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ABSTRACT

Female First Marriage in East and Southeast Asia: A Kiefer-Neumann Model

Mark R. Montgomery

Although many studies of households in developing countries have identified wife's education and the education (or permanent income) of the husband as important determinants of behavior, there is surprisingly little known about the way these characteristics come to be associated with each other in the marriage market. This paper uses the theory of search to investigate marriage markets in Korea, Indonesia, and Malaysia. The aim is to estimate an empirical model of search in which a woman's education is treated as an exogenous variable and her age at first marriage and the education of the husband are jointly determined, endogenous variables. The maximum likelihood model proposed by Kiefer and Neumann for labor market search problems is applied. The estimates suggest that female education increases both the reservation and offer levels, with the effect on reservation levels dominant. Thus, better-educated women tend to marry later and to marry men with better education. The behavior of the reservation function with the age of the woman is less clear. Kiefer-Neumann estimates, which rely on a restrictive assumption about offer frequency, show a decline in reservation levels with age. The Flinn-Heckman diagnostic test does not support that finding. Better estimates of the reservation function will have to await data on marriage offer frequencies.

The literatures devoted to age at first marriage and to assortative mating in marriage markets are largely separate literatures. The first is concerned with the timing of an individual's transition in marital status; studies of age at marriage seldom consider the characteristics of wife-husband pairs in any detail. By contrast, theories of assortative mating (Becker, 1974, 1985) focus on combinations of husband and wife characteristics without explicit attention to issues of marriage timing. In an important contribution, Becker, Landes, and Michael (1977) use the language of search theory to integrate these two perspectives. The underlying notion is quite simple. Female age at marriage is taken to represent the length of marriage search (for females) and the characteristics of the husband, considered in conjunction with the woman's characteristics, to represent search outcome.

An analogy is useful in making the point. Consider the comparison between search in the marriage market for a spouse and an unemployed worker's search for a suitable job. In each market the length of search results from the searcher's definition of the minimally acceptable match. Jobs might be ranked by their wage rates; the wage rate just sufficient to induce a searcher to take a job is called, by economists, the "reservation wage". Other things held equal, the higher a searcher's reservation wage, the longer his expected period of search. In the marriage market potential spouses might be ranked according to a variety of criteria; just as in the labor market, the more restricted is the set of acceptable traits--that is, the "reservation set"-- the longer a marital searcher would be expected to remain single before encountering an acceptable spouse. In short, search theory makes it clear that the duration of search and its outcome are joint products of a decision on reservation sets.

The descriptive usefulness of the search framework is now well recognized. What is perhaps less well appreciated is that the theory offers something more for the understanding of marriage patterns than an organizing framework or vocabulary: it suggests an econometric technique for analyzing readily available demographic data on marriage. In this paper we present the econometric method, due to Kiefer and Neumann (1979), and discuss its application to female first marriage in Malaysia, Korea, and Indonesia. Particular attention is given to the links between female schooling, female age at marriage, and the education of first husbands. In what follows we shall attempt a critical assessment of search theory and its econometric implementation to first marriage. That is, throughout the paper we ask whether search theory can indeed provide richer insights than those suggested by the separate literatures on age at marriage and assortative mating, and whether the new methodology avoids biases inherent in other, simpler approaches.

The paper is in five parts. In Part I a simplified model of marriage search is outlined. Part II considers special aspects of the marriage markets in Korea, Indonesia, and Malaysia. In Part III we discuss the Kiefer-Neumann statistical model as it is applied to marriage search. The results of the Kiefer-Neumann analyses are then presented in Part IV and the paper concludes in Part V.

I. Search Theory and First Marriage

A model of female education and marital search should draw together three issues. The first is a consideration of the direct and opportunity costs of schooling. Education--particularly secondary education--reduces a daughter's work contribution to the family, at least for the period of time she is in school. The family must also bear the direct costs of her education: school fees, supplies, special clothing, and other expenditures. It is clear that these are important factors in parental decisions about female schooling (Strange, 1981:92-96; Rogers, 1977:7,22; Tan and Haines, 1984; DeTray, 1983; White, 1975). A second issue to consider is whether an educated daughter will have as many marriage opportunities as a less-educated one might; in some settings, extending a daughter's education might render her less "marriageable". Finally, a theory of education and marriage search should include the direct payoff to a daughter's schooling: the likelihood that an educated daughter will attract a spouse whose social or economic status is as high or higher than hers. Such payoffs might be thought of in terms of their utility benefits for parents or as benefits accruing to both parents and daughter (Geertz, 1961:55-56).

A simple, formal model of search in the marriage market integrates these arguments. The search framework to be described here is indeed the simplest possible one. Marital search is imagined to take place in a time-homogeneous environment, with the search horizon treated as infinite (future costs and benefits are discounted). Marriages, once contracted, are assumed to last forever. Let us suppose that parents encounter an eligible male with probability q per period; associated with each such male is the parents' evaluation of him as a partner for their daughter, denoted with the random variable ε. We assume that ε is independently and identically distributed across periods; that is, no matter what the age of an unmarried daughter or the offers already made to her, the "quality" distribution of spouses available to her remains unchanged. $F(\varepsilon)$ denotes the cumulative distribution function for ε. The net, per-period cost of maintaining an unmarried daughter is given by c. This cost, the offer probability q, and the location of the offer distribution F are each affected by the years of schooling parents invest in their daughter, denoted by e, with:

$$\frac{dc}{de} > 0, \quad \frac{dq}{de} \gtrless 0 \quad \text{and} \quad \frac{\partial F(\varepsilon;e)}{\partial e} = -f(\varepsilon;e)$$

Note that a unit increase in daughter's schooling shifts the offer distribution $F(\varepsilon)$ to the right by one unit.[1]

Parents choose the level of daughter's education, e, to maximize their own expected utility. As is well known (Lippman and McCall, 1976), for a given choice of e there is a reservation level for spouse quality, denoted by ε_r, such that the first potential spouse encountered whose value $\varepsilon > \varepsilon_r$ is accepted. In other words, the quality distribution characterizing potential partners is F; the distribution for accepted partners is F^*, a truncated version of F, with the point of truncation given by ε_r. Time homogeneity and the infinite horizon assumption ensure that the threshold or truncation point ε_r is constant across search periods.

The parental search problem, then, is to choose the level of daughter's education and the level of ε_r given her education, to maximize:

$$E_S\{-\sum_{t=1}^{S} D^{t-1}c(e) + D^S \frac{E[\varepsilon|\varepsilon>\varepsilon_r;e]}{1-D}\} . \qquad (1)$$

In (1), the expected payoff to search is

$$E_S\{D^S \frac{E[\varepsilon|\varepsilon > \varepsilon_r;e]}{1-D}\} .$$

D is the parents' rate of discount (0<D<1); it appears in the denominator of the search payoff expression to reflect the assumption that marriages are perfectly stable. S is the random variable denoting search duration, that is, the number of periods before a partner with value $\varepsilon > \varepsilon_r$ is encountered. S could be interpreted here as age at marriage. Under our assumptions, S is geometrically distributed with exit parameter $q(e)(1-F(\varepsilon_r;e))$. In other words,[2] a marriage occurs if an offer is made (with probability q) and that offer is acceptable (probability $1-F(\varepsilon_r;e)$). In each period until an acceptable offer is received, the cost c is paid; as (1) makes clear, ε_r and e affect the costs of search as well as its benefits.

For a given choice with respect to daughter's schooling (and, therefore, given levels of c, q, and location of F), the reservation level can be written as

$$\varepsilon_r^* = \varepsilon_r(c,q,e) \qquad (2)$$

where, as shown in Appendix A,

$$\frac{\partial \varepsilon_r^*}{\partial c} < 0, \frac{\partial \varepsilon_r^*}{\partial q} > 0, \text{ and } \frac{\partial \varepsilon_r^*}{\partial e} > 0.$$

These results are intuitively sensible. The higher the cost required to maintain an unmarried daughter, c, the lower the reservation ε_r level -- that is, the more willing parents are to compromise on a match. The more frequently eligible males are encountered, the higher the ε_r standard that parents can set. Finally, the better positioned is the offer distribution, the higher is the minimum acceptable match.

The association between daughter's education and ε_r^* therefore consists of three factors. As e increases, so would the maintenance costs c; that effect alone would reduce ε_r and hasten marriage. If $q'<0$, then the frequency of marriage offers falls with increasing education; that effect would also tend to reduce ε_r. Offsetting these is the direct effect of education in shifting F, the offer distribution. The net effect of e on ε_r is given in (3):

$$\frac{d\varepsilon_r^*}{de} = \frac{\partial\varepsilon_r^*}{\partial c}c'(e) + \frac{\partial\varepsilon_r^*}{\partial q}q'(e) + \frac{\partial\varepsilon_r^*}{\partial e} \tag{3}$$

This is the structural relationship of primary interest in the model.

