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**Taxes and Marriage: A Two-Sided
Search Analysis**

by

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Taxes and Marriage: A Two-Sided Search Analysis*

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Abstract

This paper analyzes the effects that differential tax treatment of married and single individuals has on marriage behavior. using a version of the two-sided search model of Burdett-Wright (1998). The main results are the following: i) an increase in the 'marriage tax' reduces the number of marriages; ii) an indirect strategic effect due to two-sided search considerations mitigates the impact that changes in the 'marriage tax' have on marriage formation: iii) the quantitative analysis of the model indicate that. in the US. large increases in the 'marriage tax' are associated with small changes in the number of marriages. KEYWORDS: Marriage Tax. Two-Sided Search. JEL Numbers: H2. D1.

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1 Introduction

Since Becker's (1973. 1974) seminal papers on marriage, researchers from different fields have been paying close attention to how economic factors affect the formation. composition. and dissolution of households.

Among these factors. one that has received considerable attention recently is the so called "marriage tax": i.e.. the differential tax treatment of married and single individuals in the US. which alters the combined tax liabilities of two single individuals after they marry. Such a feature leads to substantial tax "penalties" and "bonuses". making the tax code significantly non-neutral with respect to marital decisions. Feenberg and Rosen (1995) estimated that, in 1994. 52% of couples in the United States incurred in a marriage tax or penalty, while 38% received a marriage subsidy or bonus, with marriage penalties and bonuses averaging $1.244 and $1.399, respectively. A closer look at the data reveals that the distribution of the size of these penalties and bonuses varies across the income distribution. Furthermore. they are non-negligible for every income class: in fact. for some low income level couples the marriage penalty can be as high as 18 percent of their total income![1]

Given that changes in marital status can carry substantial income tax consequences with them. it is natural to surmise that this differential tax treatment should affect people's behavior towards marriage. Indeed. a straightforward application of Becker's competitive marriage market model shows that. everything else constant. the imposition of a tax on married couples

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[1]Feenberg and Rosen (1995). table 2. pp.94. See Congressional Budget Office (1997) for additional estimations of the size of marriage penalties-bonuses and their distribution.

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decreases the gains from marriage and this makes the equilibrium number of married people to decrease.[2]

This clear qualitative insight prompted some researchers to assess its empirical significance. In a series of papers. Alm and Whittington have estimated the effects that income taxation has on marital decisions in the United States.[3] Among other results. the empirical evidence they analyze reveals that the marriage tax has a negative impact on the number of marriages; however. the magnitude of the effect in all of their estimations is systematically small. with point elasticities of the number of marriages with respect to the change in the marriage penalty ranging from $-.05$ to about 0.[4] A similar exercise was conducted by Sjoquist and Walker (1995), but they found no statistically significant effect of the marriage tax on the rate of marriage formation.

In this paper. we analyze a marriage market environment with costly search and focus on the effect of marriage penalties and bonuses on the decision to marry: to make the analysis as simple and clear as possible. we abstract from potential effects on other variables such as divorce. labor supply, fertility decisions. timing of marriage, etc. We use a modified version of the two-sided search framework developed by Burdett and Wright (1998). and study a marriage market model with differential tax treatment of single and married individuals. In doing so. we provide a first attempt to understand and isolate the different effects that the marriage tax imposes on marriage formation in a two-sided search environment. and rationalize some

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[2]See for example the discussion in Sjoquist and Walker (1995). pp.548-549.

[3]See Alm and Whittington (1995a). (1995b). (1996). and (1997).

[4]Whittington and Alm (1996) find that changes in the marriage tax has small but positive effect on the probability of divorce. Their (1997) paper shows that this tax also affects the timing of marriage: again. the magnitude of the effect is small.

of the empirical evidence on the subject.

Our main findings are the following. An increase in the marriage tax has two effects on the equilibrium stock of marriages: on the one hand. each agent becomes choosier in their acceptance decision of potential mates. since the income gains from marriage decrease. While this effect has a clear negative impact on the stock of marriages, there is a countervailing one that can substantially mitigate it: agents realize now that they are accepted less often and. since search is costly. this makes them more prone to marriage. We show that this strategic or indirect effect. which is due exclusively to two-sided search considerations. can dominate the first for one of the populations (men or women), but it cannot do it for both of them. As a result. although the net effect on the equilibrium stock of marriages is still negative, it is smaller than when this strategic or general equilirium effect is ignored. We also parametrize the model and calibrate it using US data in order to study some of its quantitative implications. For the parametrization chosen. we find that the quantitative impact of an increase in the marriage tax or penalty on marriage formation is small. When we measure the impact across steady states. the highest elasticity of the stock of marriages to changes in the marriage penalty found is about -0.012.

