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MATCHING ACROSS MARKETS: AN ECONOMIC ANALYSIS OF CROSS-BORDER MARRIAGE *

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Abstract

Severe gender imbalances coupled with the stark income differences across countries are driving an increase in cross-border marriages in many Asian countries. This paper theoretically and empirically studies who marries whom, including how cross-border couples are selected, and how marital surplus is allocated within couples in the marriage markets of Taiwan (a wealthier side with male-biased sex ratios) and Vietnam (a poorer side with balanced sex ratios). Among the cross-border marriages that are predominantly made up of Taiwanese men and Vietnamese women, I find that Taiwanese men are selected from the middle level of the socioeconomic status distribution, and Vietnamese women are positively selected for cross-border marriages. Moreover, I show that changes in costs of cross-border marriage, incurred by immigration-policy changes and proliferation of matching services, also affect the welfare of Taiwanese and Vietnamese who do not participate in cross-border marriages by altering marriage rates, matching partners, and intra-household allocations.

JEL classifications: C78, D10, D13, J11, J12, J18, F22

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1 Introduction

Marriage markets in many Asian countries, including China and India, the two most populous countries in the world, have a vast excess supply of men. For example, 120 and 111 boys were born per every 100 girls in China in 2000 (Almond et al. [2019]) and in India in 2006-2008 (Anukriti [2018]), respectively. With the sex ratios at birth having been above the natural ratios for decades, it is estimated that men outnumber women by more than 50 million in these two countries alone (Zhu et al. [2009]; Anderson and Ray [2012]). This phenomenon of excess men in the marriage market is not limited to these two countries. It is prevalent across East Asia. These striking demographic imbalances suggest that the demand for brides from other countries and the market for cross-border marriage will expand significantly in the near future.

As a consequence of these severe gender imbalances in the marriage market, along with the stark income differences across countries, several wealthy countries in Asia, including South Korea, Taiwan, and Singapore, began to import brides from less wealthy countries, such as China and Vietnam, in the late 1990s. In more recent years, China has also imported brides from Vietnam. According to the International Organization for Migration [2015], cross-border marriages account for 10-39% of all marriages in South Korea, Taiwan, and Singapore. Despite its volume and growing importance, the burgeoning cross-border marriage market has received relatively little attention in the literature. Only a small number of studies have focused on the causes and consequences of cross-border marriage for the bride (migrant)-receiving side, rarely focusing on how cross-border couples are selected or on any consequences for the bride (migrant)-sending side.¹

In this paper, I comprehensively analyze the impacts of cross-border marriages on marriage markets for both sending and receiving countries. Cross-border marriage can have important implications for both sides of marriage markets. The influx and outflux of women alter the relative supply of men and women in the marriage markets (i.e., sex ratios among marriageable-aged men and women). Moreover, because cross-border couples are generally self-selected, the changes in sex ratios may not be uniform across socioeconomic classes, thus changing the distributions of available men and women. These changes in marriage market conditions can affect not only matching patterns, but also how the gains from marriage are shared between spouses because the split of the marital gains is affected

¹For the causes and consequences for the bride-receiving side, see Edlund et al. [2013], Kawaguchi and Lee [2017], and Weiss et al. [2017]. Adda et al. [2019] studies intermarriages between natives and immigrants in the Italian context.

by the outside options available in the marriage markets. The welfare of *all* men and women in the marriage markets can change through these equilibrium effects.

I theoretically and empirically find that the flow of cross-border marriages significantly affects matching patterns and the division of gains from marriage on both sides of the marriage markets. Using a two-country matching model under transferable utility (TU), in line with the seminal contribution of Becker [1973], I derive predictions on the selection of cross-border couples, matching patterns, and intra-household surplus allocations given the cost of a cross-border marriage. I show that the equilibrium matching in the cross-country context, given the existence of cross-border marriage costs, is not fully assortative with respect to socioeconomic status (SES), unlike the unidimensional matching in the single-country case. I then empirically show that the cross-sectional patterns of the selection of cross-border couples are consistent with the model's predictions in the context of Taiwan and Vietnam, two closely interacting marriage markets. Furthermore, I exploit two events that changed the costs and therefore the number of cross-border marriages to evaluate their impacts: the rapid emergence of matchmaking firms in the late 1990s and the visa-tightening policy instituted by Taiwan in 2004. The first event reduced and the second increased the costs of cross-border marriages. Using these events, I show that the distribution of resources within couples is significantly affected by the magnitude of cross-border marriages, not only for men and women who marry cross-nationally but also for people who remain in their own countries without marrying cross-nationally.

Several features of Taiwan and Vietnam make them particularly suitable and interesting for studying this topic. The surge in cross-border marriages was a sudden and striking phenomenon; the total number in Taiwan increased from a few thousand in the early 1990s to more than 50,000 at the peak in the early 2000s, at which point they represented nearly 30% of all marriages in Taiwan. Vietnam is one of the largest bride-sending countries in Asia, with Taiwan being the major destination country. Although Vietnam is second to mainland China in the number of women who migrated to Taiwan for marriage, the former is more suitable for studying the consequences of cross-border marriages on the sending side because the outflow of women constitutes a meaningful proportion of women of marriageable age in Vietnam. Moreover, there exist interesting layers of exogenous variations, including a strict visa-tightening policy implemented by the Taiwanese government and a geographic concentration of matchmaking firms in Vietnam, which appear to be uncorrelated with other factors in their marriage markets. These provide unique opportunities to identify the impact of cross-border

marriages on marriage markets in both sides.

As a theoretical framework, I build a frictionless TU two-country matching model that captures the key aspects of the marriage markets in Taiwan and Vietnam—two countries with very different income levels, with a severely male-biased sex ratio for the richer side and a balanced sex ratio for the poorer side.² Men and women match on a continuous SES. If the two marriage markets are completely integrated, given the assumed supermodularity of the surplus function, the equilibrium matching is positive assortative: men with higher SES are matched with women with higher SES regardless of nationality. However, in reality, it is difficult to believe that the two markets are completely integrated; there are costs associated with cross-border marriages such as cultural differences, travel costs, and bureaucratic requirements. To make the model more realistic, I introduce the cost of cross-border marriages, making the model essentially bidimensional. Individuals now match on SES *and* nationality. This complicates the model but generates much richer predictions.

From the stable match that I characterize, I find that Taiwanese men in the middle and Vietnamese women at the top of their respective socioeconomic distributions marry cross-nationally. This finding contradicts the naive prediction that the lowest types of Taiwanese men who are unable to find their spouses in Taiwan and the Vietnamese women who lack economic opportunities would seek foreign spouses. The gains from marriage that lower types of Taiwanese men and Vietnamese women can generate are too small to compensate for the costs of a cross-border marriage, meaning that only Taiwanese men and Vietnamese women above certain types engage in cross-border marriages. Moreover, the equilibrium constraints imply that the existence of cross-border marriages affects the intra-household allocation for *all* couples, including those who marry within their own country, favoring Vietnamese women and Taiwanese men. Finally, the model generates powerful comparative static predictions regarding changes in the cost of cross-border marriages; in particular, selection into cross-border marriages tends to be reinforced by an increase in these costs.

I begin my empirical analysis by investigating the cross-sectional patterns of the selection of cross-border couples using individual-level data on more than 240,000 marriage migrants residing in Taiwan. The data are qualitatively consistent with the predictions on the types of cross-border couples. Using education as a proxy for SES, I find that Taiwanese men who marry Vietnamese women tend to have a junior-high- or senior-high-school education rather than a primary-or-less or

²Vietnam has had male-skewed sex ratios at birth since the mid-2000s. However, the sex ratio was rather balanced for cohorts affected by the initial flow of cross-border marriages.

university education, confirming the presence of intermediate selection. The positive selection of Vietnamese women is similarly supported; the probability of a cross-border marriage is the highest for women with a college education.

To evaluate the impacts of changes in the costs of cross-border marriages, I exploit a visa-tightening policy implemented by the Taiwanese government in 2004. This policy increased the costs of cross-border marriages by making it more difficult for foreign brides to pass the visa interview stage. I compare the group who are more likely to be affected with the group who are less likely to be affected before and after the policy change. For example, to test whether the visa-tightening policy affected the marriage rates for men in Taiwan, low-educated men who are more likely to be affected are compared with high-educated men who are unlikely to be affected.

The findings for Taiwan can be summarized as follows. (1) The marriage rates of Taiwanese men with a primary- or junior-high-school education decreased by 25% compared with those of Taiwanese men with a higher education following the implementation of the visa-tightening policy. The marriage rates of Taiwanese women did not change. (2) The Taiwanese women who were more likely to be affected by the visa-tightening policy (i.e., those with a non-university education) married men with an average of 0.2 more years of education after the policy's implementation. (3) The average SES of the brides and grooms involved in cross-border marriages, as measured by education, rose significantly after the policy change.

Regarding the predictions on intra-household allocations, it is difficult to test them in the Taiwanese setting because the event affected all men and women in the country, making it difficult to find a natural control group. To test the predictions on intra-household allocations and understand the impacts on the bride-sending side, I use a unique feature of the Vietnamese setting: the geographic concentration of matchmaking firms in several provinces. Given the low inter-provincial marriage rates in Vietnam during the study period, I consider the provinces in which matchmaking firms are located as a market separate from the rest of the country.³ This approach is acceptable insofar as the provincial location of these firms is not endogenously selected. I show that the provincial selection of the matchmaking firms was driven by a feature that is unlikely to be correlated with female status: namely, the existence of Chinese (Hoa) populations in specific provinces. Brokerage firms were run

³Of course, it is possible that the cost changes in some provinces may affect inter-provincial marriages. I check the inter-provincial marriage rates and find no meaningful changes in the short run, which supports my assumption of two separate markets in Vietnam.

by ethnic Chinese not only because they were able to translate Vietnamese into Chinese and vice versa but also because they were more trusted by Taiwanese spouses-to-be. Thus, the distribution of brides of Taiwanese men was highly correlated with Hoa populations, but the share of Hoa populations in the provinces with positive numbers of brides to Taiwan (except for Ho Chi Minh city) was just 0.8%, which means that a large influence of Hoa on the local marriage market other than cross-border marriages was unlikely. Moreover, other observable characteristics, such as income, do not have explanatory power for the patterns of the matchmaking firms' geographic distribution, suggesting that these geographic variations are arguably exogenous. I also use the sudden increase in cross-border marriages during the late 1990s as time variation, which was unlikely to be fully expected from Vietnam.⁴

In order to measure the power of wives in the household, I analyze the spending on female exclusive goods relative to male exclusive goods, a strategy that has been extensively used in the collective model literature (e.g., Browning et al. [1994]; Calvi [2020]). Using a double difference approach, I find that the “power” of the wives within Vietnamese households consisting of only Vietnamese increased after the surge in cross-border marriages in the affected areas. From the structural estimates, I find that the share of wives increased by 106,000 VND (approximately 4.5 USD) with a 1-percentage-point increase in the outflow of women (among marriageable-aged women), which amounts to 3% of the average total private expenditures of married couples.⁵ On average, 5% of females in a marriage cohort out-migrated in the affected areas, suggesting that the results are not entirely driven by out-migrant families; indeed, the effect remains unchanged when the latter are excluded from the sample. It thus appears that the impacts were transmitted to couples who remained in Vietnam via equilibrium forces.

This paper makes several contributions. First, I contribute to the literature on the impacts of marriage market conditions on marital outcomes and household behavior. Most of the existing literature has focused on marriage markets in one country (e.g., Abramitzky et al. [2011]; Angrist [2002]; Charles and Luoh [2010]; Chiappori et al. [2002]). This paper shows that sex ratio imbalances in one country can spread to neighboring marriage markets by affecting marital outcomes and gender

⁴It is more complicated to exploit the aforementioned Taiwanese visa-tightening policy in Vietnam because many Vietnamese women started to marry South Korean men after the visa-tightening policy. Although the substitution of husbands' countries is also an interesting response to the policy, I focus on the case of two countries to keep the analysis simple.

⁵All expenditures from the survey data were normalized to 1998 price levels. The gross domestic product (GDP) per capita in 1998 was \$360.

relations in these countries. Sex ratio imbalances in Asian countries, including China and India, the two most populous countries in the world, are considered to constitute a serious demographic problem, and these imbalances will not disappear in the near future. This paper contributes to understanding of this problem by studying the possible effects of sex ratio imbalances in one country on its neighboring countries and the resulting welfare implications in all of the countries involved.

Second, the existing literature on cross-border marriage largely focuses on the possible causes and consequences on the bride-receiving side, assuming exogenously given marriage migrants for the theoretical framework (Weiss et al. [2017]). I endogenize the equilibrium in the two marriage markets rather than assuming that marriage migrants are exogenously given, providing additional predictions on (1) how cross-border couples are selected and (2) the impacts on the bride-sending side. This sheds light on the full picture of the consequences of cross-border marriages in the affected countries. The empirical evidence from both sides complements the small number of existing studies on cross-border marriage that have focused on the causes and consequences of cross-border marriages in a migrant-receiving country (Edlund et al. [2013]; Kawaguchi and Lee [2017]; Weiss et al. [2017]; Adda et al. [2019]).⁶ To the best of my knowledge, this paper is the first to comprehensively analyze the impacts of cross-border marriages on the bride-receiving and bride-sending sides by combining theoretical and empirical analyses.

Third, the previous literature on migration costs and selection has primarily focused on labor migration. This study is the first to show that an increase in fixed costs results in a more positive selection of migrants in the context of marriage migration. This finding draws a parallel picture with labor migration (Chiquiar and Hanson [2005]) and contributes to the large body of literature on migration costs and selection (e.g., Borjas [1987]; Moraga [2011]; Bertoli et al. [2013]; Feigenberg [2017]).

This paper proceeds as follows. Section 2 provides background information on Taiwan and Vietnam. Section 3 presents the model. Section 4 provides empirical evidence on selection patterns. Section 5 presents the results of the impacts of changes in the costs of cross-border marriages in Tai-

⁶There is another strand of literature on how immigration flows affect the family outcomes of natives. See, for example, Furtado and Hock [2010], Furtado [2016], Carlana and Tabellini [2018]. A small number of studies have examined the causes of internal marriage migration in India. For example, Rosenzweig and Stark [1989] argue that main motivation for sending daughters to villages over long distances for marriage is to mitigate income risks and facilitate consumption smoothing. Fulford [2015] instead suggests high levels of internal migration in India are due to the geographic search for spouses given the caste level and village size. For family migration decisions, see, for example, Sandell [1977], Mincer [1978], and Smith and Thomas [1998].

wan and Vietnam, respectively. Section 6 summarizes the findings and discusses their implications for immigration policy.

2 Country Background

In this section, I provide an overview of Taiwan and Vietnam, including their economic conditions and demographic structures, focusing on the key aspects that determine the parameters of the model.

2.1 Taiwan (The migrant-receiving side)

Taiwan is a major bride-receiving country in East Asia. With a GDP per capita of US\$ 22,453 as of 2016, it is one of the developed economies in East Asia along with South Korea, Singapore, and Hong Kong. Its population size is 24 million as of 2017. Its sex ratio at birth has been male-skewed since the mid-1980s cohorts because of son-preference and the availability of sex-selective abortion technologies. Even prior to these cohorts, the sex ratio of the marriage market was male-skewed due to population decline since the mid-1960s cohorts. Because Taiwanese men tend to marry younger women, population decline led younger women to be relatively scarce in the marriage market.⁷ As a result, despite the balanced sex ratio at birth until the mid-1980s cohorts, the sex ratio of men to women three years younger became male-skewed. The ratios of single men to single women three years younger has generally been above 1.1 for people of marriageable age in the 2000s (Yang and Liu [2014]).

For these reasons, Taiwanese men began to seek brides from abroad. The two countries of origins with the largest shares of foreign brides are mainland China and Vietnam. The number of cross-border marriages grew rapidly during the late 1990s and 2000s when the matchmaking firms began to operate. The rate of growth was so dramatic that in 2003, the number of marriages including foreign brides accounted for more than 28% of all marriages. Among all cross-border marriages in Taiwan in 2003, 67% of foreign brides were from mainland China and 22% were from Vietnam.

2.2 Vietnam (The migrant-sending side)

Vietnam is one of the largest bride-sending countries in Asia, having sent more than 130,000 brides to East Asian countries, including Taiwan, between 2005 and 2010 (International Organization for Migration [2015]). It is in Southeast Asia and its GDP per capita was US\$2,086 as of 2015. Its population size was 94 million as of 2016, making it the fourteenth most populous country in the

⁷See Bronson and Mazzocco [2017b] and Bronson and Mazzocco [2017a] for more on cohort size and marriage rates.

world. The sex ratio at birth in Vietnam was in the normal range (105-6 boys per 100 girls) until the mid-2000s. The population growth until the 1990s made young women relatively abundant because Vietnamese men tend to marry women who are two to three years younger than themselves (Goodkind [1997]), making the sex ratios in the marriage market balanced or female-biased.⁸ The sex ratios for the cohorts affected by the cross-border marriage were relatively balanced. For example, the cohort sex ratio of men aged 23-27 and women aged 20-24 in 1999 was 1.01.⁹

Cross-border marriage became a notable phenomenon in Vietnam only after the early 1990s, particularly after the major economic agreements with Taiwan in 1993. The number of cross-border marriages sharply increased in the late 1990s; it increased more than 20-fold, from approximately 500 in 1994 to over 12,000 in 2000 (Wang and Chang [2002]). Until the mid-2000s, Taiwan was the major destination country. However, since the mid-2000s, as Taiwan tightened its visa policies, Vietnamese women diversified their destination countries to include South Korea, Singapore and China.¹⁰ As of 2005, the share of cross-border marriages of all marriages was estimated to be 3% in Vietnam (International Organization for Migration [2015]). However, the share of cross-border marriages was not uniform across the eight regions in Vietnam because most marriage migrants were originally from two regions, the Mekong Delta and the Southeast; for example, in Tay Ninh, a province in the Southeast region, the number of women who migrated to Taiwan for marriage amounted to more than 20% of women of average marriageable age in 2003.¹¹ On average, the share of marriage migrants was 5% of the marriage cohort in 2003 in the affected provinces.¹²

3 Conceptual Framework

To analyze (i) who marries whom and (ii) how marital gains are shared between spouses in each country and to understand how changes in the costs of cross-border marriage affect them, I build a two-country matching model. The decision to marry cross-nationally depends on what people get from such a marriage; in turn, what is gained also depends on how many and what types of people decide to marry cross-nationally. Thus, without an equilibrium framework, it is difficult to understand

⁸There was a shortage of males for the cohorts that were in their 20s and 30s during 1965-75, which was more attributable to the excess mortality of young men from the Vietnamese war (Mizoguchi [2010]).

⁹Author's calculation using the 1989 Vietnamese census. The 1989 Vietnamese census is used instead of 1999 to calculate cohort sex ratio due to the tendency to under-enumerate of men in their 20s (Mizoguchi [2010]).

¹⁰However, there are no formal statistics on how many women marriage-migrated to China or Singapore.

¹¹The average age at marriage in Vietnam was 21.

¹²The affected provinces are defined as the provinces with more than 1% of outflows of marriage migrants among a marriage cohort in 2003.

who marries cross-nationally and what impact those marriages might have on local populations. This section provides an equilibrium of the marriage markets in Taiwan and Vietnam and offers predictions on matching patterns and divisions of marital gains between spouses.

3.1 Model

3.1.1 Populations

The market is two sided (men and women), and each person is endowed with two characteristics, one being SES (i.e., income) and the other being nationality. The type for each man (and woman) can be expressed by (x, X) ((y, Y)), where x and y are continuous and $X, Y \in \{T, V\}$. T and V denote Taiwan and Vietnam, respectively, although they can be other categories in other applications.¹³ Reflecting on the market conditions of the two countries, I make the following assumptions on the model's parameters.

Assumption 1. *The populations of Taiwan and Vietnam are given as follows.*

- *Taiwanese men (women) are uniformly distributed on $[A, B]$.*
- *Vietnamese men (women) are uniformly distributed on $[A - \sigma, B - \sigma]$, where $\sigma > 0$.*
- *The mass of Taiwanese men and women are 1 and r , where $1 > r$.*
- *The mass of Vietnamese men and women are both v , where $v > 1$.*

The assumptions reflect three key features of the Taiwanese and Vietnamese marriage markets. First, Taiwan has a male-biased sex ratio, whereas Vietnam has a balanced sex ratio. Second, Taiwan is wealthier than Vietnam, as captured by the linear shift in the distributions of the SES. Finally, Vietnam—more precisely, two affected regions in the empirical application—is more populated than Taiwan, as shown by the parameter v .¹⁴ Figure 2 depicts the marriage markets of Taiwan and Vietnam, where the y-axis indicates SES, and the widths of the x-axis indicate the mass of each population.

¹³ T and V can denote any other discrete characteristics of an agent in marriage markets (or, more broadly, any one-to-one matching market). To name a few, different ethnicities, different religions, and different provinces can be other applications.

¹⁴The parameter v does not affect the qualitative features of the equilibrium results. The two affected regions are the Southeast region and the Mekong Delta region with 34 million people as of 2015. The population in Taiwan in 2015 was 23 million.

Let $F(x, X)$ ($G(y, Y)$) denote the joint cumulative distribution function of male (female) characteristics (x, X) ((y, Y)) over the set $[A - \sigma, B] \times \{T, V\}$.

3.1.2 Household problem and surplus

Within any given household, men and women value both private consumption, q , and public consumption, Q . Following Lam [1988], the utilities for men and women are assumed to be:

$$u_m = 2q_m Q$$

$$u_w = 2q_w Q$$

The multiplicative form captures complementarities between the consumption of private and public goods. Without a loss of generality, there is a factor of 2 to make subsequent calculations simpler.

As is well known, these utilities belong to the Generalized Quasi Linear (GQL) class.¹⁵ As a result, the model satisfies the TU property, and any efficient allocation maximizes the sum of the individual utilities. Therefore, a married couple solves:

$$\begin{aligned} \max_{q, Q} \quad & 2qQ \\ \text{s.t.} \quad & q + Q = x + y \end{aligned}$$

where $q = q_m + q_w$.

Solving this problem yields $q^* = Q^* = \frac{x+y}{2}$ with the total utility of $\frac{(x+y)^2}{2}$. Relative to the case in which they remain single and obtain $\frac{x^2}{2}$ and $\frac{y^2}{2}$, respectively, the total utility is larger by xy . Thus, the surplus from marriage is $S(x, y) = xy$. In addition, a match between individuals from different countries generates a fixed cost λ , reflecting matchmaking fees, travel costs, and cultural differences.

Thus, the surplus function is as follows:

$$\Sigma_{XY}(x, y) = \begin{cases} S(x, y), & \text{if } X = Y \\ S(x, y) - \lambda, & \text{if } X \neq Y \end{cases}$$

Finally, I normalize the single utility as 0.¹⁶

¹⁵See Bergstrom and Cornes [1983] and Chiappori and Gugl [2014].