Since the levels of ε_r and daughter's education e determine the exit rate to marriage, one might wonder whether any information about the derivative (3) could be gleaned from data on age at marriage. As shown in Appendix A, if $q'<0$ then age at marriage data alone are insufficient to identify even the sign of (3). An increase in daughter's education reduces the frequency of marriage opportunities at the same time that it increases the likelihood of acceptance given an offer; the net effect of education on age at marriage is ambiguous.[3] Therefore, uncovering information about the structural relationship between education and ε_r^* requires additional data on the characteristics of the spouse.

The search model described here, while admittedly artificial in its assumptions, is nevertheless useful as an organizing framework. To bring content to the model, and to help place its assumptions in perspective, we now turn to the ethnographic literature on marriage markets in East and Southeast Asia.

II. Marriage Search in Korea, Indonesia, and Malaysia

The theory presented above relies on several concepts which require clarification if the search perspective is to be applied to marriage. The first concerns the variable ε, assumed to summarize a potential spouse's "quality". In principle, the ε variable should act as a summary index, combining all the relevant traits of the woman and her potential spouse into a single indicator for the value of marriage. However, in practice, it is difficult to consider more than one characteristic at a time in econometric work. In this paper we consider only a single spouse characteristic: the level of education. To what extent might our focus on male education as the empirical counterpart for ε produce a distorted picture of the marriage market?

The question might be phrased in terms of a monotonicity assumption. Given a woman's own schooling level, is the ranking of potential spouses monotonic with respect to their education? Education represents a man's human capital accumulation and earnings potential at the time of marriage; it seems likely that a candidate with more schooling would be preferred to one with less. Geertz's (1961:58) account of marriage search among the

Javanese supports this idea. However, both Geertz and other ethnographers emphasise the social tensions created by marked inequality in spouse characteristics. Strange (1976; 1981:Chapter 5) notes that rural Malay parents seek to match "like with like" in arranging marriages; there is evident concern for balancing the characteristics of spouses so that neither's social position is too far removed from the other's.

In a theoretical discussion of the gains to marriage, Schirm (1986) shows that rankings of potential spouses based on a single trait can easily be reversed when sets of traits are considered. The ethnographies suggest that the range of spouse characteristics deemed relevant is indeed wide. Among rural Malays, a number of characteristics are considered other than education: kinship ties, geographic proximity, the gap in age between spouses, and differences in the degree of Islamic piety. Maeda (1967:17) notes that for Malaysian Chinese, area of origin in China is an important factor in mate selection. For Bali, Koentjaraningrat (1972), Geertz (1963), and H. Geertz (1967) describe the Balinese "title" system as central to spouse rankings; these authors point out that a potential mate's title is not necessarily closely linked to his education.

Thus, even if male education were the only spouse characteristic considered, the monotonicity assumption--the identification of ε with male schooling--would likely be valid only in a restricted range about a daughter's own education level. The consideration of other traits in addition to education can reverse rankings of spouses produced by education alone.

Another set of issues has to do with the offer probability variable, q, and the location of the offer distribution. First, what is a marital offer?

Are such offers observable, even in principle? Strange's account of marriage bargaining in Malaysia (1981:Chapter 5) suggests that the notion of a marital offer does have empirical content. Her discussion (also see Djamour, 1959:73-74) makes it clear, however, why data on marriage offers are rarely gathered. The negotiations between families involved in marriage bargaining appear to be remarkably subtle and stylized; it seems important to the participants that no direct statement of intent be given until the success of the bargaining is assured. Geertz (1961:62) provides a similar account of "formal calling" among the Javanese. Although the number of offers which might be entertained by a woman's family is not clear from these ethnographic descriptions, it does not appear unusual for there to be more than one such opportunity (Djamour, 1959:70). In sum, even if data on marriage offers are seldom available, the concept itself appears defensible.

The search model described above is notable for its stationarity; that is, the environment in which marital search takes place is assumed to change neither with calendar time nor with the age of an unmarried daughter. In consequence, the key decision variable in the model -- ε_r -- remains fixed over the period of search and the implied distribution of age at first marriage is the simple geometric distribution.[4] The reader familiar with empirical first marriage distributions will recall that the first marriage risk function is hardly constant, as would be predicted by a geometric model; instead, the risk function typically rises with age to a plateau (Coale, 1971; Coale and McNeil, 1972). Ethnographic accounts of marriage markets provide some insight into this empirical regularity, suggesting that marriage search is conducted in a decidedly non-stationary environment. Let us consider sources of non-stationarity in the marriage markets of Korea, Indonesia, and Malaysia, and then turn to other sources of variation.

Menarche and Search Initiation

In societies characterized by early marriage, the onset of puberty may signal the beginning of a daughter's period of eligibility for marriage. Among the Malays, for instance, menarche has been associated with a stricter application of Islamic rules to daughters, with female seclusion (Whyte and Whyte, 1982:30; Strange, 1981:109) and with parental anxieties over contacts with males. Caldwell et. al. (1985) note that such parental fears have, in South Indian populations, resulted in the withdrawl of daughters from school and there is mention of similar behavior in the ethnographies for Malays and Javanese (Geertz, 1961:56).

It is clear that female seclusion upon menarche has declined in importance over time; it is likely to be a major consideration only for the older cohorts we study. There is a more general point to be made in connection with menarche, however. If puberty initiates active marital search, then the identification of search length with age at marriage is obviously problematic. An important empirical issue in the analysis of marriage is whether any event observable to the researcher marks a transition point from ineligiblity for marriage to eligibility.

Normative Constraints on Search Length

In most societies there are widely held views concerning the appropriate age range for a woman's first marriage. One would expect that, as the end of this range is approached, spouse reservation levels would be revised downward and the risk of marriage would rise. There is an analogy which could be drawn to a related issue in labor market search: as a searcher's period of unemployment insurance comes to an end, we expect reservation wage levels to fall.

Female Employment

In each of our study countries, shifts over time in the demands for semiskilled and skilled female labor have altered the costs of maintaining a single daughter. Such jobs often require primary or secondary education; by investing in a daughter's education, however, parents may receive returns in the form of daughter-to-parent remittances. Parents might compare the returns from investing a level of education e_0 in a daughter, with associated age pattern of net costs shown in Figure 1, to those from investing in a greater degree of education e_1. The more extended a daughter's schooling, the longer the period of high net maintenance costs; parents may be willing to bear such costs in anticipation of a period of higher net returns. Since, in the societies studied here, economic contributions from daughters to parents end for the most part with marriage, remittances from a daughter's employment may serve to keep parental ε_r levels high and to delay female first marriage.

Greenhalgh (1985) and Salaff (1976) argue that earnings remitted by daughters to their parents play an important role in family accumulation strategies. Among Taiwanese, Hong Kong Chinese, and Koreans, a daughter's earnings are often used to help finance schooling for her younger siblings, especially her brothers. We expect female employment to be an important source of non-stationarity for Malaysian Chinese, for Koreans (Hong, 1984), and perhaps in recent years for urban Malays and Indonesians.

Residence Outside the Home

Closely associated with employment is the role played by residence outside the home. Hong (1984), Salaff (1976), Mintz (1977), and Ariffin (1984) emphasize the exposure to new norms and ideas experienced by those single, rural women who take urban employment. Mintz and Hong note that employment and separate residence give young women a cherished period of leisure between their responsibilities in their families of origin and the housekeeping, childbearing, and other demands which are inescapable upon marriage.

Arranged Marriage and Romantic Marriage

A young woman who is freed from immediate parental supervision, perhaps as a consequence of urban employment and residence, might come to adopt Western notions concerning appropriate dating behavior and the importance of common interests and companionship in deciding on a spouse. A number of observors (Chang,1978; Lee and Kim, 1977) agree that the notion of romantic, rather than arranged, marriage is now predominant among urban Koreans; Maeda (1967:62) mentions its growing popularity among urban Malaysian Chinese.

What precisely is the link between romantic marriage, the involvement of young people in spouse choice, and female age at marriage? Implicit in the romantic marriage ideal is a concern for spouse traits that must be established through intensive, rather than extensive search. In addition, a movement toward that ideal suggests that, for an interim period, the definition of an acceptable spouse will be the product of implicit bargaining between daughters and parents. So long as parents' interests as well as those of their daughters must be satisfied, we would expect marriage search to take longer than if only one party's interests were involved. In effect, the "reservation set" is more restricted than it would otherwise be. Finally, search efficiency is a consideration in societies moving away from the arranged marriage norm. As Salaff (1976) notes, the emergence of a dating culture may be slow in such societies. Even among the Hong Kong Chinese she describes, there is considerable anxiety over appropriate search behavior for single women. Occupational segregation limits the sort of on-the-job marriage search that Westerners enjoy.