The contributions of this paper can be summarized as follows. First. we provide the first search theoretic analysis of the effects of the differential tax treatment of married and single individuals in a general equilibrium model with endogenous marriage formation. Second. by including some realistic features such as search. match-specific components. and strategic behavior into a marriage market model. we are able to uncover an intuitive but subtle indirect effect that mitigates the initial impact the marriage tax has on marriage behavior. and one that contributes to explain the ˙smallness˙ found in

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the empirical literature on the subject. Third. the quantitative implications of the simple model studied here reveal that there need not be an empirical 'puzzle' regarding the effects of the marriage tax on marriage formation: as we show in section 4. large increases in the marriage tax can be associated with very small changes in the stock of marriages. Finally, and responding to one of Burdett and Wright (1998) desiderata. this paper shows that the two-sided search framework they developed can be useful for addressing policy issues: in particular. we illustrate its usefulness in issues related to the marriage tax and its effects.

The next section describes the model. while the equilibrium analysis is conducted in section 3. In section 4. we calibrate the model and investigate its quantitative implications. Section 5 concludes and suggests avenues for future research. The appendix contains some results on the sensitivity of the quantitative findings with respect to changes in the parameter values assumed.

2 The Model

In this section. we describe a two-sided search model of a marriage market with nontransferable utility based on the framework developed by Burdett and Wright (1998).

Consider a stationary economy populated by a continuum of agents that live in continuous time and are of two types: m (males) and f (females). The measure of each population is for simplicity normalized to one.[5]

Each agent engages in the time consuming process of looking for a mate. Ex-ante. all agents are identical: however. at each meeting, a man observes

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[5]Therefore. number or fraction of married people are equivalent concepts.

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a realization of the random variable θ_m. distributed according to $G_m(\theta_m)$, and a woman observes realization of θ_f. distributed according to $G_f(\theta_f)$. For simplicity, it is assumed that θ_m and θ_f are independent. and take values on $[\underline{\theta}, \overline{\theta}]$. The corresponding densities are denoted by $g_f(\theta_f)$ and $g_m(\theta_m)$, respectively. These realizations reflect the match-specific flow benefits. In other words. although agents are homogeneous ex-ante. they are heterogeneous ex-post. in the sense that agents are not indifferent about whom to match with.[6]

When single. the flow utility of an agent is just the after tax income $w_i(1 - t^S)$, $i = f, m$. where t^S is the tax rate for a single person.[7] If a man and a woman. after observing the realizations of θ_m and θ_f. decide to get married, then his flow utility is $k(1 - t^M)(w_m + w_f) + \theta_m$ and hers is $(1 - k)(1 - t^M)(w_m + w_f) + \theta_f$. where t^M is the tax rate for a married couple. and $(k, 1 - k)$ are the shares of the total income that each of the spouses receives.[8] Agents discount the future at the rate r.

Definition 1 *There is a marriage tax (subsidy) if $t^M > t^S$ ($t^M < t^S$).*[9]

Notice that this definition takes the *couple* as the unit of analysis: i.e.. the

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[6]Introducing ex-ante heterogeneity of agents as in Burdett and Coles (1997). Chade (1997. 1998). Morgan (1996). and Smith (1997). substantially complicates the analysis of the model when taxation is included. We regard this as an important avenue for future research that will shed some light on the potential effects that the marriage tax has on assortative mating.

[7]We are assuming that w_m and w_f belong to the same 'tax bracket'. Relaxing this only complicates the notation without altering the results. Also. we are assuming that men earn the same income w_m and women earn the same income w_f: in other words. we are considering 'representative' or 'median' taxpayers.

[8]These shares are taken as given in the model. We can think of them as determined by norms or customs. The results of the paper still hold as long as the total surplus of the match is less than perfectly transferable between the partners.

[9]This definition is consistent with the ones found in the literature. once the same 'tax bracket' assumption is imposed.

sum of the after tax incomes $(1-t^i)(w_m+w_f)$, $i = M$. S is lower (higher) when the agents are married than when they are single. But this does not mean that the income that *each* spouse receives is lower (higher) after marriage; this depends on the magnitude of w_m, w_f and k.[10]

Consider the decision problem faced by a man. Marriage proposals arrive randomly according to a Poisson process with parameter α_m. Upon receiving the proposal, a man observes a realization of θ_m and the decision to accept or reject the match. Obviously, the woman is facing an analogous problem, and the match is formed only if both find it mutually acceptable. A married man does not generate any marriage offer, and he is abandoned by his wife according to a Poisson process with parameter λ_m; even if this does not occur, a man dies according to another Poisson process with parameter δ_m.

