Marriage and the City*

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Abstract

Do people move to cities because of marriage market considerations? In cities singles can meet more potential partners than in rural areas. Singles are therefore prepared to pay a premium in terms of higher housing prices. Once married, the marriage market benefits disappear while the housing premium remains. We extend the model of Burdett and Coles (1997) with a distinction between efficient (cities) and less efficient (non-cities) search markets. One implication of the model is that singles are more likely to move from rural areas to cities while married couples are more likely to make the reverse movement. A second prediction of the model is that attractive singles benefit most from a dense market (i.e. from being choosy). Those predictions are tested with a unique Danish dataset.

Keywords: Marriage, search, mobility, city.
Classification-JEL: J12, J64

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1 Introduction

This paper tests whether cities can be viewed as marriage markets. The idea is simple. Cities are dense areas where singles can meet more potential partners than in rural areas. To enjoy these benefits, they are willing to pay a premium in terms of higher housing prices. Once married, the benefits from meeting more potential partners vanish and consequently, the countryside becomes more attractive. We extend the model of Burdett and Coles (1997) with a distinction between efficient cities and less efficient rural search markets. One obvious implication of the model is that singles are more likely to move from rural areas to cities while couples are more likely to make the reverse movement. This is exactly what we find in the data. Note that this explanation implicitly uses an increasing returns to scale (IRS) argument, namely that search is more efficient in dense areas. If this is the case and if utility is non-transferable, the above story is in particular relevant for the most attractive types because they can be most choosy and therefore benefit most from a high contact rate.

We use canonical correlations to create attractiveness indices which are a linear combination of education, income, fathers education and fathers income. We find that (1) singles are more likely to move from the countryside to the city than couples, (2) couples have the largest probability to make the reverse movement and (3) attractive singles are more likely to move to the city than less attractive singles where the effects are more pronounced for females. We also test the sensitivity of our results to different definitions of attractiveness and cities. Moreover, we take sub-samples of individuals older than 25 to eliminate a potential college-effect and of individuals who never have kids to control for the possibility that children influence the moving decision. Our main results are robust for those exclusions. Finally, we have repeated our analysis for individuals who have just been divorced and find that the probability of moving into the city is much larger than the probability to move out of the city for those divorcees. We interpret those results as evidence that our findings do not only reflect standard life cycle motives, i.e. that older high income individuals have stronger preferences for space than young low income individuals. If this were the case, they would remain in the countryside after a divorce.

There are a number of papers related to ours. Mincer (1978) argues that marriage reduces mobility because the cost are higher for families. He finds support for this pattern in US data. We must therefore allow singles and couples to have different moving cost.

Costa and Kahn (2000) argue that higher educated couples (power couples) are overrepresented in cities. The idea is that the colocation problem (both have to live close to their job) is particularly severe for higher educated couples. Their model therefore predicts that higher educated couples are more likely to move into the city and less likely to move out of the city. In terms of the latter prediction our model predicts exactly the opposite. Costa & Kahn (2000) use cross-section data from the U.S. Recently, Compton & Pollak (2004) took another look at the issue. They argue, that another explanation for the overrepresentation of power couples in the large cities is that all college educated individuals, married and unmarried, are attracted to the amenities and high returns to education of the large cities. As a result of this, the formation of power couples is more likely to occur in larger than smaller metropolitan areas. Their explanation is related to our hypothesis. Based on PSID data, they analyze the dynamic patterns of migration, marriage, divorce, and education in relation to city size and find that power couples are not more likely to migrate to the largest cities in the U.S. than part-power couples or power singles. Instead, the location trends are better explained by the higher rate of power couple formation in larger metropolitan areas. Our results are in line with Compton & Pollak (2004). With the Danish data we also find that the marriage market role of cities is more important than the colocation of job opportunities. High skilled singles move to the city but once they are married they are more likely to move out of the city.

Goldin & Katz (2002) discuss how the introduction of the birth control pill changed the career and marriage decision of women. They argue that there is a direct and an indirect effect of the pill. The direct effect is that the pill lowered the costs of engaging in long-term career investments by giving women more certainty regarding the pregnancy consequences of sex. The indirect effect works through the marriage market. Since age of marriage increased in the aftermath of the diffusion of the pill the marriage market for educated women thickened. They were more likely to find suitable partners during their time in college or thereafter. The pill was according to Goldin & Katz (2002) a crucial factor in terms of allowing women to take an education without loosing out in the marriage market. In fact, as discussed more thoroughly in Goldin (1992), going to college actually increased the chances for women of marrying a more educated and hence more wealthy husband. In this respect colleges and universities play the same role as cities do in our paper.

Black et al. (2002) suggest that the reason a city like San Francisco hosts a disproportional high number of gays is due the high housing cost of living there. San Francisco is known as one of America's loveliest cities. Hence, due to high demand for housing in San Francisco, housing prices are high. Gay couples face constraints that make having children more costly for them than for similar heterosexual couples. This frees resources for other "goods" such as housing in high-amenity locations. Although we do not explicitly consider the gay mating market, our model suggests an alternative explanation. Since the market for gays is relatively thin, they gain a lot by moving to a dense market like cities. In addition, any area that happens to have a large gay community will attract more gays because the matching rate depends not only on the contact rate but also on the share of potential mates.

Edlund (2004) argues that young women outnumber young men in urban areas. The argument is that urban areas offer skilled workers better labor markets. Assuming that there are more skilled males than females, this alone would predict a surplus of males. However, the presence of males with high incomes may attract not only skilled females but also unskilled females, and thus a surplus of females in urban areas from the combination of better labor and marriage markets. We do not find evidence for this.

Finally, Teulings and Gautier (2004) argued in a labor market context with transferable utility that cities have a comparative advantage in producing "search intensive" goods, that is, goods that require a large mix of labor inputs.

The paper is organized as follows. First, in section 2 we present a simple marriage market model. In section 3 we discuss the data. Section 4 presents the main estimation results. Section 5 carries out a number of robustness checks and section 6 concludes.

2 The model

The marriage market that we consider is in the spirit of Burdett and Coles (1997). We treat males and females symmetrically to save on notation. For convenience, we discuss the marriage decision problem from the female point of view. By our symmetry assumption, the solution carries over to males. Our economy is made up of two regions or locations, the countryside and the city. All agents have identical preferences but they differ in terms of their attractiveness as a marriage partner. Divorces are ruled out, marriage is an absorbing state. We study the behavior of a cohort of single females entering the marriage market at a particular point in time: when do they marry? with whom do they marry? and finally, where do they look for a partner?

Let r be the rank order of a person, $r = 1$ being the most attractive individual and $r = 0$ being the least attractive individual and let $a(r)$ be the attractiveness of a person as a function of his or her rank r. By construction, r is distributed uniformly between 0 and 1 among the inflow of singles.[1] The level of inflow of single women is normalized to one in each location. We assume $a(\cdot)$ to be strictly positive, strictly increasing and differentiable. Hence:

$$\begin{aligned} A1 &: a(0) > 0 \\ A2 &: a'(\cdot) > 0 \end{aligned}$$

Assume that utility is non-transferable and that the lifetime utility of a married person is equal to the attractiveness a of her partner.[2] The flow utility of a single person is equal to zero. Hence, Assumption $A1$ states that no type strictly prefers to be single. Assumption $A2$ states that each female's utility is increasing in her partner's attractiveness. Let l be the place of residence for an individual (0 = countryside, 1 = city) Let F_l be the stock of singles per unit of inflow of singles at location l and let $f_l(r)$ be the density of rank r singles at location l. If all ranks r marry equally fast, and if all ranks are distributed proportionally across both locations, than this density function is uniform: $f_l(r) = 1$ for all r and for $l = 0, 1$. By symmetry, the distributions are equal for females and males. The arrival rate of marriage opportunities for a female of rank r with males of rank r_m is $\lambda_l F_l f_l(r_m)$, where $0 < \lambda_0 < \lambda_1$. This arrival rate follows from a quadratic contact technology, where the number of contacts is proportional to the product of the number of males and females. This technology exhibits increasing returns to scale (IRS).[3] This

[1] Hence, we deviate from a common but unpleasant simplification in the literature which is the cloning assumption: each person who gets married is immediately replaced by another person of the same attractiveness, see e.g. Bloch and Ryder (2000). That assumption fixes the distribution of attractiveness over the *stock* instead of over the *inflow*.

[2] Utility depends only on the characteristics of one's partner. Specifications where the own type matters in an additive way do not change the results, i.e. a female with attrictiveness a^f married to a male a^m receiving utility, $u = a^m + h(a^f)$, with $h' > 0$. In the words of Burdett and Coles (1999): "narcissm is not necessarily ruled out".

[3] Our argument for using a quadratic contact technology with IRS is that CRS has the unrealistic property that there would be congestion in the marriage opportunities of Brad Pitt if the authors of this paper would move to Beverly Hills. See Teulings and Gautier (2004: 567) for a discussion of this issue in the context of the labor market.

IRS feature of the contact technology makes the contact rate higher in the city than on the countryside. Assume that there are no moving cost. Let c be the excess cost of urban live, $c > 0$, and normalize the cost of rural life to 0. To keep things as simple as possible, we assume that c enters additively in the utility flow of a person. This additional cost can be thought of as the cost of living in a crowded area due to the rents that are extracted by the owners of scarce real estate in the city. For singles, living in the city has the advantage of meeting more potential partners. This advantage may or may not offset c. However, couples loose the benefits of living in the city but must still pay the higher rents. Therefore, they move to the countryside directly after marriage. Let ρ be the rate of time preference. Then, the Bellman equation for the expected lifetime utility, $u(r, l)$, of a single female of rank r living in location l reads:

$$u(r, l) = \psi_l F_l \int_{m_l(r)} f_l(r_m) a(r_m) dr_m - lc \tag{1}$$

where $\psi_l \equiv \lambda_l / \rho$ (hence: $0 < \psi_0 < \psi_1$) and $m_l(r)$ is the marriage set consisting of all male ranks $\{r_m\}$ with whom a female of type r is willing *and* able to marry with. A marriage opportunity is only realized by mutual agreement. Hence, for both partners, the lifetime utility of being married to a partner of rank r_m must be greater than the lifetime utility of being single:

$$\begin{aligned} r_m &\in m_l(r) \Leftrightarrow r_m \in m_l(r) \Leftrightarrow \\ C1 &: u(r, l) < a(r_m) \wedge \\ C2 &: u(r_m, l) < a(r) \end{aligned}$$

These two conditions reflect the non-transferability of utility: condition $C1$ states that a female of rank r must be willing to marry a male of rank r_m, $C2$ states that r must be able to marry r_m, that is a male of rank r_m must be willing to marry a female of rank r. By symmetry, the marriage set of a male of rank r_m is the same, $m_l(r_m)$

Definition 1. *Equilibrium in a location l is a collection of marriage sets $m_l(r)$ that satisfies conditions $C1$ and $C2$.*

Below, we first characterize the equilibrium in a single location. Then, we turn our attention to the central theme of the paper: the sorting of singles and couples into cities and rural areas.