Whyte and Whyte (1982:67) and Koentjaraningrat (1972) caution against the notion that the involvement of young people in mate selection necessarily implies later marriage. Whyte and Whyte trace involvement of the young to land availability, inheritance, and patrilineality. They argue that where land is relatively accessible and kinship bilateral, the young tend to be more involved in mate selection. On the other hand, in patrilineal, patrilocal societies where inheritance of land is a major economic issue, control over mate selection is rarely ceded to the young. Koentjaraningrat observes that among the Sundanese and Madurese of Java, whose kinship is bilateral, young people are much involved in mate selection and courting; female age at marriage in these ethnic groups is typically quite young.

Other Sources of Variation

The Marriage Squeeze

Preston and Strong (1985), Fernando (1975), and others have remarked that the rise in female age at marriage apparent in Asia is coincident with a secular fall in mortality levels. They suggest that the trends are related: when females typically marry men several years older than themselves, a fall in mortality levels implies an imbalance in the marriage market, with surviving females in relative abundance compared to eligible males. In contrast, in the early 1950s, sex imbalances in the marriage market with males in excess were in evidence for Malaysian Chinese and Indians (Khoo and Pirie, 1984). These imbalances were the result of earlier periods of sex-selective migration associated with recruitment of labor for rubber and tea estates and for tin mining.

In terms of the search model described above, a marriage squeeze might be represented as a change in the frequency of offers, q, made to single females. If q falls when there is a relative excess of single females, there is an offsetting endogenous response in that the reservation ε_r levels for spouse quality also fall; the net effect, however, may be to delay marriage for females.[5]

Divorce

Another empirical regularity worth noting is the negative association between female age at first marriage and the prevalence of divorce. The contrast between Java and Bali, for instance, is marked. Javanese first marriages typically occur earlier than do Balinese marriages, and first marriages for the Javanese are quite often dissolved, while Balinese marriages are more stable. There are at least three interpretations for the observed association. Families with higher ε_r levels search longer and search yields a spouse whose quality is higher; perhaps better matches are less prone to dissolution. There is another search-theoretic interpretation. If the risk of divorce is exogenously high, it is rational to set lower ε_r levels and marry earlier; why be so choosy if divorce is likely in any case[6]? A third possibility is that women who have difficulty finding a spouse and who marry late may well be reluctant to divorce.

As noted by Geertz (1961:63), among the Javanese a young woman is constrained by custom from expressing an opinion concerning the match being arranged for her until the marriage ceremoney has taken place (this has also been the custom for rural Malays). After that time, however, she may refuse to consummate the marriage and pressure her husband for a divorce. Javanese parents apparently regard a daughter's first marriage as something of a celebration of her entry into adulthood, rather than as the culmination of a bargain between families that is necessarily expected to endure (Geertz, 1961:69). It is sensible, therefore, to be cautious in comparing age at marriage across cultures: evidently, the meaning of the event for the participants can vary widely.

Part III. The Kiefer-Neumann Model

As the ethnographic accounts suggest, the reservation level for spouse characteristics is unlikely to remain constant with respect to a woman's age. Neither is the offer distribution -- representing the other side of the marriage market -- likely to go unaffected by the age of the woman in question. The Kiefer-Neumann search model permits both the reservation and offer functions to vary with the length of search.

The econometric model rests on two equations and several crucial, simplifying assumptions. Equation (4) is the reservation equation for a single woman aged a; it gives the minimum level for male schooling that is acceptable in a spouse. This is the counterpart of expression (2) in Part I. The reservation level is allowed to vary with the woman's age as well as her schooling (the latter given by D_e, a vector of dummy variables for educational attainment) and other characteristics summarized in the vector X:

$$\varepsilon_{r,a} = X'\beta_r + D_e'\gamma_r + g_r(a) + u_{r,a} \tag{4}$$

Age effects are captured in the $g_r(a)$ function; in the empirical work $g_r(a)$ is represented by a cubic in age. The disturbance term $u_{r,a}$ in (4) is assumed to be normally distributed with zero mean and variance σ_{rr}.

Equation (5) represents the offer distribution F:

$$\varepsilon_{o,a} = X'\beta_o + D_e'\gamma_o + g_o(a) + u_{o,a} \tag{5}$$

The mean of the offer function also depends on the woman's education and her age (as expressed by the $g_o(a)$ function); the error term $u_{o,a}$ is assumed to be normally distributed with variance σ_{oo} and a covariance σ_{or} with the error term of the reservation equation.

Three additional assumptions complete the stochastic specification. The first, and most restrictive, assumption is that one marital offer--that is, one draw from the distribution represented by equation (5)--is assumed to be made each search period. For the analyses we conduct, the length of a search period is defined to be one year. Secondly, the disturbance vector $(u_{r,a}, u_{o,a})$ is assumed to be independently and identically distributed with respect to age; no persistent unobservables are permitted to influence either the reservation or offer distributions. Finally, search is assumed to begin at exact age a_0 for all women.

Under these assumptions a woman who first marries in the age interval [a,a+1) has experienced $a-a_0$ draws characterized by $\varepsilon_{o,s} < \varepsilon_{r,s}$ and a final draw with $\varepsilon_{o,a} > \varepsilon_{r,a}$. We observe $\varepsilon_{o,a}$ -- husband's education -- but for earlier draws we have only the qualitative information that $\varepsilon_{o,s} < \varepsilon_{r,s}$. Consider an individual woman who marries, at age a, a man with years of schooling $\varepsilon_{o,a} = e$. Her contribution to the sample likelihood is based on two components:

$$\prod_{s=a_o}^{a-1} \Pr[\varepsilon_{o,s} < \varepsilon_{r,s}] \quad \text{and} \quad \int_{-\infty}^{e} f_a(e, \varepsilon_r) d\varepsilon_r$$

where $f_a(\varepsilon_o, \varepsilon_r)$ is the joint normal density of the offer and reservation levels for age a. The first component represents the probability of surviving unmarried to exact age a; the second, the joint density for marriage in the age interval [a, a + 1] to a man with education $\varepsilon_{o,a} = e$. The likelihood function and estimation techniques for the Kiefer-Neumann model are discussed in Appendix B.

Two of the assumptions made in the Kiefer-Neumann approach deserve special comment. The first concerns the joint normality of $(\varepsilon_o, \varepsilon_r)$. The distribution of male education is certainly not normal; indeed, it would be difficult to find a parametric model that fits the education distribution closely. In our empirical work we assume that years of schooling, plus one year, can be represented by a log-normal distribution. Maddala (1983:369-370) and Lee (1982) discuss other distributional assumptions.

Perhaps the most problematic aspect of the Kiefer-Neumann approach has to do with offer frequency. The assumption that marital offers arrive one per year is neither realistic nor consistent with the hypothesis that offer frequency varies by the level of woman's education. Moreover, as shown below, the assumption has important consequences for the estimation of the reservation function. In considering alternative approaches in which offers arrive randomly, Flinn and Heckman (1982) propose the following simple diagnostic device. Consider a homogeneous sub-group of single women age a. A consistent estimate of the reservation level $\varepsilon_{r,a}$ for the subgroup is provided by the sample minimum of husband's education for those women in the group who marry at age a. That is, $\varepsilon_{r,a}$ is the lower truncation point of the accepted -- husband's -- education distribution. In large samples, the distribution of husband's education for women who marry at age a would have a spike at $\varepsilon_{r,a}$.[7]

The Flinn-Heckman technique is useful precisely because it does not impose an assumption on offer frequency. However, implementing the procedure requires that one identify homogeneous sub-samples of the data. For any given overall sample size, the finer one subdivides the data, the fewer observations fall in each homogeneous cell, and the less information is contained in the within-cell minimum of husband's education. The technique is therefore best viewed as a check on the results of the more restrictive Kiefer-Neumann approach.

It may be instructive to close this section by comparing the Kiefer-Neumann approach to others more frequently encountered in the demographic literature. Hirschman (1985) estimates equations for age at first marriage of the form:

$$A = X'\alpha_1 + D_e'\alpha_2 + \alpha_3 X_h + u \qquad (6)$$

where A is a woman's age at first marriage, D_e her education, X represents other covariates, and X_h is an indicator of husband's characteristics. (Hirschman uses husband's occupation for X_h.) Search theory makes it clear that A and X_h are jointly determined, endogenous variables. In consequence, we would expect there to be correlation between X_h and the disturbance term u, invalidating least-squares estimation of (6).

