

Matching Across Markets: Theory and Evidence on Cross-Border Marriage

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Abstract

This paper provides an equilibrium framework to understand the impact of marriage migration in *both* migrant-receiving and migrant-sending countries and presents novel and rich empirical evidence from the marriage markets of Taiwan (a migrant-receiving country) and Vietnam (a migrant-sending country to Taiwan). First, I build a two-country transferable utility matching model to analyze cross-border marriage patterns and the impact of changes in the costs of cross-border marriage (e.g., bureaucratic requirements and cultural differences). Second, I test the predictions of the model on matching patterns. I find two key patterns consistent with the model predictions. Most of Taiwanese-Vietnamese couples are Taiwanese men-Vietnamese women couples. In these dominant form of cross-border marriage, Taiwanese men are selected from the middle segment in the educational distributions while Vietnamese women are positively selected. Finally, I evaluate the impact of changes in the costs of cross-border marriages by exploiting two cost-changing shocks in Taiwan and Vietnam that led to dramatic changes in marriage migration. I show that the costs of cross-border marriage affect the welfare of men and women in both countries along different margins: marriage rate, matching pattern and intra-household allocation. The results show that the possibility of cross-border marriage not only affects people who consider marrying cross-nationally, but also affects *all* men and women in both countries. Immigration policies which change the costs of cross-border marriage can have far-reaching implications on marital outcomes, women's power within households, and global migration patterns.

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1 Introduction

International migration affects many aspects of society (see e.g. Borjas (2014)). While the existing literature has so far mostly focused on labor migration (that is, migration decisions based on potential wages), another type of migration has grown dramatically over the past two decades, namely, international migration for the purpose of marriage (hereafter referred to as *marriage migration*). Yet, marriage migration has been largely overlooked in the literature. A small number of previous studies have focused on the possible causes and consequences on the migrant-receiving side (Edlund et al. (2013b), Kawaguchi and Lee (2017), Weiss et al. (2017)), rarely exploring how marriage migrants are selected or the possible consequences on the migrant-sending side.

In this paper, I study the patterns of marriage migration and how changes in the costs associated with cross-border marriage affect marriage markets and the resulting welfare of men and women. First, I provide an equilibrium framework for marriage migration incorporating *both* migrant-sending and migrant-receiving countries. Second, I present rich and novel empirical evidence by exploring the marriage markets of Taiwan and Vietnam, a migrant-receiving country from Vietnam and a migrant-sending country to Taiwan, respectively. To evaluate the impact of changes in the costs of cross-border marriage, I use two cost-changing shocks that dramatically changed the volume of cross-border marriage.

Marriage migration can have important implications on local marriage markets and household behavior for several reasons. First, the influx and outflux of marriage migrants could change sex ratios, relative supplies of men and women, which directly affect marital outcomes (e.g. marriage rate or matching patterns). Second, marriage market conditions are known to influence household behaviors including fertility, labor supply, consumption and saving decisions (e.g. Angrist (2002), Chiappori et al. (2002), Wei and Zhang (2011)). As mentioned earlier, since marriage migrants are likely to reshape the marriage markets, the flow of marriage migrations can have far-reaching consequences on household behaviors in the involved countries. Last but not least, marriage migrants are generally long-term migrants. This suggests that marriage migration can affect long-term demographic consequences of the involved countries. For example, not only do they change the demographic compositions of the destination and origin countries, they could have children in the destination countries, which could further affect long-term demographic structures.

Several features of Taiwan and Vietnam make them particularly suitable and interesting for studying this topic. These marriage markets experienced dramatic changes in a short period of time, which can be exploited to measure the impact of marriage migration

(Figure 1 and Figure 2). The number of cross-border marriages rapidly increased in the late 1990s, when matchmaking firms in Taiwan and Vietnam emerged but then sharply decreased after the implementation of the Taiwanese visa tightening policy in 2004. Furthermore, Taiwan has actively engaged in cross-border marriage since the late 1990s, with one out of four Taiwanese marrying non-Taiwanese at its peak. This suggests that the impact of marriage migration would not have been negligible. Most of these marriages were in the form of importing brides from neighboring countries. On the other hand, Vietnam is one of the major bride-sending countries in Asia. While it is second to China in the number of women who marriage migrated to Taiwan, Vietnam provides a more suitable setting to study the consequences of cross-border marriages on the sending side as the flow of women constitutes a meaningful share of women of marriage age in Vietnam but not in China.

