\sum_{i=1}^{n} \hat{marriage}_{i,t}}{n} \\ &+ \beta_2 \frac{\sum_{i=1}^{n} X_{i,t}}{n} + \beta_3 \frac{\sum_{i=1}^{n} Y_{i,t}}{n} + \beta 4 z_i + \epsilon i, t.\end{aligned}$$

Subtracting the above equation from equation (6) implies

$$\begin{aligned}Wage_{i,t} - \overline{wage_i} = \alpha &+ \beta_0 (marriage_{i,t} - \overline{marriage_{i,t}}) + \beta_1 (\hat{marriage}_{i,t} - \overline{\hat{marriage}_i}) \\ &+ \beta_2 (X_{i,t} - \overline{X_i}) + \beta_3 (Y_{i,t} - \overline{Y_i}) + (\epsilon_{i,t} - \bar{\epsilon}).\end{aligned}$$

This equation relates within-individual deviations from average wage to within-individual deviations from average marital status and (time-variant) human-capital characteristics. It estimates the within person impact of marriage on wages.

**Table 4: Fixed Effects Estimates of the Marriage Premium, Dependent Variable: Log of Real Wage**

| dep. var = ln(rl wage) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Marriage | 0.007 | 0.006 | -0.012 | -0.012 |
| | (0.037) | (0.037) | (0.038) | (0.038) |
| Marriage (SE) | | | 0.202** | 0.201** |
| | | | (0.089) | (0.089) |
| Housework | | -0.001 | -0.001 | -0.000 |
| | | (0.001) | (0.001) | (0.001) |
| Housework (SE) | | | | -0.006* |
| | | | | (0.004) |
| N | 5901 | 5901 | 5901 | 5901 |
| Adjusted R2 | 0.7191 | 0.7191 | 0.7195 | 0.7196 |

Estimated using the 1999-2005 waves of the PSID. Other controls are years of experience and its square, and dummy variables for sector of employment (four), region of the country (three) and urban workers. Standard errors are given in parentheses.

* Significant at the 0.1 level.

** Significant at the 0.05 level.

*** Significant at the 0.01 level.

Column 1 reports the adjusted within-person marriage premium. Relative to himself, before marriage, a married man makes 0.7% more, conditional on experience. That differential is not statistically significant. In column 2 I include controls for hours spent on housework as well. Doing so slightly reduces the marriage premium, which remains small and statistically insignicant. The estimate implies that for every additional hour that a man spends on housework, his wage falls by approximately 0.1%. In column 3, I report the results of including interaction terms between self-employment and marriage. Whereas the implied return to a marriage for a man in regular employment is -1%, the implied return to marriage for a man in self-employed is 21%. This difference is statistically significant at the 0.05 level. In column 4, I include an interaction term between housework and self-employment. For every additional hour that a self-employed man spends doing housework, his wage falls by 0.6%, all else equal; for men in regular employment, housework has a miniscule impact on wages. The difference between the two impacts, however, is not statistically significant.

These estimates provide further evidence for the theory presented here, which predicts that the estimated marriage premium in the fixed effects framework should be zero, but among the self-employed, it should persist. Moreover the the size of the self-employed premium in the fixed effects specification is approximately equal to the size of the premium in the OLS specification, suggesting that all of the gains to mariage accrue to the self-employed upon entering marriage; none of the returns to marriage are associated with unobservable heterogeneity.

One might worry that, since nearly 50% of the changes in marital status are due to divorce, the specification of equation 6 is incorrect. In particular, if marriage affects wages through investment in human capital, and divorced men do not lose human capital too quickly, then when a man gets divorced, he will not experience a decline in human capital; this could bias the estimate of $\beta_1$ towards zero. In fact, however, specifications including a dummy variable for divorce do not imply

a positive or statistically significant $\beta_1$; nor does controlling for divorce have an influence upon our estimates of the returns to marriage specific to married men.

Another objection, however, concerns the interpretation of $\beta_2$. Although $\beta_2$ gives the returns to marriage among the self-employed, it also gives the returns to marriage among self-employed men. Whereas theory suggests that when the self-employed become married, they experience an increase in wages, it does not suggest that when married men enter into self-employment, their income should increase. To control for this, I also estimated equation 6 separately on men who did not enter into self-employment, so that the only interpretation possible of $\beta_2$ is that it gives the self-employed marriage premium. This alternative specification produced equivalent results.