Another approach, much closer to the one pursued here, is found in Boulier and Rosenzweig (1984). They estimate two equations,

$$A = X'\alpha_{11} + D_e'\alpha_{12} + u_a \qquad (7a)$$

$$X_h = X^{*\prime}\alpha_{21} + D_e'\alpha_{22} + \alpha_{23}A + u_h \qquad (7b)$$

where X is the vector of woman's characteristics and X* is identical to X except that at least one variable included in X is excluded from X*. Search theory suggests that the disturbance terms (u_a, u_h) for (7) are likely to be correlated; therefore, A in (7b) is correlated with u_h. Boulier and

Rosenzweig estimate (7) using two-stage least squares; exclusion restrictions are necessary to identify and consistently estimate the model.

How does the Boulier-Rosenzweig method compare to the Kiefer-Neumann approach? In place of equation (7a), the Kiefer-Neumann results provide estimates of the distribution of A. (Note that the Kiefer-Neumann method could easily accomodate censored observations.) As for equation (7b), an ordinary least squares regression of husband's characteristics on the woman's age at marriage and other covariates estimates

$$E[\varepsilon_{o,a} | \varepsilon_{o,a} > \varepsilon_{r,a}] = X'\beta_o + D_e'\gamma_o + g_o(a) + E[u_{o,a} \mid \varepsilon_{o,a} > \varepsilon_{r,a}]$$

or

$$E[\varepsilon_{o,a} \mid \varepsilon_{o,a} > \varepsilon_{r,a}] = X'\beta_a + D_e'\gamma_o + g_o(a) + E[u_{o,a} \mid u_{o,a} - u_{r,a} > z_a]$$

where

$$z_a = - \{X'(\beta_o - \beta_r) + D_e'(\gamma_o - \gamma_r) + g_o(a) - g_r(a)\}$$

Clearly the conditional expectation of the error term $u_{o,a}$ is non-zero (see Appendix B for an explicit expression) and the right hand side variables in the offer function $(X, D_e, g_o(a))$ will be correlated with $u_{o,a}$. That correlation invalidates least-squares estimation of the offer function. We emphasize that, in general, <u>all</u> of the right-hand-side variables of the offer equation are correlated with the disturbance term, not just age at marriage. Two-stage least squares estimates of the offer function therefore requires more exclusion restrictions than at first meet the eye. The Kiefer-Neumann procedure corrects estimates of the offer function to account for correlation, but does so by substituting assumptions about the nature of the unobservables for exclusion restrictions.

Part IV. Results

As mentioned in the introduction, we analyze World Fertility Survey data for Korea, Malaysia, and Indonesia. Table 1 presents summary statistics, organized by five-year birth cohorts, for the variables used in the analyses. The WFS data are limited; they contain no usable information on female employment or residence before marriage or on age at menarche. Thus, direct tests for the sources of non-stationarity reviewed in Part II are not possible. Neither is it feasible, for this study, to include information from cohorts younger than 30 at the time of the survey. To be included in the WFS individual records, a woman must have been ever-married at the time of survey. Women younger than thirty included in the WFS are therefore quite unrepresentative of all younger women.[8]

The Kiefer-Neumann estimates are presented in Tables 2 through 4, along with ordinary least squares estimates of the offer function for comparison. The reader should recall that the variables being modeled are reservation and offer levels for a transform of male schooling, the transform being given by log(e+1), where e is husband's years of schooling. The results presented here include cubic terms in age in the reservation equation but only squared terms in the offer equation (cubic terms were insignificant).

Let us first consider the results in qualitative terms. By comparing coefficient estimates for a given covariate in the offer and reservation equations, one can determine whether (holding other covariates constant) that covariate is associated with delays in marriage. Considering education effects, we see that across countries female schooling has a positive effect on both the offer and reservation equations. The higher the level of schooling, the larger the shift in the two equations. With minor exceptions, female education shifts the reservation equation by larger amounts than it does the offer equation; on net, therefore, greater educational attainment is associated with delays in first marriage.[9]

With respect to other covariates, we see that for Malaysia (Table 2) the Chinese have systematically higher reservation levels than their Malay counterparts; thus, on balance, Chinese tend to marry later. In Indonesia, Balinese reservation levels are significantly higher than for Javanese, with offer levels insignificantly different. This is consistent with later marriage in Bali. Note that the Madurese tend to have lower education offer levels as well as reservation levels; on net, however, the Madurese marry earlier than Javanese. Urban place of birth is a significant covariate in the Korean analyses for cohorts 35-39 and 45-49. For these cohorts, urban birth is associated with higher reservation levels but not higher offer levels.

Figure 2 graphs the offer and reservation functions by age, using the Korean results from cohort 30-34 for illustration. As would be expected, there is a systematic decline in reservation levels with age; the offer function, on the other hand, rises with age at a declining rate. Figure 3 presents estimated marriage probabilities for ages 18, 20, and 25. The shaded areas in the graph represent $\Pr[\varepsilon_{o,a} > \varepsilon_{r,a}]$; as noted in the figure, the estimates fit the sample marriage transition probabilities well.

In qualitative terms, then, the results of Tables 2 through 4 are entirely plausible. The maximum likelihood estimates of the offer function are, in fact, rather similar to the ordinary least squares results. Are the reservation function estimates equally persuasive?

Consider Figure 2 again. The functions graphed there are in terms of log(e+1), where e is years of male schooling. If the estimates are transformed to actual years of schooling, the position of the reservation distribution is sensible in the prime marrying ages, but is absurdly high at ages 14 and 15, in which relatively few marriages occur. What is the source of this difficulty?

The problem is not one of model fit; indeed, it would only be magnified by more flexible parametric forms than the cubic in age used here. The problem lies instead in the logic of the Kiefer-Neumann approach and, in particular, with the assumptions made about marriage eligibility and offer frequency.

Recall that the reservation level $\varepsilon_{r,a}$ is never directly observed. Its distribution is identified primarily by the "cap" on $\varepsilon_{r,a}$ implied when a woman marries a man of (transformed) education $\tilde{\varepsilon}_{o,a}$; that is, by the information that $\varepsilon_{o,a} = \tilde{\varepsilon}_{o,a}$ and $\varepsilon_{r,a} < \varepsilon_{o,a}$. At young ages, where few marriages occur, the cap or constraint $\varepsilon_{r,a} < \tilde{\varepsilon}_{o,a}$ is infrequently imposed. Now, if it were indeed the case that women are 'eligible' for marriage in each period, and that one offer is always available for consideration each period, then implication that $\varepsilon_{r,s} > \varepsilon_{o,s}$ whenever period s passes without a marriage would be valid. At young ages, however, women may simply be out of the market or, equivalently, offer frequencies may be very low.

In sum, the reservation distribution in the Kiefer-Neumann approach is simply made to perform too many roles; it must shift to reflect changes in eligibility and offer frequency as well as reservation levels given an offer. Thus, at young ages, where the Kiefer-Neumann restrictions are least realistic, the reservation distribution estimates largely reflect the high proportions of women ineligible or not receiving offers rather than reservation thresholds with respect to spouse's eduction.

The point is confirmed by the Flinn-Heckman diagnostic results, presented in Table 5. For each distinct combination of covariates, including age at marriage, the sample minimum of husband's education (transformed) has been extracted. The descriptive regressions in Table 5 trace out the associations between the covariates and the (within-cell) sample minimum. A consistent result from the Kiefer-Neumann models is that the reservation function declines with age. That result is not supported in Table 5. There is little systematic association between the within-cell sample minimum for husband's schooling and wife's age at marriage. Note, in contrast, that the effect of education on the reservation level is confirmed in the Flinn-Heckmann findings.

Part V. Conclusions

We began by asking whether search theory and its econometric implementation can provide richer insights into first marriage than can the separate literatures on age at marriage and assortative mating. Search theory is, in effect, a theory of assortative mating in which uncertainty and the time and resource costs of identifying potential marriage partners are explicitly recognized. Its contribution is to demonstrate that observed matches -- the characteristics of which are data for the static theory of assortative mating (Schirm, 1986) -- must lie in a reservation set and that the definition of the reservation set may change with the searcher's age, perception of marrige market conditions, and other covariates. Tests of assortative mating that ignore the possibility of changes in the reservation set are likely to confuse individual constraints on search with individual preferences regarding spouse characteristics. At least in principle, then, search theory is likely to make its most valuable contribution when reservation sets vary systematically with length of search and changes in market conditions.