¹⁶Note that all of the results except for Proposition 4, which finds specific functions for the equilibrium, do not rely on the assumptions of distributions of men and women and the surplus function as long as S is strictly increasing,

The setup is reminiscent of Chiappori et al. [2017], which studies bi-dimensional matching with heterogeneous preferences. However, instead of multiplicative costs, as presented in Chiappori et al. [2017], I focus on fixed costs because of their higher relevance to my empirical setting.¹⁷ This different cost structure drastically changes the equilibrium, giving very different results from Chiappori et al. [2017].

3.1.3 Stable matching

A matching is defined as a measure μ on the set $([A - \sigma, B] \times \{T, V\})^2$ and four value functions $u_T(x)$, $u_V(x)$, $v_T(y)$, and $v_V(y)$. μ is a mapping from a given man to a given woman and it indicates the probability that the given man is matched to the given woman. The marginals of μ should coincide with the initial distributions of men and women, F and G . For any male (female), $u_X(x)$ ($v_Y(y)$) is the equilibrium share that he (she) receives at a stable matching.

A matching is *stable* if (i) no matched individual would be better off unmatched, and (ii) no two individuals who are not matched with each other prefer being matched together to their current situation. Stability can be summarized by the following set of inequalities: for any $(x, X), (y, Y)$, we require:

$$u_X(x) \geq 0, v_Y(y) \geq 0 \text{ and } u_X(x) + v_Y(y) \geq \Sigma_{XY}(x, y).$$

For couples matched with positive probability,

$$u_X(x) + v_Y(y) = \Sigma_{XY}(x, y), \forall ((x, X), (y, Y)) \in \text{Supp}(\mu).$$

The equilibrium shares $u_X(x)$ and $v_Y(y)$ can be interpreted as the demand prices that men from country X with income x and women from country Y with income y require to participate

continuously differentiable, and supermodular.

¹⁷The emergence of matchmaking firms in Vietnam and Taiwan reduced the costs of cross-border marriages because such firms provided efficient matching services. In contrast, the visa-tightening policy in Taiwan increased the costs of cross-border marriages because the interview stage became stricter and required more preparation (e.g., language). These costs are one-time, are more or less fixed, and do not depend on types of SES; thus, focusing on fixed costs is a natural choice. It is interesting to compare the results under fixed costs with the results under multiplicative costs that vary with the surplus. I present the results from the multiplicative cost case—a slight modification of Chiappori et al. [2017]—in the Appendix. The traditional immigration selection literature on labor migration has studied both fixed and skill-dependent costs and has shown that, depending on the nature of the cost, immigration selection can be different even when we maintain the wage structures of the two countries as fixed. In the Appendix, I explore how the selection would differ under different cost schemes when agents make migration decisions based on with whom they would be matched instead of potential wages.

in any marriage. For matched couples, the stability condition holds as an equality, suggesting that the generated surplus meets the demands of both partners and they exhaust family resources. For unmatched couples, the demand prices required by men and women are higher than what they can generate because, otherwise, they would benefit from forming a new couple.

If $(\mu, u_T(x), u_V(x), v_T(y), v_V(y))$ is a stable matching, then the measure μ solves

$$\max_{\nu \in \mathcal{M}} \int \Sigma_{XY}(x, y) d\nu((x, X), (y, Y)),$$

where \mathcal{M} denotes the set of measures on the set $([A - \sigma, B] \times \{T, V\})^2$, where marginal distributions are equal to the initial measures of male and female populations (Shapley and Shubik [1971]). In other words, a matching is stable when it maximizes the social surplus. A stable matching exists under mild continuity and compactness conditions.¹⁸ In the following section, I find a stable matching under different cost structures.

3.2 Results

Using the setup of the marriage markets given in the previous section, I consider three cases under different cost schemes: (1) autarky, (2) complete integration, and (3) the intermediate case. The equilibrium, the stable matching, consists of a matching function and intra-household allocations. In the first subsection, I discuss the results on the matching function under different cost structures. In the second subsection, I present results on how couples share their marital gains.

3.2.1 Matching function

-Autarky: If the cost of cross-border marriage is high enough, the two marriage markets are completely in isolation. In this case, the problem is equivalent to two unidimensional matching problems. Matching functions are determined from the relationship

$$m_1(1 - F(x, X)) = m_2(1 - G(y, X))$$

where m_1 and m_2 are the mass of men and the mass of women, respectively. The set of men with SES above x must have the same measure as the set of women with SES above y .

Thus, the matching function in Taiwan is $\phi_T(x) = \frac{1}{r}x - \frac{1-r}{r}B$, indicating that a Taiwanese man

¹⁸See Chiappori et al. [2010], Chiappori et al. [2016], and Chiappori [2017].

with SES x is matched to a Taiwanese woman with SES $y = \phi_T(x)$ (Figure 1). That is, a Taiwanese man with SES x is matched with a Taiwanese woman with SES $\phi_T(x)$. We can see that $\phi_T(x) < x$ for any $x < B$. This shows that a man marries a woman whose SES is lower than his because the sex ratio in Taiwan is male-biased. With the imbalanced sex ratio, some men remain single. The cutoff for singles $x_{0,T}$ can be found by finding the type of man who marries the lowest type of woman, A , using the matching function. Using the same method, the matching function in Vietnam is $\phi_V(x) = x$. In Vietnam, men marry women of the same SES type because the sex ratio in Vietnam is balanced. Everyone is married in Vietnam, making the cutoff for single men the same as the lowest type of men, $x_{0,V} = A - \sigma$. The positive first derivatives of the matching functions, $\phi'_T(x) > 0$ and $\phi'_V(x) > 0$, show that the matchings are positive assortative on SES, meaning that a male with a high SES is matched to a female with a high SES in Taiwan and Vietnam, respectively. Figure 2a shows the overall marriage markets in autarky. Men and women with the same colors are matched together and are matched positive assortatively.

-Complete integration: If the cost of a cross-border marriage is nil, the problem is simply a uni-dimensional matching problem, and nationality is no longer relevant; the matching $\phi(x)$ is positively assortative on SES regardless of nationality. In the overlapped SES ranges of two countries, $[A, B - \sigma]$, the matching function is the same for Taiwanese and Vietnamese (Figure 1). The combined marriage market has more men than women, making some men remain single. These single men are now all in Vietnam because they are the lowest types among all men (Figure 1, Figure 2d).

-Intermediate case: The interesting case is obviously the intermediate one. It is no longer a simple uni-dimensional matching problem whose prediction is positive assortative matching on SES within a country or regardless of countries. Men and women in the marriage markets need to take into account both SES and nationalities, making this problem essentially a more complicated bi-dimensional matching problem. I begin with a result on the positive assortativeness.

Proposition 1 (Conditional Positive Assortativeness). *In the stable matching, for any two couples $(x, X), (y, Y)$ and $(x', X'), (y', Y')$, if $x \geq x', X = X'$, then $y \geq y'$ almost surely.*

Similarly, in the stable matching, for any two couples $(x, X), (y, Y)$ and $(x', X'), (y', Y')$, if $y \geq y'$ and $Y = Y'$, then $x \geq x'$ almost surely.

Proof. See the Appendix. □

Proposition 1 states that for all men in a given country X , the higher type men are matched with the higher type women regardless of the women's country of origin. For instance, for any subset of agents in the stable matching that includes men from T country but *does not* include men from V country, the matching is assortative on SES regardless of the women's nationality. However, if we take a subset of the agents in the matching that includes men from *both* T and V countries, there is no guarantee that the matching is assortative on SES. If the cost is zero and free trade is possible such that the market is completely combined, stable matching would be the matching that is positive assortative on SES regardless of nationalities because that matching maximizes the total surplus. However, because the cost imposes friction in the market, the fully assortative matching on SES may not maximize the total surplus and, thus, is no longer stable.

In particular, the stable matching involves randomization, whereby an open set of Taiwanese men may marry either a Vietnamese or a Taiwanese woman with positive probability. The next Proposition restricts the form that such randomization may take. Let $p(Y|x, X)$ denote the probability that a male from X country with SES x marries a female from Y country. Similarly, $q(X|y, Y)$ denotes the probability that a female from Y country with SES y marries a male from X country. These probabilities are determined in the equilibrium.

Proposition 2 (Randomization Among Same SES I). *Suppose an open set of males from country X are indifferent between marrying a woman from T country and a woman from V country such that $0 < p(T|x, X) < 1$ in the stable match for any x in the open set. If (x, X) is matched to either (y, T) or (y', V) , then $y = y'$.*

Similarly, suppose an open set of females from Y country are indifferent between marrying a man from T country and a man from V country such that $0 < q(X|y, Y) < 1$ in the stable match for any y in the open set. If (y, Y) is matched to either (x, T) or (x', V) , then $x = x'$.

Proof. See the Appendix. □

Proposition 2 states that if a male is matched to either a female from the same country or a female from the different country with positive probability in the stable match, then their types must be equal. This is a somewhat surprising result, since one might have expected that the foreign wife has to *compensate* for this feature by a higher income. In fact, the latter intuition is incorrect, which illuminates the inherent ambiguity of the notion of *compensation*. A compensation does take place,

but it takes the exclusive form of a different intra-household allocation; de facto, the foreign wife *pays* for the cost. This is discussed more in the section on intra-household allocations.

Proposition 3 (One-sided Randomization). *Assume that there exists an open set O such that for all (x, X) , where $x \in O$, $0 < p(T|x, X) < 1$. That is, (x, X) marries either a woman (y, T) or (y, V) with positive probability. Then, $q(\bar{X}|y, X) = 0$ for almost surely, where $\{\bar{X}\} = \{T, V\} - \{X\}$.*

Similarly, assume that there exists an open set O' such that for all (y, Y) , where $y \in O'$, $0 < q(T|y, Y) < 1$. That is, (y, Y) marries either a woman (x, T) or (x, V) with positive probability. Then, $p(\bar{Y}|y, Y) = 0$ for almost surely, where $\{\bar{Y}\} = \{T, V\} - \{Y\}$.

Proof. See the Appendix. □

Proposition 3 states that the direction of the randomization is always one-sided for a given neighborhood. If randomizations occurred in both directions, simply switching the matches would only remove the fixed cost because the types involved in the mixing are unique (x for males and y for females) regardless of the nationality. The next Proposition presents the equilibrium matching.

Proposition 4 (Who marries whom/equilibrium matching). *There exists a unique equilibrium and there exist a cutoff $z_M(\lambda)$ for men and $z_W(\lambda)$ for women such that the matching above $z_M(\lambda)$ and $z_W(\lambda)$ is positive assortative on SES regardless of nationalities. The matching below $z_M(\lambda)$ and $z_W(\lambda)$ is positive assortative on SES within each country. The unique stable matchings depending on the value of $z_M(\lambda)$ and $z_W(\lambda)$ are depicted in Figure 2.*

Proof. See the Appendix. □

The cutoff $z_M(\lambda)$ for positive assortative matching on SES is determined in the equilibrium. The idea of the equilibrium described above is as follows. Because of the cost, the social surplus may not be maximized when the matching is positive assortative on SES regardless of the nationalities. In that case, positive assortative matching on SES regardless of the nationalities occurs only for men and women above certain types who can generate enough benefit from the positive assortative matching regardless of nationalities. For the low types, the benefits from positive assortative matching cannot compensate for the cost of matching across countries. Thus, for the low types, people only marry within countries not incurring any costs. When the cost is high enough, the equilibrium coincides

with the case of autarky. When the cost is small enough, the equilibrium is the same as that of the complete integration case.

Figure 2 presents the equilibrium matching patterns of men and women under different levels of costs. When the two marriage markets are completely in isolation because of high costs, the cutoff $z_M(\lambda)$ is greater than or equal to B . In another extreme, when the two marriage markets are completely integrated with no cost, the cutoff $z_M(\lambda)$ is smaller than the last SES type of Taiwanese men A .

There are two types of equilibrium for the intermediate case. When the cost is low enough to allow some cross-border marriages but is still relatively high, all Vietnamese women at the top marry Taiwanese men (Figure 2b). The highest type of Taiwanese men marry Taiwanese women because the top Vietnamese women are still lower than the top Taiwanese women. However, Taiwanese men of lower SES may marry either Taiwanese or Vietnamese women. Thus, these lower types of men use a mixed strategy to marry either Taiwanese or Vietnamese women, suggesting that some marry Taiwanese women and the rest marry Vietnamese women. In this range, the matching is positive assortative regardless of nationalities. The types below the cutoff $z_M(\lambda)$ marry within their own countries.

When the cost becomes even lower (Figure 2c), Vietnamese women of a wider range of types can marry Taiwanese men; however, Vietnamese women who are below a certain type begin to mix between Taiwanese and Vietnamese men because the Taiwanese men whom they can marry are not necessarily better than the Vietnamese men. Again, the types below the cutoff $z_M(\lambda)$ match within each country. In both cases, Vietnamese women are positively selected, and Taiwanese men are selected from the middle of the socioeconomic distributions.

From the marriage market equilibrium under the intermediate case, I obtain three qualitative predictions on the selection of cross-border couples, which are tested in the empirical section.

1. There exist Taiwanese men–Vietnamese women couples; however, there do not exist Taiwanese women–Vietnamese men couples.
2. Taiwanese men are selected from the middle of the SES distributions of all Taiwanese men.
3. Vietnamese women are selected from the top of the SES distributions of all Vietnamese women.

3.2.2 Intra-household allocations (individual utilities)

Intra-household allocations $(u_T(x), u_V(x), v_T(y), v_V(y))$ are pinned down by the following equilibrium conditions. The stability condition $u_X(x) + v_Y(y) \geq \Sigma_{XY}(x, y)$ implies the following: for any $(x, X), (y, Y)$,

$$\begin{aligned} u_X(x) &= \max_{(y, Y)} (S_{XY}(x, y) - v_Y(y)) \\ v_Y(y) &= \max_{(x, X)} (S_{XY}(x, y) - u_X(x)) \end{aligned}$$

These conditions show that each male and female get a spouse that maximizes his or her profit from the pair, considering the reservation utility (the price) of any potential partner. Using the envelop theorem, the first-order conditions are as follows:

$$\begin{aligned} u'_X(x) &= \frac{\partial}{\partial x} S_{XY^*}(x, y^*) \\ v'_Y(y) &= \frac{\partial}{\partial y} S_{X^*Y}(x^*, y) \end{aligned}$$

These conditions imply that the marginal equilibrium share is the same as the marginal contribution of his or her own characteristic to the marital output. Integrating these conditions and using boundary conditions for which the last married person has to have the same utility as singles, a unique intra-household allocation rule can be obtained.¹⁹

-*Autarky*: Under autarky, the problem for Taiwan is:

$$\begin{aligned} u_T(x) &= \max_y (xy - v_T(y)) \\ v_T(y) &= \max_x (xy - u_T(x)) \end{aligned}$$

Using the envelop theorem,

$$\begin{aligned} u'_T(x) &= \phi_T(x) \\ v'_T(y) &= \phi_T^{-1}(y) \end{aligned}$$

The last married man $x_{0,T}$ should be indifferent with a single man; therefore, his utility should be

¹⁹There is no unique allocation rule if there are no singles; that is, the mass of men and women are exactly the same.

0. Using this boundary condition, $u_T(x) = \int_{x_{0,T}}^x \phi_T(x)$. For the couple $(x_{0,T}, A)$, the woman extracts all of the surplus; therefore, using this condition, $v_T(y) = \int_A^y \phi_T^{-1}(y) + x_{0,T}A$. The individual utilities of Vietnamese men and women can be obtained similarly.²⁰ Figure 3a depicts $u_T(x)$, $v_T(x)$, $v_T(y)$, and $v_V(y)$. Because the Taiwanese marriage market is less favorable to men because of the country's male-biased sex ratio, the equilibrium shares for Taiwanese men are lower than those for Vietnamese men given their types, and the opposite is true for women. All single men in Taiwan whose types are below $x_{0,T}$ get 0. In contrast, men with types below $x_{0,T}$ in Vietnam enjoy positive utilities because they are all married with the balanced sex ratio in Vietnam.

-*Complete integration*: The individual utilities of men and women can be found similar to the autarky case. When two markets are completely integrated, the gap between the utilities of Taiwanese and Vietnamese disappears because it is essentially one market and only SES matters. All single men are in Vietnam and get 0. Figure 3d shows that the utilities of men and women coincide in Taiwan and Vietnam within the overlapped SES range $[B - \sigma, A]$.

-*Intermediate case*: In the intermediate cases, the gap between the utilities of Taiwanese men and Vietnamese men (Taiwanese women and Vietnamese women) is in between the autarky and complete integration cases.

Proposition 5 (Individual utilities/equilibrium shares). *Individual utilities $u_T(x)$, $u_V(x)$, $v_T(y)$, and $v_V(y)$ in the intermediate cases are depicted in Figure 3b and Figure 3c, and the exact functional forms are presented in the Appendix.*

The exact forms of individual utilities can be found by using the stability conditions. They are increasing in SES and, as the cost increases, the shares of Vietnamese men and Taiwanese women increase, and those of Vietnamese women and Taiwanese men decrease. The following result shows how the cost of cross-border marriage is shared between spouses.

Proposition 6 (Randomization Among Same SES II). *Suppose an open set of males from country X are indifferent between marrying a woman from T country and a woman from V country such that $0 < p(T|x, X) < 1$ in the stable match for any x in the open set. If (x, X) is matched to either (y, T) or (y', V) , then $y = y'$. Moreover, $v_X(y) = v_{\bar{X}}(y) + \lambda$ where $\{\bar{X}\} = \{T, V\} - \{X\}$.*

²⁰The only difference is that no boundary condition exists in the Vietnamese case because the mass of men and women are exactly same. I focus on the $u_V(x)$ and $v_V(y)$ which are the most favorable to women.

Similarly, suppose an open set of females from Y country are indifferent between marrying a man from T country and a man from V country such that $0 < q(X|y, Y) < 1$ in the stable match for any y in the open set. If (y, Y) is matched to either (x, T) or (x', V) , then $x = x'$. Moreover, $u_Y(x) = u_{\bar{Y}}(x) + \lambda$ where $\{\bar{Y}\} = \{T, V\} - \{Y\}$.

Proof. See the Appendix. □

Proposition 6 expands Proposition 2. Men who employ a mixed strategy should have the same utilities from marrying a woman from either their or the alternative country, suggesting that all of the costs of cross-border marriage, λ , is borne by the foreign wife, making her power within households weaker than that of a native.

3.2.3 Comparative statics with respect to costs of cross-border marriage

An interesting exercise from this model is the comparative statics with respect to the costs of cross-border marriages. Costs are frequently tied to immigration policies. Thus, changing legislation can directly increase or decrease the costs of cross-border marriages. By conducting this exercise, we can learn what to expect from such policy changes. These predictions are tested in the empirical section using variations in the costs of cross-border marriages.

Proposition 7 (Comparative statics with respect to λ).

- *Cutoffs (the lowest types who engage in cross-border marriage):* $\frac{\partial z_M}{\partial \lambda} > 0, \frac{\partial z_W}{\partial \lambda} > 0$
- *Matching:* $\frac{\partial \phi_T(x)}{\partial \lambda} < 0, \frac{\partial \phi_V(x)}{\partial \lambda} > 0$
- *Singles:* $\frac{\partial x_{0,T}}{\partial \lambda} > 0, \frac{\partial x_{0,V}}{\partial \lambda} < 0$
- *Individual utilities:* $\frac{\partial u_T(x)}{\partial \lambda} > 0, \frac{\partial u_V(x)}{\partial \lambda} < 0, \frac{\partial v_T(y)}{\partial \lambda} < 0, \frac{\partial v_V(y)}{\partial \lambda} > 0$

Proof. See the Appendix. □

When costs increase, the cutoff for Taiwanese men marrying Vietnamese women and that for Vietnamese women marrying Taiwanese men increase. Cross-border marriage is beneficial only when the generated surplus is large enough to compensate for the cost. If the cost is higher, only higher types can afford such cross-border marriages, making the cutoffs higher. The cutoff of being single for Taiwanese men increases accordingly, whereas the cutoff of being single for Vietnamese men decreases.

Equilibrium shares also change; when costs increase, the shares for Taiwanese men and Vietnamese women decrease, and those for Taiwanese women and Vietnamese men increase.

Table 1 summarizes the theoretical predictions on marital outcomes, intra-household allocations (individual utilities), and migration patterns when costs increase. Figure A1 shows the comparison of probabilities of being single, marrying a local spouse, and marrying cross-nationally, matching functions, and individual utilities under two different costs. Regarding the probabilities of being single or matching patterns, not all types of men and women are affected by changes in costs. For example, Taiwanese men with low SES are matched to spouses with lower SES when costs increase, but Taiwanese men with high SES are always matched to the same types of Taiwanese women regardless of cost. However, the predictions for individual utilities (intra-household allocations) are different: cost changes affect the utilities of *all* men and women in Taiwan and Vietnam through equilibrium effects. This finding suggests that the impacts of changes in technology (e.g., easier travel and matchmaking services) or migration policies can be very extensive.

4 Empirical Evidence on the Selection of Cross-border Couples

This section cross-sectionally tests the theoretical predictions on the forms of cross-border marriage and the selection of marriage migrants and their spouses. In the first subsection, I introduce the data. In the next subsection, I present the results.

4.1 Data

To understand the characteristics of marriage migrants and their spouses, I use unique datasets of individual-level marriage migrants: the Census of Foreign Spouses (CFS) in 2003 and the Foreign and Mainland Spouse Living Needs Survey (FMSLNS) in 2008 and 2013 by the Taiwanese Ministry of Interior. All of these datasets all contain rich information on individual characteristics, such as age, education, marriage year, migration year, original nationality, and visa type, as well as spousal characteristics.²¹

To compare the characteristics of Taiwanese men who engage in cross-border marriages and those of local Taiwanese men, I use the Taiwanese census conducted in 2000. For Vietnamese women, I use the Vietnamese census in 1999.

²¹The CFS surveyed 240,837 residents who were married to Taiwanese citizens but did not have Taiwanese citizenship themselves at the time of their marriage. The subsequent FMSLNS in 2008 and 2013 have smaller sample sizes of approximately 13,000 each year.

4.2 Results

Prediction on Selection 1. *(The “mixed” couples are one kind) Taiwanese men and Vietnamese women (TV) couples should be more prevalent than Vietnamese men and Taiwanese women (VT) couples.*

This prediction suggests that we would observe a dominant share of one type of “mixed” couples, which is indeed confirmed by multiple sources of data. In the CFS, among all of the Taiwanese–Vietnamese couples who married before 2003, the share of VT couples is less than 0.5%. The yearly marriage data from the Taiwanese Ministry of Interior bolsters this prediction. The number of VT couples is less than 1% during all of the years available in the data (2004–2010). The gendered patterns of cross-border marriages in Asian countries have been numerous reported in sociological, demographic, and economics literatures. I show that this pattern can be explained as an *equilibrium* of the two marriage markets rather than as a simply descriptive pattern.