## 4.2 Census

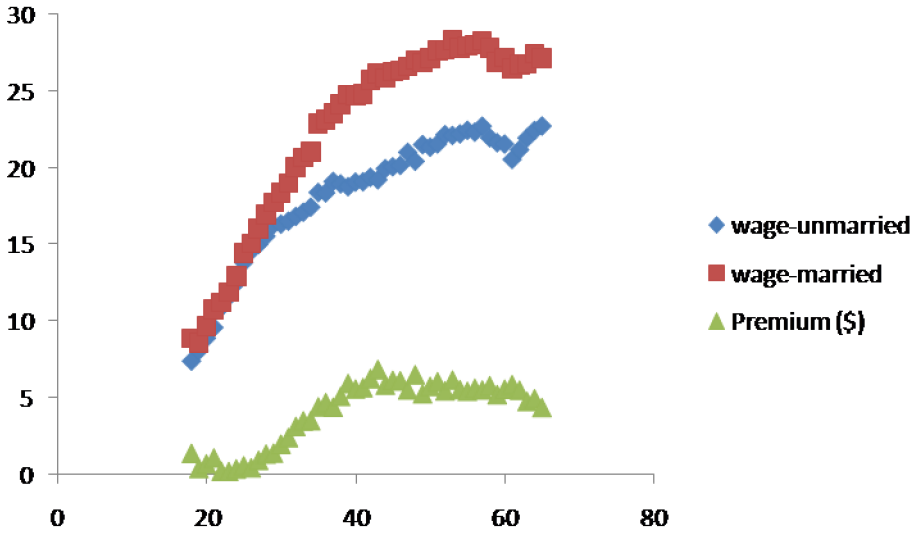


Figure 4: Average wages for married and unmarried men, by age, as well as the difference in wages by age.

In this section I analyze the impact of marriage on wages over time using data drawn from the 5% public use microsample of the 2000 US Census. To do so, I divide the Census into quartiles by age and estimate a separate marraige premium for each quartile, allowing for the possibility of a quadratic specification. If the quadratic specification is correct, then there should be no discontinuities between quartiles. To provide intuition and develop the analysis, I first present average (unadjusted) age-wage profiles, and the results of estimating the returns to marriage for the entire sample. Conceptually, my approach resembles that of Murphy and Welch (1990), who divide their CPS sample into cells by education and experience, and the compute an average wage by cell. They can then plot the average wages to depict the age-earninsg profile. I differ, however, in that I focus on the marriage premium, I only have four cells, divided by age, and I present adjusted premia (controlling for education, race, and so on.) I limit my sample to American citizens working more than 20 hours/week. I also cut from my sample all women, men with disabilities, men under the age of 18 and over the age of 65, and men not fluent in English. This leaves me with well

over 2 million observations The Census contains data on wages, marital status, years and type of education, and sector of employment. Appendix A contains summary statistics of these variables for the sample and for married and unmarried individuals.

To get a sense of the marriage premium over time, in figure 4 I plot the average wage of married and unmarried men at every age, and also the average (unadjusted) difference. The plot suggests a small premium at a young age, then a rapid rise in the premium until it reaches a plateau around age 40; it decline slightly after age 60, apparently due to the faster growth of earnings among unmarried men at that age. The figure looks tantalizingly close to the idealized age-earnings profile in the theory of human capital, but any resemblance is coincidental, since the figure plots the difference since entering the labor force and not since marriage, and since the estimates are cross-sectional.