2.1 Characterization of the equilibrium

The shape of the marriage sets is determined by a number of simple observations. First, if a female of rank r is willing to marry a male of a particular rank r_m^*, then she is willing to marry with any higher ranked male than r_m^*. Formally: if, for a particular r, condition $C1$ is satisfied for r_m^*, then it is satisfied for any $r_m \geq r_m^*$ by assumption $A2$. Second, the utility of a single $u(r, l)$ is weakly increasing in r, as can be seen from equation (1): by our symmetry assumption, each male type that is willing to marry with a female of type r is also willing to marry with higher r types. Hence, the matching set of more attractive females is at least as good as the matching set of less attractive females. Third, by the previous two arguments, the marriage set of a female of type r is convex, where the lower bound $r_l^-(r)$ is determined by the lowest male type to which that female is willing to marry to and where the upper bound $r_l^+(r)$ is determined by the highest male type that is willing to marry her. In other words, the lower bound is the rank r_m for which condition $C1$ is just violated (i.e. holds by equality), the upper bound is the highest rank r_m for which condition $C2$ is just violated (i.e. holds by equality).

Hence, the marriage set of a female of type r is defined as $\{r_m\} \in \langle r_l^-(r), r_l^+(r)]$. Since these conditions apply for females and males symmetrically, we can leave out the gender index in the upper and lower bound functions. By the same argument, a male with the same rank as a female is always part of the marriage set of that female: $r \in \langle r_l^-(r), r_l^+(r)]$. If that would not be the case the condition of mutual approval would not be satisfied. Now, consider the most attractive female, $r = 1$. By the previous argument, all males are willing to marry her, so the upper bound of her marriage set is $r_m = 1$. The lower bound of her marriage set, denoted r_l^1, is determined by the lowest ranked male that gives her more utility than she would get when remaining single and keeping the option value of continued search. Combining (1) and the equality version of $C1$ determines r_l^1 as the fixed point of:

$$a\left(r_l^1\right) = \psi_l F_l \int_{r_l^1}^{1} f_l\left(r_m\right) a\left(r_m\right) dr_m - lc \tag{2}$$

It is easily verified that all single women with rank$\{r\} \in \langle r_l^1, 1]$ set the lower bound of their marriage set at the same value as the most attractive type because they solve exactly the same problem. Hence, all these single women have the same utility, $u(r, l) = u(1, l), \forall r \in \langle r_l^1, 1]$. By symmetry, the same applies for males. The females and males with rank $\{r\}$

$\in \langle r_l^1, 1]$ form a closed segment and marry with each other, but they do not marry with anybody else. A woman of type r_l^1 can therefore not marry with a higher type. Her own type is the upper bound of her marriage set. The whole logic that applies to the highest segment therefore carries over to the next segment. The lower bound of the next segment, r_l^2 can be calculated in a similar way as r_l^1.

$$a\left(r_l^2\right) = \psi_l F_l \int_{r_l^2}^{r_l^1} f_l\left(r_m\right) a\left(r_m\right) dr_m - lc$$

The whole market falls apart in a number of consecutive, non overlapping segments. Agents marry with all ranks within their own segment and never marry outside their segment. The full set of upper and lower bounds can be calculated recursively by the following algorithm:

$$\begin{aligned} r_l^0 &\equiv 1 \\ a\left(r_l^i\right) &= \psi_l F_l \int_{r_l^i}^{r_l^{i-1}} f_l\left(r_m\right) a\left(r_m\right) dr_m - lc \end{aligned} \quad (3)$$

except for the lowest segment which is treated separately below. The final step in the characterization of the equilibrium is the derivation of the density of single males $f_l\left(r_m\right)$ by an equilibrium flow condition:

$$1 = \lambda_l F_l f_l\left(r_m\right) \int_{r_l^i}^{r_l^{i-1}} F_l f_l\left(r\right) dr, \forall r_m \in \langle r_l^i, r_l^{i-1}]$$

The lhs is the inflow (which we normalized to 1), the rhs is the outflow of type r. Since all females within a segment follow the same strategy, their expected search time length is the same, and hence the density of their ranks is the same. Hence, the integral simplifies to $F_l f_l\left(r\right)\left[r_l^{i-1} - r_l^i\right]$. By the same argument, and by the symmetry between males and females, $f_l\left(r\right) = f_l\left(r_m\right)$, for r and r_m belonging to the same segment. Hence:

$$\begin{aligned} f_l\left(r_m\right) &= \left[F_l \sqrt{\lambda_l\left(r_l^{i-1} - r_l^i\right)}\right]^{-1}, r_m \in \langle r_l^i, r_l^{i-1}] \\ F_l &= \sqrt{\lambda_l}^{-1} \end{aligned} \quad (4)$$

The density in segment i is therefore negatively related to the width of the marriage set $r_l^{i-1} - r_l^i$, but less than proportional, since the lower density itself partially offsets the negative impact of the wider matching set because in a non dense segment fewer types get married.

The above argument leads to the following Proposition:

Proposition 1 *An equilibrium in the marriage market is a collection of connected non overlapping segments such that the lower bound r_l^i of each segment i at region l is the upper bound of the next segment. The lower bounds, r_l^i of segments i are determined recursively by the following algorithm:*

$$
\begin{aligned}
r_l^0 &\equiv 1 \\
A(r) &\equiv \int_r^1 a(r_m)\, dr_m \\
u\left(r_l^i, l\right) &\equiv \psi_l \frac{A\left(r_l^i\right) - A\left(r_l^{i-1}\right)}{\sqrt{r_l^{i-1} - r_l^i}} - lc \qquad (5)\\
a\left(r_l^i\right) &\geq u\left(r_l^i, l\right)
\end{aligned}
$$

where the inequality applies only if $r_l^i = 0$. An equilibrium exists, but need not be unique.

Proof:

Combining equations (1) and (4) yields equation (5). Consider segment i. For this segment, r_l^{i-1} is given (implicitly), either by equation (5) for segment $i-1$ for $i > 1$, or by $r_l^0 \equiv 1$ for $i = 1$. Consider the lower bound r_l^i. $u\left(r_l^i, l\right)$ is continuous in r_l^i, $u\left(r_l^i, l\right) = 0$ for $r_l^i = r_l^{i-1}$, and $u\left(r_l^i, l\right) > 0$ for $r_l^i < r_l^{i-1}$. Hence, either $u\left(r_l^i, l\right)$ is equal to $a\left(r_l^i\right)$ for some $r_l^i, 0 < r_l^i < r_l^{i-1}$, yielding an equilibrium, or it is not, but then $a(0) > u(0, l)$, so that $r_l^i = 0$ is an equilibrium. Partially differentiating equation (5) with respect to r_l^i yields:

$$
\frac{\partial\left[a\left(r_l^i\right) - u\left(r_l^i, l\right)\right]}{\partial r_l^i} = a'\left(r_l^i\right) + \frac{\psi_l}{2\sqrt{r_l^{i-1} - r_l^i}} \left[2a\left(r_l^i\right) - \frac{A\left(r_l^i\right) - A\left(r_l^{i-1}\right)}{r_l^{i-1} - r_l^i}\right]
$$

The first term and the first term between square brackets are positive by Assumption $A1$ and $A2$. The second term between square brackets is negative. By the definition of $A(\cdot)$, we have:

$$
a\left(r_l^i\right) < \frac{A\left(r_l^i\right) - A\left(r_l^{i-1}\right)}{r_l^{i-1} - r_l^i} < a\left(r_l^{i-1}\right)
$$

Hence, for a sufficiently low $a'\left(r_l^i\right)$ and for a value of $a\left(r_l^{i-1}\right)$ at least twice as large as $a\left(r_l^i\right)$, this derivative becomes negative. Therefore, there may be multiple fixed points.■

The equilibrium is illustrated in Figure 1 for the case that there are only three segments. Panel A shows the segments in the rank space of males and females. The segments are given by the shaded areas. Panel B shows the relationship between a woman's attractiveness and her utility when being single. By symmetry, the relation for males is exactly the same. For this figure, it is convenient to define the boundaries in terms of attractiveness instead of rank: $a_l^i \equiv a\left(r_l^i\right)$ and to write utility as a function of attractiveness: $\overline{u}\left[a\left(r\right), l\right] \equiv u\left(r, l\right)$. The expected utility of all women in the first segment, $i = 1$, is equal to the attractiveness of the least attractive woman in the segment, a_l^1, because all males in the first segment are indifferent between marrying this woman and remaining single. Since by symmetry, the utility of the least attractive male in the segment is equal to the utility of the least attractive female, the attractiveness of the least attractive female is equal to her utility as a single. In a "Walrasian" marriage market without search cost, the utility of a single equals her attractiveness for all ranks, because each rank forms a separate segment and marriage sets are reduced to singletons (Gale & Shapley, 1962). In terms of panel A, all matches will be on the diagonal. The shaded surface between the diagonal $u = a$ and the actual utility, $\overline{u}\left(a, l\right)$ in panel B can be viewed of as a measure of the cost of search frictions. Only for the least attractive single woman in each segment her utility is equal to what it would be in a "Walrasian" market. For her, the cost of waiting for a suitable marriage partner is exactly offset by the chance of finding a better partner than she would have been able to find in a "Walrasian" market. A slight change in the segmentation would therefore make her worse off, since she would no longer be the least attractive woman in a her segment, and hence she would get a lower pay off than in the "Walrasian equilibrium". Hence, there is no unambiguous Pareto ranking for equilibria with a different number of segments. This feature complicates the comparative statics analysis in the next section. However, there is a one-to-one relation between the size of a segment and the utility of the highest ranked woman. She is always part of the first segment. The more exclusive this segment, the higher the attractiveness of the least attractive woman in this segment is, and as a result, the higher is the utility of a single in that segment. The negative relation between segment size and the utility of being single applies for the "average" cost of search across all attractiveness levels: the smaller the segments, the smaller the surface between the diagonal and the actual utility in Panel B, and the smaller therefore the cost of search.