It is imperative to consider the features of both countries including the economic conditions and the demographic structures to understand how migrants are chosen and to predict who would be most likely affected when there is a change in the costs of cross-border marriage. This is because an agent compares the benefit and the cost of migrating, which crucially depends on the aforementioned factors in each country. Moreover, the matching in each country depends on the types of migrants, but the types of migrants also depend on the potential matching outcomes. Thus, without an equilibrium framework, which incorporates the demographic and economic factors, it is difficult to predict who would be the migrant or who marries whom. Moreover, the resulting shares of men and women within a marriage, which are often interpreted as shadow prices in the marriage markets, can only be determined within an equilibrium framework.

Motivated by this, I build a two-country matching model to find an equilibrium, and explain matching patterns and predict possible consequences from the changes in the costs of cross-border marriage. Specifically, I use a transferable utility (TU) matching model with two dimensions, namely, socioeconomic status (SES) and nationality.¹ A key difference compared to a single dimensional matching model is that cross-border marriage incurs costs, which could reduce surplus. These may include bureaucratic requirements, travel costs, or cultural differences. Reflecting the actual economic conditions and demographic structures, I assume that Taiwan is wealthier than Vietnam, Taiwan has a male-biased sex ratio, and Vietnam a balanced sex ratio.² I characterize the equilibrium

¹The SES may be interpreted as income or ability.

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

under a quadratic surplus function using a similar method as Chiappori et al. (2017)³. I focus on fixed costs of cross-border marriage due to its relevance to my empirical setting.⁴ While I concentrate on the case of two specific countries, the framework is general enough to accommodate settings involving any two different marriage markets with different distributions of SES and demographic structures.

The first set of predictions from the model is on the patterns of cross-border marriage. The model predicts that the dominant form of cross-border marriage is the marriages between Taiwanese men and Vietnamese women, rather than the marriages between Vietnamese men and Taiwanese women. If there are both types of “mixed” couples, there is always a way to increase total surplus by switching the two kinds of mixed couples, which contradicts the stability of matching. The model also gives predictions on the selection of people who are engaged in cross-border marriage. The model predicts that there is an intermediate selection for Taiwanese men and positive selection for Vietnamese women. That is, the middle segments of SES distributions of Taiwanese men marry Vietnamese women, and the top segments of Vietnamese women marry Taiwanese men. For Taiwanese men, the costs preclude the cross-border marriage of the lowest types. The high types do not marry Vietnamese women because they have strictly better Taiwanese alternatives. For Vietnamese women, again due to the costs, the low types cannot engage in cross-border marriage. However, for Vietnamese women, since Vietnamese men are not necessarily strictly better than Taiwanese men, a positive share of top Vietnamese women engage in cross-border marriage.

To further understand the impact of potential changes in the costs, I conduct comparative statics with respect to cost and derive the predictions on marriage market outcomes (marriage rate, matching patterns, and selection of cross-border couples) and intra-household allocations. The model predicts that when the fixed cost increases, the welfare of Taiwanese women and Vietnamese men decreases and that of Taiwanese men and Vietnamese women increases. Specifically, in Taiwan, the bride-receiving country, the marriage rate of men decreases but the probability of marrying “up” for women increases. The equilibrium share of wives within the households improves. The direction of the effects on those outcomes are opposite in Vietnam, the bride-sending country. Moreover, the model predicts that the average SES of Vietnamese women who marry Taiwanese men and the average SES of Taiwanese men who marry Vietnamese women increase. Overall, when the fixed cost increases, Taiwanese women and Vietnamese men gain and Taiwanese

³The closed-form solution cannot be obtained without such assumption.(Chiappori et al. (2017))

⁴The predictions on the multiplicative case can be obtained with a slight modification to the model presented in Chiappori et al. (2017).

men and Vietnamese women lose. The total surplus from marriages in the two countries decreases.