Let U_m be the expected discounted utility of an single man, and let $V_m(\theta_m)$ be the expected discounted utility of a man who is in a marriage characterized by a match specific component θ_m. Formally, they are recursively defined as follows:[11]

$$(r + \delta_m)U_m = (1 - t^S)w_m + \alpha_m E[\max\{V_m(\theta_m) - U_m, 0\}] \qquad (1)$$

$$(r + \delta_m)V_m(\theta_m) = k(1 - t^M)(w_m + w_f) + \theta_m + \lambda_m(U_m - V_m(\theta_m)) \qquad (2)$$

---

[10]For instance, the difference between the flow income a man receives when married and when single is

$$k(1 - t^M)(w_m + w_f) - (1 - t^S)w_m = w_m(t^S - t^M) + (k(w_f + w_m) - w_m)(1 - t^M)$$

which can be positive *even* if $t^M > t^S$.

[11]These equations are derived using a straightforward discrete approximation argument. See the appendix in Burdett-Wright (1998).

Therefore.

$$V_m(\theta_m) = \frac{k(1 - t^M)(w_m + w_f) + \theta_m + \lambda_m U_m}{r + \delta_m + \lambda_m} \tag{3}$$

An optimal strategy for a man is to accept a match if and only if the match specific component is above a threshold θ_m^*, defined by $V_m(\theta_m^*) = U_m$. Plugging this in (3) yields.

$$\theta_m^* = (r + \delta_m)U_m - k(1 - t^M)(w_m + w_f) \tag{4}$$

and we can rewrite (1) as

$$\theta_m^* + k(1 - t^M)(w_m + w_f) - (1 - t^S)w_m = \alpha_m \int_{\theta_m^*}^{\bar{\theta}} (V_m(\theta_m) - V_m(\theta_m^*))dG_m(\theta_m)$$

Integrating by parts the integral on the right hand side, and using the derivative of $V_m(\theta_m)$ with respect to θ_m gives

$$\theta_m^* + k(1 - t^M)(w_m + w_f) - (1 - t^S)w_m = \frac{\alpha_m}{r + \delta_m + \lambda_m}\mu_m(\theta_m^*)$$

where $\mu_m(\theta_m^*) = \int_{\theta_m^*}^{\bar{\theta}}(1 - G_m(\theta_m))d\theta_m$.

Women face an analogous problem. and their (common) threshold θ_f^* is implicitly defined by:

$$\theta_f^* + (1 - k)(1 - t^M)(w_m + w_f) - (1 - t^S)w_f = \frac{\alpha_f}{r + \delta_f + \lambda_f}\mu_f(\theta_f^*)$$

with $\mu_f(\theta_f^*) = \int_{\theta_f^*}^{\bar{\theta}}(1 - G_f(\theta_f))d\theta_f$.

When a man or a woman dies. he or she is replaced by a new entrant so as to keep the population sizes stationary. There is also a matching technology that yields the number of meetings among men and women as a function of the measure of unmatched individuals. This meeting technology is assumed to exhibit constant returns to scale: i.e.. the total number of meetings per

unit of time is $N = \beta(1 - M)$, where β is the contact rate for an individual and $(1 - M)$ is the number (measure) of singles in the population (equal to the size of the population, normalized to one, minus the measure M of married agents). Since a meeting with a woman generates a match for a man only if $\theta_f \geq \theta_f^*$, then the probability of receiving a marriage offer is

$$\alpha_m = \beta(1 - G_f(\theta_f^*)) \qquad (5)$$

Similarly,

$$\alpha_f = \beta(1 - G_m(\theta_m^*)) \qquad (6)$$

In this simple setup there are no incentives to terminate a marriage; thus, the terminations only happen when one of the spouses dies. This means that, in equilibrium, $\lambda_f = \delta_m$ and $\lambda_m = \delta_f$.

Definition 2 *A steady-state equilibrium is a pair* (θ_m^*, θ_f^*) *that satisfies the following equations:*

$$\theta_m^* + k(1 - t^M)(w_m + w_f) - (1 - t^S)w_m = \frac{\beta(1 - G_f(\theta_f^*))}{r + \delta_f + \delta_m}\mu_m(\theta_m^*) \qquad (7)$$

$$\theta_f^* + (1 - k)(1 - t^M)(w_m + w_f) - (1 - t^S)w_f = \frac{\beta(1 - G_m(\theta_m^*))}{r + \delta_f + \delta_m}\mu_f(\theta_f^*) \qquad (8)$$

Burdett-Wright (1998) show that, if $\mu_m(\theta^*)$ and $\mu_f(\theta^*)$ are log-concave functions (i.e., $\mu_j''\mu_j - (\mu_j')^2 \leq 0$, $j = m, f$), then there is a unique equilibrium. We will maintain this assumption in the next section.

3 Equilibrium Analysis

In a steady state equilibrium, the flow into the pool of married agents in each population, given by $(1 - M)\beta(1 - G_m(\theta_m^*))(1 - G_f(\theta_f^*))$,[12] must be equal to

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[12]In words, the flow into the pool of married individuals is the total number of singles that meet times the probability of marriage.