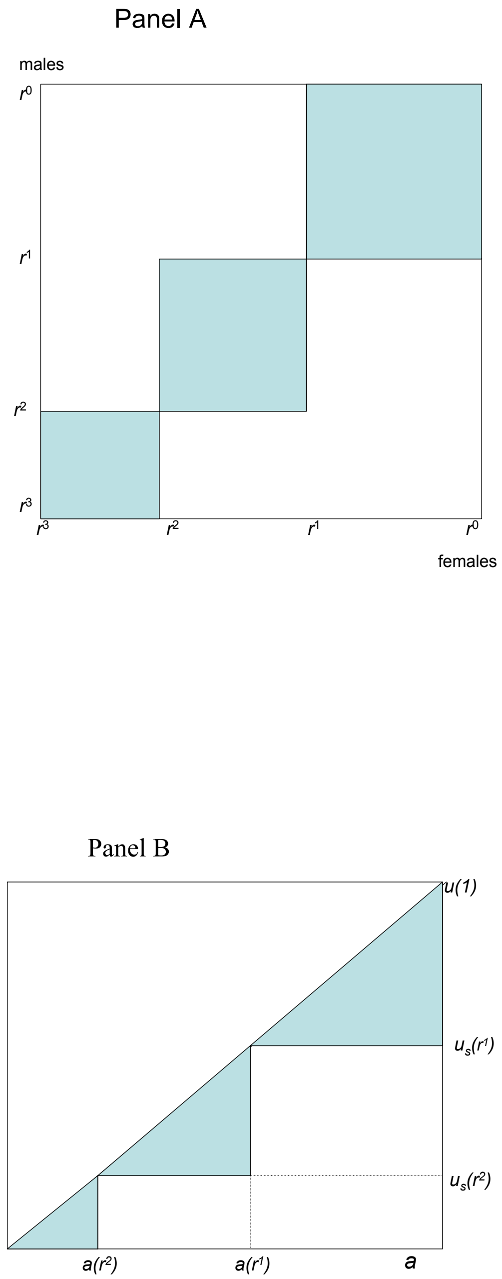
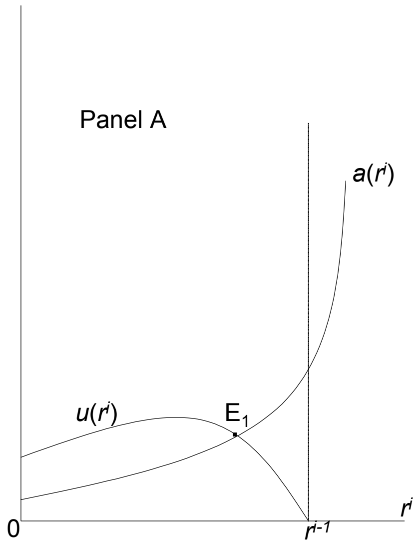


Figure 1, Marriage market segments

Figure 2 plots for location $l = 0$ the utility $u(r_0^i, 0)$ of a female in segment i as a function of the lower bound r_0^i of that segment (the figure for $l = 1$ is essentially the same). If the lower bound were equal to the upper bound, it would take the woman forever to find a male of this type, so $u(r^{i-1}, 0) = 0$. If she sets her lower bound at 0, she will marry very fast but possibly below her league, $u(0) \geq 0$. The $a(r^i)$ curve gives the attractiveness of the lowest type in the segment which is strictly positive and increasing by Assumption $A1$ and $A2$. An equilibrium requires $a\left(r_0^i\right) \geq u(r_0^i, 0)$, where the inequality can only apply for $r_0^i = 0$. This is generically the case for the lowest segment in the market. Panel A, B, and C show three possible cases. In Panel A, there is a unique interior equilibrium, point E. In Panel B, there is no interior equilibrium, so that $r_0^i = 0$. In Panel C, there are multiple equilibria.



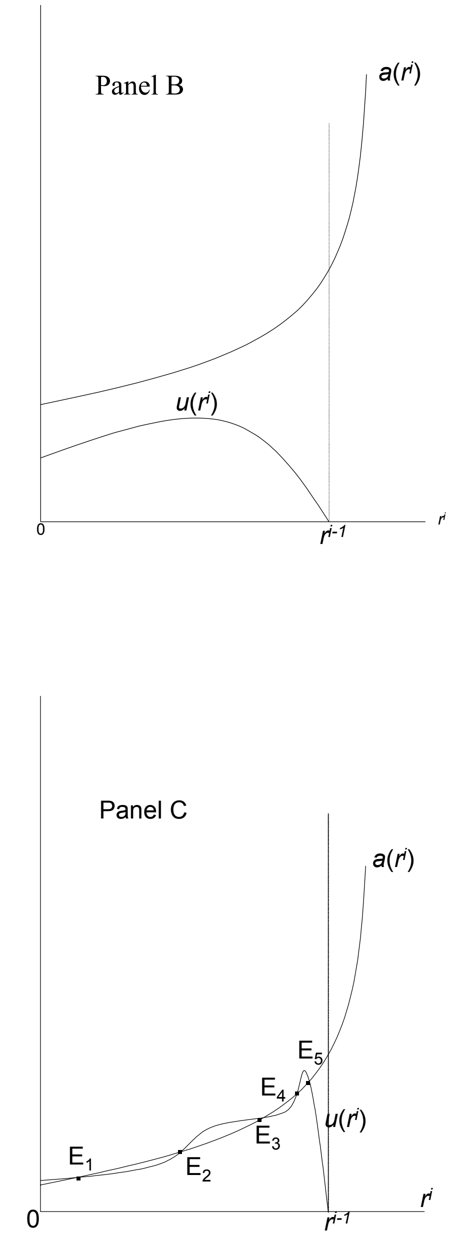


Figure 2. Equilibria

The intuition for the multiplicity of equilibria is that if all women use a non-selective acceptance strategy, where they also marry with unattractive males, they all marry fast. By symmetry, this implies that males do the same. Hence, everybody marries fast and the stock of singles is small. This reduces the probability of finding a really attractive male, and hence the non-selective acceptance strategy is the rational choice for each individual. However, if the most attractive agents in the segment are all selective, then they stay single for a longer period. This raises the probability of finding an attractive partner, and hence the selective strategy is an equilibrium as well. By the switch to this more selective marriage strategy, some less attractive agents fall out of the segment, and they have to form a new segment of their own. Some of them are likely to be worse off. By the mutual agreement requirement for marriage, the role of these less attractive women in this strategy shift is entirely passive. There is nothing that they can do to stop this shift. The existence of multiple equilibria is due to a standard thick market externality, see Diamond (1982). The investment in search activities by attractive males has a positive effect on the search activities of attractive females, and the other way around. Hence, if females invest more in search, search becomes more attractive for males and vice versa.

For reasons discussed before, there is no unambiguous Pareto ranking of the various equilibria in Panel C.

A planner who would give all individuals the same weight would simply maximize the total number of marriages and would create one big segment. This would however be the most unfavorable outcome for the most attractive types. They are best of when the segments are as small as possible. Below, we introduce the notion of hierarchical efficiency.

Definition 2. *An hierarchically efficient equilibrium is an equilibrium where the expected utility of no single with rank r^* can be improved without making a higher ranked single $r > r^*$ worse off.*

The hierarchically efficient equilibrium, E_5, in Panel C is the equilibrium with the smallest segments. The higher r_0^i, the higher $a\left(r_0^i\right)$, and hence the higher the utility of the highest rank in the segment, r_0^{i-1}. In what follows, we focus on this hierarchically efficient equilibrium because this is the only equilibrium for which there exists no profitable deviation of a coalition of agents. In all other equilibria, there exists such a profitable deviation. I.e. in E_4, the highest types would be better of if they would all be more selective.

As shown in Panel C, the following lemma applies for an hierarchically efficient equilibrium:

Lemma

In an hierarchically efficient equilibrium, we have:

$$\frac{\partial\left[a\left(r_l^i\right)-u\left(r_l^i,0\right)\right]}{\partial r_l^i}\geq 0$$

where strict inequality holds generically.

The non-ambiguity of this partial derivative with respect to r_l^i will be helpful for the comparative statics to be discussed in the next section.[4]

2.2 Comparing the city to the countryside

Proposition 2 *Consider an hierarchically efficient equilibrium. Taking the upper bound r_l^{i-1} of segment i as given, an increase in ψ_l raises the lower bound r_l^i of segment i.*

Proof. Totally differentiating equation (5) and rearranging terms yields:

$$\frac{\partial\left[a\left(r_l^i\right)-u\left(r_l^i,0\right)\right]}{\partial r_l^i}dr_l^i-\frac{a\left(r_l^i\right)+lc}{\psi_l}d\psi_l=0$$

Hence, $dr_l^i/d\psi_l>0$.■

Proposition 2 tells us that market segmentation increases when ψ_l goes up. The reason for this phenomenon is obvious: when search becomes more efficient, people become more selective in choosing a marriage partner. Since ψ_l is larger in the city than in the countryside, our model predicts that market segmentation will be tighter in the city than on the countryside.