I begin by testing two key predictions of the model on matching patterns using multiple datasets from Taiwan and Vietnam. The first prediction I test is on the dominant form of cross-border marriages. The data confirms that Taiwanese men and Vietnamese women couples are indeed the dominant form. Among all Taiwanese-Vietnamese marriages, Vietnamese men-Taiwanese women couples account for less than one percent every year. This gendered pattern has already been reported in the sociology, demographics and economics literature. However, I first show that this is an *equilibrium* outcome rather than a descriptive pattern. The predictions on selection are also confirmed by the data. Taiwanese men who marry Vietnamese women are concentrated in the group with junior high or senior high school education, not in the group with primary or less than primary education, confirming intermediate selection. The positive selection of Vietnamese women is also supported by the data.

To test the predictions on the comparative statics, I evaluate the impact of a cost increase using visa tightening policy that Taiwanese government implemented in 2004. This increased the cross-border marriage costs by making it more difficult for foreign brides to pass the visa interview stage. I employ a difference-in-differences (DID) strategy with treatment and control groups defined based on the model predictions. For example, to test whether visa tightening policy affected the marriage rate of men, I use the model prediction that only the marriage rate of low-educated men is affected by the policy changes, naturally setting this group as a treatment group. To validate the DID strategy, the pre-trends of the control group and the treatment group are compared. For testing the average SES of brides and grooms marrying cross-nationally, the average education level right before and right after the implementation of the policy are compared. I also present suggestive evidence that the wives' decision-making power within households improved after the changes in policies.

The findings on Taiwan can be summarized as follows: (1) The marriage rate of Taiwanese men with primary or junior high school education decreased by 25 percent compared to those with higher education after the visa tightening policy. The marriage rate of Taiwanese women did not change. (2) Taiwanese female who were more likely to be affected (i.e. with non-university education) by visa-tightening policies married men with an average of 0.2 years of higher education after the policy implementation. (3) The average SES type of brides and grooms involved in cross-border marriages, measured by education, rose significantly after the policy changes. (4) The power of wives within

households, proxied by time spent on household work and spending patterns on clothing for husbands and wives, was enhanced after the change. However, the finding on intra-household allocations is only suggestive as the event affected all men and women in the country, making it difficult to find a natural control group and test the predictions on intra-household allocation.

To test the predictions on intra-household allocations more concretely and to understand the impact on migrant-sending side, I use a unique feature of the Vietnamese setting, i.e., the geographic concentration of matchmaking firms. It is reasonable to suspect that these provinces were selected endogenously. However, the provincial selection was made by the marriage brokerage firms, and this decision was driven by a feature that is unlikely to be correlated with female status, which is the existence of Chinese (Hoa) population in the province. This was mainly because the brokerage firms needed to translate Vietnamese and Chinese. I show that most observable characteristics do not have explanatory power on the patterns of geographic distributions. I also use as a time variation the sudden increase in the cross-border marriage during the late 1990s, which was unlikely to be fully expected from Vietnam.

My empirical analysis for Vietnam proceeds in two steps and uses data on the consumption of gender-exclusive goods: jewelry and make-up consumption for women and tobacco consumption for men. First, I establish the reduced-form estimates of the impact of cross-border marriage on female bargaining power using a DID. I find that the consumption of women-exclusive goods increased and the consumption of men-exclusive goods decreased in the areas with greater outflow of women after the surge of cross-border marriages. Second, I employ a structural model to draw a broader implication on the resource allocations of married couples. Using a collective model (Chiappori et al. (2002)) that incorporates two decision makers, husband and wife, I identify the partial of the sharing rule of married couples with respect to the intensity of cross-border marriage. I find that the share of wives of married couples increases by 193,000 VND (≈ 8.5 USD) with a one-percentage-point increase of outflow of women (among marriageable-aged women), which amounts to the 5% of the average total private expenditure of married couples.⁵ The results suggest that the change in the costs of cross-border marriage not only affected migrants or people who consider migrating, but also decision making powers of *all* married men and women.