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the flow out of it. given by $M(\delta_f + \delta_m)$.[13]

The steady-state measure of married agents M^* is thus given by

$$
\begin{aligned}
M^* &= \frac{\beta(1 - G_m(\theta_m^*))(1 - G_f(\theta_f^*))}{\beta(1 - G_m(\theta_m^*))(1 - G_f(\theta_f^*)) + (\delta_f + \delta_m)} \\
&= \frac{\gamma}{\gamma + (\delta_f + \delta_m)}
\end{aligned}
\tag{9}
$$

Notice that M^* depends on t^S and t^M through the thresholds (θ_f^*, θ_m^*) that are functions of the primitives of the model. given by the vector $(t^S, t^M, w_f, w_m, k, \delta_f, \delta_m, r, \beta, G_f(\cdot), G_m(\cdot))$.[14] The signs of $\frac{\partial M^*}{\partial t^j}$, $j = S, M$ are equal to the sign of $\frac{\partial \gamma}{\partial t^j}$; the latter derivative is given by[15]

$$
\frac{\partial \gamma}{\partial t^j} = -\beta(g_m(1 - G_f)\frac{\partial \theta_m}{\partial t^j} + g_f(1 - G_m)\frac{\partial \theta_f}{\partial t^j})
\tag{10}
$$

The derivatives $\frac{\partial \theta_m}{\partial t^M}$ and $\frac{\partial \theta_f}{\partial t^M}$ can be found by implicit differentiation of (7) and (8). They are given by the following expressions

$$
\frac{\partial \theta_m}{\partial t^M} = \frac{k(1 + \pi\mu_f'\mu_m') - (1 - k)\pi\mu_m\mu_f''}{(1 + \pi\mu_f'\mu_m')^2 - \pi^2\mu_f''\mu_m\mu_m''\mu_f}(w_m + w_f)
\tag{11}
$$

$$
\frac{\partial \theta_f}{\partial t^M} = \frac{(1 - k)(1 + \pi\mu_f'\mu_m') - k\pi\mu_f\mu_m''}{(1 + \pi\mu_f'\mu_m')^2 - \pi^2\mu_f''\mu_m\mu_m''\mu_f}(w_m + w_f)
\tag{12}
$$

where $\pi = \frac{\beta}{r + \delta_f + \delta_m}$.

Similarly. $\frac{\partial \theta_m}{\partial t^S}$ and $\frac{\partial \theta_f}{\partial t^S}$ are given by

$$
\frac{\partial \theta_m}{\partial t^S} = -\frac{w_m(1 + \pi\mu_f'\mu_m') - w_f\pi\mu_m\mu_f''}{(1 + \pi\mu_f'\mu_m')^2 - \pi^2\mu_f''\mu_m\mu_m''\mu_f}
\tag{13}
$$

$$
\frac{\partial \theta_f}{\partial t^S} = -\frac{w_f(1 + \pi\mu_f'\mu_m') - w_m\pi\mu_f\mu_m''}{(1 + \pi\mu_f'\mu_m')^2 - \pi^2\mu_f''\mu_m\mu_m''\mu_f}
\tag{14}
$$

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[13]This is the total number of married agents times the probability of becoming a widow.

[14]It is important to emphasize the dependence of the equilibrium number of marriages on the primitives of the model. This should help researchers when choosing the set of independent variables that are relevant for an empirical analysis of the effects of the marriage tax on marriage behavior.

[15]For simplicity. we omit the arguments of the functions.

Consider first the symmetric case in which $G_f = G_m = G$, $w_f = w_m = w$, $k = \frac{1}{2}$, and $\lambda_f = \lambda_m$; in this case, the unique equilibrium is symmetric with both populations choosing the same threshold θ^*: thus $\mu_f = \mu_m = \mu$. In this case, the signs of the derivatives with respect to t^M and t^S depend on the sign of the following expression:

$$\frac{1 + \pi(\mu'^2 - \mu''\mu)}{(1 + \pi\mu'^2)^2 - (\pi\mu''\mu)^2} \tag{15}$$

The log-concavity assumption on μ ensures that the numerator and denominator of the above expression are non-negative. Therefore, both, θ_f^* and θ_m^* increase (in the same magnitude) when t^M increases, and decrease when t^S increases. In turn, this implies that M^* decreases with t^M and increase with t^S. The intuition is rather simple: an increase in t^M keeping t^S constant implies that the 'income gains' from marriage are lower; therefore, agents will not 'tie the knots' unless match-specific components are high enough to compensate for the loss in marriage income. A similar intuition holds for a change in t^S.

It is easy to demonstrate that the change in the thresholds is smaller than in the case in which agents do not take into account the reaction of the other population. The intuition is the following: when t^M increases, there are two opposite effects that affect θ_m^* and θ_f^*. First, the decrease in the *income* gains from marriage increases the acceptance thresholds of men and women; second, each agent faces a 'tighter' search environment (since they are accepted less often) and this makes them less choosy. In the symmetric case, we just showed that the first effect dominates for *both* men and women, and the net result is an increase in the thresholds; nevertheless, the second effect makes the thresholds *less* sensitive to changes in the marriage tax.