Proposition 3. *Consider an hierarchically efficient equilibrium. Suppose agents choose recursively whether to locate in the city or in the countryside. That is, first, the highest ranks make their location choice $l=0$ or 1 and choose their acceptance threshold for a marriage partner of the opposite sex, r_l^1. Then, the next highest ranks $r\leq r_l^1$ make their choice, and so on, and so forth, till all ranks have made a location and threshold choice. Then, there exists a critical rank r^* such that all $r\leq r^*$ prefer location $l=0$ and all $r>r^*$ prefer location $l=1$.*

Proof. Suppose that the rank r^{i-1} (we leave out the location index of the previous segment, since that is irrelevant at this stage) is the highest rank who has not decided

[4] Burdett and Coles (1997) take an alternative approach to this problem by deriving conditions on $a(\cdot)$ for a unique equilibrium.

yet where to locate (by the recursive decision making, higher ranks have already decided by the same procedure as described here). This rank will choose location according to $a(r_1^i) \gtrless a(r_0^i)$. Suppose that $a(r_1^i) > a(r_0^i)$, and hence $r_1^i > r_0^i$, so that rank r^{i-1} will choose the location $l = 1$. Then, all ranks $r \in \langle r^{i-1}, r_1^i]$ will choose location $l = 1$ since that gives them the highest utility $a(r_1^i)$. For these ranks to prefer $l = 1$, it must be true that:

$$0 < (\psi_1 - \psi_0) \frac{A(r_1^i) - A(r^{i-1})}{\sqrt{r_1^{i-1} - r^i}} - c \tag{6}$$

Mutatis mutandis the same applies for the reverse case $a(r_0^i) > a(r_1^i)$:

$$0 \geq (\psi_1 - \psi_0) \frac{A(r_0^i) - A(r^{i-1})}{\sqrt{r_0^{i-1} - r^i}} - c \tag{7}$$

At the margin there is an agent who is just indifferent between $l = 0$ or 1. In that case, $r_0^i = r_1^i \equiv r^*$, and the above condition holds with equality. Substitution of equation (5) for $l = 0$ yields an implicit solution for r^*:

$$\frac{\psi_1 - \psi_0}{\psi_0} a(r^*) = c$$

Since $a(\cdot)$ is monotonically increasing by Assumption $A2$, this equation can have at most one interior solution. It is easy to see that for any $r > r^*$, equation (6) applies, and that for any $r < r^*$, equation (7) applies. If there is no interior solution for r, either everybody prefers the city, or everybody prefers the countryside, which does not violate the proposition.■

Proposition 3 shows that the most attractive women prefer the city and the least attractive women prefer the countryside unless the city premium is so low that everybody prefers the city or so high that everybody prefers the countryside. We label this outcome the *elite city ordering*. The elite prefers the efficiency of the city marriage market above the cheap cost of living in the countryside, because they gain more by a higher contact rate than the lower types. Their high attractiveness allows them to marry with attractive partners. This raises the expected difference in the utility flow of being married versus being single. Hence, they have a greater interest in an efficient marriage market than the lower ranks. Note, however, that the greater interest in getting married does not necessarily imply that they marry faster. If the "spread" in marriage opportunities is greater among the elite (that is, $a''(r) \gg 0$), this elite will have a large incentive to be selective in their acceptance strategy, and hence it will take them a long time to find a suitable partner.

It is tempting to jump from this result to the general conclusion that *Elite city ordering* will always be the natural outcome. This is not the case since there may exist multiple equilibria. For example, if all attractive singles move to the countryside, than it does not make sense for an individual attractive single to move to the city, since she will not find a suitable marriage partner there. Indeed, all attractive singles would gain if they could coordinate on moving to the city, but for an individual woman it is not rational to deviate from the strategy of the rest of the segment. Hence, there are stable equilibria that do not fit the elite city ordering. However, Proposition 3 describes the only equilibrium that is hierarchically efficient.

The elite city ordering exists only for a suitable level of c, the excess cost of living in a city. If c is too high, everybody prefers the countryside since cities are too expensive to live in. If c is too low, each single prefers the city to take advantage of the higher contact rate. Now the question remains whether there exists a mechanism that guarantees the value c to be in this critical intermediate range? The answer is: yes, there is. Part of the excess cost of living in a city are the rents that are extracted by the owners of real estate in the city. These owners are able to collect those rents because the city is a more efficient place to find a marriage partner. Because the value of a suitable partner is higher for the more attractive singles, this group benefits in particular from moving to the city. If there is some capacity constraint on living in the city, the laws of supply and demand guarantee that c settles at a level that induces only the most attractive singles to move to the city.

We can summarize the empirical predictions as follows. First, to the extent that there is no sorting of attractiveness types between locations, the segmentation of the marriage market is coarser in the city than in the countryside, leading to a higher rank correlation of the attractiveness levels of married couples. Second, the comparative advantage of a city is its higher contact rate. For married couples, who have no particular reason to prefer the city above the countryside, the excess cost makes cities an unattractive place to be. Hence, we expect singles to move to the city and married couples to move out. Third, this prediction holds in particular for the most attractive singles, who are able to marry the most attractive partners and who are therefore most willing to pay the higher cost of living. Therefore, this group is most likely to move to the city.

3 Data

The data that we use to test the main implications of the model come from IDA (Integrated Database for Labor Market Research) created by Statistics Denmark. The information comes from various administrative registers that are merged in Statistics Denmark. The IDA sample used here contains (among other things) information on marriage market conditions for a randomly drawn sub-sample of all individuals born between January 1, 1955 and January 1, 1965. The individuals are followed from 1980 to 1995. The data set enables us to identify individual transitions between different states on the marriage market on an annual basis. In addition we have information about current geographical location. This implies that we observe an individual's mobility pattern on an annual basis. If the individual enters a relationship we also observe the personal characteristics of the partner. There are 21840 individuals in our sample. We use the following variables:

Education. We define three types of individuals according to their level of education. Since most of the sample is acquiring education in the sample period we will use level of education in 1995 (when the youngest person in the sample was 30) as the indicator for level of education (to avoid problems with unfinished education). Individuals with low levels of education have no education beyond elementary school; individuals with medium levels are vocationally trained, and individuals with high levels of education have taken some kind of further education.

Income. We use (log) gross income. The income figures are all in terms of 1980 prices. The consumer price index is used as a deflator. For individuals with missing incomes we fix log income at 0 and include a dummy variable for missing income.

City- rural definition. We divide Denmark into cities and rural areas. The five largest Danish cities are Copenhagen (incl. Frederiksberg), Aarhus, Odense, Aalborg, and Esbjerg.

The most dense area in Denmark is the Copenhagen metropolitan area. 12.7 % of the population lived there in 1995. The other cities host 15% of the population in 1995. The five cities are distributed across the country as shown in Figure 3. We therefore conjecture that the relevant city definition is to include the largest cities in each region of Denmark. We repeat our analysis with a different definition of dense and non-dense areas based on the population density. This changes the city definition somewhat. Some suburbs of Copenhagen are more densely populated than the large cities. It turns out however, that our main results are robust to changes in the city definition.

Figure 3 Map of Denmark

Marriage. Individuals can occupy one of three states in the marriage market: single, cohabiting, or married. In this paper we merge cohabitation and marriage into one group and refer to this group as married. Cohabitation as either a prelude to or a substitute of marriage is very common in Denmark (see e.g. Svarer, 2004). There are some qualifications to this definition of marriage. Some of the couples - presumably a small minority - that are registered as cohabiting are simply sharing a housing unit, and do not live together as a married couple.

Personal characteristics. In addition to the information presented above we also have detailed information about the number of kids in the household. We know the labor market status of the individuals, their age and their income. In addition, we have information on the income and education of the father of each individual in the sample.

Table 1: Descriptive statistics (in 1987)

	City		Rural	
	Women	Men	Women	Men
Number of observations	3612	3815	7920	8325
Single (%)	46.3	55.4	26.0	44.0
Children (%)	35.4	19.3	56.2	33.3
Age (in years)	26.4	26.7	27.0	26.9
Low level of education (%)	44.9	40.6	39.8	34.5
Medium level of education (%)	34.3	40.0	46.0	53.6
High level of education (%)	20.8	19.4	14.2	11.9
Gross income (in 1,000 dkk)	188.5	246.7	176.2	249.6
Father's gross income (in 1,000 dkk)	150.1	109.0	124.8	104.6
Missing income (%)	0.5	0.6	0.4	0.4
Father has missing income (%)	35.7	34.8	35.4	31.7
Divorced last year (%)	6.0	5.5	4.0	4.0
Moved from rural to city (%)			3.3	
Moved from city to rural (%)	7.6			

Note: Numbers represent percentages - unless stated otherwise.

As expected we see more single individuals in the city and more people without kids. The age difference between the two regions is quite small, though. People tend to be more educated in the city. The fraction of divorcees is slightly larger in the city. Table 1 also reveals that men marry later because the cohort contains relatively many single men.

3.0.1 Constructing a measure of attractiveness

The model presented in Section 2 suggests that more attractive singles are more likely to move to the city. Individual attractiveness presumably depends on a whole range of characteristics like weight, height, age, intelligence, humor, physical appearance, income etc. Obvious data limitations restrict us from using a complete set of personal attributes. Regrettably, pictures of the individuals in the sample are not available, so that we cannot rank individual according to their looks, as in e.g. Hamermesh & Biddle (1994). We therefore follow Wong (2003) and Anderberg (2004) and use income and education as attractiveness components. In addition we also exploit information on father's level of education and income.[5] Below, we explain how we determine their relative importance. In a frictionless world, the most attractive females marry the most attractive males, resulting

[5] If the common wisdom that rich males marry attractive females is true than fathers income will be correlated with physical attractiveness.

in a perfect correlation between male and female attractiveness. In a world with frictions this correlation will not be equal to one but it will be positive. Here, we conjecture that attractiveness for both males (A^M) and females (A^F) is a linear function of the four factors described above and the dummies for missing income.[6]

$$\begin{aligned} A^F &= edu * \alpha_1 + \ln(inc) * \alpha_2 + f\_edu * \alpha_3 + \ln(f\_inc) * \alpha_4 \\ &\quad + miss\_inc * \alpha_5 + f\_miss\_inc * \alpha_6 \\ A^M &= edu * \beta_1 + \ln(inc) * \beta_2 + f\_edu * \beta_3 + \ln(f\_inc) * \beta_4 \\ &\quad + miss\_inc * \beta_5 + f\_miss\_inc * \beta_6. \end{aligned}$$

We estimate the relative importance of those factors (the $\alpha's$ and the $\beta's$) by canonical correlation, as was already suggested by Becker (1973). Canonical correlations (see e.g. Johnson & Wichern (1998)) construct several indices of A^F and A^M such that the correlation between each of them is maximized subject to the indices being orthogonal to each other. In the model we assume that the two sets of variables are related to each other only through a single index. In Table 2 we present the results from the canonical correlation analysis.

All estimated coefficients are significantly different from zero. In order to determine the relative importance of the underlying variables, we also report the canonical coefficients of the standardized variables. The standardized coefficients show that the attractiveness level is mainly determined by education. Further, note that father's income is more important factor for female attractiveness than for males while the reverse holds for own income. The first canonical root is 0.36 and although the second is significantly positive it is much smaller. Hence, the first canonical correlation captures most of the correlation between the two sets of variables and we can use a single index.

[6]We did not include age because it is likely that preferences are based on age differences between own's and partner's type rather than the absolute value of age.