Prediction on Selection 2. *(Taiwanese men involved in cross-border marriage) Taiwanese men who are involved in cross-border marriages are selected from the middle segment of SES.*

The model suggests that Taiwanese men who are matched to Vietnamese women are selected from the middle of the SES distributions and not the bottom, given that the cost of a cross-border marriage is not zero. In Taiwan, to marry a Vietnamese woman, Taiwanese men need to pay matchmaking firms approximately \$10,000. This cost precludes cross-border marriages for the lowest types. The high types do not marry Vietnamese women because they have strictly better Taiwanese alternatives.

The data confirms the prediction of the intermediate selection of Taiwanese men (Figure 4). Taiwanese men who marry Vietnamese women are concentrated in the group with junior-high or senior-high school educations, not in the group with a primary or lower than a primary education. The share of people with a junior-high or senior-high education was 87% for the grooms of Vietnamese brides, whereas in the entire population of Taiwanese men, the share was only 57%.²²

Prediction on Selection 3. *(Vietnamese women involved in cross-border marriage) Vietnamese women who are involved in cross-border marriages are selected positively from the SES distribution.*

²²More continuous measures of SES exist, such as incomes or wages. However, using these variables is more difficult because these variables may respond to marriage decisions. Education is the best available measure but is not a perfect measure for SES and has inherent noise. Thus, we do not expect to observe that the Taiwanese men marrying foreign women are entirely concentrated in the middle, as in the model. However, the patterns of the data show that the majority is concentrated in the middle, which is consistent with the prediction.

Vietnamese women with high SES among their population marry Taiwanese men. Again, because of the cost of cross-border marriages, women below certain types cannot engage in a cross-border marriage. The data largely confirm the prediction of the positive selection of Vietnamese women (Figure 5). Vietnamese women who marry Taiwanese men are better educated than their counterparts in Vietnam. The positive selection is more pronounced when the education of Vietnamese marriage migrants is compared with the education of Vietnamese women in the Mekong Delta and Southeast area, which are the marriage markets of my focus.²³

5 Empirical Evidence on the Comparative Statics Results: Impacts of Cost Changes

In this section, I test the theoretical predictions of the impacts of cost changes and show how cost changes affect matching outcomes and intra-household allocations. In the first subsection, I investigate the impacts of cost increases in Taiwan. In the second subsection, the impacts of cost decreases in Vietnam are explored. Given the data limitations and the nature of the settings, I focus on the impacts on matching patterns in Taiwan and on intra-household allocations in Vietnam.

5.1 Impacts of increases in costs of cross-border marriages in Taiwan

In this section, I analyze the impacts of increases in the costs of cross-border marriage on the bride-receiving side, exploiting the visa-tightening policy in Taiwan that was phased in during 2004 and 2005.²⁴

5.1.1 Background: Visa-tightening policy

In the early 2000s in Taiwan, the strikingly high share of foreign brides raised concerns over the country's national security and demographic composition. Given these concerns, in September 2003, the government strengthened its visa requirements by requiring compulsory interviews to screen mainland Chinese brides. At first, the Immigration Bureau began to interview 10% of all mainland spouses. However, the mandatory interview for all women from the mainland was implemented in March 2004 (Lu [2008]). As a result, the number of Chinese brides decreased by half between 2003 and 2004

²³Empirically testing Proposition 2 would be very interesting. However, doing so is challenging because Taiwan and Vietnam have very different education systems, making it difficult to develop a unified measure of SES across two countries. Instead, I focus on selection patterns within the countries.

²⁴In Taiwan, it is challenging to test the impacts on intra-household allocations because all men and women are affected by marriage migration flows, making it difficult to find a proper control group. I test predictions on intra-household allocations in the Vietnamese setting in subsection 5.2.

(Figure 6). Moreover, the Taiwanese government subsequently launched a similar policy in 2005 that involved changing the bulk processing of visas to one-on-one interviews to better screen Southeast Asian brides. This change resulted in a further decrease in the number of foreign brides that came to Taiwan per year. Brides from Southeast Asian countries decreased by approximately 40 percent in one year. The impact of this increase in the cost for women from mainland China should be in the same direction as that for women from Vietnam as long as Taiwan has a higher sex ratio than mainland China, which was indeed the case for the cohorts involved in cross-border marriages. The sex ratio of mainland China increased only after 1980, and the population increased until 1975, meaning that a male-biased sex ratio was unlikely. In this paper, I ignore three country effects, and use 2004 as a treatment year.

5.1.2 Data

Data on marriage: To investigate whether the increase in the costs of cross-border marriages induced by the visa-tightening policy affected marriage rates in Taiwan, I utilize yearly marriage and population data from 2001 to 2010. Both marriage and population data are collected at the district level for 368 districts by the Department of Household Registration in Taiwan.²⁵ For yearly marriage data, the number of marriages is available by sex, education, and nationality. The population data for people older than age 15 are available by sex, education, and marital status. Using these datasets, I construct marriage rates by education for Taiwanese males and females. The district-level marriage rate for each education level is calculated by dividing the number of marriages involving Taiwanese males (females) by the number of singles at the corresponding education level.

Data on matching pattern: To evaluate the impact of the visa-tightening policy on matching patterns, the data should include information on the characteristics of the spouses and the year of marriage. I use the Women’s Marriage, Fertility and Employment Survey (WMFES), a supplementary survey to the Manpower Survey of Taiwan (an equivalent to the Current Population Survey of the United States), which contains such information. The survey is conducted every three or four years.²⁶ The sample consists of women who are over 15 years of age within the representative sample of households. For this sample, the survey collects information on their characteristics, such as age, educational attainment, and marital status. Furthermore, for currently married women, information

²⁵The area of Taiwan is approximately 1.5 times that of the state New Jersey in the United States.

²⁶The survey was first conducted in 1979 and then annually between 1979 and 1988; however, because of budget limitations, it has been conducted every three or four years since 1988.

on the characteristics of their spouses and the year of marriage are also available. I use WMFES 2006, 2010, and 2013, which also contain information on pre-marriage nationality, and limit the sample to only include women whose pre-marriage nationality is Taiwanese.²⁷

Data on selection of cross-border couples: I use the CFS and the FMSLNS to test the impacts of cost changes on selection patterns.

5.1.3 Results

Prediction 1 (Marriage rate). *When the cost of cross-border marriage increases, the marriage rate for Taiwanese males decreases overall. However, the decrease is concentrated among males with low SES; the marriage rate of those with high SES is not affected. The marriage rate for Taiwanese females is not affected by the policy.*

To test this prediction, I exploit the insights from the model that Taiwanese men with high SES are not affected by changes in the visa policy, whereas Taiwanese men with low SES are expected to be affected. I compare the marriage rates of these two groups before and after the policy change using education as a proxy for SES. Education is a better choice than other measures of SES, such as income or wages, because education is a pre-determined variable and is unlikely influenced by marriage or decisions after marriage.

The model predicts that the increase in the cost of a cross-border marriage does not affect the marriage rate of females; I use the same strategy for females to test this hypothesis. I estimate the following regression separately for Taiwanese men and women:

$$Y_{dey} = \beta LowEdu_e \times Post_y + \theta_d + \gamma_e + \delta_y + \nu X_{dey} + \varepsilon_{dey}$$

where d is a district; e is educational level (primary, junior-high, senior-high, vocational, university); and y is year of marriage. The dependent variable Y is the marriage rate by education level at each district in a given year. The θ_d are district fixed effects, γ_e are education fixed effects, and δ_y are year of marriage fixed effects. X_{dey} controls the number of male and female single populations at each education level in a given district and year. $Post_y$ is one if year y is after the visa-tightening policy was implemented; that is, $Post_y = 1$ for any $y \geq 2004$. $LowEdu_e$ takes the value of one when

²⁷The information on pre-marriage nationality is not available for the WMFES before 2006.

the education group is either primary or junior-high and is zero if the education level is higher than junior-high (i.e., senior-high or above). I refer to the former as the low-education group and the latter as the high-education group. As a robustness check, different definitions of treatment groups are also explored. β is the coefficient of interest and is expected to be negative for Taiwanese males and zero for Taiwanese females.

Figure 7 depicts the marriage rates for each education group in each year. The graphs confirm that the pre-trends are similar for the low- and high-education groups for both males and females. However, after the implementation of the policy, the marriage rates of low-educated males declined sharply. In particular, the drop in marriage rates for males with a primary education is striking, but we do not see such a pattern for females.

One notable feature in the graphs is that there are two dips for the marriage rate for people with a vocational education or university education in 2004 and 2009, respectively. These years are superstitiously believed to be unlucky for getting married and are called “lonely-phoenix years.” As is shown in the graphs, the different education groups respond differently to superstitions. Therefore, including year-specific fixed-effects is not sufficient to capture the full effect of such superstitions on marriage rates. That is, because year-specific fixed-effects can capture only the education-invariant year-specific effects, they do not capture the different responses from different education groups, thus biasing my estimates. Moreover, because this superstition is widely known, people may display forward-looking behavior and adjust the timing of their marriages accordingly. To address this concern, I estimate the same equation, excluding samples from 2004 and 2009 and for the years before and after the focal years (2004 and 2009).

The results are given in Table 2. As expected from the model, the marriage rate for low-educated males decreased compared with the high-educated group after the visa-tightening policy. The marriage rate for the low-educated group decreased by 8 to 10 marriages per 1,000 singles relative to the high-educated group depending on whether or not unlucky years are excluded. This change is equivalent to a 23-29% decrease in the marriage rate for low-educated males. Different definitions of the low-education group provide similar results; when the low-educated group’s cutoff is lower, the estimates of β become larger. I find a small coefficient size for females, and it is essentially zero when the unlucky years and its windows are excluded, confirming the model prediction.

Prediction 2 (Matching patterns). *When the cost of cross-border marriage increases, Taiwanese*

females are more likely to marry up, except for females with a high education. The matching of females with high SES is not affected by the policy.

The prediction for the matching patterns can also be tested using a similar strategy. In the model, Taiwanese females with SES higher than that of the top Vietnamese women always match the same set of Taiwanese men regardless of the cost. These top females in Taiwan serve as a control group. I define this control group as females with a university or higher education because few Vietnamese females hold such degrees. I estimate the following regression:

$$Y_{mey} = \beta LowEdu_e \times Post_y + Wifeduc_e + \delta_y + \nu X_{mey} + \mu Z_{ey} + \varepsilon_{mey}$$

where m is each marriage; e is educational level (primary, junior-high, senior-high, vocational, university); and y is year of marriage. The dependent variable Y is the husbands' level of education. The δ_y are the year of the marriage fixed effects. The control vector X_{mey} includes county fixed effects, husband's age, and wife's age. Because I test whether the partner's education increases given the female's education, I control for the wife's education. The education-year level control vector Z_{ey} includes the excess share of males with an education higher than e .²⁸ $Post_y$ is one if y is 2004—the year during which the visa-tightening policy was implemented—or later. $LowEdu_e$ is one when the education group is lower than a university education and zero if the education level is university or higher.

Figure 8 plots the average years of the husbands' education by the wives' education level.²⁹ The figure shows that the pre-trends are similar across education groups. The average education level of husbands of wives with a university or higher education remains stable over time (if anything, a slight increase occurs), and the average education level of husbands of wives with less than a university education increases after the implementation of the visa-tightening policy.

Table 3 shows the regression results. After the visa-tightening policy, Taiwanese women with less than a university education marry a man with 0.2 more years of education. Alternative dependent variables, including the probability of marrying up for females and the educational year differences

²⁸Specifically, it is calculated as the difference between the share of males with educations higher than e and the share of females with educations of e or higher. For university females, I use the difference in the share of males with a university or higher education and the share of females with a university or higher education, which is based on the assumption that the matching is assortative.

²⁹Because of the small sample sizes, I aggregate the education groups into two groups: a group with a university education and a group without a university education.

for couples, also provide similar results.

Prediction 3 (Selection of people who marry cross-nationally). *When the cost of a cross-border marriage increases, the average SES of Taiwanese males who marry foreign brides increases. When the cost of a cross-border marriage increases, the average SES of foreign brides increases.*

Given that the cost associated with the visa application process can be understood as being more or less fixed, the model predicts that the average SES of foreign women married to Taiwanese men increases when the visa-related cost increases. In addition, the average SES of Taiwanese men matched to foreign women increases because the cost becomes too high for marginal types. To test these predictions, I compare the educational level of female marriage migrants immediately before and immediately after the visa-tightening policy. I estimate the following equation for female marriage migrants and their spouses to capture the changes in the SES of migrants and their spouses.

$$Y_{icy} = \delta_y + \beta Post_y + \nu_c + \varepsilon_{icy}$$

where i is an individual, and y is the year of marriage (as well as the year of migration for foreign brides). The ν_c are county/city fixed effects. The dependent variable Y is an indicator for each education group (primary, junior high, senior high/vocational, university or higher). Thus, the coefficient of interest β captures whether the share of each education decreased or increased with the stricter visa policies.

Figure 9 shows the composition of education by year of marriage cohort. As predicted by the model, for foreign spouses, the share of the low-educated group (e.g., primary or junior high) decreased, whereas the share of the high-educated group (e.g., senior high/vocational or university or higher) increased. The same figures for the composition of education by the origins of the brides (mainland China and Southeast Asian brides) confirm the impact of the visa-tightening policy. The SES of mainland Chinese brides increased immediately after 2004 when the visa-tightening policy targeted at mainland brides was first implemented. Similarly, when the visa screening for Southeast Asian brides was strengthened in 2005, a similar increase in the education level was observed.

The patterns are similar for the Taiwanese spouses of foreign brides. One notable difference from the results for foreign brides is that the average education level of Taiwanese males who marry Southeast Asian brides increased immediately after 2004 and not 2005, although the education level

increased as well after 2005. This is because the average cost associated with marrying any foreign bride for Taiwanese men had already increased in 2004.

Table 4 and Table 5 show the regression coefficients for each education level.³⁰ The results of the foreign brides show that the education level shifted toward higher education. The share of brides with a primary school education decreased, whereas the share of brides higher than that education level increased. The results for the Taiwanese grooms reveal similar patterns. However, because the base education level of Taiwanese grooms marrying foreign brides is higher than that of foreign brides, the share of people with a primary or junior high education decreased, and the share of people with higher than a junior high education (i.e., senior high/vocational or university or higher) increased.

One alternative hypothesis that could explain these results is that the educational level of *all* mainland Chinese women/Vietnamese women or *all* Taiwanese men may have increased over time. This hypothesis can be tested by looking at the educational composition of mainland Chinese women/Vietnamese women and Taiwanese men for each year. There is indeed an increasing trend for the education level of mainland Chinese women/Vietnamese women; however, the increase is so smooth that it is unlikely that the jump in 2004-2005 is driven solely by this trend. Similarly, the education level of Taiwanese men has grown smoothly, which invalidates the alternative hypothesis.

As suggested by the model, the changes in the costs of cross-border marriage should affect the outcomes in Vietnam in the opposite direction of the impacts in Taiwan. However, it is difficult to test the model's predictions in Vietnam using the Taiwanese visa-tightening policy because Vietnamese women diversified their destination countries and migrated en masse to South Korea after the visa-tightening policy (Figure 10).³¹ Although this response is also important, I ignore three country interactions in this paper for simplicity. Thus, in subsection 5.2, I instead focus on the cost decrease of cross-border marriages between Vietnamese and Taiwanese during the late 1990s to identify the impacts in Vietnam.

³⁰The results by origins of foreign brides are presented in Table A1 and Table A2.

³¹The change in destination countries cannot be solely attributed to the visa-tightening policy because South Korea actively invested in Vietnam in the early 2000s, and this action led to an emergence of matchmaking firms operating in Vietnam and Korea. This change lowered the cost of cross-border marriages between Vietnamese and Koreans. If we consider only Vietnam and Korea, the predictions of the model for these countries are in the same direction as in the case of Vietnam and Taiwan because Korea is wealthier than Vietnam and has male-biased sex ratios. However, the model predictions are less clear when interactions occur among the three countries; for example, in this case, the cost of a cross-border marriage in one destination country increased, whereas this cost in another country decreased.

5.2 Impacts of decreases in costs of cross-border marriages in Vietnam

In this section, I evaluate the impact of the changes in the cost of cross-border marriages in Vietnam, which is the bride-sending country. Specifically, I focus on testing the model's prediction on intra-household allocations, which could not be fully tested in the Taiwanese setting because of a lack of variations within the country. To investigate intra-household allocations, I exploit a unique feature in Vietnam: considerable geographic variations in the origin of Vietnamese marriage migrants.³² In the following subsection, I provide background information on the identification strategy. Then, I introduce the data and present the results.

5.2.1 Background: Emergence of matchmaking firms and geographic concentrations of cross-border marriages

In this subsection, I describe the two sources of variations that I use to identify the impacts of a cost decrease on the intra-household allocation outcomes of Vietnamese couples: the emergence of matchmaking firms in the late 1990s and the geographic concentration of cross-border marriages in certain areas of Vietnam. In particular, I explain why these can plausibly be used as exogenous variations.

Emergence of matchmaking firms: The sudden increase in cross-border marriages between Taiwan and Vietnam during the 1990s was related to the reduced physical cost of cross-border marriages. The active economic interaction between Taiwan and Vietnam since the early 1990s eased travel between the two countries. Moreover, the emergence of cross-border matchmaking firms in Taiwan and Vietnam facilitated efficient meetings of potential grooms and brides.³³ Although the matchmaking firms began to operate in the early 1990s, the most rapid expansion was during the late 1990s and the matchmaking service became known to ordinary people in Taiwan only after the late 1990s (Tseng [2016]).³⁴

³²Using the geographic variations in Vietnam implicitly assumes multiple marriage markets in the country. This assumption is reasonable because cross-provincial marriages are rare. One concern could be that interactions between the marriage markets in each province could have occurred when the cost of cross-border marriages changes. However, this is unlikely the case because internal migrations were not significantly different in the affected and non-affected provinces during the periods of study (1997-2004).

³³The entire marriage package had a cost of US\$10,000-20,000 in 2000, which was usually paid by the Taiwanese men.

³⁴The entire marriage process is efficient and quick and takes at most a month. Matchmaking firms operate on both sides of the market. Those in Taiwan recruit men who want to marry Vietnamese women. They organize trips to Vietnam to introduce several potential brides to the potential groom. If the marriage is successfully arranged, a wedding usually takes place in Vietnam and the couple returns to Taiwan together. Potential brides are recruited by small branches of matchmaking firms in Vietnam. These matchmakers visit the communities and recruit females who want to marry foreign men.

I use the sudden increase in matchmaking firms and, thus, the number of cross-border marriages in the late 1990s to identify the impact of cross-border marriages on intra-household allocations (Figure 10). Given the structure of matchmaking services wherein Taiwanese men visiting Vietnam choose their Vietnamese bride, the variations in the number of cross-border marriages between Taiwan and Vietnam were primarily driven by the demand factor.³⁵ This sudden increase was less predictable from the Vietnamese side, making it exogenous to the Vietnam side. To some extent, the Vietnamese may have predicted the increase in such a demand. However, it is unlikely that the local couples perfectly expected this sudden increase, fully internalized this expectation, and changed their household behaviors based solely on expectations of possibly out-migrating women.

Geographic concentration of cross-border marriages: Because Internet use was not very common in Vietnam until the early 2000s, most cross-border marriages could only happen through brokerage firms or networks of migrant brides— a situation that is notably different compared with the mail-order bride systems that operate online today.³⁶ This feature made cross-border marriages highly concentrated in certain regions wherein the networks of matchmaking firms were located.

Marriage migration was highly concentrated in the southern regions of the country, particularly the Mekong Delta region and certain provinces of the Southeast region; more than 99 % of women who married Taiwanese men in 2003 were from either of the two regions (Nguyen and Tran [2010]).³⁷ This condition was mainly driven by the locational decisions of marriage brokerage firms; in 2002, more than two-hundred matchmaking agencies visited the Taiwan Economic and Cultural Office (TECO) in the southern region, but only two visited the north and none visited central Vietnam (Wang and Chang [2002]).³⁸ The intensity of the sudden increase in cross-border marriages is depicted in Figure 11. Such provincial differences in the intensity add a nice layer of variation that can be used to identify the effect of cross-border marriages. However, before moving on to the main analysis, understanding why such geographic patterns appeared is imperative.

Extensive research on the prior literature and institutional background suggests four potential

³⁵Finding evidence that Taiwanese men could not find spouses in Vietnam because of a short supply of potential brides is difficult.

³⁶As of 2002, only 0.25 percent of the population had access to the Internet (Lam et al. [2004].) According to the Vietnam Internet Network Information Center (VNNIC), by the end of 2012, 35.4% of the population was Internet users. Internet penetration has steadily increased since the mid-2000s, and the origins of marriage migrants has become more diverse, although 60-70% of marriage migrants still came from the Mekong Delta or Southeast regions through the established networks.

³⁷As of 2004, Vietnam consisted of eight regions and sixty-four provinces. Currently, the country has fifty-eight provinces. The lower administrative tiers include districts and communes.

³⁸TECO is a representative office alternative to an embassy or a consulate that handles visa-related issues.

drivers of the location of cross-border marriages: (1) the existence of the Chinese (Hoa) population, (2) the locations of foreign direct investments from Taiwan, (3) economic development of the provinces, and (4) the marriage market conditions.

The first and one of the most important factors is the existence of the Chinese (Hoa) population in those regions. Because brokerage firms need to communicate in both Vietnamese and Chinese (Taiwanese), most matchmakers are ethnic Chinese (Wang and Chang [2002]). Ethnic Chinese are concentrated in the southern part of the country.³⁹ Second, foreign direct investments from Taiwan could have played a role. It is easier for Taiwanese matchmaking firms to penetrate the province when an established network of Taiwanese people exists.⁴⁰ The third potential driver is the economic development of the provinces; that is, the matchmakers may have selected less developed provinces because doing so would make the financial benefits of international marriage stand out further. However, this possibility is limited because the Mekong Delta is not a very poor region; out of six regions included in the study, it has the third-largest average household expenditures. Finally, the marriage market conditions—typically proxied by sex ratios—could have affected the brokerage firms’ locational decisions. If there is a considerable variation in sex ratios across provinces, the matchmakers may have selected the provinces with more females. This selection can be especially problematic because sex ratios are known to be associated with the status of women (Angrist [2002]; Chiappori et al. [2002]; Abramitzky et al. [2011]). However, the comparison of sex ratios by age in two affected regions reveals that no systematic pattern of sex ratios exist, especially for the cohorts that were likely to be affected.