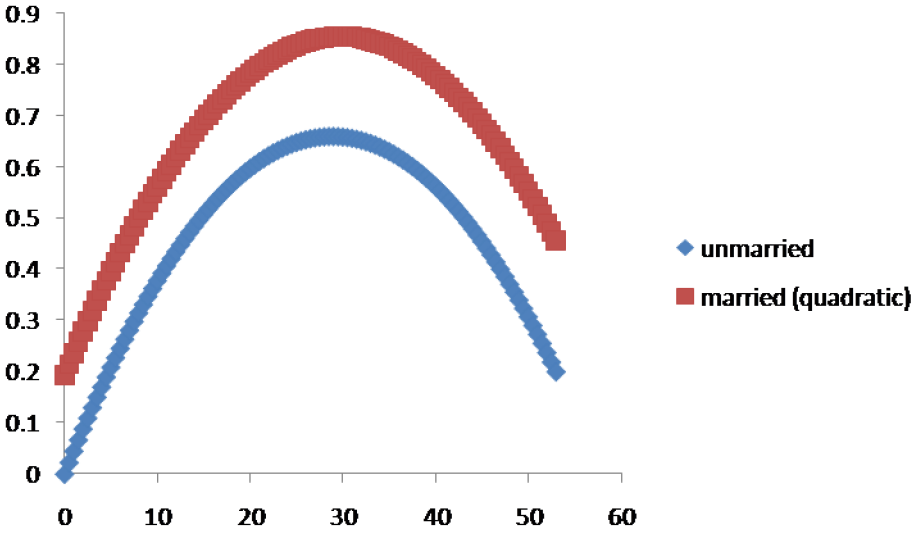


Figure 5: Earnings of married and unmarried men, as implied by estimates of an OLS wage regression using Census data.

Although intriguing, figure 4 cannot shed much light on whether the returns to marriage increase over the course of that marriage, or whether they are static but positively related to the length of the marriage. This is because the differential in figure 4 is unadjusted; I have not controlled for education and other determinants of income. To determine whether the marriage premium varies over time, I estimate a wage equation for each of the four age quartiles as well as for the entire sample. The $25^{th}$ percentile of age is 31, the median age is 40, and the $75^{th}$ percentile is 49. I construct my quartiles so that they include the lower but not the upper bound; therefore they are not of equal size and in fact the top quartile is noticeably smaller than the lower three. Critically, although marriage increases with age from 38.6% in the youngest cohort to 81.4% in the oldest, there are still many unmarried individuals in every quartile, so that estimation is possible. Estimating by age quartile allows me to see whether the marriage premium varies by age cohort. I estimate the following equation:

$$ln(Wage_i) = \alpha + \beta_0 marriage_i + \beta_1 mar_i * exp_i + \beta_2 mar_i * exp_i^2 + \beta_3 X_i + \beta_4 Y_i + \epsilon_i, \qquad (8)$$

Since I can estimate different quadratic forms by age quartile, I can distinguish between a marriage premium that rises with age and a marriage premium that declines over time. If the marriage premium did not vary secularly with time, then $\beta_0$, $\beta_1$ and $\beta_2$ would be the same in every regression, provided the quadratic specification is correct. If, on the other hand, the gains to marriage do not vary over the course of a marriage, but do changes over time, varying with the lengh of marriage and the degree of specializaiton, then we would expect the marriage premium to vary from cohort to cohort.

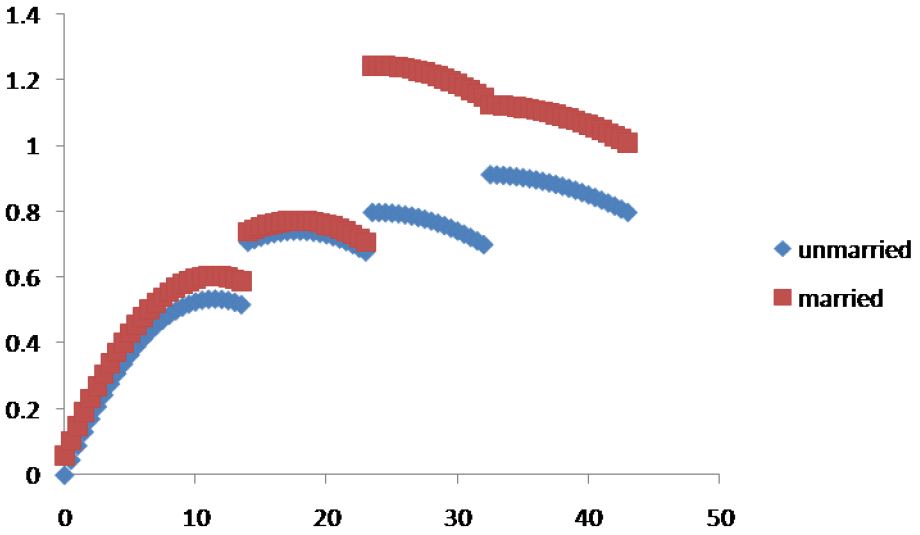


Figure 6: Earnings of married and unmarried men, as implied by estimates of the wage equation by quartile.