Unfortunately, as the preceding section makes clear, we are not likely to make much progress in estimating marital reservation levels (or their multiple-characteristic counterparts, reservation sets) in the absence of data on eligibility and offer frequency. The Kiefer-Neumann results suggest rather strongly that reservation levels for spouse schooling fall with the age of a single woman but, despite its apparent strength, the finding does not stand up under diagnostic checking. Yet marriage transition probabilities certainly do rise with age; either marriage searchers make their compromises with respect to characteristics other than a spouse's education or else there are strong age patterns of offer frequencey and marriage eligibility which produce the result. We cannot distinguish among these possibilities without data on eligibility and offers. Our view is that the collection of such data should be given high priority.

Appendix A

Results from the Theoretical Search Model

Expression (1) in the text can be rewritten as (A.1):

$$\max_{e,\varepsilon_r} V(e,\varepsilon_r) = -\frac{c(e)}{1 - D + q(e)D(1-F(\varepsilon_r;e))} + \frac{q(e)\,D\int_{\varepsilon_r} \varepsilon\, dF(\varepsilon;e)}{(1-D)(1-D+q(e)D(1-F(\varepsilon_r;e))} \quad (A.1)$$

Holding e constant, differentiating (A.1) with respect to ε_r and simplifying yields the familiar first-order condition (A.2):

$$c = \frac{qD}{1-D} \int_{\varepsilon_r} (\varepsilon-\varepsilon_r)dF - \varepsilon_r \quad (A.2)$$

Expression (A.2) implicitly defines the reservation level ε_r. We seek to determine the partial derivatives of $\varepsilon_r = \varepsilon_r^*(c,q,e)$. Straightforward differentiation establishes:

$$\frac{\partial\varepsilon_r}{\partial c} = -\frac{1-D}{1-D + qD(1-F)} < 0 , \quad (A.3)$$

$$\frac{\partial\varepsilon_r}{\partial q} = \frac{D\int_{\varepsilon_r} (\varepsilon-\varepsilon_r)dF}{1-D + qD(1-F)} > 0 , \quad (A.4)$$

and

$$\frac{\partial\varepsilon_r}{\partial e} = \frac{qD(1-F)}{1-D + qD(1-F)} > 0 , \quad (A.5)$$

Note from (A.5) that a unit shift in the location of the offer distribution induces a positive but smaller response in the reservation level. Thus (holding q constant) a rightward shift in the offer distribution increases the exit rate q(1-F) on net, at the same time that it increases the reservation level ε_r.

Similar results with respect to changes in the offer frequency q are more difficult to establish. Flinn and Heckman (1983) show that the net change in the exit rate when q changes depends on the form of the offer distribution F. They prove conditions on F under which an increase in offer frequency leads to a net increase in the exit rate.

In the text it is stated that the impact of an increase in daughter's education on age at marriage is ambiguous. Expressions (A.3) to (A.5), together with the assumptions $c'(e)>0$ and $q'(e)<0$, show that when e changes, the net effect on ε_r is less positive than if c and q were held constant. Thus the full impact of a change in e is to increase $1-F(\varepsilon_r;e)$. However, with $q'<0$, the impact on the exit rate q(1-F) is uncertain.

Appendix B

The Kiefer-Neumann Procedure

The Kiefer-Neumann model is a straightforward adaptation of the selectivity bias models developed by James Heckman to search problems. As a detailed discussion of the Heckman models can be found in the textbook by Maddala (1983), only essential concepts are covered in what follows.

Equations (5) and (6) in the text are reproduced here as equations B.1 and B.2.

$$\varepsilon_{r,a} = z_{r,a} + u_{r,a} \tag{B.1}$$

$$\varepsilon_{o,a} = z_{o,a} + u_{o,a} \tag{B.2}$$

where $z_{r,a} = X'\beta_r + D_e'\gamma_r + g_r(a)$

$$z_{o,a} = X'\beta_o + D_e'\gamma_o + g_o(a).$$

The disturbance terms $(u_{r,a}, u_{o,a})$ are assumed joint normal $(0, \Sigma)$ and independent across age. By assumption, one marital offer is considered in each period.

The probability that a woman, single at exact age a, does not marry before exact age a + 1 is

$$\Pr[\varepsilon_{o,a} < \varepsilon_{r,a}] = \Pr[u_{o,a} - u_{r,a} < -(z_{o,a} - z_{r,a})]$$

or, equivalently,

$$\Pr[\varepsilon_{o,a} < \varepsilon_{r,a}] = \Pr[(u_{o,a}-u_{r,a})/\sigma < -(z_{o,a}-z_{r,a})/\sigma]$$

where $\sigma = [\sigma_{oo} - 2\sigma_{or} + \sigma_{r}]^{\frac{1}{2}}$. Since $(u_{o,a} - u_{r,a})/\sigma$ is standard normal,

$$\Pr[\varepsilon_{o,a} < \varepsilon_{r,a}] = \Phi[-(z_{o,a}-z_{r,a})/\sigma] \qquad (B.3)$$

where Φ is the cumulative distribution function of the standard normal distribution.

As noted in the text, the conditional density associated with marriage in the age interval [a,a+1] to a man with (transformed) years of eduction e is

$$\int_{-\infty}^{e} f_a(e, \varepsilon_r)d\varepsilon_r \qquad (B.4)$$

where $f_a(\varepsilon_o, \varepsilon_r)$ is the joint density for $(\varepsilon_{o,a}, \varepsilon_{r,a})$; these variables are joint normal with means $z_{o,a}$ and $z_{r,a}$ and covariance matrix Σ.

It is useful to factor the joint density $f_a(\varepsilon_o, \varepsilon_r)$ into the marginal density for ε_o and the conditional density for ε_r given ε_o before proceeding. As Maddala (1983:175-176) shows, expression (B.4) may then be written as:

$$\sigma_{oo}^{-1}\phi[(e-z_{o,a})/\sigma_{oo}^{\frac{1}{2}}]\ \Phi\ [W_a] \qquad (B.5)$$

where $W_a = [e-z_{r,a} - \frac{\sigma_{or}}{\sigma_{oo}}(e-z_{o,a})][\sigma_{rr}-\sigma_{or}^2/\sigma_{oo}]^{-1}$

and ϕ is the standard normal density.

Each woman's contribution to the sample likelihood is the product of terms like B.3, one for each period in which marriage does not take place, and a single term B.5 for the period in which marriage does take place. The models were estimated using the DFP algorithm available in the optimization package GQOPT (Goldfeld and Quandt, 1972).

As Maddala notes, model identification requires either (i) $\sigma_{12} = 0$ or (ii) that at least one covariate in the offer equation be excluded from the reservation equation. For the problem at hand, exclusion restrictions cannot be justified. Thus, the identifying assumption used in estimation is $\sigma_{12} = 0$. An alternative strategy would have been to permit $\sigma_{12} \neq 0$ and to estimate the reservation function "up to a scale factor". However, as discussed at length in the text, information about the scale of the reservation function -- and not just its qualitative properties -- is important to a critical asessment of the Kiefer-Neumann model. We prefer to estimate an identified model in which the scale of the reservation function is evident rather than an under-identified model in which it is hidden.

Finally, we note in connection with ordinary least squares estimation of the offer function that

$$E[\varepsilon_{o,a} \mid \varepsilon_{o,a} > \varepsilon_{r,a}] = z_{o,a} + E[u_{o,a} | u_{o,a} - u_{r,a} > -(z_{o,a} - z_{r,a})]$$

where the conditional expectation of the disturbance term $u_{o,a}$ is:

$$E[u_{o,a} | u_{o,a} - u_{r,a} > -(z_{o,a} - z_{r,a})] =$$

$$\frac{\sigma_{oo} - \sigma_{or}}{\sigma} \frac{\phi[z]}{1 - \Phi[z]} \tag{B.6}$$

with $z = -(z_{o,a} - z_{r,a})/\sigma$. Since $z_{o,a}$ affects the expected value of the $u_{o,a}$ disturbance term, ordinary least squares estimation of the offer equation mean yields coefficient estimates that are inconsistent.

Footnotes

1. The unit shift in the F distribution produced by an increase of one unit in female eduction involves two assumptions. The first is a choice of units in which schooling and utility are measured; the second, that the extent of the shift is independent of the level of female education. The first of these assumptions is innocuous; the second is a simplifying restriction.