To understand which of these stated factors affect the geographic distribution of marriage migrants, I investigate the relationship between cross-border marriage intensity and potential drivers. By exploring their correlation, I find the factors that were indeed relevant. Based on this process, I assess whether concerns exist for the identification of the effect in question.

Table 6 suggests that the presence of the Hoa population is the strongest predictor of the location choice by brokerage firms. FDI had no effect on the intensity of cross-border marriages, as did the

³⁹In the past, a significant number of Hoa people resided in the north; however, more than 90% of them were forced to emigrate to China by 1980. Many Chinese in the south also left Vietnam in the late 1970s and early 1980s but to a much lesser degree than in the north (Banister [1985]). As a result, the vast majority of the current Hoa population lives in the southern parts of Vietnam.

⁴⁰Taiwan was the largest investor in Vietnam in terms of the total registered capital by the end of 2006. The two largest recipients of FDI by Taiwan were Hanoi and Ho Chi Minh city, with higher concentrations in the south, especially in the initial years of investments (Minh [2011]).

sex ratio. Furthermore, brokerage firms did not select into the poorest areas; rather, provinces with a higher intensity of outflow of women were slightly wealthier than in other areas.

Although these findings alleviate many potential concerns, they leave us with the question of the comparability of regions with and without a Hoa population, especially in terms of the status of women or the related characteristics. If the existence of a Hoa population was systematically correlated with those factors, it would pose problems for the identification. However, that is not likely the case for several reasons. First, even in the provinces in which the Hoa population is relatively large, the proportion of the ethnic group is nevertheless very small. The average proportion of the Hoa population across all the provinces that sent any positive number of brides was 0.8%, whereas the major ethnicity is Kinh, as in all other areas. Even if the Hoa population had different characteristics, its sheer population size makes it unrealistic—if not impossible—to assume that provinces with a larger Hoa population are different from the other provinces in terms of female status.

Furthermore, province-level characteristics do not move exactly as how that the cross-border marriages are distributed. The variables used as covariates or dependent variables are fairly well-balanced across the areas (Table 7).⁴¹ One concern is the lower education level in the areas with higher numbers of marriage migrants. However, relative education, which has been known to be critical in determining the couples' bargaining positions (Browning et al. [1994]; Oreffice [2011]; Browning et al. [2014]), is fairly similar across the areas because the education levels of husbands and wives are *both* lower in areas with many marriage migrants. Although this alleviates the potential concerns regarding education levels, I also control for the education levels of husbands and wives in the main analysis to capture any effects of education on women's positions within their marriage. To account for any potential change in the economic environment, I control for the time-varying FDI at the province level and household-level expenditures.

5.2.2 Data

Data on household expenditures: To understand how cost changes affect the intra-household resource allocations of married couples, I utilize the Vietnam Living Standards Survey (VLSS) in 1997-98 and the Vietnam Household Living Standards Survey (VHLSS) in 2002 and 2004, which contained detailed household-level expenditures. These surveys were conducted as part of the Living

⁴¹The additional variables from the census also show that there are no systematic patterns of the geographic distribution of marriage migrants on observables, including industry composition and literacy rate.

Standards Measurement Survey of the World Bank.⁴²

I focus on the samples of married couples with a husband aged between 20 and 45 years. I restrict my sample to married couples living in rural areas because most marriage migrants have been from the rural areas, and economic investment was active in urban areas. Additionally, two regions in mountainous areas are excluded from the analysis because of their considerably different ethnic composition from the rest of the country.⁴³ For a similar reason, I also exclude two provinces with less than sixty percent of Kinh, the major ethnicity in Vietnam.⁴⁴

Data on the intensity of cross-border marriages in each province: I use the visa counting of the Taipei Economic and Cultural Office (TECO) in Ho Chi Minh City in 2003 to construct a measure of the intensity of cross-border marriages in each province. The TECO keeps province-level records on the number of people who obtained interviews with the TECO, which is required for Vietnamese who want to migrate to Taiwan, as well as on the number of people who were granted Taiwanese visas for the cross-border marriages.⁴⁵ I use the total number of visas issued for marriage migration scaled by the population of marriageable women in each province as an intensity measure.⁴⁶

Data on other factors: The population size of the Hoa people and sex-ratios are calculated from the 1989 and 1999 Vietnamese decennial census. The data on the number of foreign direct investment firms are from the Chamber of Commerce and Industry of Vietnam (VCCI) for the 1990s and from the General Statistics Office of Vietnam (GSO) for the 2000s.

⁴²The VLSS was first conducted in 1992-93, and another wave in 1997-98 is available. The VHLSS has been collected every two years since 2002. The VHLSS maintains the structure of the VLSS with some modifications. However, the expenditure sections are largely comparable across different waves of the VLSS and the VHLSS. I do not use the 1992-93 VLSS because no consumer price index covered this period, making it difficult to construct a harmonized measure of expenditures.

⁴³The two excluded regions are the Northeast and Northwest. As of 2009, the fractions of Kinh were 51.28% and 19.51%, respectively. Other regions except for the Central Highlands have at least 80% of Kinh. Kom Tum, a province with a very low fraction of Kinh in the Central Highlands, is also excluded.

⁴⁴The excluded provinces are Kon Tum and Gia Lai in central Vietnam. As of 2009, the fractions of Kinh in those provinces were 37.32% and 49.52%, respectively. The purpose of excluding these areas is mainly to make the control group comparable to the treatment group. The results are stronger when those areas are included in the samples.

⁴⁵Because another TECO is located in Hanoi, Vietnam, this number might underestimate the number of marriage migrants in north Vietnam. However, many sources (Do et al. [2003]; Nguyen and Tran [2010]) indicate that most marriage migrants come from the south. Wang and Chang [2002] reported that more than 240 marriage agencies were registered at the TECO in HCMC, whereas only two agencies visited the TECO in Hanoi for migration documents in 2002.

⁴⁶It is difficult to determine the precise number of marriageable women in each province. As a proxy for that, I use the size of female population aged 21, which is the average age of first marriage for females.

5.2.3 Results

Prediction 4 (Intra-household allocations). *When the cost of cross-border marriage decreases, the power of wives within households improves whereas the power of husbands deteriorates on the bride-sending side.*

The prediction suggests that if the cost of cross-border marriages decreases, the power of women within households improves. That of men within households in Vietnam decreases. This is because sex ratio gets more male-skewed for Vietnam when the markets are more integrated, given the male-skewed sex ratios in Taiwan and the balanced sex ratios in Vietnam. This situation is favorable to Vietnamese women because they become relatively scarcer.

Because we do not observe the equilibrium shares of husbands and wives, it is challenging to test the predictions on intra-household allocations. However, this challenge can be overcome if we observe expenditures on gender-exclusive goods. The collective model literature (e.g., see Browning et al. [2014]) has extensively shown that if the Pareto weights (respective powers) of husbands and wives change toward the wives, the consumption patterns of gender-exclusive goods change in favor of the wives. Thus, if the equilibrium shares of husbands and wives change, we expect to observe a larger consumption for women-exclusive goods and a smaller consumption for men-exclusive goods.

As a measure to proxy how the gains from marriage are shared within couples, I use tobacco as the men-exclusive good and the category of jewelry, watches, and make-up category as the women-exclusive goods. In Vietnam, smoking is considered to be a crucial part of male social behavior, and the smoking rate of men is much higher than that of women. In 1997-8, in rural areas, the smoking rate was 52.2%, and that of women was 3.9% (Morrow and Barraclough [2003]), suggesting that tobacco is a good candidate for a male-exclusive good.⁴⁷ Because women represent the majority of luxury (jewelry and watch) consumers in Vietnam (Luxury Market in Vietnam report, 2009), jewelry, watch, and make-up are likely to be women-intensive expenditures. However, there is a potential concern about watches because they can be a gender-neutral good. The data alleviate this concern: less than 3% of single male households spent a positive amount on the jewelry, watches, and make-up category, suggesting that the assumption that this category pertains to women-exclusive consumption is reasonable.

I begin by investigating the expenditure patterns in the affected areas and unaffected areas before

⁴⁷In the entire country, the smoking rate was 50.7% for men and 3.5% for women.

and after the large outflow of women in the late 1990s. More specifically, I compare the patterns before and after the sudden increase in cross-border marriages in the late 1990s. The years 1997-8 serves as the pre-treatment period, and 2002 and 2004 are the post-treatment periods. My baseline model has the following form:

$$y_{hpt} = \delta_p + \gamma_t + X'_{hpt}\beta + Z'_{pt}\theta + \varphi Post_t * M_p + \varepsilon_{hpt}$$

where the subscript h denotes household, p the province, and t the year. The dependent variable y_{hpt} is the consumption (share) of women- and men-exclusive goods. M_p is the intensity of cross-border marriage in province p . $Post_t$ is a binary variable that is equal to 1 if the year is after the surge of cross-border marriages and 0 otherwise. X_{hpt} is a vector of control variables at the household level. This vector includes age, age squared, education, dummies of ethnicity of husband (or wife), total expenditures, and the number of children. Z_{pt} is a vector of time-varying characteristics at the province level that includes the consumer price index and foreign direct investments. The regressions include the province fixed effect δ_p and year fixed effect γ_t absorbing the time-invariant province effect and province-invariant time effects.

The coefficient of interest is φ , which measures whether provinces with larger outflows of women consumed larger amounts of women-exclusive goods or smaller amounts of men-exclusive goods.

The results in Table 8 indicate that households in areas with more marriage migrants consume less tobacco but more jewelry, watches, and make-up. In areas with a 10% percent outflow of women, households on average spend approximately 45,000 VND less on tobacco and 27,000 VND more on jewelry, watches, and make-up. Tobacco consumption decreased approximately 2% in the areas with one more percentage point of outflows of women because of marriage migration. For women-exclusive goods, a one percentage point increase in the outflow of women is associated with an approximately 5% increase in women-exclusive good consumption. The results are similar when shares are used instead of levels of expenditures.

With the data on gender-exclusive expenditures and provincial exposure to cross-border marriages, it is possible to draw broader implications for the resource allocations of married couples using a structural model. In particular, it is possible to identify the partials of the sharing rule (i.e., how much the shares of husbands and wives change with respect to the exposure to cross-border marriages

and to the total private expenditures) of married couples using a collective model and the well-known identification results of Chiappori et al. [2002] with a slight modification. The details of the model are presented in the Appendix. Here, I provide only the results.

In Table 9, the partial with respect to total private expenditures indicates that a one-unit (1,000VND) increase in total private expenditures is associated with a 0.57-unit increase in the husbands' share. When the expenditure increases, husbands take up approximately 14 percentage points more than their wives. The partial with respect to cross-border marriages suggests that a one percentage point increase in the outflow of women is associated with a 193 (1,000VND) less share of husbands. This amounts to approximately the value of 120 pounds of rice. In other words, women in the areas with more outflow of women control more money within the household.

Considering these estimates, the impact of cross-border marriages is substantial for women's power within the households. Furthermore, cross-border marriages can have an implications for children's outcomes because women's increased power within households is known to be related to better outcomes for children (Duflo [2012]).

6 Conclusion

This paper examines the economic impacts of cross-border marriages in *both* migrant-sending and migrant-receiving countries by answering four questions: (i) who moves, (ii) who benefits, (iii) who loses, and (iv) to what extent. I first develop a theoretical framework to comprehensively understand these multifaceted issues and then provide empirical evidence to support these theoretical predictions. Although multidimensional matching models with one discrete characteristic and one continuous characteristic are interesting and relevant to many real-world situations, they have not been explored extensively in the literature (Chiappori et al. [2017]). This paper finds a new equilibrium with additive costs and provides highly relevant empirical applications.

I show that the selection of cross-border couples is governed by the demographic structures and economic conditions of the countries involved and by the costs of cross-border marriages. Agents with low SES cannot engage in cross-border marriages because of the associated costs. Agents with high SES in the wealthier country also do not marry across borders because they can secure better domestic partners. I also find that the long sides of marriage markets benefit, and the short sides lose, from the reduced cost of cross-border marriages on various margins. Through marriage market equilibrium effects, the flows of marriage migrants affect not only the direct marital outcomes but

also the respective power of *all* men and women in both countries by altering their shadow prices in the markets.

The situation in Taiwan and Vietnam may seem unique in several ways. However, there are many other examples of marriage markets that actively interact. For example, there are up to 300,000 Turkish-Russian married couples, and the spousal category accounted for 40% of migrant settlements in the United Kingdom in 2009 (Charsley et al. [2012]). Other European countries, including Spain, France, and Switzerland, have also experienced an increase in the number of cross-border marriages in the past two decades, which could be explained by the negligible associated costs within the European Union. Moreover, long-lasting sex ratio imbalances in China and India could affect the dynamics of the neighboring countries' marriage markets. The framework developed in this paper sheds light on why this phenomenon occurs, who becomes a marriage migrant, and to what extent this phenomenon can affect the welfare of the local people.

This paper also illustrates the implications of cost-changing policies for marriage markets and women's power. Many countries faced with increasing immigration, including Taiwan, South Korea, Denmark, and the Netherlands, have implemented restrictive immigration policies. The results of this paper suggest that such policies can have broad influences on populations because they can affect the economic decisions of every man and woman in the countries involved, not only those who are in or considering cross-border marriages. In countries with male-skewed sex ratios, lowering the cost of entry for women from other countries can certainly mitigate the imbalances in the marriage market. However, at the same time, it can decrease local women's power within households and affect the marital outcomes of the local people. These findings highlight that the related costs and benefits should be carefully weighed when designing immigration policies.

References

- ABRAMITZKY, R., A. DELAVANDE, AND L. VASCONCELOS (2011): “Marrying up: the role of sex ratio in assortative matching,” *American Economic Journal: Applied Economics*, 124–157.
- ADDA, J., P. PINOTTI, AND G. TURA (2019): “There’s More to Marriage than Love: The Effect of Legal Status and Cultural Distance on Intermarriages and Separations,” Tech. rep., mimeo.
- ALMOND, D., H. LI, AND S. ZHANG (2019): “Land Reform and Sex Selection in China,” *Journal of Political Economy*, 127, 560–585.
- ANDERSON, S. AND D. RAY (2012): “The age distribution of missing women in India,” *Economic and Political Weekly*, 87–95.
- ANGRIST, J. (2002): “How do sex ratios affect marriage and labor markets? Evidence from America’s second generation,” *Quarterly Journal of Economics*, 997–1038.
- ANUKRITI, S. (2018): “Financial incentives and the fertility-sex ratio trade-off,” *American Economic Journal: Applied Economics*, 10, 27–57.
- BANISTER, J. (1985): *The Population of Vietnam*, 77, US Department of Commerce, Bureau of the Census.
- BECKER, G. S. (1973): “A theory of marriage: Part I,” *Journal of Political economy*, 81, 813–846.
- BERGSTROM, T. C. AND R. C. CORNES (1983): “Independence of allocative efficiency from distribution in the theory of public goods,” *Econometrica: Journal of the Econometric Society*, 1753–1765.
- BERTOLI, S., J. F.-H. MORAGA, AND F. ORTEGA (2013): “Crossing the border: Self-selection, earnings and individual migration decisions,” *Journal of Development Economics*, 101, 75–91.
- BORJAS, G. J. (1987): “Self-selection and the earnings of immigrants.” *American Economic Review*, 77, 531–53.
- BRONSON, M. A. AND M. MAZZOCCO (2017a): “Cohort Size and The Marriage Market: Explaining a Century of Changes in U.S. Marriage Rates,” *Working Paper*.
- (2017b): “Cohort Size and The Marriage Market: What Explains the Negative Relationship?” *Working Paper*.

- BROWNING, M., F. BOURGUIGNON, P.-A. CHIAPPORI, AND V. LECHENE (1994): “Income and outcomes: A structural model of intrahousehold allocation,” *Journal of political Economy*, 102, 1067–1096.
- BROWNING, M., P.-A. CHIAPPORI, AND Y. WEISS (2014): *Economics of the Family*, Cambridge University Press.
- CALVI, R. (2020): “Why are older women missing in India? The age profile of bargaining power and poverty,” *Journal of Political Economy*, 128, 2453–2501.
- CARLANA, M. AND M. TABELLINI (2018): “Happily Ever After: Immigration, Natives? Marriage, and Fertility,” .
- CHARLES, K. K. AND M. C. LUOH (2010): “Male incarceration, the marriage market, and female outcomes,” *The Review of Economics and Statistics*, 92, 614–627.
- CHARSLEY, K., B. STORER-CHURCH, M. BENSON, AND N. HEAR (2012): “Marriage-Related Migration to the UK,” *International Migration Review*, 46, 861–890.
- CHIAPPORI, P.-A. (2017): *Matching with Transfers: The Economics of Love and Marriage*, Princeton University Press.
- CHIAPPORI, P.-A., B. FORTIN, AND G. LACROIX (2002): “Marriage market, divorce legislation, and household labor supply,” *Journal of Political Economy*, 110, 37–72.
- CHIAPPORI, P.-A. AND E. GUGL (2014): “Necessary and sufficient conditions for transferable utility,” Tech. rep., Mimeo, Columbia University.
- CHIAPPORI, P.-A., R. J. MCCANN, AND L. P. NESHEIM (2010): “Hedonic price equilibria, stable matching, and optimal transport: equivalence, topology, and uniqueness,” *Economic Theory*, 42, 317–354.
- CHIAPPORI, P.-A., R. J. MCCANN, AND B. PASS (2016): “Multi-to One-Dimensional Optimal Transport,” *Communications on Pure and Applied Mathematics*.
- CHIAPPORI, P.-A., S. OREFFICE, AND C. QUINTANA-DOMEQUE (2017): “Bidimensional matching with heterogeneous preferences: education and smoking in the marriage market,” *Journal of the European Economic Association*.

- CHIQUIAR, D. AND G. H. HANSON (2005): “International migration, self-selection, and the distribution of wages: Evidence from Mexico and the United States,” *Journal of Political Economy*, 113, 239–281.
- DO, T. N. T., H. GLIND, P. KELLY, G. KAMPHUIS, M. HEESWIJK, D. MCARTHUR, N. PHAN, T. TONG, A. TRAN, AND T. TRAN (2003): “Marriages of Convenience: Context, processes and results of cross-border marriages between Vietnamese young women and Taiwanese men,” *Mobility Research and Support Center, Hanoi*.
- DUFLO, E. (2012): “Women Empowerment and Economic Development,” *Journal of Economic Literature*, 50, 1051.
- EDLUND, L., E. M. LIU, AND J.-T. LIU (2013): “Beggar-Thy-Women: Foreign Brides and the Domestic Front—The Case of Taiwan,” *Working Paper*.
- ENGEL, E. (1895): *Die Lebenskosten belgischer Arbeiter-Familien früher und jetzt*, C. Heinrich.
- FEIGENBERG, B. (2017): “Fenced Out: Why Rising Migration Costs Matter,” *Working Paper*.
- FULFORD, S. L. (2015): “Marriage migration in India: Vast, varied, and misunderstood,” Tech. rep., Boston College Working Paper 820.
- FURTADO, D. (2016): “Fertility responses of high-skilled native women to immigrant inflows,” *Demography*, 53, 27–53.
- FURTADO, D. AND H. HOCK (2010): “Low skilled immigration and work-fertility tradeoffs among high skilled US natives,” *American Economic Review: Papers & Proceedings*, 100, 224–28.
- GOODKIND, D. (1997): “The Vietnamese double marriage squeeze,” *International Migration Review*, 108–127.
- INTERNATIONAL ORGANIZATION FOR MIGRATION (2015): “Asia-Pacific migration report 2015: Migrants’ contribution to development,” .
- KAWAGUCHI, D. AND S. LEE (2017): “Brides For Sale: Cross-border Marriages and Female Immigration,” *Economic Inquiry*, 55, 633–654.

- LAM, D. (1988): “Marriage markets and assortative mating with household public goods: Theoretical results and empirical implications,” *Journal of Human resources*, 462–487.
- LAM, D., J. BOYMAL, AND B. MARTIN (2004): “Internet diffusion in Vietnam,” *Technology in Society*, 26, 39–50.
- LEWBEL, A. (2008): “Engel curves,” *The New Palgrave Dictionary of Economics*, 2.
- LU, M. C.-W. (2008): “Gender, marriage and migration: contemporary marriages between mainland China and Taiwan,” Ph.D. thesis, Research School of Asian, African and Amerindian Studies (CNWS), Faculty of Arts, Leiden University.
- MINCER, J. (1978): “Family migration decisions,” *Journal of political Economy*, 86, 749–773.
- MINH, T. Q. (2011): “Two decades of Taiwan’s FDI in Vietnam - An Analysis and Assessment,” .
- MIZOGUCHI, N. (2010): “The Consequences of the Vietnam War on the Vietnamese Population,” .
- MORAGA, J. F.-H. (2011): “New evidence on emigrant selection,” *The Review of Economics and Statistics*, 93, 72–96.
- MORROW, M. AND S. BARRACLOUGH (2003): “Tobacco control and gender in south-east Asia. Part II: Singapore and Vietnam,” *Health Promotion International*, 18, 373–380.
- NGUYEN, X. AND X. TRAN (2010): “Vietnamese-Taiwanese Marriages,” *Asian cross-border marriage migration: Demographic patterns and social issues*, 157–176.
- OREFFICE, S. (2011): “Sexual orientation and household decision making.: Same-sex couples’ balance of power and labor supply choices.” *Labour Economics*, 18, 145–158.
- ROSENZWEIG, M. R. AND O. STARK (1989): “Consumption smoothing, migration, and marriage: Evidence from rural India,” *Journal of political Economy*, 97, 905–926.
- SANDELL, S. H. (1977): “Women and the economics of family migration,” *The Review of Economics and Statistics*, 406–414.
- SHAPLEY, L. S. AND M. SHUBIK (1971): “The assignment game I: The core,” *International Journal of game theory*, 1, 111–130.

- SMITH, J. P. AND D. THOMAS (1998): “On the road: Marriage and mobility in Malaysia,” *Journal of Human Resources*, 805–832.
- TSENG, H. (2016): *Racialization of Foreign Women in the Transnational Marriage Market of Taiwan*, Cultural Politics of Gender and Sexuality in Contemporary Asia, Chapter twelve.
- WANG, H.-Z. AND S.-M. CHANG (2002): “The Commodification of International Marriages: Cross-border Marriage Business in Taiwan and Viet Nam,” *International migration*, 40, 93–116.
- WEISS, Y., J. YI, AND J. ZHANG (2017): “Cross-border Marriage Costs and Marriage Behavior: Theory and Evidence,” *International Economic Review*, Forthcoming.
- YANG, W. S. AND Y.-Y. T. LIU (2014): “Gender imbalances and the twisted marriage market in Taiwan,” in *The Family and Social Change in Chinese Societies*, Springer, 117–130.
- ZHU, W. X., L. LU, AND T. HESKETH (2009): “China’s excess males, sex selective abortion, and one child policy: analysis of data from 2005 national intercensus survey,” *Bmj*, 338, b1211.