Table 2: Results from canonical correlations

	Canonical coefficients	t-value	Standardized canonical coefficients
α_1 : Man's education	1.02	21.1	0.69
α_2 : Man's father's education	0.51	10.5	0.36
α_3 : Man's income	0.43	6.1	0.31
α_4 : Man's father's income	0.33	6.4	0.26
α_5 : Man has missing income	5.39	4.8	0.24
α_6 : Man's father has missing income	3.77	3.6	0.01
β_1 : Woman's education	1.03	23.0	0.75
β_2 : Woman's father's education	0.41	8.6	0.29
β_3 : Woman's income	0.22	3.8	0.18
β_4 : Woman's father's income	0.47	9.1	0.45
β_5 : Woman has missing income	3.41	3.7	0.17
β_6 : Woman's father has missing income	4.91	5.9	0.29
1. canonical correlation between A^M and A^F	0.36	34.1	
2. canonical correlation between A^M and A^F	0.09	7.4	
# couples[7]		6754	

Note: All weights are significant different from 0 at the 5% level.

Based on the estimated weights we construct an attractiveness number for each individual by adding up the weighted values of their characteristics. The summary statistics for the attractiveness index (singles only) for both cities and rural areas are:[8]

Table 3: Summary statistics for the standardized attractiveness measure

	Singles	
	Mean	Std. Dev.
Rural		
Male attractiveness	-0.107	0.986
Female attractiveness	-0.032	0.982
City		
Male attractiveness	0.256	1.099
Female attractiveness	0.366	1.061

Note: A t-test cannot reject that attractiveness is higher in the city for both genders at the 1% level.

[7]For some couples fathers education and income is missing. These couples are dropped in the canonical analysis.

[8]The attractiveness measure is constructed based on 1995 observations. The results throughout the paper are however unaffected if we use each year's income to construct the measure.

The fact that higher single types are more likely to live in the city is by itself consistent with our model but also consistent with many other stories. In the next section we try to isolate the marriage market effect from other motivations to live in the city.

4 Estimation results

In this section we provide evidence for the main implications of the model. We allow all agents who enter the marriage market to have idiosyncratic utility, γ_0, for the countryside and, γ_1, for the city. Both are assumed to be independent of one's attractiveness. Let X be a set of controls like age, having children, and working full-time. A denotes attractiveness. To save on notation we leave out the subscripts M and F here. We include a cross term of attractiveness and single status, S. Let U_0, the utility of living in the countryside be determined by:

$$U_0 = \mu_1 X + \mu_2 S + \mu_3 A + \mu_4 S \cdot A + \gamma_0,$$

and let U_1, the utility of living in the city, be determined by:

$$U_1 = \chi_1 X + \chi_2 S + \chi_3 A + \chi_4 S \cdot A + \gamma_1.$$

The main prediction of the model is that χ_2 is positive (being single increases the utility of living in the city) and that χ_4 is positive (in particular attractive people move to the city). We allow the moving cost, C, either from countryside to city or from city to countryside to depend on personnel characteristics and marital status:

$$C = \varphi_1 X + \varphi_2 S + e$$

Let $M^{01} = U_1 - U_0 - C$, be the net benefit of moving from the countryside to the city and let $M^{10} = U_0 - U_1 - C$, be the net benefit of moving from the he city to the countryside. If $M^{01} > 0$, individuals move from the countryside to the city while if $M^{10} > 0$, individuals move from the city to the countryside. We then estimate the following equations

$$M^{01} = \beta_1^{01} X + \beta_2^{01} S + \beta_3^{01} A + \beta_4^{01} S \cdot A + \gamma^{01} \quad (8)$$

$$M^{10} = \beta_1^{10} X + \beta_2^{10} S + \beta_3^{10} A + \beta_4^{10} S \cdot A + \gamma^{10} \quad (9)$$

where $\gamma^{01} = \gamma_1 - \gamma_0 - e$, and $\gamma^{10} = \gamma_0 - \gamma_1 - e$ are type-1-extreme-value distributed random variables. Individuals with a high γ^{01} and a low γ^{10} have strong idiosyncratic preferences for the city while individuals with a low γ^{01} and a high γ^{10} have strong idiosyncratic preferences for the countryside. Individuals who have both a low γ^{01} and a low $\gamma^{10}$are immobile. If we would only consider (8), then a positive value for β_2^{01} would be only weak evidence for our model because it tells us that either attractive singles have preferences for the city or couples have higher moving cost. However if we find that $\beta_2^{01} > 0$ and $\beta_2^{10} < 0$ this would be strong evidence in favor of our model because it implies that $U_1 - U_0 > 0$ for singles and $U_1 - U_0 < 0$ for couples. Below we summarize the predictions of our model: i) $\beta_2^{01} > 0$ ii) $\beta_2^{10} < 0$ iii) $\beta_4^{01} > 0$ iv) $\beta_4^{10} < 0$. Attractive singles are most likely to move to the city and least likely to leave the city. The model has no predictions on whether attractive married individuals are more likely to move than less attractive married individuals.

We test those predictions with a set of logits estimating the probability of moving from the countryside to the city and the reverse movement, conditional on marriage market status, level of attractiveness, age, presence of children, employment status and an interaction term between being single and level of attractiveness. For the first prediction we can simply look at the sign and significance of the estimated indicator variable for being single. In terms of evaluating, whether more attractive singles are more likely to move to the city than less attractive singles we have to be a bit more careful. Since the logit model is by itself already non-linear it makes no sense to make inference on the interaction term between single and level of attractiveness. As pointed out by e.g. Ai and Norton (2003) the correct way to make inference in this situation is to evaluate the cross derivative of the expected value of the dependent variable. In our application the dependent variable takes the value 1 if a transition between the two geographical location is observed and 0 otherwise. In the logit model the probability of a transition is modelled as

$$\Pr(Y = 1|S, A, X) = \frac{\exp(\beta_S S + \beta_A A + \beta_{AS} AS + \beta X)}{1 + \exp(\beta_S S + \beta_A A + \beta_{AS} AS + \beta X)} = P$$

where X contains the other explanatory variables. In our application where the interaction term consists of an indicator variable and a continuous variable the cross derivative is

$$\begin{aligned} \frac{\Delta \partial P}{\partial A \Delta S} &= (\beta_A + \beta_{AS}) \left[P((\beta_A + \beta_{AS})A + \beta_S + X\beta) \times (1 - P((\beta_A + \beta_{AS})A + \beta_S + X\beta)) \right] \\ &\quad - \beta_A \left[P((\beta_A A + X\beta) \times (1 - P((\beta_A A + X\beta)) \right]. \end{aligned}$$

Obviously, this is not equal to β_{AS}. Ai and Norton (2003) also provides consistent asymptotic standard errors for the interaction terms based on the delta method. The cross derivative depends on the values of the other covariates and consequently, the interaction term differs across individuals. Below we therefore present both β_{AS} and the estimated z-statistics plotted against the predicted probability of moving to make inference of the interaction terms.

First, we present the results for the rural to city movement. For both men and women we see that the mobility pattern is exactly as the model predicts although for females the effects are more pronounced. Single people are most likely to move to the city. In addition there is a strong effect of level of attractiveness on the mobility from rural to city. This effect could to some extent be driven by individuals attending schools and universities. We will return to this issue in section 5 when we examine a sample consisting of individuals above 25 years old.

Table 4: Logit for transition from rural to city[9]

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	0.077*	0.040	0.047	0.053	0.707**	0.041	0.599**	0.052
Attractiveness			0.471**	0.037			0.351**	0.038
Single*attractiveness			-0.047	0.045			-0.003	0.046
# Observations	82469				75628			

Note: * (**) denotes significant different from 0 at the 10% (5%) level.

In Figure 4 we plot the Z-statistics of the cross derivative against the predicted value. A positive (negative) Z-statistic implies that the cross derivative is positive (negative) and a value which in absolutely terms is greater than 1.96 implies that the cross derivative is significantly different from 0 at a 5% level of significance. For women we see that for the great majority of observations, the interaction term is indeed positive and significant. For men we do not find significant interaction terms in the relevant range.

[9]Note, that in this and all subsequent tables we also condition on age, presence of children and employment status.

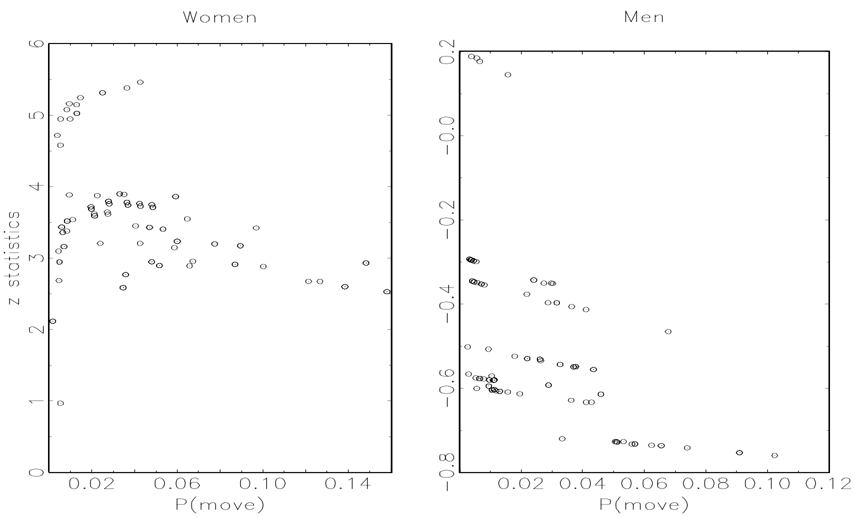


Figure 4: Interaction of single and attractiveness - transition from rural to city.

Next, we consider the transition from city to rural areas. Again, the model's predictions are supported by the results - married individuals are more likely to move to rural areas.

The results in Table 5 also suggest that the reason people move to the city is not only to obtain higher wages. More attractive people also have higher levels of education. If there is a higher return to education in the city that could explain why highly educated people move there but not why highly educated people move out of the city as we find. Note, that for women the marriage market prediction is strongly supported. In Figure 5 we see that the probability of moving from the city to the countryside is especially lower for the most attractive singles. For men, the interaction effect also points towards this direction but the effect is insignificant at conventional levels. The results also show that for both the transition into the city and out of the city more attractive people are more mobile. This is consistent with other studies on individual mobility (e.g., Greenwood, 1997 and Compton & Pollak, 2004). Higher educated individuals are more likely to be geographically mobile. In section 5 we carry out a number of robustness checks.

Table 5: Logit for transition from city to rural

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	-0.282**	0.041	-0.260**	0.056	-0.360**	0.039	-0.326**	0.050
Attractiveness			0.108**	0.028			0.083**	0.027
Single*attractiveness			-0.034	0.042			-0.148**	0.042
# Observations	31607				30023			

Note: * (**) denotes significant different from 0 at the 10% (5%) level.