Now consider the asymmetric case. The sign of the denominator in all

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the derivatives is positive given the log-concavity assumption. For.

$$(1 + \pi\mu_f'\mu_m')^2 - \pi^2\mu_f''\mu_m\mu_m''\mu_f = 1 + 2\pi\mu_f'\mu_m' + \pi^2((\mu_f'\mu_m')^2 - \mu_f''\mu_m\mu_m''\mu_f)$$

$$\geq 1 + 2\pi\mu_f'\mu_m' + \pi^2((\mu_f'\mu_m')^2 - (\mu_f'\mu_m')^2)$$

$$= 1 + 2\pi\mu_f'\mu_m' > 0$$

However. the signs of the numerators are ambiguous. Let us focus only (11) and (12), since the analysis of the other expressions is similar. The numerators of these expressions can be written. respectively, as

$$k[a(k) + b(k)] - b(k)$$

$$a(k) - k[a(k) + c(k)]$$

where $a(k) \equiv 1 + \pi\mu_f'\mu_m'$, $b(k) \equiv \pi\mu_m\mu_f''$, and $c(k) \equiv \pi\mu_f\mu_m''$.[16]

Although each of these expressions can be positive or negative. it is easy to show that they cannot be *both* negative. If the first expression is negative, then it must be the case that $k < \frac{b(k)}{a(k)+b(k)}$; therefore.

$$a(k) - k[a(k) + c(k)] > a(k) - \frac{b(k)[a(k) + c(k)]}{a(k) + b(k)}$$

$$= \frac{a(k)^2 - b(k)c(k))}{a(k) + b(k)}$$

$$= \frac{(1 + \pi\mu_f'\mu_m')^2 - \pi^2\mu_f''\mu_m\mu_m''\mu_f}{a(k) + b(k)} \geq 0$$

given the log-concavity of μ_f and μ_m.

However. it is still possible that one of the thresholds increases and the other one decreases when t^M goes up; in other words. the second effect mentioned above can dominate the first for one of the populations.[17] This makes

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[16]These expressions depend on k through θ_f^* and θ_m^*.

[17]See section 4 for a quantitative illustration.

the probability of marriage γ and therefore the steady state measure of marriages M^* *even* less sensitive to changes in the marriage tax than in the symmetric case. It also suggests the theoretical possibility that M^* could actually *increase* with an increase in t^M: nevertheless. this cannot happen under log-concavity. If we insert (11) and (12) in (10) then. after some manipulation. it is easy to show that a sufficient condition for $\frac{\partial \gamma}{\partial t^M}$ to be nonpositive is

$$ k\mu_m''(\mu_f')^2\mu_m' - (1-k)\mu_m\mu_f'\mu_m''\mu_f' + (1-k)\mu_f''(\mu_m')^2\mu_f' - k\mu_f\mu_f'\mu_m''\mu_m' \leq 0 $$

But, under log-concavity, this expression is less than or equal to

$$ k\mu_m''(\mu_f')^2\mu_m' - (1-k)(\mu_m')^2\mu_f''\mu_f' + (1-k)\mu_f''(\mu_m')^2\mu_f' - k(\mu_f')^2\mu_m''\mu_m' = 0 $$

We summarize the results of this section in the following proposition:

Proposition 1 *If μ_m and μ_f are log-concave, then*

1. *In the symmetric case, an increase in the marriage tax (increase in t^M or decrease in t^S) increases the acceptance thresholds of men and women. and therefore reduces the steady state measure of marriages.*

2. *In the asymmetric case. an increase in the marriage tax can either a) increase both acceptance thresholds or. b) increase one and decrease the other. In both cases. the steady state measure of marriages decreases.*

3. *The reduction in the measure of marriages is smaller than in the case in which agents ignore the reaction of the other population.*[18]

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[18]The fact that agents are risk-neutral does not seem to be crucial for these results. If agents were risk-averse. the indirect effect is likely to be even more pronounced. A tighter search environment makes the probability that an agent will be rejected larger. and this induces a more 'cautious' acceptance behavior from this agent.

As stated in the introduction. these results are important in the sense that they shed some light on some of the empirical findings on the effects of the marriage tax on marriage behavior. While Alm and Whittington (1995a. 1995b) found a negative. but quantitatively small effect of changes in taxes on the number of marriages, Sjoquist and Walker (1997) found no statistically significant effect on the rate of marriage formation. Data problems and divergence in the implementation of the empirical tests aside.[19] the results presented above are *not* inconsistent at the theoretical level with the findings of these authors: in the simple general equilibrium model studied in this paper. changes in the tax burden on married couples can be associated with changes in the number of marriages of small magnitude *even* if agents take into account the income effects of marriage formation. Whether or not the consequences of marriage penalties and bonuses on marriage formation are indeed small in the context of the present model. is a quantitative question that we tackle in the next section.