For ease of interpretation, I report the results graphically in figure 5; the full results may be found in the appendix. Figure 5 depicts the implied wage of married and unmarried men at every age, holding all else constant and based on estimates from the pooled sample. The figure implies that wages rise until approximately 30 years of experience, when they begin to fall rapidly, so that a man with 40 years of experience earns as much, on average and all else equal, as a man with approximately 20 years of expeerience. This result does not correspond to empirical age-earnings of figure 4; in particular, there is too much curvature in the quadratic specification. Wages rise too rapidly at first, and fall too slowly in the extreme. This differential is roughly consistent with the results of Murphy and Welch (1990), who estimate that the quadratic specification understates earnings growth at the beginning of the career by as much as 50%, and overstates end-of-career earning decline by a factor of three.

Figure 6 confirms the impression that the quadratic specification is incorrect, and also suggests that the marriage premium has changed over time. Figure 6 plots the implied wages for married and unmarried men, using only the coefficients from that cohort. Figure 6 depicts, first, striking discontinuities between the four cohorts, particularly between the first and second and second and third. (Recall that the marriage premium is given by the distnace between the married and unmarried curves.) The second important feature is the difference in the marriage premium within

and between cohorts. The premium appears to rise slightly within the oungest cohort, and not at all in the second cohort. In the third and fourth cohort, however, the premium falls, if it changes at all. The premium appears roughly the same in cohorts 1 and 2, much larger in cohort 3, and somewhat smaller in cohort 4 than in 3. Since the difference in the premium is greater between cohorts than within them, it is likely that the apparent increase in the marriage premium with age is actually due to a secular decline in the marriage premium. Although it is possible that the quadratic specification is driving these results, that is unlikely. The marriage premium in the upper three quartiles is relatively flat, suggesting that the curvature is not too extreme. Moreover experimentation with log specifications provided qualitatively similar results.

The Census data strongly suggest a secular decline in the marriage premium. To the extent that a man's marriage premium increases with length of marriage, it is likely to do increase only over the first few years of marriage, and then remain constant, as he reaches the steady state optimal level of human capital. This result provides further evidence in support of the notion that the marriage premium is due to human capital accumulation; moreover it is a result not predicted elsewhere in the literature.

# 5 Conclusion

In this paper I argue that household specialization and investment in firm-specific human capital explains the male marriage premium. First I develop a model of human capital in which to-be-married men invest in human capital over two rounds, upon entering the work force and upon marriage. The promise of high returns to the *second* round of investment encourages firms to offer high wages before the *first* round, so that wages do not change upon marriage. These high wages are the source of the marriage premium. The model has two other predictions, that among the self-employed wages should increase upon marriage, because the self-employed cannot literally offer themselves higher wages, and second that the cross-secional marriage premium should have declined over time with increasing female labor force participation and older age of marriage. Using the Panel Study on Income Dynamics, I estimated a cross-sectional marriage premium of approximately 20% among both the self-employed and those employed in regular employment. Controlling for individual fixed effects, the estimated marriage premium falls to zero for those employed in regular employment, but remains at 20% among the self-employed. The results suggest that marriage improves productivity, but that marginal productivity does not equal wages for those employed in regular employment.

The theory also predicts a static marriage premium that depends on the length of marriage and on the degree of specialization within marriage. To test this prediction I use the 2000 Census and divide it into quartiles by age. Since the degree of specialization and the length of marriage have both decreased across quartiles, I can use quartile membership as a proxy for these variables. Estimating the marriage premium by quartile indicates that it has indeed declined across them, and substantially.

This paper builds on the literature in two ways. It provides an empirical exploration of two open questions on the economic impact of marriage: whether it increases productivity or merely signals it, and whether its impact on earnings is felt all at once or over time. The evidence on the self-employed strongly suggest that marriage increases productivity. Althoguh I am not the first to consider the marriage premium among the self-employed, my measure of their labor income is unique in accounting for their return on equity. This paper also clarifies the predictions

of Becker's theory of household specialization. Under his theory, although marriage does increase productivity, it does not necessarily increase wages, because of the incomplete markets and property right problems implicit in the theory.

# Works Cited


Acemoglu, Daron and Jorn-Steffen Pischke. 1998. "Why Do Firms Train? Theory and Evidence" Quarterly Journal of Economics, Vol. 113, No. 1, pp 79-119.

Akerlof, George A. 1998. "Men Without Children." Economic Journal, Vol. 108, No. 447 (Mar.), pp. 287-309.

—, Janet Yellen, and Michael Katz. 1996. "An Analysis of Out-of-Wedlock Childbearing in the United States." Quarterly Journal of Economics, Vol. 111, No. 2 (May), pp. 277-317.