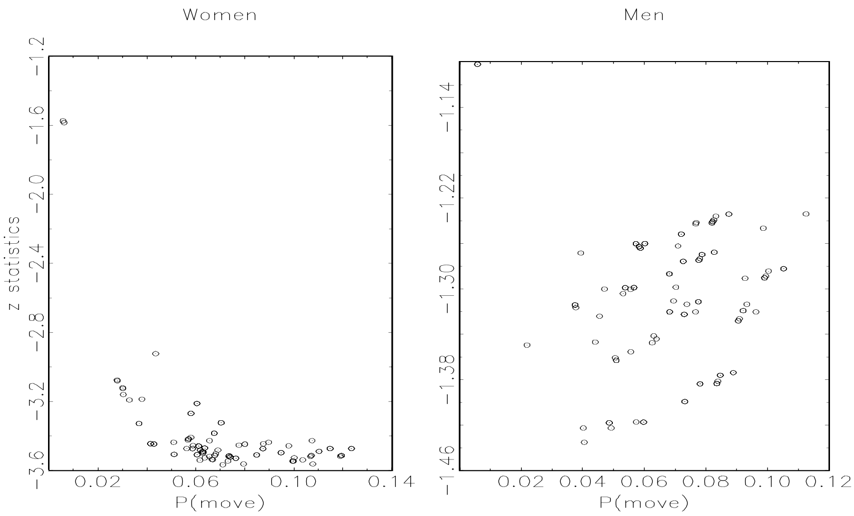


Figure 5: Interaction of single and attractiveness - city to rural.

The results in Tables 4 and 5 suggest that the mobility flows work in favor of our marriage market hypothesis. In order to shed further light on the mobility patterns we look in table 6 at the distribution of individuals between rural and city conditional on their level of attractiveness at different life stages.

Table 6: Geographical location of individuals based on attractiveness at different life-stages

	Fraction living in city		
Level of attractiveness	At age 18	At marriage	After 5 years of marriage
< 1st quartile	0.22	0.28	0.20
between1st and 2nd quartile	0.20	0.27	0.18
between 2nd and 3rd quartile	0.23	0.33	0.22
> 3rd quartile	0.18	0.50	0.32

Table 6 shows that at age 18 (when individuals are typically not yet operating on the marriage market and often still live with their parents) most people live in rural areas and there is not a lot of difference between individuals at the high and the low end of the attractiveness distribution. However, at the time of marriage, many of them live in the city. In particular, a large share of the individuals above the third quartile have moved to the city and married there. Amongst the individuals who stay married for 5 years we see that a significant fraction has moved back to the rural areas. The relative fractions located in the countryside and the city is now very close to the pattern at age 18. Only, the most attractive individuals prefer to live in the city, although also for this group we see transitions from city to rural upon marriage.

4.1 Size of the segments

The model has no predictions on the correlation between A^M and A^F. There are two opposing effects. Cities have more and smaller segments which increases the correlation but the fact that the attractiveness distribution is more skewed to the right[10] combined with the fact that the most attractive singles live in the city makes the correlation smaller. The latter effect basically makes the market for the high types more heterogeneous.

In this section we present evidence on the size of the marriage market segments in cities and rural areas. First, we investigate whether differences in our attractiveness measure between partners differ between the city and rural areas. Then, we do the same for age. The underlying assumption is here that agents prefer to marry partners within their cohort.

To test whether couples are more alike in cities, we run four regressions at the start of the relationship. In the first we regress the squared difference between the attractiveness

[10] The skewness of the standardized attractiveness distribution is 0.102.

of men and women on (i) a city dummy (ii) the level of attractiveness and a city dummy. We include the level of attractiveness to correct for level effects. In addition, to account for skewness, we run a regression where we take the squared difference between the percentiles of men and women in the distribution and regress it on level of attractiveness and a city dummy.

TABLE 7: HOMOGENEITY OF MATCHES WRT. ATTRACTIVENESS

Dependent variable:$(A^M - A^F)^2$	Coeff.	Std. err.	Coeff.	Std. err.
City	0.127	0.078	0.304**	0.056
Woman's attractiveness			-2.23**	0.026
Man's attractiveness			1.86**	0.028
Dependent variable:$(A_P^M - A_P^F)^2$				
City	-77.41**	34.93	-74.19**	34.903
Woman's attractiveness, percentile			-0.70	0.608
Man's attractiveness, percentile			-2.28**	0.616
# Observations			24812	

Note: * (**) denotes significant different from 0 at the 10% (5%) level.

The squared difference between the attractiveness of men and women is not lower in the city. However, because the attractiveness distribution is right skewed the distance between two individuals in the high end of the attractiveness distribution is potentially larger than between two individuals in the low end of the distribution. Since attractive people are more likely to live in the city this biases the coefficient on the city dummy upward. To overcome this issue we also look at the squared difference of *the percentiles* of the attractiveness distributions. In this regression individuals are placed in percentiles and the difference in percentiles squared is the dependent variable. In this regression the squared difference is significantly lower in the city. Suggesting that market segmentation is indeed tighter in the city.

Next, we turn to age. Consider the following expression:

$$\Delta = \left(Age^M - Age^F - E\left(Age^M - Age^F\right)\right)^2.$$

If search frictions are smaller in the city and people prefer to marry in their own cohort than the segments must be smaller as well. Table 8 presents the results for age at the time the relationship starts:

Table 8: Homogeneity of matches wrt. age

	City		Rural	
	Mean	Std. error	Mean	Std. error
Δ	22.53	0.53	26.72	0.43
# Observations	8934		15878	

Difference in means is -4.19 with a standard error of 0.70.

In cities, age differences between married couples are significantly smaller than in the rural areas which is supporting the prediction from our theoretical model that matching is more tight in the city.

5 Alternative explanations and robustness checks[11]

In this section we carry out a number of sensitivity checks and test whether our results can be driven by other factors. First we test whether the inflow of singles into the city merely reflects a "college effect", second we experiment with different attractiveness and city definitions, third we test whether the fact that couples move out of the city is mainly due to the presence of children and finally we test whether our results could be driven by life cycle motives.

5.1 Going to the city to get a college education

In Denmark, most universities are located in the big cities so we must worry about whether our results are driven by youngsters who move into the city to get an education, get married and then move back to the countryside. First, this story is not necessary inconsistent with our marriage market model because colleges and universities are good marriage markets themselves because they select a fairly homogeneous group of highly educated individuals (see e.g. Goldin, 1992 and Goldin & Katz, 2002). Nevertheless, it is still useful to check whether our model would also work in the absence of colleges. We can do this by restricting the sample to individuals who are older than 25 years. The motivation for those individuals to move to the city cannot be the presence of colleges. The results of this exercise are presented in Table 9 and 10 and in Figure 6 and 7.

[11] In all the tables in this section we also condition on age, presence of children and whether the individual works full-time.

Table 9: Logit for transition from rural to city, older than 25

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	0.377**	0.054	0.391**	0.073	1.133**	0.060	1.087**	0.082
Attractiveness			0.477**	0.048			0.302**	0.057
Single*attractiveness			-0.045	0.062			0.067	0.074
# Observations	50832				45979			

Note: * (**) denotes significant different from 0 at the 10% (5%) level.

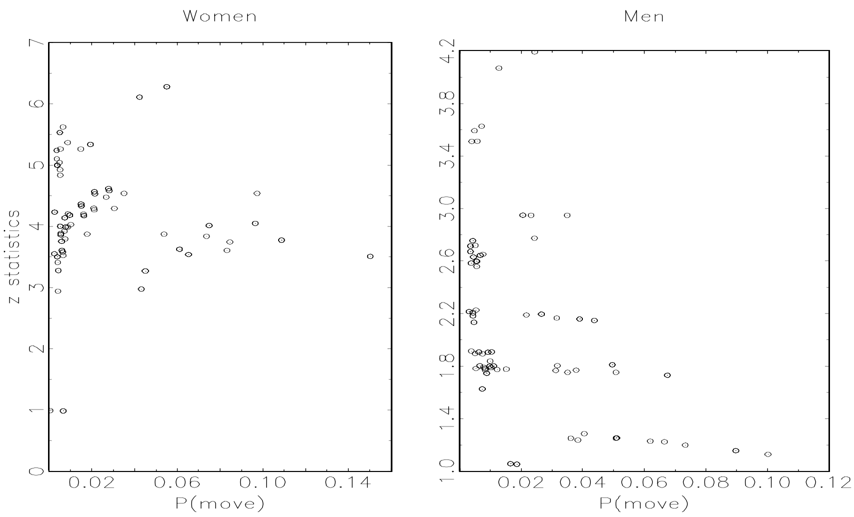


Figure 6: Interaction of single and attractiveness for individuals above 25 years old - transition from rural to city.

Table 10: Logit for transition from city to rural, older than 25

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	-0.261**	0.049	-0.258**	0.068	-0.450**	0.049	-0.375**	0.067
Attractiveness			0.138**	0.032			0.126**	0.033
Single*attractiveness			-0.043	0.050			-0.161**	0.056
# observations	20851				18840			

Note: * (**) denotes significant different from 0 at the 10% (5%) level

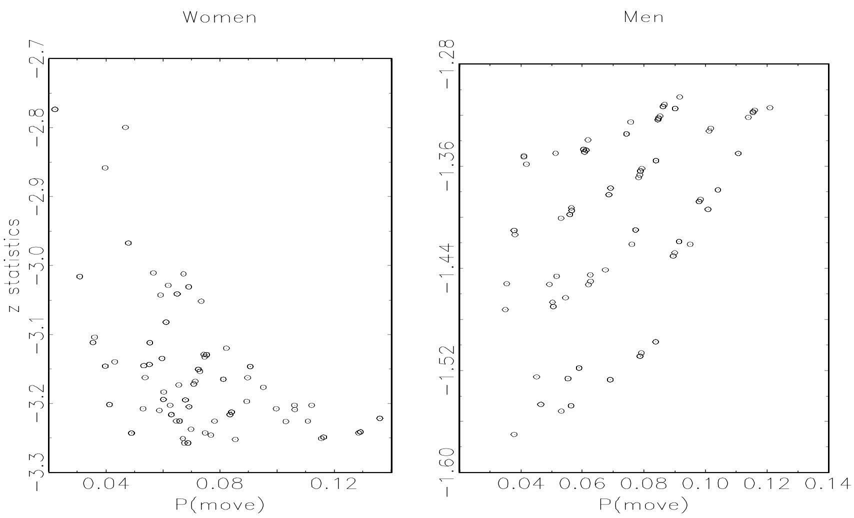


Figure 7: Interaction of single and attractiveness for individuals above 25 years old - transition from city to rural.