2. Note that offer frequency is assumed independent of the offer distribution F.

3. If $q'>o$, on the other hand, the simple search model would predict that better-educated daughters would marry earlier (so long as $d\varepsilon_r^*/de < 1$). Thus, the simple search model is broadly consistent with the data only if (1) $q'<o$, $d\varepsilon^*_r/de<1$ or if (2) $q'>o$, $d\varepsilon_r^*/de>1$.

4. That is, if all marriage search begins at daughter's exact age a_o, then $A-a_o$ is geometrically distributed, where A is age at marriage.

5. See Flinn and Heckman (1983) for conditions under which the net impact of a fall in q is to increase search duration.

6. Flinn and Heckman (1983) consider exogenous layoff risks in job search models in making this point.

7. The logic of the Flinn-Heckman approach is clearest if we think of $\varepsilon_{r,a}$ as non-stochastic given observed covariates.

8. A statistical correction for sample truncation is available (see Maddala, 1983: 175-177), but its implementation is beyond the scope of the paper.

9. Note that one common-sense explanation for the delaying effect of education on marriage focuses on the woman's time constraint. As the argument goes, both schooling and marriage are time-intensive activities; thus, women enrolled in school will tend to postpone marriage until schooling is complete. For the sample of developing countries considered here, the explanation is simply not tenable: schooling attainment is not high enough to produce a direct conflict between schooling and marriage. The only exception would be the youngest cohort of Korean women.

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Table 1

Sample Means for Variables Used in the Analyses

	Women 30-34	Women 35-39	Women 40-44	Women 45-49
Malaysia				
Age at Marriage	19.49	18.99	18.70	18.27
Husband's Schooling	5.46	4.97	4.42	4.30
Proportion of Women with:				
Some primary schooling	.38	.40	.32	.31
Completed Primary	.17	.12	.08	.06
Secondary or Higher	.13	.09	.06	.06
Town Birth	.28	.29	.33	.32
Estate Birth	.07	.08	.06	.06
Chinese a/	.46	.39	.47	.50
Indian	.09	.10	.12	.10
Sample Size	973	808	592	460
Indonesia				
Age at Marriage	17.87	17.54	17.27	17.49
Husband's Schooling	5.14	4.12	3.59	3.15
Proportion of Women with:				
Some Primary	.18	.12	.12	.09
Completed Primary	.13	.06	.07	.05
Secondary or Higher	.14	.13	.08	.05
Town Birth	.69	.70	.71	.69
City Birth	.10	.10	.11	.11
Indonesian b/	.12	.12	.10	.12
Sundanese	.14	.13	.13	.09
Madurese	.03	.04	.03	.07
Balinese	.17	.17	.09	.09
Sample Size	946	882	714	514
Korea				
Age at Marriage	21.44	20.02	18.48	17.12
Husband's Schooling	9.25	8.21	6.96	5.64
Proportion of Women with:				
Some Primary	.10	.16	.17	.10
Completed Primary	.43	.38	.34	.28
Secondary	.19	.13	.09	.07
Higher	.15	.08	.06	.04
Town Birth	.07	.07	.09	.07
City Birth	.21	.15	.15	.12
Sample Size	1,040	970	784	589

Notes: a/ Omitted category: Malays
b/ Omitted category: Javanese. Note that the category "Indonesian" includes those who speak the "Indonesian" language.

Table 2

Kiefer-Neumann Estimates for Malaysia
Asymptotic t-statistics in parentheses.

	Women 30-34			Women 35-39			Women 40-44			Women 45-49		
	OLS	Offer	Reservation	OLS	Offer	Reservation	OLS	Offer	Reservation	OLS	Offer	Reservation
Constant	1.088	.579	2.588	1.150	.722	2.759	1.161	.619	3.432	1.044	.587	2.963
(t)	(15.70)	(5.71)	(13.12)	(16.51)	(6.95)	(9.74)	(11.83)	(4.56)	(9.25)	(10.10)	(2.97)	(4.42)
Age[a]	.059	.083	-.297	.044	.060	-.341	-.000	.044	-.771	-.034	-.012	-.392
	(2.78)	(3.72)	(8.30)	(2.04)	(2.65)	(6.93)	(.01)	(1.38)	(9.44)	(.98)	(.32)	(3.94)
Age, squared	$-.352 \times 10^{-2}$	$-.309 \times 10^{-2}$	$.331 \times 10^{-1}$	$-.213 \times 10^{-2}$	$-.173 \times 10^{-2}$	$.413 \times 10^{-1}$	$.10 \times 10^{-2}$	$-.055 \times 10^{-2}$	$.919 \times 10^{-1}$	$.349 \times 10^{-2}$	$.338 \times 10^{-2}$	$.363 \times 10^{-1}$
	(2.63)	(2.18)	(12.37)	(1.55)	(1.25)	(12.26)	(.35)	(.27)	(13.16)	(1.40)	(1.33)	(4.06)
Age, cubed			$-.174 \times 10^{-2}$			$-.203 \times 10^{-2}$			$-.376 \times 10^{-2}$			$-.149 \times 10^{-2}$
			(44.19)			(43.07)			(12.99)			(5.11)
Some Primary	.353	.320	.524	.326	.301	.509	.444	.422	.542	.450	.461	.426
Schooling	(7.43)	(6.43)	(7.77)	(6.54)	(5.97)	(4.58)	(6.92)	(5.60)	(4.08)	(5.82)	(5.69)	(2.37)
Completed	.535	.453	.954	.523	.452	.949	.754	.683	1.152	.893	.865	1.210
Primary	(8.81)	(7.05)	(10.37)	(7.14)	(5.88)	(6.97)	(6.73)	(5.72)	(6.11)	(6.21)	(5.78)	(3.44)
Secondary or	.956	.793	1.772	.940	.814	1.815	1.107	.941	1.980	.939	.853	1.827
Higher	(12.96)	(9.98)	(14.23)	(10.41)	(8.32)	(5.53)	(8.38)	(6.92)	(7.66)	(6.13)	(5.22)	(4.91)
Town Birth	.105	.125	.014	.191	.185	.184	.117	.092	.238	.083	.069	.121
	(2.04)	(2.35)	(.20)	(3.54)	(3.27)	(1.65)	(1.72)	(1.34)	(2.17)	(1.00)	(.79)	(.66)
Estate Birth	-.106	-.078	-.261	.179	.120	.043	.085	.134	-.098	-.085	-.114	-.058
	(1.20)	(.83)	(2.01)	(1.91)	(1.44)	(.080)	(.66)	(1.01)	(.42)	(.55)	(.61)	(.19)
Chinese	.053	-.056	.606	-.131	-.230	.539	-.076	-.198	.688	.220	.165	.683
	(1.12)	(1.08)	(7.16)	(2.45)	(3.34)	(2.45)	(1.11)	(2.43)	(4.27)	(2.76)	(1.99)	(3.93)
Indian	.055	.045	.135	-.112	-.083	-.224	-.131	-.154	.005	.210	.178	.643
	(.67)	(.52)	(1.17)	(1.27)	(.66)	(.39)	(1.24)	(1.20)	(.03)	(1.60)	(1.28)	(2.54)
q_{ii}		.442	1.618		.434	2.059		.541	2.359		.563	3.332
log-likelihood		-2448.7			-2023.0			-1497.1			-1192.2	
R^2 for regression:	.25			.22			.21			.22		

Note: a/ The "age" variable takes the value "1" for age 14, "2" for age 15, and so on.

Table 3
Kiefer-Neumann Estimates
for Indonesia. Asymptotic t-statistics in parentheses