Alchian, Armen A. and Harold Demsetz. 1972. "Production, Information Costs, and Economic Organization." American Economic Review, Vol 62, No. 5 (December), pp. 777-95.

Antonovics, Kate and Robert Town. 2004. "Are all the Good Men Married? Uncovering the Soruces of the Marital Wage Premium." American Economic Review, Papers and Proceedings, Vol. 94, No. 2 (May), pp. 317-321.

Bardasi, Elena and Mark Taylor. 2005. "Marriage and Wages." ISER Working Papers Number 2005-1.

Becker, Gary S. 1962. "Investment in Human Capital: A Theoretical Analysis." Journal of Political Economy, Vol. 70, No. 5, Part 2: Investmet in Human Beings (Oct.), pp. 9-49.

—. 1991. A Treatise on the Family. Cambridge: Harvard University Press.

Brown, Charles, Greg J. Duncan and Frank P. Stafford. "Data Watch: The Panel Study of Income Dynamics." Journal of Economic Perspectives, Vol. 10, No. 2 (Spring), pp. 155-168.

Chun, Hyunbae and Injae Lee. 2001. Why do Married Men Earn More: Productivity of Marriage Selection?" Economic Inquiry, Vol. 39, No. 2 (Apr.), pp. 307-319.

Cornwell, Christopher and Peter Rupert. 1997. "Unobservable Individual Effects, Marriage, and the Earnings of Young Men." Economic Inquiry, Vol. 35, No. 2 (Apr.), pp. 285-294.

Dickens, Richard, Stephen Machin and Alan Manning. 1999. "The Effects of Minimum Wages on Employment: Theory and Evidence from Britain." Journal of Labor Economics, Vol. 17, No. 1 (Jan.), pp. 1-22.

Goldin, Claudia and Lawrence F. Katz. 2002. "The Power of the Pill: Oral Contraceptives and Womens Career and Marriage Decisions." Journal of Political Economy, Vol. 110, No. 4 (August), pp. 730-770.

Ginther, Donna and Madeline Zavodny. 2001. "Is the Male Marriage Premium due to Selection?

The Effect of Shotgun Weddings on the Return to Marriage." Journal of Population Economics, Vol. 14, No. 2 (June), pp. 313-328.

Gray, Jeffrey S. 1997. "The Fall in Mens Return to Marriage: Declining Productivity Effects or Changing Selection?" Journal of Human Resources, Vol. 32, No. 3 (Summer), pp. 481-504.

Hashimoto, Masanori. 1981. "Firm-Specific Human Capital as a Shared Investment." American Economic Review, Vol. 71, No. 3 (Jun.), pp. 475-482.

Hill, Martha S. 1979. "The Wage Effects of Marital Status and Children." Journal of Human Resources, Vol. 14, No. 4 (Autumn), pp. 579-594.

—. 1991. The Panel Study of Income Dynamics: A Users Guide, volume 2. New York: Sage.

Hersch, Joni and Leslie S. Stratton. 1997. "Housework, Fixed Effects, and Wages of Married Workers." Journal of Human Resources. Vol. 32, No. 2 (Spring), pp. 285-307.

Korenman, Sanders and David Neumark. 1991. "Does Marriage Really Make Men More Productive?" Journal of Human Resources, Vol. 26, No. 2 (Spring), pp. 282-307.

Krashinsky, Harry A. 2004. "Do Marital Status and Computer Usage Really Change the Wage Structure?" Journal of Human Resources, Vo. 39, No. 3 (Summer), pp. 774-791.

Lazear, Edward P. "Agency, Earnings Profiles, Productivity, and Hours Restrictions." American Economic Review, Vol. 71, No. 4 (Sep.), pp. 606-620.

—. 2003. "Firm Specific Human Capital: A Skill-Weights Approach." NBER Working Paper No. 9679, April, 2003.

Loh, Eng Seng. 1996. "Productivity Differences and the Marriage Wage Premium for White Males." Journal of Human Resources, Vol. 31, No. 3 (Summer), pp. 566-589.

Lundberg, Shelly and Elaina Rose. 2002. "The Effects of Sons and Daughters on Mens Labor Supply and Wages." Review of Economics and Statistics, Vol. 84, No 2 (May), pp. 251-268.

Malkiel, Burton G. and Judith A. Malkiel. 1973. "Male-Female Pay Differentials in Professional Employment." American Economic Review, Vol. 63, No. 4 (Sep.), pp. 693-705.