The results are now much cleaner in favour of our model in terms of describing the transition from city to rural. This suggest that the mobility of individuals to the large cities is not explained solely by educational choices.

5.2 Other attractiveness and city measures

Since education is the most important component in our attractiveness measure we have repeated our analysis with education only. We only present the results from regressions with all variables.

Table 11: Logit for transition between rural and city

	Rural to city				City to rural			
	Men		Women		Men		Women	
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	0.479**	0.155	0.801**	0.173	-0.144	0.061	0.006	0.137
Education	0.399**	0.055	0.206**	0.060	0.231**	0.035	0.207**	0.034
Single*education	-0.047	0.071	0.160**	0.079	-0.055	0.055	-0.220**	0.060
# Observations	77377		75869		33994		31588	

Note: * (**) denotes significant different from 0 at the 10% (5%) level

This does not change any of our conclusions.

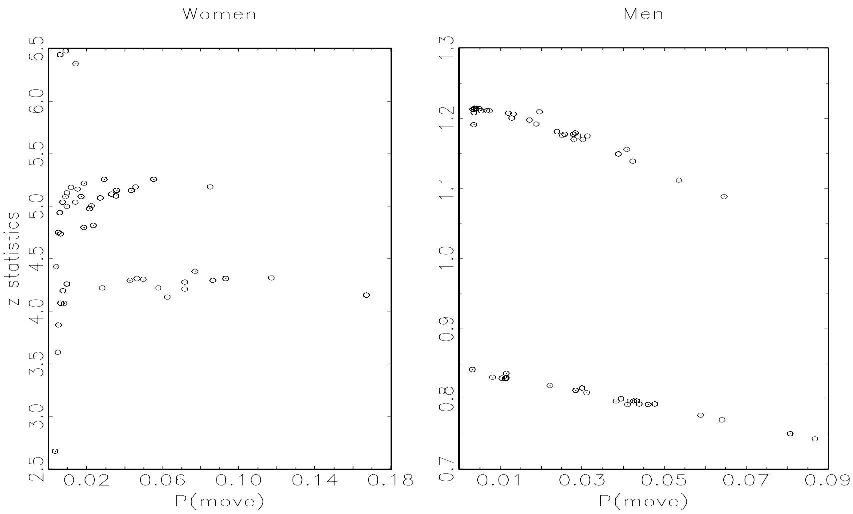


Figure 8: Interaction of single and education - transition from rural to city.

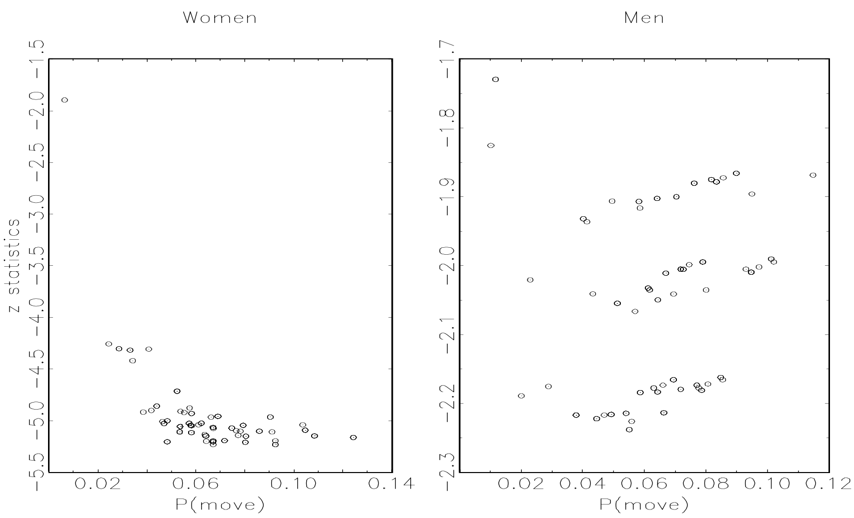


Figure 9: Interaction of single and level of education - transition form city to rural.

In addition, we have repeated our analysis for dense and non-dense areas (measured by people per square mile) rather than for the largest cities versus the countryside and again, this does not affect our results.

Below we present results for the model where city is defined as municipalities with a population density above 500 persons per square kilometer. Now 36 % of the population lives in the city. This definition implies that a number of the suburbs of Copenhagen is also included in the city definition.

Table 12: Logit for transition from rural to city(>500 persons per km^2)

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	0.187**	0.048	0.251**	0.063	0.777**	0.046	0.688**	0.058
Attractiveness			0.488**	0.044			0.387**	0.042
Single*attractiveness			0.035	0.053			0.017	0.052
# Observations	72910				67059			

Note: * (**) denotes significant different from 0 at the 10% (5%) level

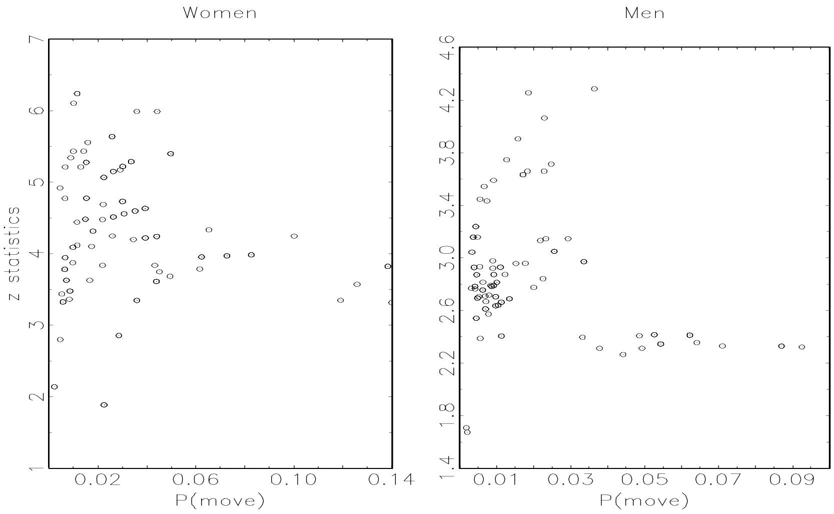


Figure 10: Interaction of single and attractiveness - transition from rural to city (>500 persons per km^2).

Table 13: Logit for transition between city(>500 persons per km^2) and rural

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	-0.198**	0.048	-0.230**	0.064	-0.269**	0.044	-0.266**	0.056
Attractiveness			0.084**	0.033			0.016	0.031
Single*attractiveness			-0.091**	0.048			-0.145**	0.047
# Observations	41166				38592			

Note: * (**) denotes significant different from 0 at the 10% (5%) level

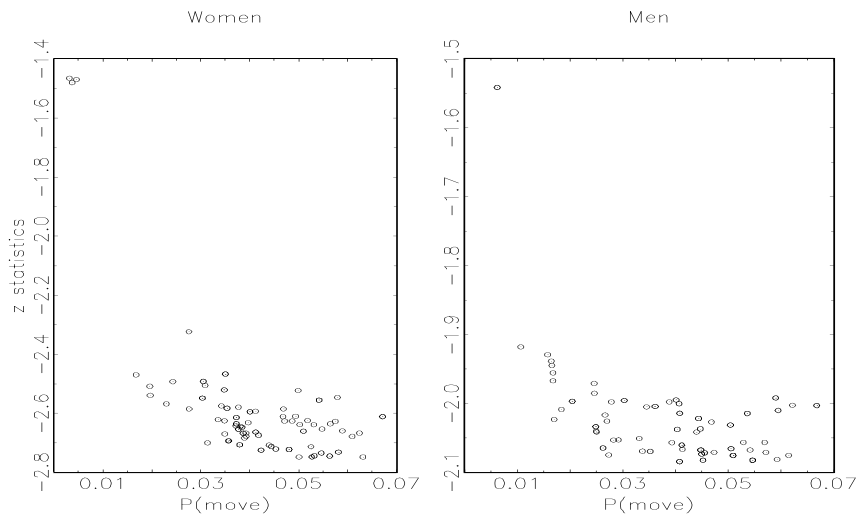


Figure 11: Interaction of single and attractiveness - transition from city (>500 persons per km^2) to rural.

Again, we find no significant changes in our conclusions. In fact, the interaction effect is now even more in favor of the marriage market hypothesis, since for both women and men we find significantly positive effects for the transition from rural to city.

5.3 The role of children

Although we control for having children, married couples could still move to rural areas because they expect to get kids. In that case, the reason to move to the countryside reflects more of a shift towards more space and not the fact that one looses the benefits of lower search-costs. In order to isolate the search motivation, we only consider the subset of couples who never get children. Under the assumption that having no kids reflects preferences rather than constraints, this group must have other motives than kids to move to the countryside.

Table 14: Logit for transition from city to rural, No kids sample

	Men				Women			
	Coeff.	std.	Coeff.	std.	Coeff.	std.	Coeff.	std.
Single	-0.322**	0.087	-0.428**	0.130	-0.345**	0.095	-0.373**	0.134
Attractiveness			-0.253**	0.107			0.021	0.099
Single*attractiveness			0.333**	0.123			-0.159	0.128
# Observations	6125				4383			

Note: * (**) denotes significant different from 0 at the 10% (5%) level

The absence of kids does not change the pattern that married people are more likely to move to the countryside than their unmarried counterparts.

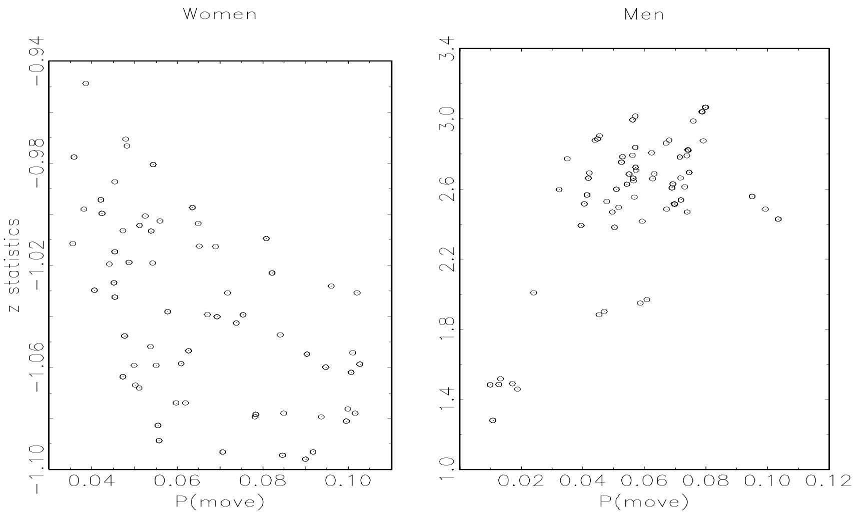


Figure 12: Interaction of single and attractiveness - transition from city to rural for no kids sample.