Table 1: Theoretical predictions on the impacts of cost increases

	Taiwan		Vietnam	
	Male	Female	Male	Female
Number of singles	+	·	-	·
Matching patterns	-	+	+	-
Intra-household allocation	-	+	+	-
Number of cross-border marriages			-	
Avg. type of female migrant			+	
Avg. type of male marrying a migrant			+	

Notes: This table summarizes the theoretical predictions on matching patterns, selections, and intra-household allocations in Taiwan and Vietnam when cost of cross-border marriage increases.

Table 2: The impact of the visa-tightening policy on marriage rate

Sample:	Dependent variable: Number of marriages per 1,000 singles							
	Males				Females			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low edu. X Post	-8.33*** (0.68)	-8.36*** (0.68)	-10.6*** (0.69)	-9.32*** (0.86)	2.19*** (0.50)	1.81*** (0.51)	-0.40 (0.54)	0.27 (0.79)
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Exc. lonely year	No	No	Yes	Yes	No	No	Yes	Yes
Exc. lonely year & ± 1 yrs	No	No	No	Yes	No	No	No	Yes
Dep. var. mean	36.6	36.6	36.6	36.6	35.1	35.1	35.1	35.1
R-squared	0.528	0.577	0.578	0.533	0.582	0.660	0.660	0.621
Observations	18,400	18,400	14,720	7,360	18,400	18,400	14,720	7,360

Notes: This table presents difference-in-differences estimates for the marriage rates for men and women. Low edu. represents people with primary education or junior high education. The control variables include dummies for districts, the number of singles for males and females at each educational level at each district. The 'lonely phoenix years' are 2004 and 2009. Standard errors are clustered at the district level. Significance levels: * 10%, ** 5%, *** 1%. Source: The Department of Household Registration, Taiwan.

Table 3: The impact of visa-tightening policies on matching patterns

	Dep. var.: Husband years of schooling		
	(1)	(2)	(3)
Non-Univ. X Post	0.16* (0.097)	0.18* (0.097)	0.23** (0.097)
Edu/year controls	No	No	Yes
Indiv. controls	No	Yes	Yes
Dep. var. mean	13.64	13.64	13.64
R-squared	0.370	0.370	0.411
Observations	7,882	7,882	7,882

Notes: This table presents difference-in-differences estimates for the matching patterns. Non-Univ. represents the educational level of wives; it is one if the level of education for wife is below university. Otherwise, it is zero. Education-year level control variable includes the excess share of males with education higher than that of a given woman. Individual level controls are dummies for year of marriage, age of husband, age of wife, wife education and the excess share of males with education higher than that of a given woman. Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Source: The Women's Marriage, Fertility and Employment Survey 2006, 2010, 2013. The couples who married after 1998 are used as the samples. Only Taiwanese women are used as samples.

Table 4: The impact of visa-tightening policies on the SES of foreign brides

Dependent variable (=1):	Primary	Junior High	Senior High or Vocational	Univ. or above
After visa-tightening (=1)	-0.18*** (0.020)	0.073* (0.040)	0.066* (0.039)	0.043* (0.024)
Controls	Yes	Yes	Yes	Yes
Dep. var. mean	0.28	0.39	0.29	0.04
R-squared	0.007	0.001	0.006	0.005
Observations	116,399	116,399	116,399	116,399

Notes: This table displays the results from regressing each dependent variable (indicating foreign brides education) listed in the first row on a dummy for post visa-tightening policies and controls (marriage year fixed effects and county city fixed effects). Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Sources: the Census of Foreign Spouse, 2003 and the Foreign and Mainland Spouse Living Needs Survey, 2008. Only the foreign brides who marry and migrate at the same time and their grooms are included in the sample. The foreign brides or grooms who married in 1998 or after are included in the sample.

Table 5: The impact of visa-tightening policies on the SES of Taiwanese grooms of foreign brides

Dependent variable (=1):	Primary	Junior High	Senior High or Vocational	Univ. or above
After visa-tightening (=1)	-0.082*** (0.021)	-0.23*** (0.028)	0.19*** (0.040)	0.12*** (0.030)
Controls	Yes	Yes	Yes	Yes
Dep. var. mean	0.15	0.36	0.45	0.04
R-squared	0.006	0.023	0.015	0.018
Observations	116,399	116,399	116,399	116,399

Notes: This table displays the results from regressing each dependent variable (indicating groom education) listed in the first row on a dummy for post visa-tightening policies and controls (marriage year fixed effects and county city fixed effects). Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Sources: the Census of Foreign Spouse, 2003 and the Foreign and Mainland Spouse Living Needs Survey, 2008. Only the foreign spouses who marry and migrate at the same time and their grooms are included in the sample. The foreign brides or grooms who married in 1998 or after are included in the sample.

Table 6: Determinants of exposure to cross-border marriages in Vietnam

	Dependent variable: Intensity of cross-border marriages			
		univariate		Multivariate
		Obs.	R-squared	
Hoa population in rural	0.00009** (0.00004)	50	0.100	0.00007* (0.00004)
Number of FDI firms by Taiwan	-0.00102 (0.0013)	50	0.001	-0.00980 (0.00625)
Average household expenditures	0.00012 (0.00008)	50	0.025	0.00023 (0.00017)
Sex ratio of teenagers	-10.81 (9.75)	50	0.021	-4.62 (10.53)
Observations				50
R-squared				0.148

Notes: The dependent variable is the intensity of cross-border marriages in 2003, the number of marriage migrants divided by the female population of aged 21, at the province level. The Hoa population is calculated from the 1989 Vietnamese census, which is the pre-period of cross-border marriages. For the sex ratios, I use the sex ratios of teenagers aged 15-17 using the 1999 Vietnamese census, and those ratios are the measures not contaminated by the marriages because the legal minimum age of marriage is 18. The data on FDI is the number of Taiwanese firms in each province in 1998. The average household expenditures are from the VLSS. Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Sources: the visa data from TECO HCMC, the Vietnamese census 1989, 1999, VLSS 1997-8, and the FDI data from the Chamber of Commerce and Industry of Vietnam (VCCI).

Table 7: Summary statistics (Vietnam)

	Mean value	Coefficients
Husband age (in years)	41.31 (1.97)	-0.051 (0.074)
Wife age (in years)	38.68 (1.94)	-0.030 (0.073)
Husband education (in years)	7.37 (1.34)	-0.126** (0.046)
Wife education (in years)	6.23 (1.66)	-0.140** (0.059)
Education differences (in years)	1.13 (0.69)	0.013 (0.026)
Kinh (%)	95.04 (10.84)	-0.257 (0.405)
Expenditure (in 1,000VND)	13469 (3976.33)	135.97 (147.91)
Tobacco expenditure (in 1,000 VND)	309.46 (147.75)	8.249 (5.401)
Jewelry, watch, make-up expenditure (in 1,000 VND)	47.30 (40.98)	1.064 (1.531)
N	50	50

Notes: This table represents the summary statistics of the characteristics at the province level before the sharp increase of cross-border marriages in the late 1990s. In column (2), the dependent variable is all the covariates and dependent variables used in the regression analysis. The coefficients are obtained by regressing each covariate and dependent variable on intensity of cross-border marriages. Significance levels: * 10%, ** 5%, *** 1%. Source: the VLSS 1997-8.

Table 8: Cross-border marriages and intra-household allocations in Vietnam

Dep. var.	(1) Tbc exp.	(2) JWM exp.	(3) Tbc share	(4) JWM share
Intensity of CBM \times Post	-4.48*** (1.63)	2.65*** (1.01)	-0.00030** (0.00013)	0.00023* (0.00012)
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Mean dep. var.	205.81	40.18	0.018	0.006
<i>N</i>	10,553	10,553	10,553	10,553

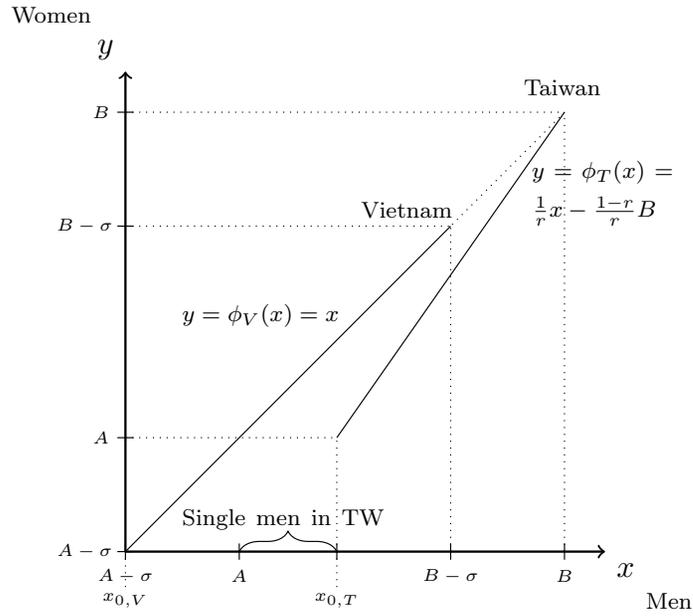
Notes: This table displays the difference-in-differences estimates of the impact of cross-border marriage on the expenditures of gender-exclusive goods. The household characteristics controls include age, age squared, education, dummies for the ethnicity of husband and wife, total expenditure, and the number of children. Time-varying controls include consumer price index and foreign direct investment at the province level. Significance levels: * 10%, ** 5%, *** 1%. Source: the VLSS 1997-8, VHLSS 2002 and 2004.

Table 9: Sharing rule estimates in Vietnam

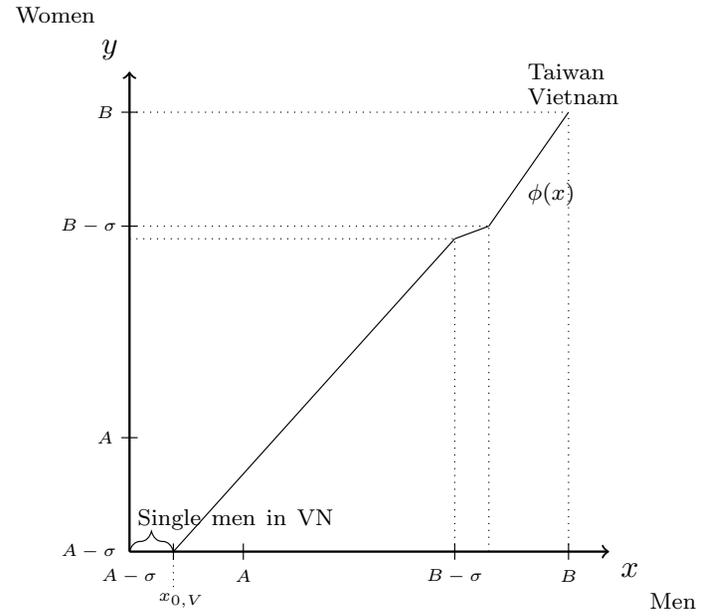
(1)	
Whole sample	
ϕ_x^H	0.57*** (0.13)
ϕ_s^H	-192.88*** (50.81)
Mean pvt. exp.	4270.11
N	10,553

Notes: This table displays the estimates of the partials of the married couples' sharing rule. ϕ^H indicates the share of husbands. ϕ_x^H and ϕ_s^H indicate the partials with respect to total private expenditure and the intensity of cross-border marriage, respectively. The household characteristics controls include age, age squared, education, dummies for ethnicity of husband and wife, total expenditure, and the number of children. Time-varying controls include consumer price index and foreign direct investment at province level. Significance levels: * 10%, ** 5%, *** 1%. Source: the VLSS 1997-8, VHLSS 2002 and 2004.

Figure 1: Matching functions



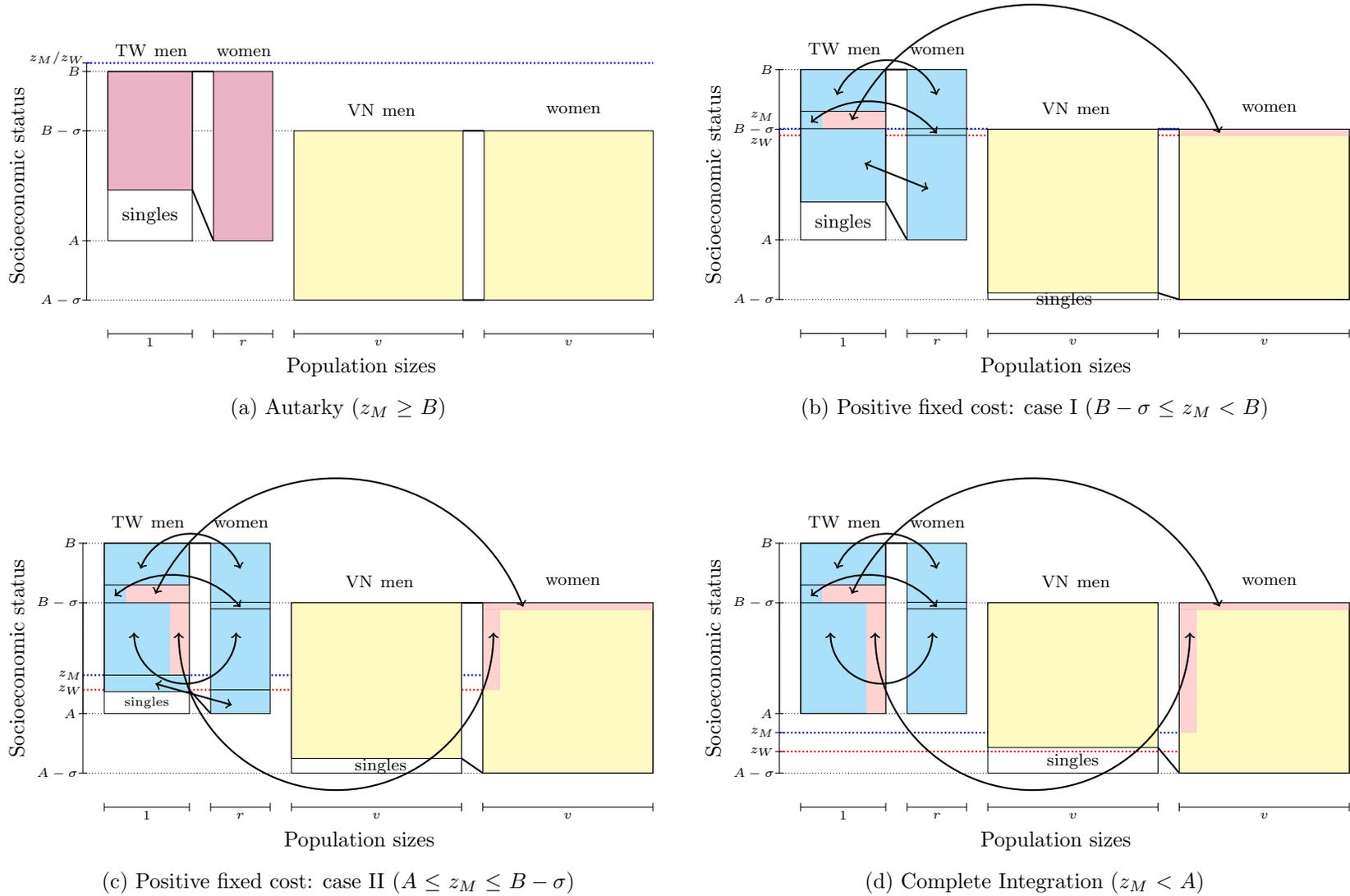
(a) Autarky



(b) Complete integration

Notes: These figures display the equilibrium matching functions in the cases of autarky and complete integration. For these illustrative figures, the parameter values $A = 2$, $B = 6$, $\sigma = 1.4$, $r = 0.7$, and $v = 2$ are used.

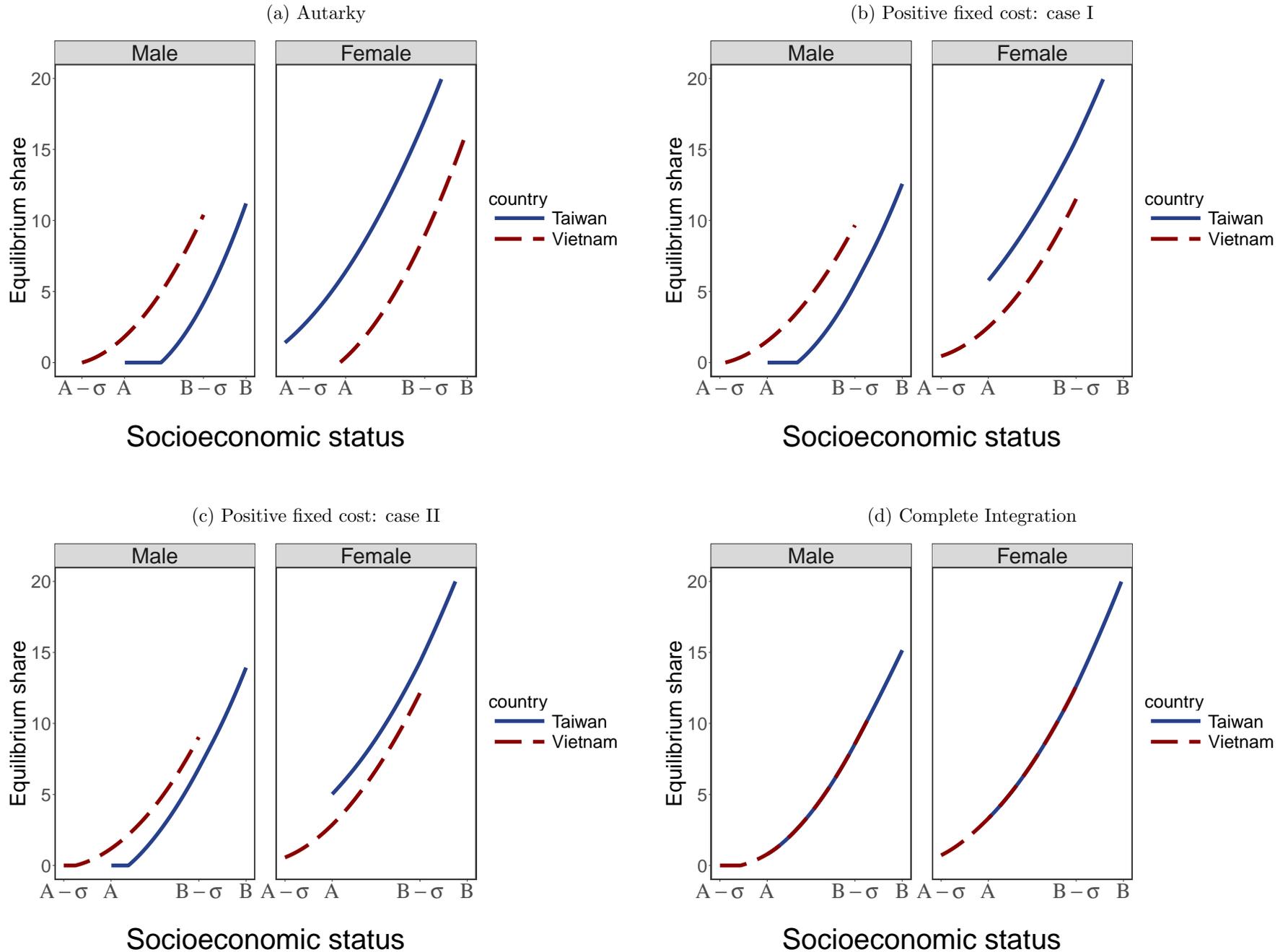
Figure 2: Matching equilibria under different costs



z_M (.....) : a cutoff of men above which matching is positive assortative regardless of nationalities
 z_W (.....) : a cutoff of women above which matching is positive assortative regardless of nationalities

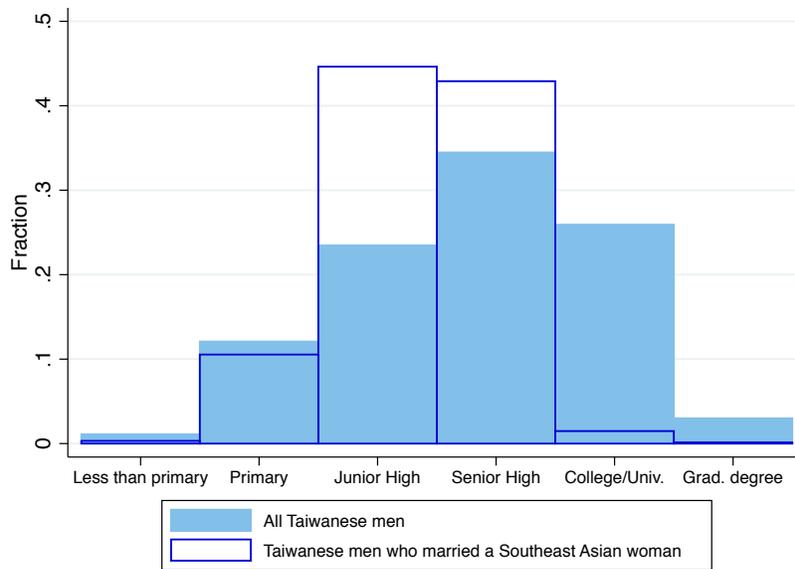
Notes: These figures display the matching equilibria under different cost λ . The width of each box denotes the mass of men and women in each country. Men and women in the same color areas match positive assortatively. For these illustrative figures, the parameter values $A = 2$, $B = 6$, $\sigma = 1.4$, $r = 0.7$, and $v = 2$ are used. $\lambda = 4.2$ and $\lambda = 2.2$ are used for (b) and (c), respectively.