4   Quantitative Results

In order to further investigate the impact of a differential tax treatment of married relative to single individuals. we numerically compute the equilibria for alternative values of the tax on married couples (t^M) and the fraction of married income captured by males (k). We do so by using actual US data to discipline our choice of some of the parameters whenever possible.[20]

Initially. we set the tax parameters values $t^M = t^S = .20$: this is the benchmark case with no marriage taxes or subsidies. The value for the rate

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[19]See Alm and Whittington (1995b) for a discussion.

[20]This is a difficult task. For instance. we are not aware of any estimations of the parameters that characterize the distributions of match-specific components. θ_m and θ_f.

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of time preference r is set equal to .04. The wages w_f and w_m are chosen in a way that approximate data on labor earnings differentials between men and women. Blau and Khan (1996) report that US average female labor earnings are about 60% — 80% of male earnings. When we take the midpoint value of 70%, this determines $w_f = 1$ and $w_m = 1.428$. The choice of the values of δ_m and δ_f is based on the life expectancy in 1990 of 71.8 years for males and 78.8 years for females.[21] This implies $\delta_m = .0139$ and $\delta_f = .0127$. We use the same distribution of match specific components for men and women, and obtain results for two different specifications. In the first one, the distribution is assumed to be log-normal with mean $\mu_i = 0$ and variance $\sigma_i^2 = 1$, $i = m, f$. In the second specification, the distribution is assumed to be exponential with parameter $\varphi_i = \varphi$, $i = m, f$. To preserve comparability between the two specifications, the parameter φ is selected so that mean-match specific components are the same in both cases.[22] In the appendix, we show results for alternative values of the parameters of these distributions. The remaining parameter of the model, the contact rate $\beta \in (0, 1)$, is set so that under the hypothesis of equal division ($k = 1/2$), the equilibrium fraction of married individuals M^* matches the observed value of 66.6% in 1996.[23]

Our findings are presented in Table 1 and Table 2 for $t^S = .20$. Two features of the results are worth noting. First, note the relative insensitivity of the equilibrium fraction of married individuals across different values of

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[21]Statistical Abstract of the U.S., 1994, Table 114.

[22]We note that the exponential distribution is log-concave, while the log-normal is not. Thus, we show quantitative results for a distribution that satisfies the sufficiency requirement of previous sections (i.e. exponential), and for one that does not satisfy that requirement (i.e. log-normal).

[23]Since, in equilibrium, marriages are terminated only by death of one of the spouses, the fraction of married individuals is calculated from the data (Statistical Abstract of the US, 1997, Table 58) by excluding divorced individuals as ($Married$ (%))/($Married$ (%) + $Never\ Married$ (%) + $Widowed$ (%)).

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the tax rate on married individuals for both of the specifications assumed for the distribution of match specific components. For example, in the lognormal case under equal division, a change of eight percentage points in t^M (from $t^M = .16$ to $t^M = .24$) which implies a change in the marriage penalty $(t^M - t^S)$ from $-.04$ to $.04$. generates only a reduction of about one percentage point in M^*. If the impact of the change in tax treatment of married and single individuals is measured as the elasticity of the stock of marriages to changes in the tax penalty associated to marriage across steady states. such elasticities are always between $-.01$ and 0.[24] These elasticities are in the same order of magnitude than those calculated by Alm and Whittington (1995a, 1995b), who reported elasticities in all cases greater between $-.05$ and 0.

Second. for different values of k the stock of marriages decreases with increases in the marriage tax. consistent with the theoretical analysis of the previous section. However. notice that in some scenarios one of the thresholds *falls* with increases in the tax on married couples. The intuition for this result is precisely the one described previously: agents whose equilibrium acceptance thresholds fall. are the ones who find that the effect of the reduction in married income due to the increase in t^M is offset by the effect due to the 'tighter' search enviroment they now face. Also. the acceptance threshold for males falls when k is relatively low. while for females falls when k is relatively high.

To close this section. we calculate the magnitude of the 'strategic' effect of marriage taxes-subsidies on the stock of marriages. In order to do it. we

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[24]The elasticities reported in table 1 are calculated for 'large' changes in the marriage tax: from -0.04 to 0.04. If they are calculated for 'small' changes (for instance. in the neighborhood of $t^M = t^S$). the resulting values are much smaller in absolute terms.

proceed as follows: first. we calculate threshold values for males and females for alternative values of τ^M. under the myopic assumption that men and women consider the threshold of the opposite population fixed at the level consistent with no marriage tax (i.e.. $\tau^M = \tau^S = .20$). Using equation (9), we then proceed to calculate the resulting stock of marriages in this scenario.

Table 1: Stock of Marriages and Individual Thresholds for Log-normal Distribution of Match Specific Components ($t^S = .20$).