5.4 Life cycle motives for leaving the city

Perhaps, the mobility pattern that we find can be described by "ordinary" life cycle behavior. People enter the city when they are young and have relatively strong preferences for bars, clubs, cinemas and other city amenities and then leave the city when they are older and richer and have stronger preferences for land. One way to "isolate" the search effect is to consider the mobility patterns of couples who have moved to the country site and who got divorced there. If they moved to the countryside for life cycle motives other than the marriage market, we expect them to stay in the countryside after divorce whereas according to the marriage market model they should move back to the city once they become single again. We find that our model still holds. Since the observations we use are annual, we only know that a divorce has occurred during the year but not the exact date. We therefore present results for both individuals who are divorced 1 year and those who are still divorced after 2 years.

Table 15: Logit for transition from rural to city

	Men				Women			
	Coeff.	Std	Coeff.	Std	Coeff.	Std.	Coeff.	Std.
Divorced, 1 year	0.765**	0.061	0.667**	0.085	1.141**	0.059	1.059**	0.078
Attractiveness			0.447**	0.021			0.359**	0.023
Divorced*attractiveness			-0.115	0.086			0.027	0.075
Divorced, 2 years	0.477**	0.084	0.486**	0.115	0.497**	0.097	0.454**	0.127
Attractiveness			0.437**	0.021			0.353**	0.022
Divorced*attractiveness			0.023	0.114			0.108	0.119
# Observations	82469				75628			

Note: * (**) denotes significant different from 0 at the 10% (5%) level

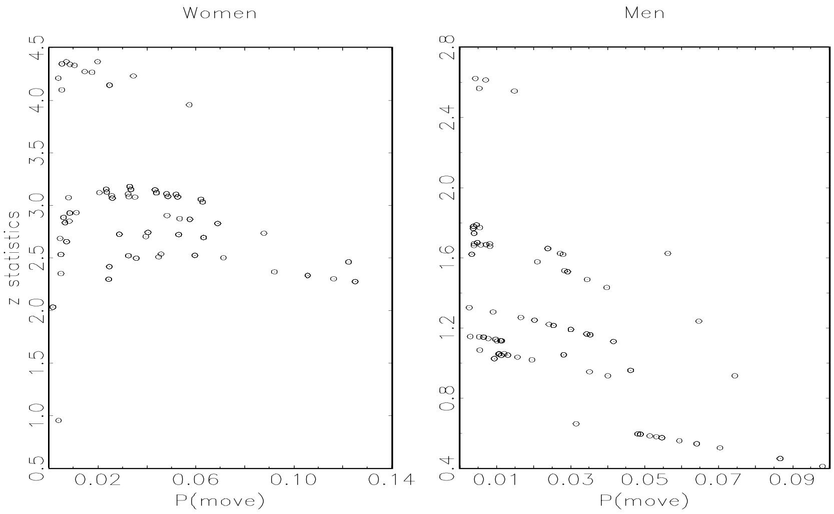


Figure 13: Interaction of divorcee for 1 year and attractiveness - transition from rural to city.

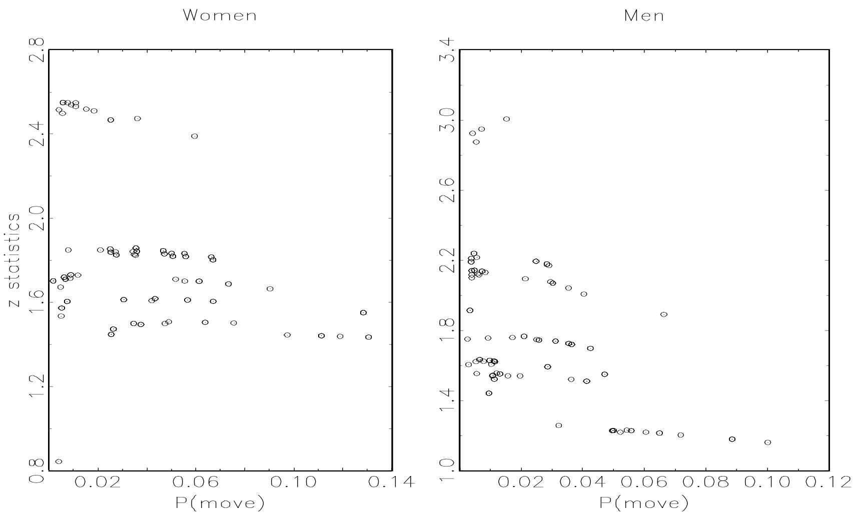


Figure 14: Interaction of divorcee for 2 years and attractiveness - transition from rural to city.

Table 16: Logit for transition from city to rural

	Men				Women			
	Coeff.	Std.	Coeff.	Std.	Coeff.	Std.	Coeff.	Std.
Divorced, 1 year	0.734**	0.063	0.747**	0.087	0.631**	0.063	0.726**	0.079
Attractiveness			0.097**	0.022			0.032	0.022
Divorced∗attractiveness			0.057	0.076			-0.020	0.071
Divorced, 2 years	0.127	0.092	0.102	0.128	-0.374**	0.112	-0.267*	0.138
Attractiveness			0.107**	0.021			0.029	0.021
Divorced∗attractiveness			-0.215**	0.118			-0.137	0.127
# Observations	31607				30023			

Note: * (**) denotes significant different from 0 at the 10% (5%) level

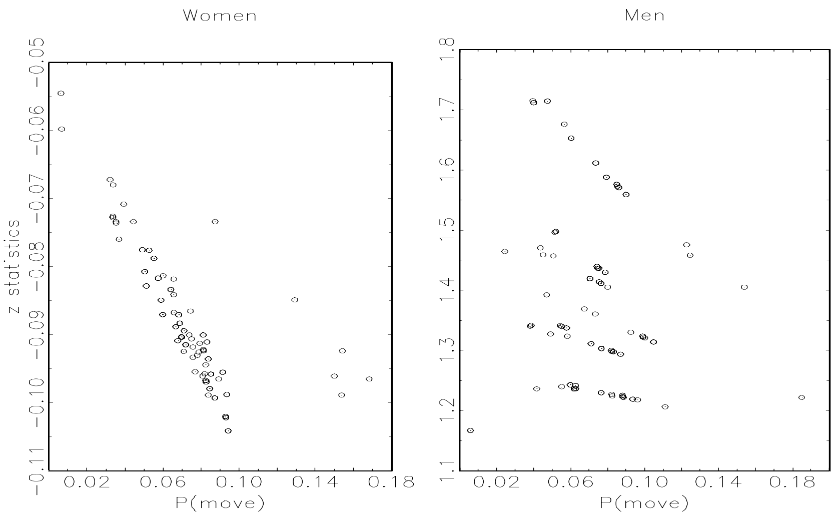


Figure 15: Interaction of divorcee for 1 year and attractiveness - transition from city to rural.

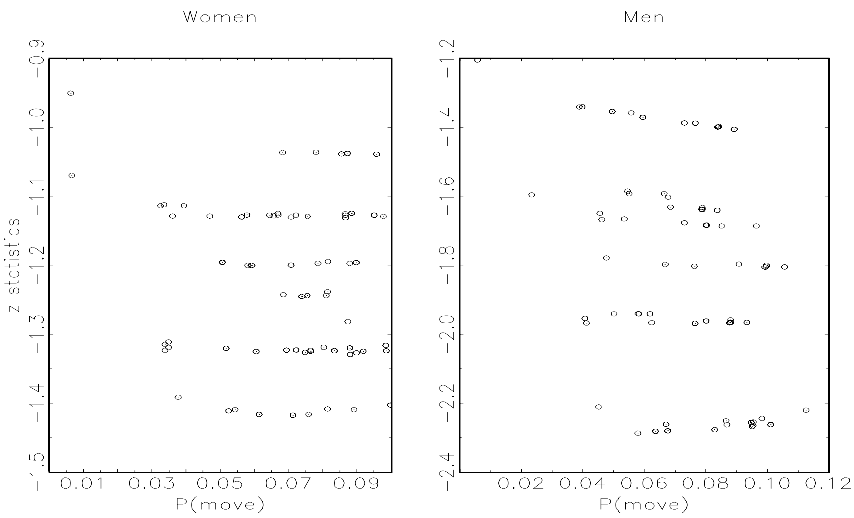


Figure 16: Interaction of divorcee for 2 years and attractiveness - transition from city to rural.

Not surprisingly, because of the nature of a divorce, divorcees are more likely to move. Therefore we must compare the likelihood to move to the city with the likelihood to move out of the city. For men, there is no large difference after the first year of divorce. In the second year after divorce they are however more likely to move to the city, but not to the rural areas compared to the reference group. For women, the propensity of the divorced to move to the city is larger than to move out of the city[12]. This pattern is even more pronounced after 2 years of divorce and can be explained by the fact that it is typically harder to find a place to live in the city than on the countryside. This supports the marriage market hypothesis.

6 Conclusion

In this paper we extend the Burdett-Coles (1997) marriage market model with a distinction between efficient marriage markets (cities) and less efficient search markets (rural

[12] Although this is evident from the size of the coefficients we have also investigated the marginal effects of being divorced. The marginal effects (available upon request) supports the claim.

areas) and derive how individuals sort into those markets. Our model predicts that singles and in particular attractive singles move to the city while couples move out of the city. Those predictions are confirmed by the data. We find that in particular for females, the cross partial of single and attractiveness on the probability of moving is positive and statistically significant. Why the cross effect is less pronounced for males is still an open issue.

In this paper we solely focussed on marriage decisions and abstracted from divorces. One interesting motivation for married couples to move to a rural area is that it is an efficient way to make a commitment. Burdett et al. (2004) showed that if one of the partners is likely to continue searching "on the job", this by itself stimulates the other partner to continue search as well. Given the many long term investments that are required, like raising children and buying a house, which all require a stable relationship, it can be efficient to move to an inefficient search market to limit "on the job" search.

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