Figure 3: Equilibrium shares of matching equilibria under different costs



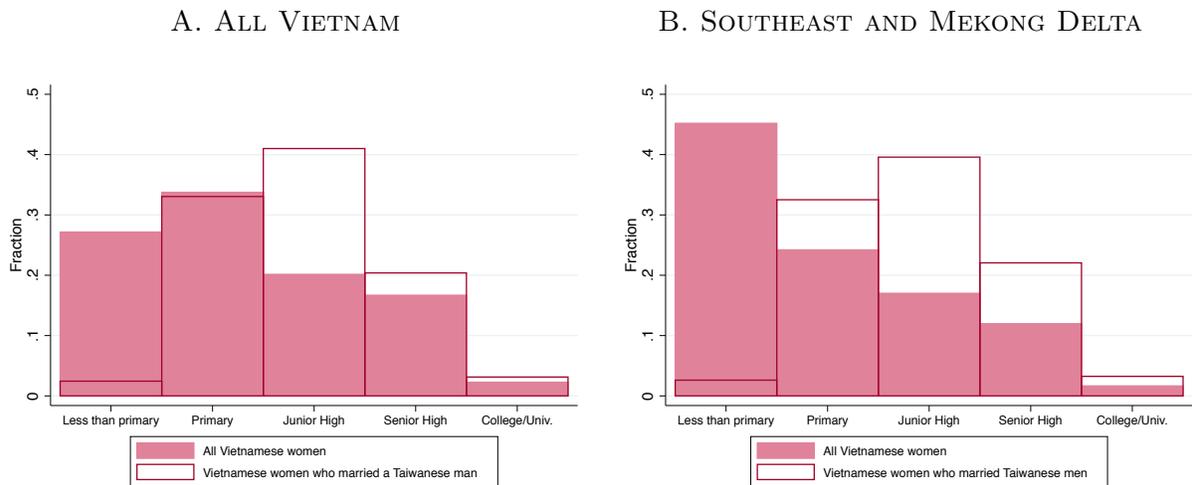
Notes: These figures display the equilibrium shares of the matching equilibria under different cost λ . For these illustrative figures, the parameter values $A = 2$, $B = 6$, $\sigma = 1.4$, $r = 0.7$, and $v = 2$ are used. $\lambda = 4.2$ and $\lambda = 2.2$ are used for (b) and (c), respectively. In (a), the equilibrium shares of Vietnamese men and women are not unique because of balanced sex ratio in Vietnam: the figure depicts the best (worst) possible case for Vietnamese women (men).

Figure 4: The selection of Taiwanese men who marry Vietnamese women



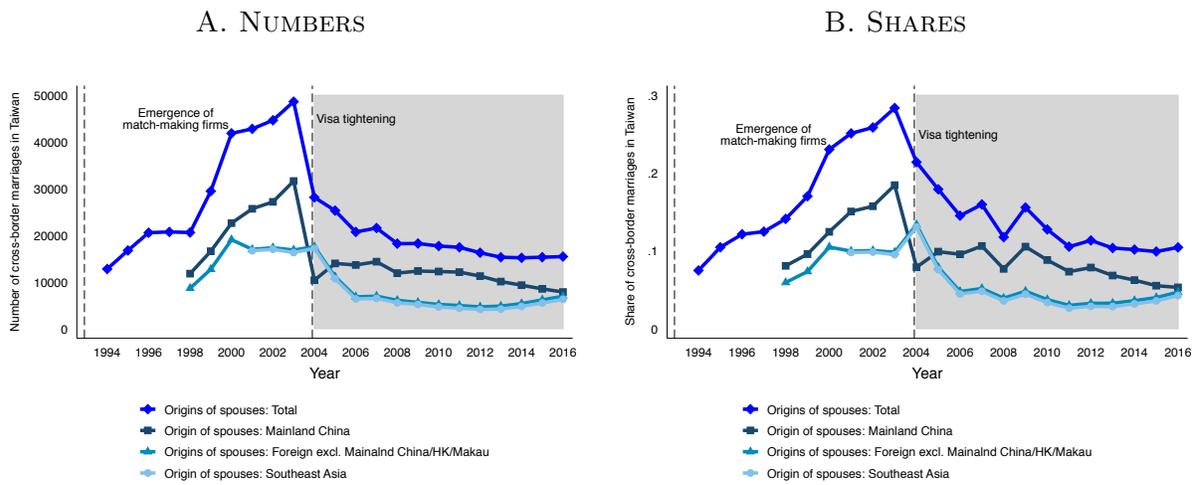
Notes: This figure displays the educational distributions of all Taiwanese men and Taiwanese men who married Vietnamese women. Sources: Taiwanese census 2000 and CFS 2003. I focus on men who were aged 28-53 in 2003.

Figure 5: The selection of Vietnamese women who marry Taiwanese men



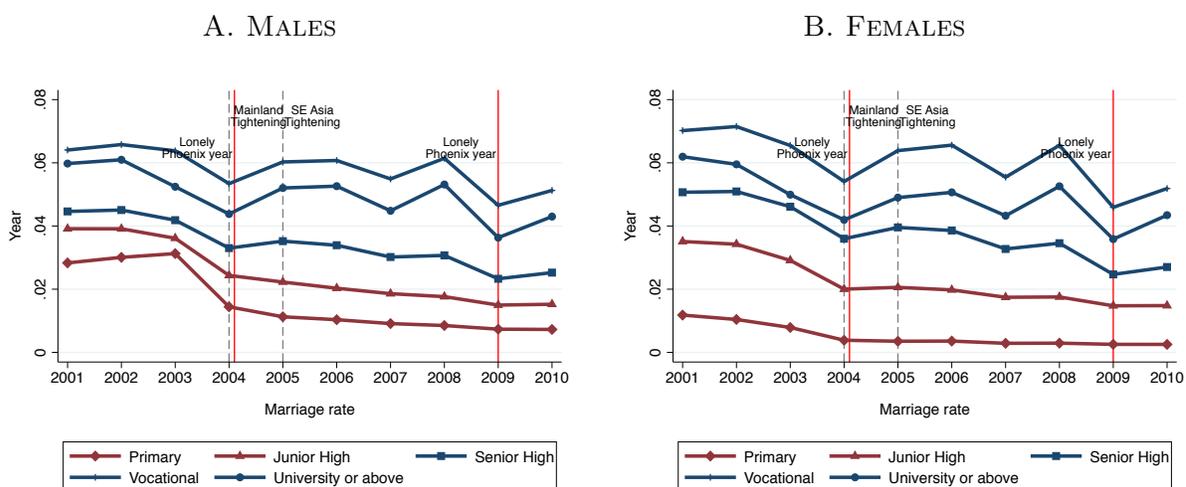
Notes: These figures display the educational distributions of all Vietnamese women and Vietnamese women who married Taiwanese men. The right panel displays the educational distribution of Vietnamese women in the Southeast and the Mekong delta regions, which are the origins of most Vietnamese women who marry Taiwanese men instead of the educational distribution of all Vietnamese women. Sources: Vietnamese census 1999 and CFS 2003. I focus on women who were aged 25-50 in 2003.

Figure 6: Numbers and shares of cross-border marriages in Taiwan



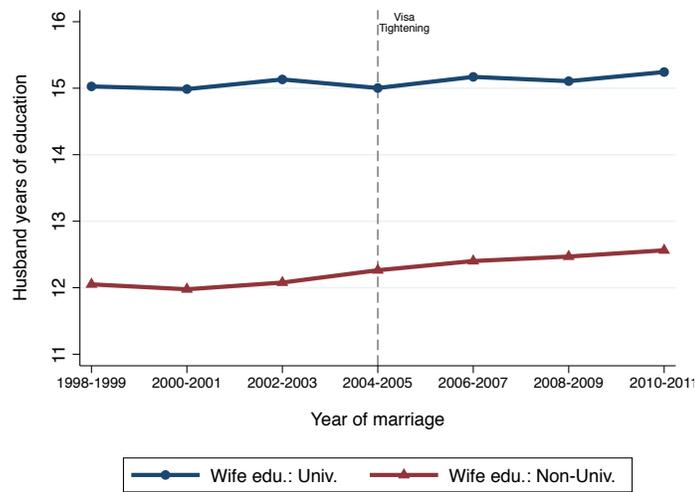
Sources: The Ministry of Interior, Taiwan. The numbers of cross-border marriages between 1994-1997 are from Wang and Chang [2002].

Figure 7: Marriage rates of Taiwanese men and women



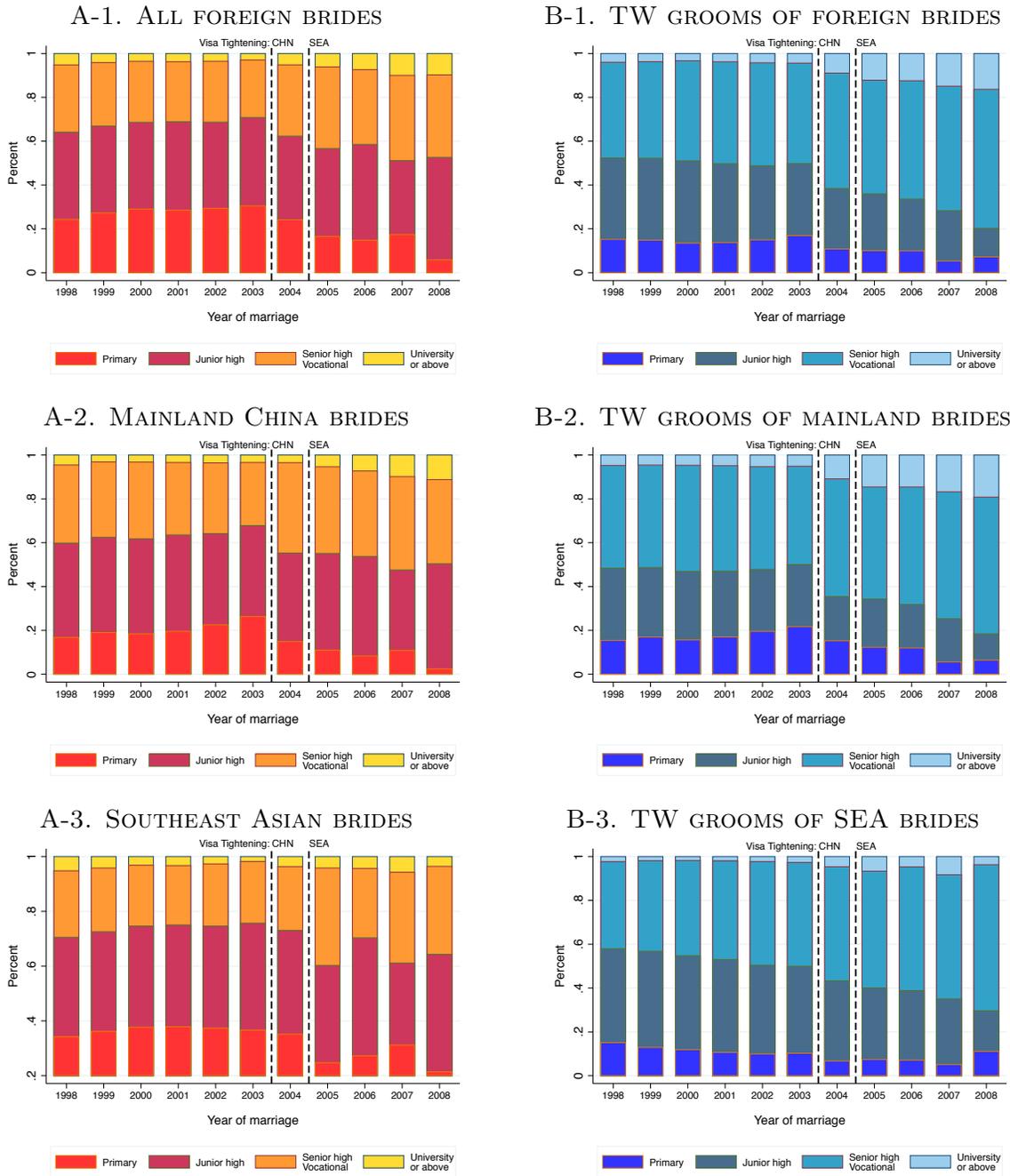
Notes: The figures plot the average of district-level marriage rate (defined as the number of marriages of Taiwanese divided by the number of the single population) by education for each gender. The grey lines indicate the implementation of the visa-tightening policies in 2004 and 2005, respectively. The red colors indicate the treated group and the blue colors indicate the control group. The red vertical lines indicate the 'lonely phoenix year' in 2004 and 2009. Source: The Department of Household Registration, Taiwan.

Figure 8: The average level of husbands' education by the level of wives' education



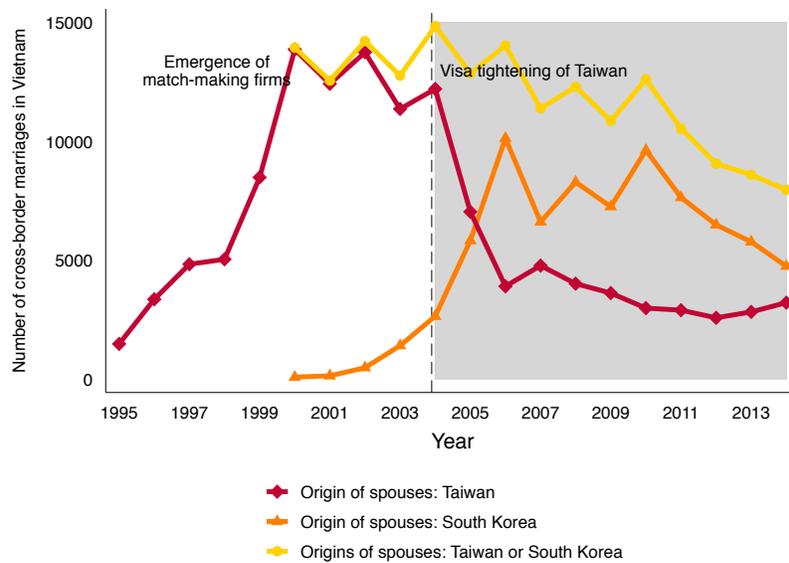
Notes: This figure plots the average level of husbands' education by education of wives in Taiwan. The grey dashed line indicates the implementation of the visa-tightening policies in 2004-2005. The red colors indicate the treated group and the blue colors indicate the control group. Source: The Women's Marriage, Fertility and Employment Survey 2006, 2010, 2013. The sample includes couples who married in 1998 or after. Only Taiwanese women are included in the sample.

Figure 9: The composition of education for foreign brides and their Taiwanese grooms



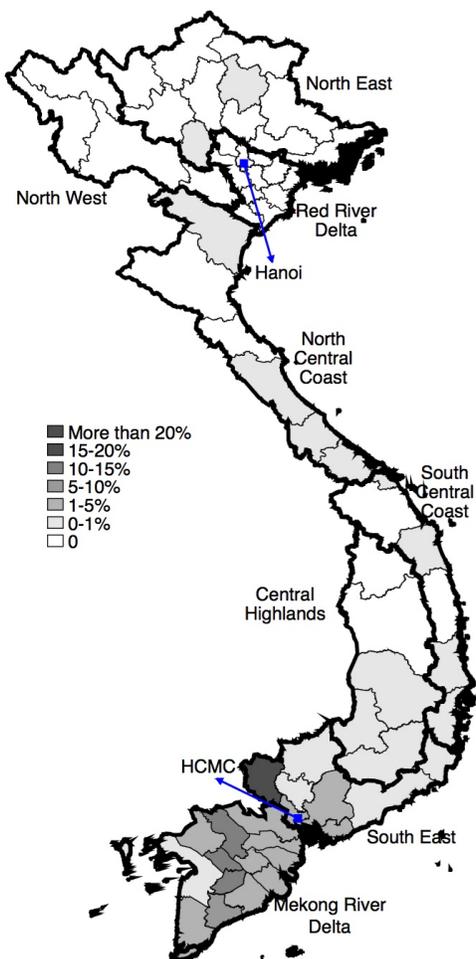
Notes: These figures depict the composition of education for foreign brides and their Taiwanese grooms. The left column is for the foreign brides and the second column is for the Taiwanese grooms. The second row uses only the subsample of mainland brides and their grooms. The third row uses the subsample of Southeast Asian brides and their grooms. The black dashed lines indicate the implementation of the visa-tightening policies in 2004 and 2005, respectively. As the 2008 data does not contain the origins of countries, it is impossible to draw this figure on the level of each individual country. Sources: the Census of Foreign Spouse, 2003 and the Foreign and Mainland Spouse Living Needs Survey, 2008. Only the foreign spouses who marry and migrate at the same time and their grooms are included in the sample. The foreign brides or grooms who married in 1998 or after are used as the samples.

Figure 10: The number cross-border marriages in Vietnam



Notes: This figure plots the number of cross-border marriages in Vietnam by destination countries. Sources: the numbers of cross-border marriages with Taiwanese in 1995-2003 and in 2004-2014 are from TECO HCMC and the Ministry of Interior, Taiwan, respectively. The numbers of cross-border marriages with Koreans are from the Statistics Korea.

Figure 11: Geographic distribution of cross-border marriages



Notes: This map represents the intensity of cross-border marriage at the province level. The intensity is calculated by dividing the number of cross-border marriages (visa counting) by the number of women at age 21, the mean age of first marriage in 2003 in each province. Source: the visa data from TECO HCMC (Taipei Economic and Cultural Office, Ho Chi Minh City) in 2003 and the 1999 Vietnamese census.

Appendix

A Proof of Proposition 1

Proof. 1. When $Y = Y'$

Suppose $x \geq x'$ but $y' > y$ on a subset of positive measure. Consider the surplus of $(x, X), (y, Y)$ and $(x', X), (y', Y)$ matches:

$$\Sigma_1 = \Sigma_{XY}(x, y) + \Sigma_{XY}(x', y') - 2\lambda \mathbb{1}(X \neq Y)$$

Switching the matching generates:

$$\Sigma_2 = \Sigma_{XY}(x, y') + \Sigma_{XY}(x', y) - 2\lambda \mathbb{1}(X \neq Y)$$

By supermodularity $\Sigma_2 > \Sigma_1$. Since $x \geq x'$ but $y < y'$ on a subset of positive measure, the surplus can be improved by switching. Contradiction.

2. When $Y \neq Y'$

Without loss of generality, let $Y = X$. Suppose $x \geq x'$ but $y' > y$ on a subset of positive measure. Consider the surplus of $(x, X), (y, Y)$ and $(x', X), (y', Y')$ matches:

$$\Sigma_1 = \Sigma_{XY}(x, y) + \Sigma_{X'Y'}(x', y') = S(x, y) + S(x', y') - \lambda$$

Switching the matching generates:

$$\Sigma_2 = \Sigma_{XY}(x, y') + \Sigma_{X'Y'}(x', y) = S(x, y') + S(x', y) - \lambda$$

By supermodularity $\Sigma_2 > \Sigma_1$. Since $x \geq x'$ but $y < y'$ on a subset of positive measure, the surplus can be improved by switching. Contradiction.

The proof of the second part is similar. □

B Proof of Proposition 2 and Proposition 6

Proof. Without a loss of generality, let X be T . Suppose a man x from country T is matched to either a woman y from country T or a woman y' from country V at the stable match. Let $u_T(x)$ be his utility. Then, by stability,

$$\begin{aligned} u_T(x) &= \max_s (S(x, s) - v_T(s)) \\ &= \max_{s'} (S(x, s') - \lambda - v_V(s')) \end{aligned}$$

where $v_T(s)$ ($v_V(s')$) is the utility of a woman from country T (a woman from country V) with the type s (s'); note that the maximum is reached at $s = y$ and $s' = y'$ respectively. By the envelope theorem:

$$u'_T(x) = \frac{\partial}{\partial x} S(x, y) = \frac{\partial}{\partial x} S(x, y')$$

Since $\frac{\partial S}{\partial x}$ is strictly increasing in y , $y = y'$.

From the stability conditions, we have

$$\begin{aligned} u_T(x) &= S(x, y) - v_T(y) \\ &= S(x, y) - \lambda - v_V(y) \end{aligned}$$

Thus, $v_V(y) + \lambda = v_T(y)$.

The second part can be proved similarly. □

C Proof of Proposition 3

Proof. Suppose $q(\bar{X}|y, X) > 0$. Then, (y, X) is matched to either (x, T) or (x, V) . The couples (x, T) , (y, V) and (x, V) , (y, T) generate the surplus of $\Sigma_1 = S(x, y) - \lambda + S(x, y) - \lambda$. If switching the match, the surplus is $\Sigma_2 = S(x, y) + S(x, y) > \Sigma_1$. Contradiction. The second part can be proved similarly. □

D Matching functions of Proposition 4

1. If $z_M(\lambda) \geq B - r\sigma$

- Same as autarky.

2. If $B - \sigma \leq z_M(\lambda) \leq B - r\sigma$

- Taiwanese men

- A Taiwanese man with $x \in [B - r\sigma, B]$ is matched to a Taiwanese woman y with probability 1.

$$y = \frac{1}{r}x - \frac{1}{r}B + B = \tilde{\phi}_T(x)$$

- A Taiwanese man with $x \in [z_M, B - r\sigma]$ is matched to a Taiwanese woman y

with probability $\frac{r}{r+v}$ and to a Vietnamese woman with y with probability $\frac{v}{r+v}$.

$$y = \frac{1}{r+v}x + B - \sigma - \frac{B - r\sigma}{r+v} = \hat{\phi}(x)$$

- A Taiwanese man with $x \in [x_{0,T}, z_M]$ is matched to a Taiwanese woman with y with probability 1.

$$y = \frac{1}{r}x - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B - \sigma) = \phi_T(x)$$

where $x_{0,T} = \phi_T^{-1}(A)$.

- Vietnamese men

- A Vietnamese man with $x \in [x_{0,V}, B - \sigma]$ is matched to a Vietnamese woman with y with probability 1.

$$y = x - z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B - \sigma) = \phi_V(x)$$

where $x_{0,V} = \phi_V^{-1}(A - \sigma)$.

- Taiwanese women

- A Taiwanese woman with $y \in [A, B]$ is matched to a Taiwanese man with x with probability 1.

$$\begin{aligned} x &= \tilde{\phi}_T^{-1}(y) \quad \text{if } y \geq B - \sigma \\ x &= \hat{\phi}^{-1}(y) \quad \text{if } z_W \leq y \leq B - \sigma \\ x &= \phi_T^{-1}(y) \quad \text{if } A \leq x \leq z_W \end{aligned}$$

where $z_W := \hat{\phi}(z_M)$.

- Vietnamese women

- A Vietnamese woman with $[z_W, B - \sigma]$ is matched to a Taiwanese man with x with probability 1.

$$x = \hat{\phi}^{-1}(y)$$

- Vietnamese women with $[A - \sigma, z_W]$ is matched to a Vietnamese man with x with probability 1.

$$x = \phi_V^{-1}(y)$$

3. If $B - r(B - A) \leq z_M(\lambda) \leq B - \sigma$

- Taiwanese men

- A Taiwanese man with $x \in [B - r\sigma, B]$ is matched to a Taiwanese woman y with probability 1.

$$y = \frac{1}{r}x - \frac{1}{r}B + B = \tilde{\phi}_T(x)$$

- A Taiwanese man with $x \in [B - \sigma, B - r\sigma]$ is matched to a Taiwanese woman y with probability $\frac{r}{r+v}$ and to a Vietnamese woman with y with probability $\frac{v}{r+v}$.

$$y = \frac{1}{r+v}x + B - \sigma - \frac{B - r\sigma}{r+v} = \hat{\phi}(x)$$

- A Taiwanese man with $x \in [z_M, B - \sigma]$ is matched to a Taiwanese woman with y with probability $\frac{r(1+v)}{r+v}$ and to a Vietnamese woman with y with probability $\frac{v(1-r)}{r+v}$.

$$y = \frac{1+v}{r+v}x + M - \frac{1+v}{r+v}(B - \sigma) = \phi(x)$$

where $M := \frac{1}{r+v}(B - \sigma) + B - \sigma - \frac{B-r\sigma}{r+v}$.