	Women 30-34			Women 35-39			Women 40-44			Women 45-49		
	OLS	Offer	Reservation	OLS	Offer	Reservation	OLS	Offer	Reservation	OLS	Offer	Reservation
Constant	.864	.091	3.837	1.056	.194	3.408	1.192	.538	5.241	.985	.223	4.201
(t)	(7.96)	(.43)	(4.97)	(9.60)	(.67)	(4.20)	(9.19)	(2.89)	(6.84)	(6.54)	(.73)	(3.63)
Age[a]	.055	.107	-.521	.006	.067	-.448	-.029	.019	-.885	-.007	.037	-.684
	(2.30)	(3.88)	(4.51)	(.21)	(1.96)	(4.52)	(.98)	(.59)	(4.28)	(.19)	(1.02)	(3.85)
Age, squared	$-.209\times10^{-2}$	$-.346\times10^{-2}$	$.468\times10^{-1}$	$-.051\times10^{-2}$	$-.196\times10^{-2}$	$.349\times10^{-1}$	$.261\times10^{-2}$	$.120\times10^{-2}$	$.830\times10^{-1}$	$.199\times10^{-2}$	$.118\times10^{-2}$	$.732\times10^{-1}$
	(1.51)	(2.32)	(5.43)	(.32)	(1.15)	(8.27)	(1.49)	(.63)	(3.27)	(.94)	(.56)	(4.31)
Age, cubed			$-.163\times10^{-2}$			$-.122\times10^{-2}$			$-.276\times10^{-2}$			$-.282\times10^{-2}$
			(5.85)			(28.67)			(2.77)			(4.24)
Some Primary	.543	.580	.382	.487	.478	.537	.464	.457	.520	.283	.298	.214
Schooling	(8.19)	(8.44)	(3.44)	(5.81)	(5.62)	(4.16)	(4.96)	(4.71)	(4.34)	(2.23)	(2.29)	(1.10)
Completed	.981	.954	1.166	.986	.871	1.524	.986	.943	1.367	1.120	.998	1.929
Primary	(12.68)	(12.06)	(9.89)	(8.62)	(7.26)	(6.90)	(8.26)	(7.36)	(8.34)	(6.71)	(5.74)	(5.45)
Secondary or	1.332	1.193	2.084	1.482	1.249	2.485	1.307	1.132	2.715	1.272	1.154	2.085
Higher	(15.45)	(13.40)	(10.88)	(15.44)	(10.54)	(7.42)	(10.14)	(8.45)	(11.19)	(7.05)	(6.13)	(5.71)
Town Birth	-.223	-.204	-.301	-.238	-.238	-.266	-.428	-.416	-.544	-.436	-.412	-.562
	(3.42)	(3.05)	(2.95)	(3.32)	(3.25)	(2.48)	(5.16)	(4.83)	(5.00)	(4.46)	(4.21)	(3.71)
City Birth	.240	.212	.442	.036	.040	.000	.089	.111	-.114	.334	.356	.218
	(2.47)	(2.09)	(2.82)	(.35)	(.39)	(.01)	(.77)	(.91)	(.75)	(2.46)	(2.61)	(1.04)
Indonesian	.025	.022	.031	-.049	-.033	-.135	.207	.248	-.102	.053	.003	.404
	(.31)	(.26)	(.26)	(.54)	(.35)	(.95)	(1.91)	(2.16)	(.70)	(.45)	(.02)	(1.84)
Sundanese	.019	.052	-.140	.014	.124	-.473	-.054	.026	-.736	.197	.297	-.436
	(.25)	(.69)	(1.22)	(.16)	(1.40)	(2.72)	(.59)	(.26)	(4.85)	(1.52)	(2.15)	(1.54)
Madurese	-.385	-.357	-.597	-.446	-.372	-.733	-.380	-.300	-1.005	-.359	-.297	-.698
	(2.59)	(2.30)	(2.51)	(3.19)	(2.54)	(3.01)	(2.28)	(1.66)	(4.28)	(2.53)	(2.02)	(2.89)
Balinese	.064	-.001	.436	.014	-.122	.591	.027	-.073	.811	-.029	-.139	.614
	(.91)	(.02)	(3.26)	(.19)	(1.38)	(2.86)	(.25)	(.63)	(4.76)	(.22)	(1.00)	(2.20)
σ_{ii}		.649	2.636		.725	2.262		.686	4.243		.733	3.220
log-likelihood		-2636.8			-2430.7			-1971.2			-1454.3	
R^2 for regressions:				.38			.35			.36		

Note: a/ The "age" variable takes the value "1" for age 12.

Table 4.
Kiefer-Neumann Estimates for Korea
Asymptotic t-statistics in parentheses

	Women 30-34			Women 35-39			Women 40-44			Women 45-49		
	OLS	Offer	Reservation	OLS	Offer	Reservation	OLS	Offer	Reservation	OLS	Offer	Reservation
Constant	1.220	.539	3.896	.717	-.194	3.293	.626	-.024	3.456	.487	.037	5.539
(t)	(11.38)	(3.80)	(16.53)	(6.50)	(1.25)	(13.12)	(6.18)	(.15)	(7.10)	(4.19)	(.22)	(3.52)
Age[a/]	.059	.130	-.534	.156	.276	-.486	.169	.245	-.648	.137	.212	-2.269
	(2.36)	(4.57)	(9.51)	(5.20)	(8.23)	(7.92)	(4.83)	(6.64)	(5.18)	(2.82)	(3.98)	(3.04)
Age, squared	$-.230\times10^{-2}$	$-.415\times10^{-2}$	$.428\times10^{-1}$	$-.777\times10^{-2}$	$-.125\times10^{-1}$	$.389\times10^{-1}$	$-.844\times10^{-2}$	$-.111\times10^{-1}$	$.709\times10^{-1}$	$-.422\times10^{-2}$	$-.814\times10^{-2}$	.332
	(1.65)	(2.65)	(8.68)	(4.16)	(6.19)	(6.09)	(3.21)	(4.01)	(4.41)	(1.02)	(1.82)	(2.96)
Age, cubed			$-.160\times10^{-2}$			$-.142\times10^{-2}$			$-.329\times10^{-2}$			$-.157\times10^{-1}$
			(10.81)			(5.70)			(4.34)			(2.83)
Some Primary	.330	.320	.426	.559	.548	.674	.568	.517	.852	.701	.681	1.065
Schooling	(5.18)	(4.70)	(4.07)	(9.03)	(8.48)	(7.51)	(7.58)	(6.76)	(7.52)	(6.216)	(5.85)	(4.72)
Completed	.654	.580	1.087	.812	.715	1.311	.885	.804	1.415	1.080	1.014	2.077
Primary	(13.42)	(10.59)	(14.27)	(15.77)	(12.86)	(16.71)	(13.69)	(12.09)	(13.23)	(13.48)	(12.45)	(7.42)
Secondary	.996	.874	1.678	1.059	.922	1.751	1.241	1.111	2.087	1.292	1.154	3.074
	(17.24)	(13.60)	(17.98)	(14.96)	(12.16)	(16.26)	(12.09)	(10.41)	(11.37)	(9.08)	(7.90)	(5.90)
Higher	1.223	1.049	2.189	1.254	1.036	2.185	1.341	1.133	2.923	1.211	1.038	3.666
	(18.19)	(14.30)	(19.65)	(14.27)	(11.11)	(16.35)	(10.15)	(7.98)	(10.14)	(6.43)	(5.22)	(3.07)
Town Birth	-.144	-.148	-.077	.017	.011	.039	-.098	-.120	.104	.180	.121	.975
	(2.38)	(1.83)	(.88)	(.22)	(.13)	(.35)	(1.03)	(1.21)	(.74)	(1.42)	(.94)	(3.03)
City Birth	-.062	-.085	.070	.099	.038	.360	-.096	-.140	.121	.133	.087	.705
	(1.43)	(1.86)	(1.09)	(1.64)	(.59)	(4.32)	(1.23)	(1.73)	(1.03)	(1.22)	(.77)	(3.07)
σ_{ii}		.279	1.023		.430	1.252		.574	2.718		.643	6.316
log - likelihood		-2238.7			-2203.4			-1901.2			-1319.2	
R^2 for regression:	.39			.40			.38			.43		

Note: a/ The "age" variable takes the value "1" for age 14.

Table 5

Flinn-Heckman Estimates of the Reservation Function. Dependent Variable is log(husband's ed + 1).