Tax on Married Couples (t^M)	$k = .30$	$k = .40$	$k = .50$	$k = .60$	$k = .70$
16%					
Fraction Married	.6770	.6737	.6716	.6712	.6721
θ_f^*	.7869	1.0641	1.3547	1.6597	1.9810
θ_m^*	2.5601	2.2092	1.8759	1.5601	1.2598
18%					
Fraction Married	.6743	.6711	.6691	.6686	.6695
θ_f^*	.8121	1.0820	1.3644	1.6602	1.9712
θ_m^*	2.5451	2.2054	1.8824	1.5758	1.2839
20%					
Fraction Married	.6716	.6685	.6660	.6661	.6669
θ_f^*	.8373	1.0999	1.3741	1.6608	1.9618
θ_m^*	2.5305	2.2019	1.8890	1.5916	1.3079
22%					
Fraction Married	.6689	.6659	.6640	.6634	.6642
θ_f^*	.8624	1.1177	1.3838	1.6617	1.9527
θ_m^*	2.5163	2.1986	1.8957	1.6074	1.3318
24%					
Fraction Married	.6661	.6632	.6614	.6608	.6616
θ_f^*	.8874	1.1355	1.3936	1.6627	1.9440
θ_m^*	2.5025	2.1954	1.9025	1.6231	1.3557
Elasticity ($M^*. t^M - t^S$)	-0.0081	-0.0078	-0.0076	-0.0078	-0.0079

Table 2: Stock of Marriages and Individual Thresholds for Exponential Distribution of Match Specific Components ($t^S = .20$).

Tax on Married Couples (t^M)	$k = .30$	$k = .40$	$k = .50$	$k = .60$	$k = .70$
16%					
Fraction Married	.6717	.6717	.6717	.6717	.6710
θ_f^*	.7197	.9240	1.1280	1.3320	1.5361
θ_m^*	1.8788	1.6749	1.4710	1.2665	1.0625
18%					
Fraction Married	.6692	.6692	.6692	.6692	.6692
θ_f^*	.7386	.9381	1.1373	1.3364	1.5356
θ_m^*	1.8783	1.6790	1.4798	1.2807	1.0815
20%					
Fraction Married	.6660	.6660	.6660	.6660	.6660
θ_f^*	.7577	.9523	1.1466	1.3409	1.5352
θ_m^*	1.8779	1.6834	1.4891	1.2948	1.1005
22%					
Fraction Married	.6642	.6642	.6642	.6642	.6642
θ_f^*	.7767	.9665	1.1560	1.3454	1.5349
θ_m^*	1.8775	1.6880	1.4984	1.3090	1.1196
24%					
Fraction Married	.6616	.6616	.6616	.6616	.6616
θ_f^*	1.8773	1.6925	1.1654	1.3500	1.5346
θ_m^*	.7959	.9808	1.5079	1.3233	1.1387
Elasticity ($M^*. t^M - t^S$)	-.007556	.007557	-.007557	-.007557	-.007557

These results are displayed in figures 1 and 2. and tables 3 and 4 for the case of equal division ($k = .5$). For comparison. in figures 1 and 2 we also plot the relationship between the stock of marriages and the tax on married couples when agents take into account the 'strategic' or indirect effect. Qualitatively. the figures clearly depict the following intuitive result: in the myopic scenario. the stock of marriages is lower than in the strategic

case if a 'marriage tax' exists $(\tau^M > .20)$, and higher if a 'marriage subsidy' prevails $(\tau^M < .20)$. Of course. the stock of marriages in both cases coincide when $\tau^M = \tau^S = .20$.

<center>Insert figures 1 and 2 here</center>

How important is the role of the two-sided search effect from a quantitative point of view? Tables 3 and 4 cast some light on this issue. It is clear from these tables that the 'strategic' effect present in a general equilibrium analysis substantially dampens the changes in the stock of marriages associated to changes in the marriage tax. For the cases displayed in the tables, the changes in the stock of marriages in the general equilibrium situation are. as a maximum, only about 69% of the changes in the myopic case. In other words. the explicit consideration of the strategic effect reduces the changes in the stock of marriages associated with marriage taxes-subsidies in a magnitude of about *thirty* percent as a maximum.