Mehay, Stephen L. and William R. Bowman. 2005. "Marital Status and Productivity: Evidence from Personnel Data." Southern Economic Journal, Vol. 72 No. 1 (Jul.), pp. 63-77.

Murphy, Kevin M. and Finish Welch. "Empirical Age-Earnings Profiles." 1990. Journal of Labor Economics, Vol. 8, No. 2 (Apr.), pp. 202-229.

Neumark, David. 1988. "Employers Discriminatory Behavior and the Estimation of Wage

Discrimination." Journal of Human Resources, Vol. 23, No. 3 (Summer), pp. 279-295.

Oaxaca, Ronald. 1973. "Male-Female Wage Differentials in Urban Labor Markets." International Economic Review, Vol. 14, No. 3 (Oct.), pp. 693-709.

Stewart, Mark B. 2004. "The Employment Effects of the National Minimum Wage." Economic Journal, Vol. 114, No. 494 (Mar.), pp 110-116.

Stratton, Leslie S. 2002. "Examining the Wage Differential for Married and Cohabiting Men." Economic Inquiry, Vol. 40, No. 2 (Apr.), pp. 199-212.

# Appendix: Census Details

**Table 5: Census Summary Statistics**

| | all | married | unmarried | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|---|---|---|
| Wage | 21.44 | 24.11 | 16.32 | 13.96 | 21.48 | 24.62 | 26.50 |
| Marriage | 0.66 | 1 | 0 | 0.39 | 0.70 | 0.76 | 0.81 |
| Age | 39.98 | 42.89 | 34.41 | – | – | – | – |
| Associate | 0.07 | 0.08 | 0.07 | 0.07 | 0.08 | 0.08 | 0.06 |
| Bachelor's | 0.19 | 0.20 | 0.17 | 0.18 | 0.21 | 0.20 | 0.19 |
| Master's | 0.07 | 0.08 | 0.04 | 0.03 | 0.06 | 0.08 | 0.11 |
| Professional | 0.023 | 0.03 | 0.01 | 0.01 | 0.02 | 0.03 | 0.04 |
| Doctorate | 0.01 | 0.02 | 0.01 | 0.002 | 0.01 | 0.01 | 0.03 |
| Government | 0.15 | 0.16 | 0.12 | 0.10 | 0.13 | 0.17 | 0.20 |
| Self-Employment | 0.06 | 0.08 | 0.03 | 0.02 | 0.06 | 0.08 | 0.09 |
| Nonprofit | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.05 | 0.06 |
| Asian | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Black | 0.07 | 0.06 | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 |
| Potential Experience | 20.20 | 22.93 | 14.98 | 6.21 | 16.38 | 24.87 | 35.27 |
| Observations | 2095262 | 1375760 | 719502 | 556008 | 527378 | 525311 | 486565 |

**Table 6: Marriage Premium by Quartile, OLS Regression, Dependent Variable: Log wage**

| | All | First Quartile | Second Quartile | Third Quartile | Fourth Quartile |
|---|---|---|---|---|---|
| Marriage | 0.193*** | 0.058*** | 0.016 | 0.458*** | 0.211** |
| | 0.003 | 0.006 | 0.028 | 0.073 | 0.098*** |
| Marriage Length | -0.001*** | 0.015*** | 0.021*** | -0.015*** | 0.002 |
| | 0.0003 | 0.0015 | 0.003 | 0.0006 | 0.005 |
| $(\text{Marriage Lenth})^2$ | -0.00005*** | -0.0006*** | -0.0006*** | 0.0002** | -0.00001*** |
| | 0 | 0.0001 | 0.0001 | 0.0001 | 0.00001 |
| Potential Experience | 0.046*** | 0.093*** | 0.083*** | 0.0674*** | 0.058*** |
| | 0.0002 | 0.008 | 0.003 | 0.005 | 0.005 |
| $(\text{Potential Experience})^2$ | -0.0008*** | -0.004*** | -0.002*** | -0.0014221*** | -0.001*** |
| | 0 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| N | 2095262 | 556008 | 527378 | 525311 | 486565 |
| Adjusted $R^2$ | 0.2443 | 0.217 | 0.1629 | 0.161 | 0.1484 |

Estimated using the 2000 Census PUMS. The dependent variable is the log of real hourly income from labor. Other controls are dummy varibles for education and sector of employment. Standard errors are given in parentheses.

* Significant at the 0.1 level.

** Significant at the 0.05 level.

*** Significant at the 0.01 level.