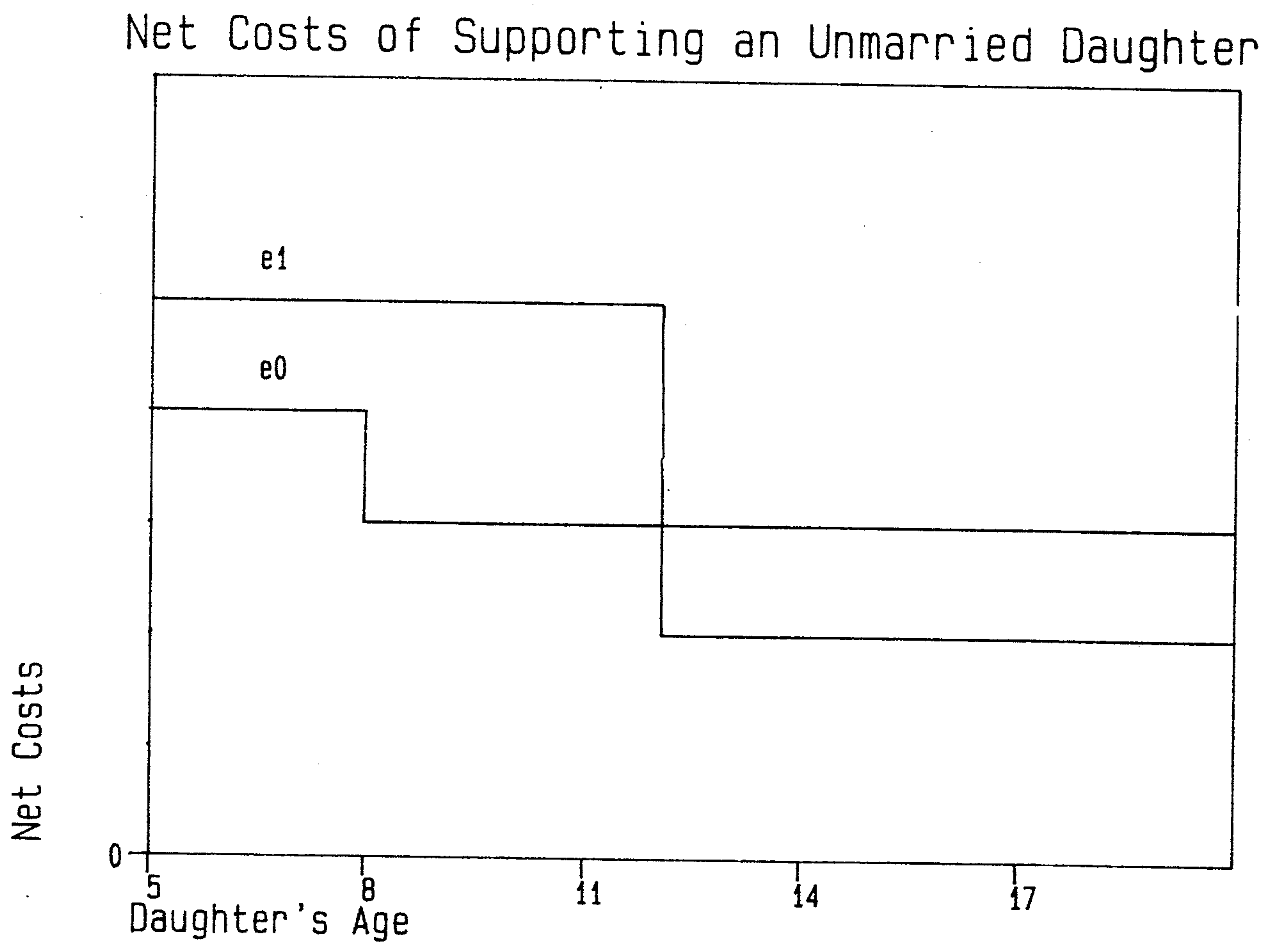
Asymptotic t-statistics in parentheses

	Malaysia		Indonesia		Korea
Constant	.412		.542		.121
(t)	(4.27)		(5.34)		(.84)
Age at	.042		-.095		.085
Survey 35-39	(.70)		(1.65)		(1.08)
Age at	.075		-.004		-.020
Survey 40-44	(1.19)		(.06)		(.24)
Age at	.097		-.004		.217
Survey 45-49	(1.43)		(.05)		(2.43)
Age[a] at	.024	Age[b] at	.008	Age[a] at	.065
Marriage	(1.10)	Marriage	(.39)	Marriage	(2.02)
Age at	$.444 \times 10^{-3}$	Age at	$.928 \times 10^{-3}$	Age at	$-.395 \times 10^{-3}$
Marriage, Squared	(.33)	Marriage, Squared	(.83)	Marriage, Squared	(.20)
Some Primary	.367		.710	Some Primary	.514
Schooling	(6.36)		(11.67)	Schooling	(5.14)
Completed Primary	.896		1.303	Completed	.814
	(13.44)		(19.86)	Primary	(8.89)
Secondary or	1.222		1.631	Secondary	1.394
higher	(16.87)		(25.02)		(14.59)
				Higher	1.562
					(15.56)
Town Birth	.344	Town Birth	-.385	Town Birth	.382
	(6.77)		(7.23)		(5.04)
Estate Birth	.380	City Birth	.254	City Birth	.375
	(5.12)		(4.09)		(5.46)
Chinese	-.049	Indonesia	.256		
	(.90)		(4.32)		
Indian	.123	Sundanese	.146		
	(1.82)		(2.37)		
		Madurese	.002		
			(.02)		
		Balinese	.086		
			(1.14)		
R^2	.39		.57		.53
Sample Size	874		1035		530

Notes: a/ The "age" variable takes the value "1" for age 14.

b/ The "age" variable takes the value "1" for age 12.

Figure One



Net Costs of Supporting an Unmarried Daughter
e1
e0
Net Costs
0
5
8
11
14
17
Daughter's Age

Figure Two

Women age 30-34 at survey
Omitted Category estimates used in calculations.

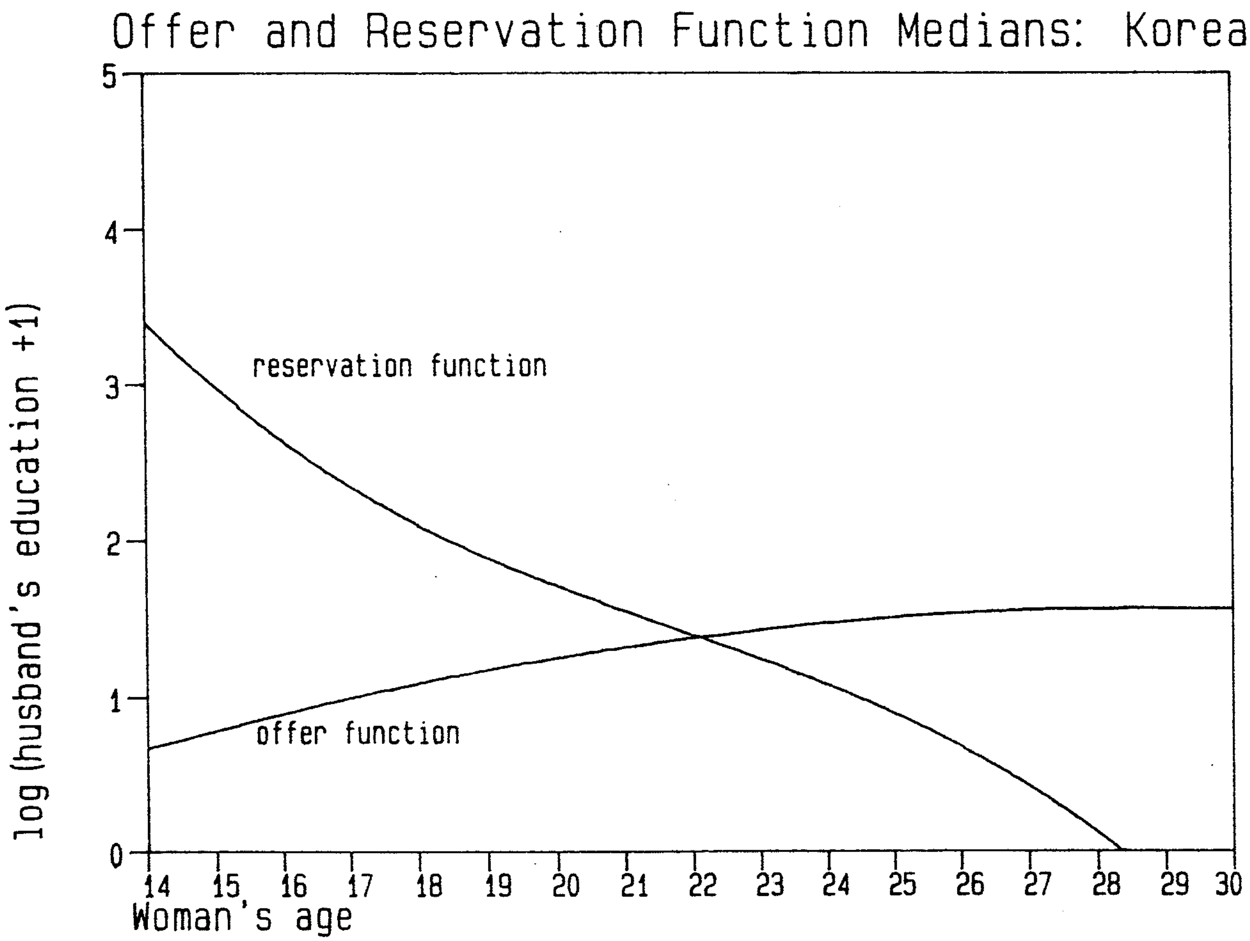


Figure Three. Estimated Marriage Transition Probabilities for Korea. Cohort of women 30-34. Omitted category estimates used in calculations.