- A Taiwanese man with $x \in [x_{0,T}, z_M]$ is matched to a Taiwanese woman with y with probability 1.

$$y = \frac{1}{r}x - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B - \sigma) = \phi_T(x)$$

where $x_{0,T} = \phi_T^{-1}(A)$.

- Vietnamese men

- A Vietnamese man with $x \in [x_{0,V}, B - \sigma]$ is matched to a Vietnamese woman with y with probability 1.

$$\begin{aligned} y &= \frac{1+v}{r+v}x + M - \frac{1+v}{r+v}(B - \sigma) = \phi(x) \quad \text{if } x \geq z_M \\ y &= x - z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B - \sigma) = \phi_V(x) \quad \text{if } x \leq z_M \end{aligned}$$

where $x_{0,V} = \phi_V^{-1}(A - \sigma)$.

- Taiwanese women

- A Taiwanese woman with $y \in [A, B]$ is matched to a Taiwanese man with x with probability 1.

$$\begin{aligned}
x &= \tilde{\phi}_T^{-1}(y) \text{ if } y \geq B - \sigma \\
x &= \hat{\phi}^{-1}(y) \text{ if } M \leq y \leq B - \sigma \\
x &= \phi^{-1}(y) \text{ if } z_W \leq y \leq M \\
x &= \phi_T^{-1}(y) \text{ if } A \leq x \leq z_W
\end{aligned}$$

where $z_W := \phi(z_M)$.

- Vietnamese women

- A Vietnamese woman with $[M, B - \sigma]$ is matched to a Taiwanese man with x with probability 1.

$$x = \hat{\phi}^{-1}(y)$$

- A Vietnamese woman with $[z_W, M]$ is matched to Taiwanese man with x with probability $\frac{1-r}{1+v}$ and Vietnamese men with $[z_M, B - \sigma]$ with probability $\frac{r+v}{1+v}$.

$$x = \phi^{-1}(y)$$

- Vietnamese women with $[A - \sigma, z_W]$ is matched to a Vietnamese man with x with probability 1.

$$x = \phi_V^{-1}(y)$$

4. If $z_M(\lambda) \leq B - r(B - A)$

- Same as no cost.

E Individual utilities of Proposition 5 and the proof of Proposition 4 and 5

Proof. There are multiple ways to approach the problem. I start with a direct approach; assuming that the equilibrium is as explained in the Proposition, a complete characterization on matching and surplus division can be obtained. Then, the stability conditions can be verified. I show the case when $z_M(\lambda) \leq B - \sigma$. Other cases can be proved in a similar way.

- Step 1 (Matching functions):

- Taiwanese men

- * A Taiwanese man with $x \in [B - r\sigma, B]$ is matched to a Taiwanese woman y with probability 1.

$$y = \frac{1}{r}x - \frac{1}{r}B + B = \tilde{\phi}_T(x)$$

- * A Taiwanese man with $x \in [B - \sigma, B - r\sigma]$ is matched to a Taiwanese woman y with probability $\frac{r}{r+v}$ and to a Vietnamese woman with y with probability $\frac{v}{r+v}$.

$$y = \frac{1}{r+v}x + B - \sigma - \frac{B - r\sigma}{r+v} = \hat{\phi}(x)$$

- * A Taiwanese man with $x \in [z_M, B - \sigma]$ is matched to a Taiwanese woman with y with probability $\frac{r(1+v)}{r+v}$ and to a Vietnamese woman with y with probability $\frac{v(1-r)}{r+v}$.

$$y = \frac{1+v}{r+v}x + M - \frac{1+v}{r+v}(B - \sigma) = \phi(x)$$

where $M := \frac{1}{r+v}(B - \sigma) + B - \sigma - \frac{B-r\sigma}{r+v}$.

- * A Taiwanese man with $x \in [x_{0,T}, z_M]$ is matched to a Taiwanese woman with y with probability 1.

$$y = \frac{1}{r}x - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B - \sigma) = \phi_T(x)$$

where $x_{0,T} = \phi_T^{-1}(A)$.

– Vietnamese men

- * A Vietnamese man with $x \in [x_{0,V}, B - \sigma]$ is matched to a Vietnamese woman with y with probability 1.

$$\begin{aligned} y &= \frac{1+v}{r+v}x + M - \frac{1+v}{r+v}(B - \sigma) = \phi(x) \quad \text{if } x \geq z_M \\ y &= x - z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B - \sigma) = \phi_V(x) \quad \text{if } x \leq z_M \end{aligned}$$

where $x_{0,V} = \phi_V^{-1}(A - \sigma)$.

– Taiwanese women

- * A Taiwanese woman with $y \in [A, B]$ is matched to a Taiwanese man with x with

probability 1.

$$\begin{aligned}
x &= \tilde{\phi}_T^{-1}(y) \quad \text{if } y \geq B - \sigma \\
x &= \hat{\phi}^{-1}(y) \quad \text{if } M \leq y \leq B - \sigma \\
x &= \phi^{-1}(y) \quad \text{if } z_W \leq y \leq M \\
x &= \phi_T^{-1}(y) \quad \text{if } A \leq x \leq z_W
\end{aligned}$$

where $z_W := \phi(z_M)$.

– Vietnamese women

- * A Vietnamese woman with $[M, B - \sigma]$ is matched to a Taiwanese man with x with probability 1.

$$x = \hat{\phi}^{-1}(y)$$

- * A Vietnamese woman with $[z_W, M]$ is matched to Taiwanese man with x with probability $\frac{1-r}{1+v}$ and Vietnamese men with $[z_M, B - \sigma]$ with probability $\frac{r+v}{1+v}$.

$$x = \phi^{-1}(y)$$

- * Vietnamese women with $[A - \sigma, z_W]$ is matched to a Vietnamese man with x with probability 1.

$$x = \phi_V^{-1}(y)$$

– Step 2 (Individual utilities):

- * Taiwanese men

$$u_T(x) = \begin{cases} \tilde{u}_T(x), & \text{if } B - r\sigma \leq x \leq B \\ \hat{u}_T(x), & \text{if } B - \sigma \leq x \leq B - r\sigma \\ \dot{u}_T(x), & \text{if } z_M \leq x \leq B - \sigma \\ \bar{u}_T(x), & \text{if } x_{0,T} \leq x \leq z_M \\ 0, & \text{if } x \leq x_{0,T} \end{cases}$$

* Vietnamese men

$$u_V(x) = \begin{cases} \hat{u}_V(x), & \text{if } z_M \leq x \leq B - \sigma \\ \bar{u}_V(x), & \text{if } x_{0,V} \leq x \leq z_M \\ 0, & \text{if } x \leq x_{0,V} \end{cases}$$

* Taiwanese women

$$v_T(x) = \begin{cases} \tilde{v}_T(y), & \text{if } B - \sigma \leq y \leq B \\ \hat{v}_T(y), & \text{if } M \leq y \leq B - \sigma \\ \dot{v}_T(y), & \text{if } z_W \leq y \leq M \\ \bar{v}_T(y), & \text{if } A \leq y \leq z_W \end{cases}$$

* Vietnamese women

$$v_V(x) = \begin{cases} \hat{v}_V(y), & \text{if } M \leq y \leq B - \sigma \\ \dot{v}_V(y), & \text{if } z_W \leq y \leq M \\ \bar{v}_V(y), & \text{if } A - \sigma \leq y \leq z_W \end{cases}$$

where

$$\begin{aligned}
\tilde{u}'_T(x) &= S_x(x, \tilde{\phi}(x)) & \tilde{v}'_T(y) &= S_y(\tilde{\phi}^{-1}(y), y) \\
\tilde{u}_T(x) &= \int_{B-r\sigma}^x S_x(s, \tilde{\phi}(s))ds + P & \tilde{v}_T(y) &= \int_{B-\sigma}^y S_y(\tilde{\phi}^{-1}(t), t)dt + J \\
\hat{u}'_T(x) &= S_x(x, \hat{\phi}(x)) & \hat{v}'_T(y) &= S_y(\hat{\phi}^{-1}(y), y) \\
\hat{u}_T(x) &= \int_{B-\sigma}^x S_x(s, \hat{\phi}(s))ds + Q & \hat{v}_T(y) &= \int_M^y S_y(\hat{\phi}^{-1}(t), t)dt + K \\
u'_T(x) &= S_x(x, \phi(x)) & v'_T(y) &= S_y(\phi^{-1}(y), y) \\
u_T(x) &= \int_{z_M}^x S_x(s, \phi(s))ds + R & v_T(y) &= \int_{z_W}^y S_y(\phi^{-1}(t), t)dt + L \\
\bar{u}'_T(x) &= S_x(x, \phi_T(x)) & \bar{v}'_T(y) &= S_y(\phi_T^{-1}(y), y) \\
\bar{u}_T(x) &= \int_{x_{0,T}}^x S_x(s, \phi_T(s))ds + S & \bar{v}_T(y) &= \int_a^y S_y(\phi_T^{-1}(t), t)dt + O
\end{aligned}$$

$$\begin{aligned}
i'_V(x) &= S_x(x, \phi(x)) & \hat{v}'_V(y) &= S_y(\hat{\phi}^{-1}(y), y) \\
i_V(x) &= \int_{z_M}^x S_x(s, \phi(s))ds + R' & \hat{v}_V(y) &= \int_M^y S_y(\hat{\phi}^{-1}(t), t)dt + K' \\
\bar{i}'_V(x) &= S_x(x, \phi(x)) & v'_V(y) &= S_y(\phi^{-1}(y), y) \\
\bar{i}_V(x) &= \int_{x_{0,V}}^x S_x(s, \phi_V(s))ds + S' & v_V(y) &= \int_{z_W}^y S_y(\phi^{-1}(t), t)dt + L' \\
& & \bar{v}'_V(y) &= S_y(\phi_V^{-1}(y), y) \\
& & \bar{v}_V(y) &= \int_a^y S_y(\phi_V^{-1}(t), t)dt + O'
\end{aligned}$$

* The constants are:

$$\begin{aligned}
S &= 0 \\
S' &= 0 \\
R &= \int_{x_{0,T}}^{z_M} S_x(s, \phi_T(s))ds \\
R' &= \int_{x_{0,V}}^{z_M} S_x(s, \phi_V(s))ds \\
Q &= \int_{z_M}^{B-\sigma} S_x(s, \phi(s))ds + \int_{x_{0,T}}^{z_M} S_x(s, \phi_T(s))ds \\
P &= \int_{B-\sigma}^{B-r\sigma} S_x(s, \hat{\phi}(s))ds + \int_{z_M}^{B-\sigma} S_x(s, \phi(s))ds + \int_{x_{0,T}}^{z_M} S_x(s, \phi_T(s))ds
\end{aligned}$$

$$\begin{aligned}
O &= S(x_{0,T}, A) \\
O' &= S(x_{0,V}, A - \sigma) \\
L &= \int_A^{z_W} S_y(\phi_T^{-1}(t), t) dt + S(x_{0,T}, A) \\
L' &= \int_{A-\sigma}^{z_W} S_y(\phi_V^{-1}(t), t) dt + S(x_{0,V}, A - \sigma) \\
K &= \int_{z_W}^M S_y(\phi^{-1}(t), t) dt + \int_A^{z_W} S_y(\phi_T^{-1}(t), t) dt + S(x_{0,T}, A) \\
K' &= \int_{z_W}^M S_y(\phi^{-1}(t), t) dt + \int_{A-\sigma}^{z_W} S_y(\phi_V^{-1}(t), t) dt + S(x_{0,V}, A - \sigma) \\
J &= \int_M^{B-\sigma} S_y(\hat{\phi}^{-1}(t), t) dt + \int_{z_W}^M S_y(\phi^{-1}(t), t) dt + \int_A^{z_W} S_y(\phi_T^{-1}(t), t) dt + S(x_{0,T}, A)
\end{aligned}$$

First two are zero because the last married men should be indifferent with being single. Accordingly, the lowest type women exploit all the surplus generated from the marriage. The rest follows from the continuity of utilities.

- Step 3 (Finding z_M and z_W): From Proposition ??, we have $\dot{u}_T(x) + \lambda = \dot{u}_V(x)$. Thus, $R + \lambda = R'$ and z_M can be found. z_W can be found by plugging z_M in $z_W = \phi(z_M)$.
- Step 4 (Verifying stability conditions): The stability conditions need to be verified for all possible couples. There are 72 possible pairs ($\tilde{u}_T, \hat{u}_T, \dot{u}_T, \bar{u}_T, \dot{u}_V, \bar{u}_V$, Taiwanese single, Vietnamese single for men and $\tilde{v}_T, \hat{v}_T, \dot{v}_T, \bar{v}_T, \dot{v}_V, \bar{v}_V$ for women). Among those, the pairs who marry with positive probability in the equilibrium (8 cases) satisfy the stability condition because within categories, male and female match positive assortatively from Proposition 1 (under supermodularity, such match is stable). Note that $S(x, y) = xy$.

* \bar{u}_T and \bar{v}_V :

We need to check

$$P(x, y) = \bar{u}_T(x) + \bar{v}_V(y) - S(x, y) + \lambda \geq 0$$

for $x_{0,T} \leq x \leq z_M$ and $A - \sigma \leq y \leq z_W$. $P(x, y)$ can be rewritten as

$$P(x, y) = \int_{x_{0,T}}^x S_x(s, \phi_T(s)) ds + S + \int_{A-\sigma}^y S_y(\phi_V^{-1}(t), t) dt + O' - xy + \lambda \geq 0$$

This gives $P_{xx} = \phi'_T(x) = \frac{1}{r}$, $P_{yy} = \phi_V^{-1\prime}(y) = 1$, and $P_{xy} = -1$. Thus, $P(x, y)$ is convex in (x, y) and its minimum satisfies

$$\frac{\partial P(x, y)}{\partial x} = \frac{\partial P(x, y)}{\partial y} = 0$$

$$\begin{aligned} S_x(x, \phi_T(x)) - S_x(x, y) &= 0 \\ S_y(\phi_V^{-1}(y), y) - S_y(x, y) &= 0 \end{aligned}$$

To satisfy both conditions, the following should be the case: $y = \phi_T(x)$ and $y = \phi_V(x)$. This happens at the cutoff $x = z_M$. Note that $\bar{v}_V(z_W) + \lambda = \bar{v}_T(z_W)$. $P(z_M, z_W) = \bar{u}_T(z_M) + \bar{v}_V(z_W) - S(x, y) + \lambda = \bar{u}_T(z_M) + \bar{v}_T(z_W) - S(x, y) = 0$, so the condition is satisfied.

* \bar{u}_T and \dot{v}_V :

We need to check

$$P(x, y) = \bar{u}_T(x) + \dot{v}_V(y) - S(x, y) + \lambda \geq 0$$

for $x_{0,T} \leq x \leq z_M$ and $z_W \leq y \leq M$. Since we know $P(z_M, z_W) = 0$, if $P(x, y)$ is decreasing in x and increasing in y , $P(x, y)$ in all (x, y) in the ranges. This can be shown as follows:

$$\begin{aligned} \frac{\partial P(x, y)}{\partial x} &= \phi_T(x) - y \leq 0 \\ \frac{\partial P(x, y)}{\partial y} &= \phi^{-1}(y) - x \geq 0. \end{aligned}$$

For the remaining cases as well, using similar computations, it can be shown that the difference $u + v - \Sigma$ between the sum of individual utilities and potential surplus is minimum at the boundary or at some non-negative interior point. The explicit calculations are available upon request.

□

F Proof of Proposition 7

Proof. $-\frac{\partial z_M}{\partial \lambda} > 0$:

This can be proved by using the Leibniz integral rule.

$$\begin{aligned}
\lambda &= R' - R \\
&= \int_{x_{0,V}}^{z_M} S_x(s, \phi_V(s)) ds - \int_{x_{0,T}}^{z_M} S_x(s, \phi_T(s)) ds \\
&= \int_{A-\sigma+\frac{r-1}{r+v}z_M-M+\frac{1+v}{r+v}(B-\sigma)}^{z_M} S_x(s, s - z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B-\sigma)) ds \\
&\quad - \int_{rA+\frac{v(1-r)}{r+v}z_M-M+\frac{1+v}{r+v}(B-\sigma)}^{z_M} S_x(s, \frac{1}{r}s - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B-\sigma)) ds
\end{aligned}$$

Using the Leibniz integral rule,

$$\begin{aligned}
\frac{\partial \lambda}{\partial z_M} &= S_x(z_M, z_W) + S_x(A - \sigma + \frac{r-1}{r+v}z_M - M + \frac{1+v}{r+v}(B-\sigma), A - \sigma) \frac{1-r}{r+v} \\
&\quad + \int_{A-\sigma+\frac{r-1}{r+v}z_M-M+\frac{1+v}{r+v}(B-\sigma)}^{z_M} S_{xy}(s, s - z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B-\sigma)) \frac{1-r}{r+v} ds \\
&\quad - S_x(z_M, z_W) + S_x(rA + \frac{v(1-r)}{r+v}z_M - M + \frac{1+v}{r+v}(B-\sigma), A) \frac{1-r}{r+v} v \\
&\quad + \int_{rA+\frac{v(1-r)}{r+v}z_M-M+\frac{1+v}{r+v}(B-\sigma)}^{z_M} S_{xy}(s, \frac{1}{r}s - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B-\sigma)) \frac{v(1-r)}{r(r+v)} ds \\
&> 0
\end{aligned}$$

because $S_{xy} > 0$. Thus, we have $\frac{\partial z_M}{\partial \lambda} > 0$.

$-\frac{\partial z_W}{\partial \lambda} > 0$:

$z_M = \phi(z_W)$ and $\phi'(x) > 0$. From $\frac{\partial z_M}{\partial \lambda} > 0$, $\frac{\partial z_W}{\partial \lambda} > 0$.

$-\frac{\partial \phi_T(x)}{\partial \lambda} < 0$

Note that $\phi_T(x) = \frac{1}{r}x - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B-\sigma)$. Given x , $\frac{\partial \phi_T(x)}{\partial z_M} = \frac{v(r-1)}{r(r+v)} < 0$.

From $\frac{\partial \phi_T(x)}{\partial \lambda} = \frac{\partial \phi_T(x)}{\partial z_M} \frac{\partial z_M}{\partial \lambda}$, the result follows.

$-\frac{\partial \phi_V(x)}{\partial \lambda} > 0$

Note that $\phi_V(x) = x - z_M + \frac{1+v}{r+v}z_M + M - \frac{1+v}{r+v}(B-\sigma)$. Given x , $\frac{\partial \phi_V(x)}{\partial z_M} = -1 + \frac{1+v}{r+v} > 0$.

From $\frac{\partial \phi_V(x)}{\partial \lambda} = \frac{\partial \phi_V(x)}{\partial z_M} \frac{\partial z_M}{\partial \lambda}$, the result follows.

$-\frac{\partial x_{0,T}}{\partial \lambda} > 0$

Note that $x_{0,T} = \phi_T^{-1}(A) = rA + \frac{v(1-r)}{r+v}z_M - M + \frac{1+v}{r+v}(B - \sigma)$. Using the chain rule, the result follows.

$$- \frac{\partial x_{0,V}}{\partial \lambda} < 0$$

Note that $x_{0,V} = \phi_V^{-1}(A - \sigma) = A - \sigma + \frac{r-1}{r+v}z_M - M + \frac{1+v}{r+v}(B - \sigma)$. Using the chain rule, the result follows.

$$- \frac{\partial u_T(x)}{\partial \lambda} < 0$$

Use the Leibniz integral rule to show $\frac{\partial u_T(x)}{\partial z_M} < 0$. Then use the chain rule.

$$- \frac{\partial u_V(x)}{\partial \lambda} > 0$$

Use the Leibniz integral rule to show $\frac{\partial u_V(x)}{\partial z_M} > 0$. Then use the chain rule.

$$- \frac{\partial v_T(y)}{\partial \lambda} > 0$$

Use the Leibniz integral rule to show $\frac{\partial v_T(y)}{\partial z_M} > 0$. Then use the chain rule.

$$- \frac{\partial v_V(y)}{\partial \lambda} < 0$$

Use the Leibniz integral rule to show $\frac{\partial v_V(y)}{\partial z_M} < 0$. Then use the chain rule.

□

G Multiplicative cost

This subsection provides the theoretical results when cost varies with the surplus. These results can be obtained with a minor modification to the surplus function given in Chiappori et al. [2017]. Assume the same population structures given in 3.1.1. Suppose the surplus function is given as follows:

$$\Sigma_{XY}(x, y) = \begin{cases} S(x, y), & \text{if } X = Y \\ (1 - \lambda)S(x, y), & \text{if } X \neq Y \end{cases}$$

where $\lambda < 1$. The function S is strictly increasing, continuously differentiable, and supermodular. Normalize single utility as 0 and assume that $S(0, 0) \geq 0$.

Proposition 8. *In the stable matching, if (x, X) and (x', X) such that $x \geq x'$ are matched to (y, Y) and (y', Y) , respectively, $y \geq y'$ almost surely.*

Proof. Suppose $x \geq x'$ but $y' > y$ with a positive measure. The surplus is:

$$\Sigma_1 = \Sigma_{XY}(x, y) + \Sigma_{XY}(x', y')$$

By switching the couples, the surplus becomes

$$\Sigma_2 = \Sigma_{XY}(x, y') + \Sigma_{XY}(x', y) > \Sigma_1$$

by supermodularity. It contradicts to surplus maximization. \square

Note that under the multiplicative cost case, the matching is positive assortative on SES within same categories of men and women. The positive assortative matching results under the fixed cost case is stronger because a stable matching is positive assortative on SES when holding one gender's country and considering the two countries for the other gender. This result does not hold anymore under multiplicative cost because the cost depends on the types of the agents.

Proposition 9. *Suppose an open set of males from X country are indifferent between marrying a woman from T country and a woman from V country so that $0 < p(T|x, X) < 1$ in the stable match for any x in the open set. If (x, X) is matched to either (y, T) or (y', V) , then $y < y'$ if $X = T$ and $y > y'$ if $X = V$.*

Similarly, suppose an open set of females from Y country are indifferent between marrying a man from T country and a man from V country so that $0 < q(X|y, Y) < 1$ in the stable match for any y in the open set. If (y, Y) is matched to either (x, T) or (x', V) , then $x < x'$ if $Y = T$ and $x > x'$ if $Y = V$.