Table 3: Absolute Changes in the Stock of Marriages: Myopic vs. General Equilibrium Case (Log-Normal Distribution. $t^S = .20$)

Marriage Tax-Subsidy $(t^M - t^S)$	Myopic Case (1)	General Eq. Case (2)	(2)/(1)
-.20	.0401	.0244	.6086
-.10	.0205	.0125	.6108
.10	-.0213	-.0131	.6173
.20	-.0433	-.0269	.6218

Table 4: Absolute Changes in the Stock of Marriages: Myopic vs. General Equilibrium Case (Exponential Distribution, $t^S = .20$)

Marriage Tax-Subsidy $(t^M - t^S)$	Myopic Case (1)	General Eq. Case (2)	(2)/(1)
-.20	.03471	.0238	.6861
-.10	.01775	.0122	.6873
.10	-.0186	-.0129	.6954
.20	-.0380	-.0266	.6987

5 Concluding Remarks

Some papers have documented empirically how the differential tax treatment of married and unmarried couples affect marital decisions. In this paper, we provide a simple theoretical structure to analyze this question in terms of the effects of marriage taxes-subsidies on marriage formation, and high-light a general equilibrium effect that contributes to explain why marriage taxes-subsidies can have small consequences on marriage formation. We also demonstrate. at the quantitative level, that large increases in tax penalties on marriage are associated with very small changes in the number of marriages.

In order to show our results in a clean and simple way, we assumed away some important issues like home production and labor supply, ex-ante heterogeneity, progressive taxation and fertility decisions. Their inclusion would allow researchers to cast some light on the effects of the marriage tax on intrahousehold bargaining, assortative mating, household labor supply, and the size of the families. These are fascinating issues that have been hitherto neglected in the public finance literature. and ones that we plan to explore in the near future.

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7 Appendix

We now briefly conduct a sensitivity analysis with regard to some of the calibrated parameters of the problem. In particular. we investigate the role of higher and lower values of the labor earnings ratio (w_m/w_f), and the role of higher and lower parameter values in the distribution of match specific components. We concentrate on the implied elasticities of the steady-state mass of marriages with respect to the marriage tax , calculated as in Table 1 in the text. In all cases. we adjust the contact rate β so that the steady-state stock of marriages equals 66.6% of the population whenever $t^S = t^M$.

Table A.1: Role of Wage Differential in Elasticities

	$w_m/w_f = 1.0$	$w_m/w_f = 1.4$	$w_m/w_f = 2.0$
Log-Normal Case	-0.0090	-0.0076	-0.0096
Exponential Case	-0.0089	-0.0075	-0.0093

Table $A.1$ presents the results when the earnings differential is increased and reduced relative to the benchmark case $(w_m/w_f = 1.4)$. whenever $k = 1/2$ and the parameters of the distribution of match specific components are as in the text. The case of $w_m/w_f = 1.0$ corresponds to the case in which earnings of females are increased to the level of males (i.e. $w_m = w_f = 1.4$). while the case of $w_m/w_f = 2.0$ corresponds to the case in which the earnings ratio increases to 2 (i.e. $w_m = 2.0$ and $w_f = 1.0$). The elasticities reported in Table $A.1$ show an increase in absolute value relative to the benchmark case. The results suggest. however. that despite rather large changes in the earnings differential. the quantitative response across steady states of the

stock of marriages is not large. As in the text, elasticities are between -0.01 and 0.

Table A.2: Role of (σ_m^2, σ_f^2) and (ϕ_m, ϕ_f) in Elasticities

	$\sigma_f^2 = .50$	$\sigma_f^2 = .96$	$\sigma_f^2 = 1.0$	$\sigma_f^2 = 1.04$
$\sigma_m^2 = .50$	-0.0118 (-0.0097)	-0.0109 (-0.0087)	-0.0102 (-0.0086)	-0.0095 (-0.0085)
$\sigma_m^2 = .96$	-0.0079 (-0.0087)	-0.0085 (-0.0077)	-0.0081 (-0.0076)	-0.0076 (-0.0075)
$\sigma_m^2 = 1.0$	-0.0072 (-0.0086)	-0.0081 (-0.0076)	-0.0076 (-0.0075)	-0.0073 (-0.0074)
$\sigma_m^2 = 1.04$	-0.0066 (-0.0085)	-0.0076 (-0.0075)	-0.0073 (-0.0074)	-0.0068 (-0.0073)

Table A.2 presents results for a combination of values of the variances of match specific components for the log-normal distribution, with the rest of the parameter values as in the main text. Values in parenthesis correspond to the equivalent case in terms of the exponential distribution that keep the same mean value of match specific components. Observe that for a fixed value of the variance for females, elasticities decrease in absolute value with increases in the variance for males. The same result is present when the roles of males and females are reversed. The reason for this is that an increase in σ_m^2 (σ_f^2) makes marriage more atractive for males (females), and thus, males (females) become less responsive to changes in married income generated by changes in the t^M. This 'partial equilibrium' reasoning still prevails in the calculations reported, as Table $A.2$ demonstrates. Relatedly, notice that we perform the analysis for values of parameters that reduce significantly the mean value of match specific components ($\sigma_i^2 = .50$, $i = m, f$, in the

case of the log-normal distribution). and thus. that increase significantly the importance of married income in the marriage decision relative to the benchmark case. Again . the elasticities calculated are not quantitatively large, with a highest value of about -0.012.

Figure 1

Importance of Strategic Effect
Log-Normal Distribution

Figure 2

Importance of Strategic Effect
Exponential Distribution