Proof. Let X be T . Suppose a man x from country T is matched to either a woman y from country T or a woman y' from country V at the stable match. Let $u_T(x)$ be his utility. Then, by stability,

$$\begin{aligned} u_T(x) &= \max_s (S(x, s) - v_T(s)) \\ &= \max_{s'} (\lambda S(x, s') - v_V(s')) \end{aligned}$$

where $v_T(s)$ ($v_V(s')$) is the utility of a woman from country T (a woman from country V) with the type s (s'); note that the maximum is reached at $s = y$ and $s' = y'$ respectively. By the envelope theorem:

$$u'_T(x) = \frac{\partial}{\partial x} S(x, y) = \lambda \frac{\partial}{\partial x} S(x, y')$$

Since $\frac{\partial S}{\partial x}$ is strictly increasing in y and $\lambda < 1$, $y < y'$. The remainder can be proved similarly. \square

Note that unlike the fixed cost case where the types of spouses from different countries are same, with the multiplicative cost, the type of spouse from the different country should be higher

than that from the same country. If the spouse is from the different country, the part of the surplus that generates complementarities decreases unlike the fixed cost case. That loss of the surplus is compensated by the higher type of the spouse from the different country.

Proposition 10. *Assume that there exists an open set O such that for all (x, X) where $x \in O$, $0 < p(T|x, X) < 1$. That is, (x, X) marries either a woman (y, T) or (y, V) with positive probability. Then, $q(\bar{X}|y, X) = 0$ for almost surely where $\{\bar{X}\} = \{T, V\} - \{X\}$.*

Similarly, assume that there exists an open set O' such that for all (y, Y) where $y \in O'$, $0 < q(T|y, Y) < 1$. That is, (y, Y) marries either a woman (x, T) or (x, V) with positive probability. Then, $p(\bar{Y}|y, Y) = 0$ for almost surely where $\{\bar{Y}\} = \{T, V\} - \{Y\}$.

Proof. Without loss of generality, let $X = T$. Suppose $q(V|y, T) > 0$ on a set with positive measure. That is, (y, T) is matched to either (x, T) and (x', V) with $x' > x$. Since we have $0 < p(T|x, T) < 1$, (x, T) is matched to either (y, T) or (y', V) with $y' > y$. The surplus generated from (x, T) , (y', V) couple and (x', V) , (y, T) couple is

$$\Sigma_1 = \lambda S(x, y') + \lambda S(x', y)$$

By switching the surplus is

$$\Sigma_2 = S(x, y) + S(x', y') > \Sigma_1$$

since $x' > x$ and $y' > y$. The rest can be proved similarly. \square

The result on the one-sided randomization holds under both fixed cost case and multiplicative cost case. In a given neighborhood, two types of randomization cannot happen at the same time. For instance, if Taiwanese women marry cross-nationally, it must be the case that Taiwanese men marry only Taiwanese women in that neighborhood.

H Structural model for intra-household allocation in Vietnam

In this section, I highlight the broader implications for the resource allocations of married couples. Using a structural model incorporating more than one decision maker in a household, it is possible to identify the partials of the sharing rule of married couples. In particular, I use a *collective model* and the well-known identification results of Chiappori et al. [2002] with a slight modification.⁴⁸

Unlike the unitary model, which assumes a single utility function for each household, the collective model allows for multiple agents with distinct utility functions. In particular, a household maximizes its welfare function, which is a weighted sum of the individuals' private utility

⁴⁸They focus on the labor supply decisions of married couples whereas I concentrate on consumption decisions.

functions. Throughout my analysis, each household contains two decision makers, a husband and a wife, who each have utility functions. It is assumed that the decision-making process leads to Pareto-efficient outcomes. This assumption reflects reality, given that the married couples interact very frequently. It is likely that husbands and wives know each other's preferences well. In particular, consumption decisions are not once-in-a-lifetime decisions. Given the repeated interactions of married couples, it is unlikely that profitable opportunities are left on the table without being exploited.

In terms of preferences, I assume egoistic preferences where each agent cares only about his or her own consumption.⁴⁹ More specifically, the utility function takes the form of $u^i(\mathbf{q}^i, \mathbf{z})$ where i denotes the agent (i.e., $i = h, w$), \mathbf{q}^i denotes the consumption of agent i and \mathbf{z} denotes preference factors such as age and education level. \mathbf{q}^i can be either gender-exclusive goods or assignable goods from which we can observe individual consumption patterns. I assume a well-behaved utility function that is strictly quasi-concave, increasing and continuously differentiable. I assume that the agents face the same prices.

The household solves the following program:

$$\max_{q^h, q^w} \mu(\mathbf{z}, \mathbf{s})u^h(\mathbf{q}^h, \mathbf{z}) + (1 - \mu(\mathbf{z}, \mathbf{s}))u^w(\mathbf{q}^w, \mathbf{z}) \quad (1)$$

subject to

$$\mathbf{e} \cdot (\mathbf{q}^h + \mathbf{q}^w) \leq x$$

where \mathbf{e} , \mathbf{z} , \mathbf{s} , and x denote a price vector of ones, a vector of preference factors, a vector of distribution factors, and total expenditure on private consumption, respectively.⁵⁰ Pareto weight μ is a function of \mathbf{z} and \mathbf{s} and is assumed continuously differentiable with respect to each argument. Note that distribution factors, \mathbf{s} , affects consumption choice only through μ . In other words, when \mathbf{s} changes, the allocation moves along the Pareto frontier without changing the Pareto frontier.

Under the egoistic preference assumption, the above problem is equivalent to solving two problems of husbands and wives. That is, there exist *sharing rule* functions $\phi^h(x, \mathbf{z}, \mathbf{s})$ and

⁴⁹Given that my analysis focus on the private consumption of households, this assumption is not too extreme. However, the model can be extended to have Beckerian "caring" preferences.

⁵⁰This can be thought of a two-stage budgeting. The households first decide on how much to allocate on public good and private good. For the second stage, they decide on how much to spend on different private commodities with the budget allocated in the first stage. The problem considered here is exactly this second stage. The condition to guarantee two-stage budgeting is weak separability of preferences across public goods and private goods, and I assume that this is the case.

$\phi^w(x, \mathbf{z}, \mathbf{s})$ such that $\phi^h + \phi^w = x$. Each member solves the program below:

$$\max_{q^i} u(\mathbf{q}^i, \mathbf{z}) \quad (2)$$

subject to

$$\mathbf{e} \cdot \mathbf{q}^i \leq \phi^i$$

where $i = h, w$. The result follows from the second fundamental theorem of welfare economics. Any Pareto efficient allocation can be achieved as a competitive equilibrium with a lump-sum wealth redistribution. For the complete proof, see Browning et al. [1994].

Assuming interior solutions, equation (2) yields demand equations for husbands and wives. I focus on two gender-exclusive goods, one for the husband and one for the wife. The demand functions are as follows:

$$c^h = C^h(\phi^h(x, \mathbf{z}, \mathbf{s}), \mathbf{z}) \quad (3)$$

$$c^w = C^w(x - \phi^h(x, \mathbf{z}, \mathbf{s}), \mathbf{z}) \quad (4)$$

where C^i is a demand function for member i ($i = h, w$). These two equations allow me to identify the partials of the sharing rule. The identification result closely follows Chiappori et al. [2002]. The idea is using the fact that total private expenditure and distribution factors affect consumption behavior only through the sharing rule. The responses of the consumption behaviors to these variables allow me to estimate the marginal rate of substitution between x and \mathbf{s} for husbands and wives. Moreover, equation (3) and equation (4) generate testable restrictions on consumption behavior.

To formalize this idea, let $A = \frac{\partial c^h / \partial s}{\partial c^h / \partial x}$ and $B = \frac{\partial c^w / \partial s}{\partial c^w / \partial x}$ when $\frac{\partial c^h}{\partial x} \cdot \frac{\partial c^w}{\partial x} \neq 0$. Assume that there is only one distribution factor. A and B are directly observable from the data. From the demand equations, $A = \frac{\partial c^h / \partial s}{\partial c^h / \partial x} = \frac{\phi_s^h}{\phi_x^h}$ and $B = \frac{\partial c^w / \partial s}{\partial c^w / \partial x} = \frac{-\phi_s^h}{1 - \phi_x^h}$. Their relationships allow the recovery of the partials of sharing rule, ϕ_s^h and ϕ_x^h . They are given by the following:

$$\phi_x^h = \frac{B}{B - A} \quad (5)$$

$$\phi_s^h = \frac{AB}{B - A} \quad (6)$$

assuming that $A \neq B$.

There is a cross-derivative restriction that must be satisfied.

$$\frac{\partial}{\partial s}\left(\frac{B}{B-A}\right) = \frac{\partial}{\partial x}\left(\frac{AB}{B-A}\right) \quad (7)$$

Given the results above, the sharing rule can be identified up to a constant function $\kappa(\mathbf{z})$.

Estimation of the model

In this section, estimation procedures are detailed. In order to estimate the collective model, the functional form should be chosen first. I begin with the unrestricted linear functional form with one distribution factor given below:⁵¹

$$TBC_{ipt} = \tau_0 + \tau s_{pt} + \tau_2 x_{ipt} + \mathbf{z}'_{ipt} \tau_3 + \varepsilon_{ipt} \quad (8)$$

$$JWM_{jpt} = \delta_0 + \delta s_{pt} + \delta_2 x_{jpt} + \mathbf{z}'_{jpt} \delta_3 + \varepsilon_{jpt} \quad (9)$$

where s denotes a distribution factor. x_{ipt} is total private expenditure and \mathbf{z}_{ipt} indicates preference factors including age, age squared, education, year dummies, province dummies, children, consumer price index and foreign direct investment.

This functional form has several advantages. First of all, this functional form is simple and has a straightforward interpretation. This linear Engel curve has been used ever since Engel [1895] (Lewbel [2008]). Second, this functional form is compatible with the collective model and allows the testing of the proportionality restrictions imposed by the model. It does not violate any restrictions imposed by the model *a priori*. Third, with this functional form, sharing rule can be identified up to a constant.

If equation (7) is satisfied, the partials of sharing rule are given as follows:

$$\phi_x^h = \frac{\tau_2 \delta_1}{\tau_2 \delta_1 - \tau_1 \delta_2} \quad (10)$$

$$\phi_s^h = \frac{\tau_1 \delta_1}{\tau_2 \delta_1 - \tau_1 \delta_2} \quad (11)$$

Finally, the sharing rule equation is given by:

$$\phi^h = \frac{\tau_2 \delta_1}{\tau_2 \delta_1 - \tau_1 \delta_2} x + \frac{\tau_1 \delta_1}{\tau_2 \delta_1 - \tau_1 \delta_2} s + \kappa(\mathbf{z}) \quad (12)$$

$\kappa(\mathbf{z})$ is not identifiable, thus making the sharing rule identified up to a constant.

Distribution factor

⁵¹Any number of distribution factors can be incorporated.

I employ the intensity of cross-border marriages as the distribution factor. To be a valid distribution factor, it should affect sharing rules but not the budget constraint or preferences. One potential concern is that the households that were directly affected by the cross-border marriages (e.g., those who sent their daughters abroad) might have received remittances from abroad. To address this, I estimate the sharing rule for households with and without remittances from abroad.

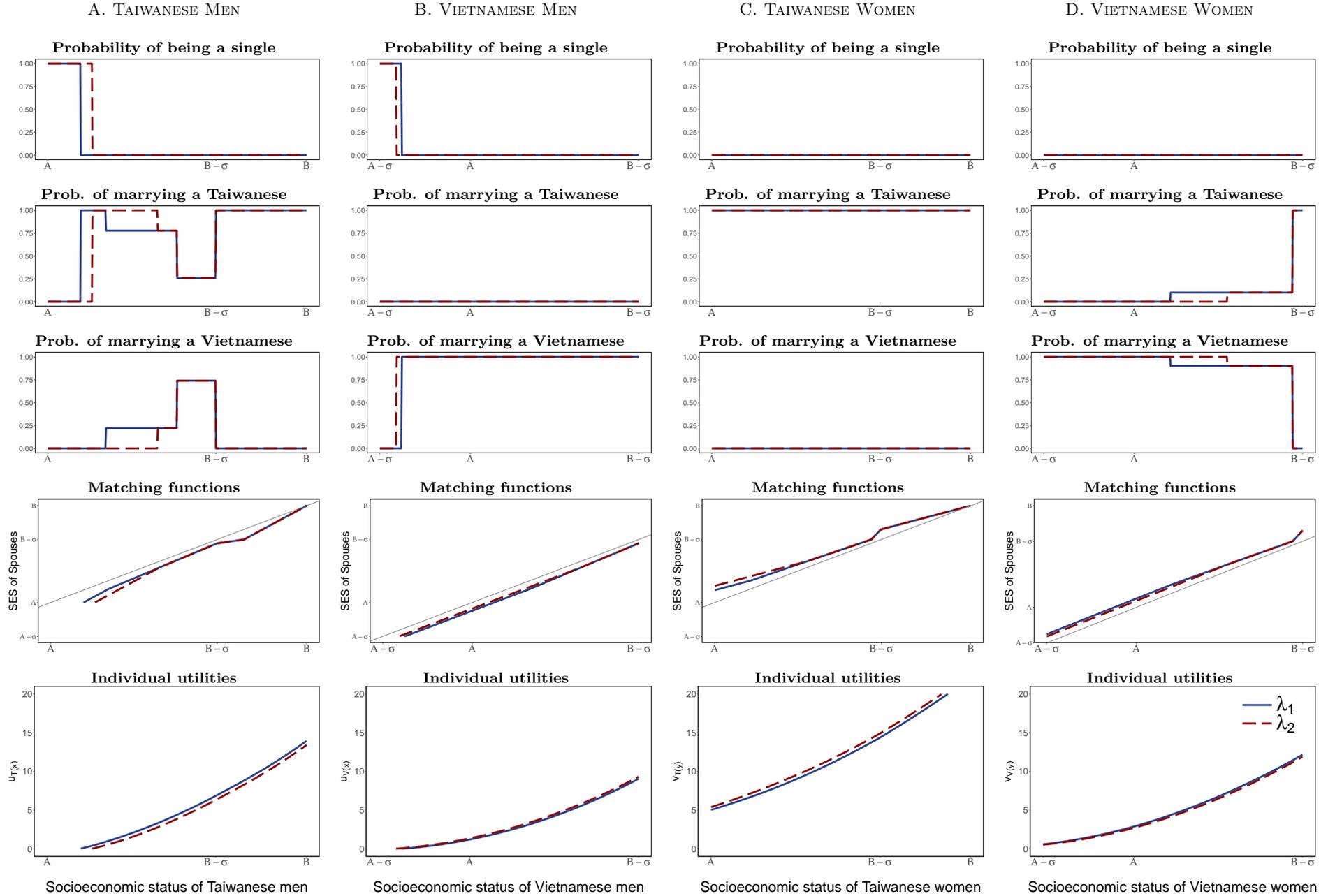
Sharing rule estimates

In this section, the results of empirical tests of collective model is presented and the sharing rule estimates are given. First, the unrestricted equations (3) and (4) are estimated and then the restrictions imposed by the collective model are tested. Then, the sharing rule is estimated.

The results are presented in Table 9. The partials of sharing rule are all statistically significant. The partial with respect to total private expenditure indicates that one unit (1,000VND) increase of total private expenditure is associated with 0.53 unit increase of husbands' share. When the expenditure increases, husbands take up approximately six percentage points more than their wives. The partial with respect to cross-border marriages suggests that one percentage point increase of outflow of women is associated with 106 (1,000VND) less share of husbands. This amounts to approximately the value of 120 lbs of rice. In other words, women in the areas with more outflow of women control more money within the household.

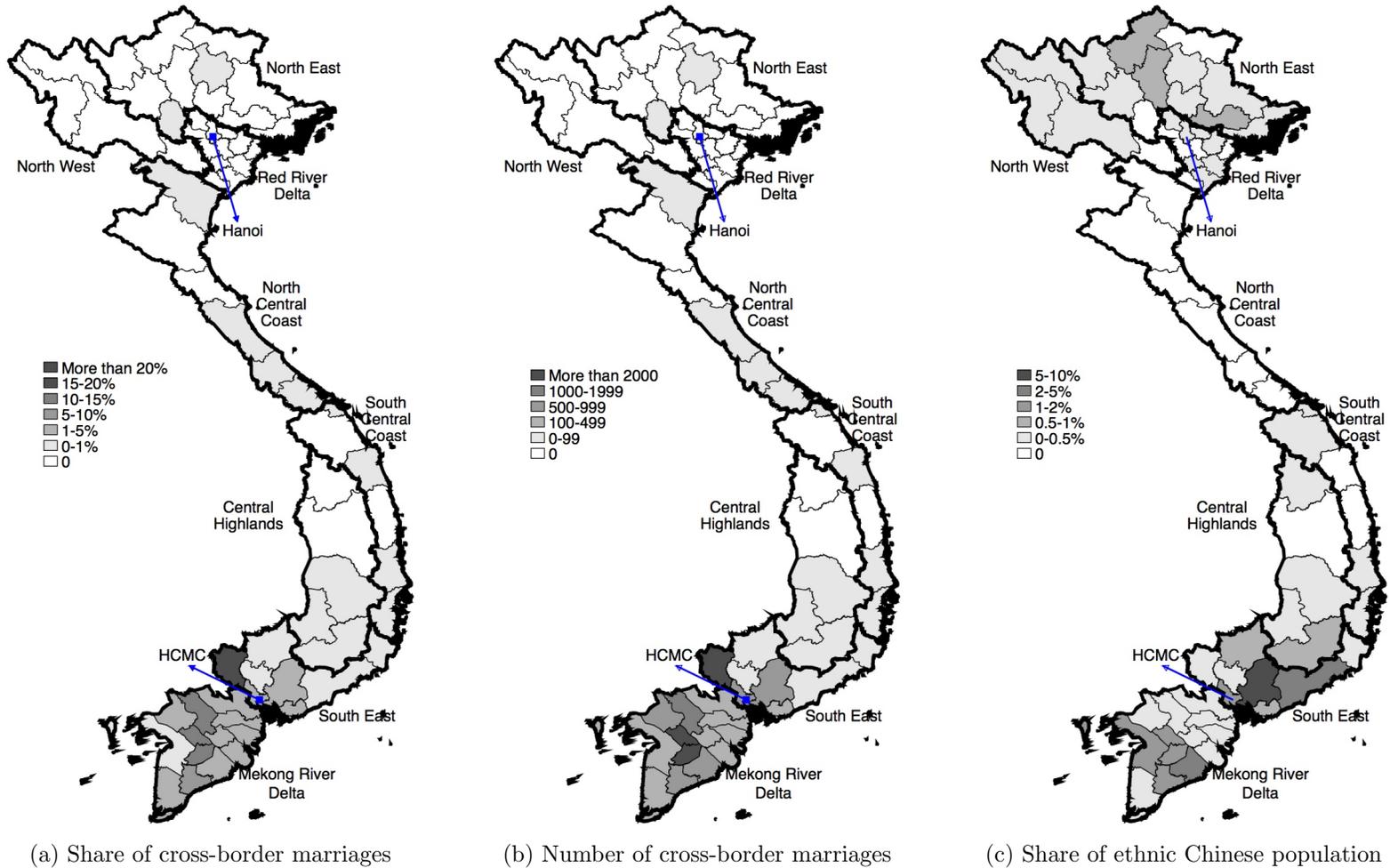
Considering these estimates, the impact of cross-border marriages is substantial for women's power within the households. Furthermore, cross-border marriages can have an implication on children's outcome because women's increased power within the households is known to be related to better outcome of children (Duflo [2012]).

Figure A1: Comparative statics with respect to cost of cross-border marriages ($\lambda_1 < \lambda_2$)



Notes: These figures plot comparative statics results. For these illustrative figures, the parameter values $A = 2$, $B = 6$, $\sigma = 1.4$, $r = 0.7$, $v = 2$, $\lambda_1 = 2.2$ and $\lambda_2 = 3$ are used. The grey lines on matching graphs indicate $y = x$.

Figure A2: Geographic distributions of cross-border marriages and ethnic Chinese population



Notes: These figures display the distributions of the share and number of cross-border marriages and the share of ethnic Chinese at the province level. The thick black lines indicate the regions.

Table A1: The impact of visa-tightening policies on the SES of foreign brides by origins

Sample:	Mainland Brides				Southeast Asian Brides			
Dependent variable (=1):	Pri.	JH	SH/ Voca.	Univ./ above	Pri.	JH	SH/ Voca.	Univ./ above
After visa-tightening (=1)	-0.14*** (0.015)	0.052 (0.045)	0.026 (0.044)	0.065** (0.028)	-0.12 (0.078)	0.062 (0.094)	0.076 (0.088)	-0.016 (0.036)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dep. var. mean	0.20	0.42	0.34	0.04	0.37	0.36	0.23	0.04
R-squared	0.012	0.003	0.008	0.003	0.004	0.002	0.004	0.006
Observations	58,768	58,768	58,768	58,768	56,755	56,755	56,755	56,755

Notes: This table displays the results from regressing each dependent variable (indicating foreign brides education) listed in the second row a dummy for post visa-tightening policies and controls (marriage year fixed effects and county city fixed effects) by the origins of the foreign brides. Note that Pri., JH, SH, Voca. and Univ. indicate Primary, Junior High, Senior High, Vocational and University, respectively. Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Sources: the Census of Foreign Spouse, 2003 and the Foreign and Mainland Spouse Living Needs Survey, 2008. Only the foreign spouses who marry and migrate at the same time and their grooms are included in the sample. The foreign brides or grooms who married in 1998 or after are used as the samples.

Table A2: The impact of visa-tightening policies on the SES of Taiwanese grooms of foreign brides by origins

Sample:	Grooms of Mainland Chinese Brides				Grooms of Southeast Asian Brides			
	Pri.	JH	SH/ Voca.	Univ./ above	Pri.	JH	SH/ Voca.	Univ./ above
Dependent variable (=1):								
After visa-tightening (=1)	-0.088*** (0.022)	-0.21*** (0.030)	0.15*** (0.044)	0.14*** (0.035)	-0.037 (0.060)	-0.23*** (0.073)	0.22** (0.093)	0.013 (0.035)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dep. var. mean	0.18	0.30	0.47	0.05	0.13	0.42	0.42	0.02
R-squared	0.014	0.020	0.012	0.016	0.008	0.018	0.024	0.011
Observations	58,768	58,768	58,768	58,768	56,755	56,755	56,755	56,755

Notes: This table displays the results from regressing each dependent variable (indicating groom education) listed in the second row on a dummy for post visa-tightening policies and controls (marriage year fixed effects and county city fixed effects) by the origins of the foreign brides. Note that Pri., JH, SH, Voca. and Univ. indicate Primary, Junior High, Senior High, Vocational and University, respectively. Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Sources: the Census of Foreign Spouse, 2003 and the Foreign and Mainland Spouse Living Needs Survey, 2008. Only the foreign spouses who marry and migrate at the same time and their grooms are included in the sample. The foreign brides or grooms who married in 1998 or after are used as the samples.