The contribution of this paper is threefold. First, I develop a framework incorporating

⁵All expenditures from the survey data are normalized to the 1998 price level. The GDP per capita in 1998 was \$360.

two marriage markets with the possibility of cross-border marriage and characterize the matching equilibrium under the assumption of a quadratic surplus function.⁶ The most closely related work to this is Weiss et al. (2017), which proposes a similar matching framework for marriage migration. However, they focus on the impact only on one side of the market, i.e., migrant-receiving side, assuming that the type of migrants is exogenously given. Here, I jointly determine the matching and equilibrium shares of individuals in two marriage markets, providing additional predictions on (i) how migrants are selected and (ii) the impacts on migrant sending side. By considering different types of costs, I extend the multidimensional matching framework of Chiappori et al. (2017). This paper also contributes to a strand of papers studying marriage across different markets including inter-ethnicity (e.g. Rubinstein and Brenner (2013)) or inter-race marriages (e.g. Chiappori et al. (2016b)).

Second, I provide rich empirical evidence on the impact of marriage migrations in both a migrant-receiving country and a migrant-sending country. This complements the small number of existing studies on cross-border marriage that have focused on the causes and consequences of cross-border marriage in the migrant-receiving country (Edlund et al. (2013b), Kawaguchi and Lee (2017), Weiss et al. (2017)).⁷ Furthermore, I first show that the increase in fixed type of costs results in a more positive selection of migrants in the context of marriage migration. This draws a parallel picture with labor migration (Chiquiar and Hanson (2005)) and adds to the large literature on migration costs and selection (e.g. Borjas (1987), Moraga (2011), Bertoli et al. (2013), Feigenberg (2017)). The results on intra-household allocations build on the literature on the collective model of households by employing the exposure to a foreign marriage market as a novel distribution factor.⁸

Third, this study builds on the literature on sex ratios and marriage markets. Ever since the seminal work of Becker (1974), there has been extensive literature on the impact of sex ratios on a wide range of outcomes including marriage market outcomes (Abramitzky et al. (2011)), household decision-makings (Angrist (2002), Chiappori et al. (2002), Wei and Zhang (2011)) and crime (Edlund et al. (2013a)). In particular, sex-ratio

⁶The quadratic surplus function can be given micro foundations. See e.g. Browning et al. (2014), Chiappori et al. (2017)

⁷There is a small number of studies on the causes of internal marriage migration in India. For example, Rosenzweig and Stark (1989) argue that main motivation for sending daughters to villages in long distances for marriage is to mitigate income risks and facilitate consumption smoothing. Fulford (2015) instead suggests that the large internal migration in India is due to search. For family migration decisions, see e.g. Sandell (1977), Mincer (1978), Smith and Thomas (1998).

⁸Distribution factor refers to any variable that influences the decision process of couples but affects neither preferences nor budget constraints.

imbalances in Asian countries, including China and India, two most populous countries in the world, are considered a serious demographic problem and such imbalances will not disappear in a near future. This paper contributes to the literature by showing that the sex ratio imbalances in one country can spread to the neighboring marriage markets and can significantly affect marital outcomes and gender relations in those countries.

The paper proceeds as follows. Section 2 provides background information on Taiwan and Vietnam. Section 3 presents the model. Section 4 provides empirical evidence on matching patterns. Section 5 and Section 6 present the results on the impacts of changes in costs of cross-border marriage. Section 7 concludes.

2 Countries Background

In this section, I discuss background information on Taiwan and Vietnam, which I study in the empirical analysis. I provide an overview of two countries including the economic conditions and the demographic structures.

2.1 Taiwan (A bride-receiving side)

Taiwan is a major bride-receiving country in East Asia. With 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 sex-selective abortion technologies. However, the sex ratio in the marriage market was male-skewed even before these cohorts due to the population decline since the mid-1960s cohorts. More specifically, Taiwanese men tend to marry younger women, which made younger women relatively more scarce as population declined. As a result, whereas the sex ratio at birth has been balanced 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 with three years younger than men were mostly above 1.1 for people in their marriage ages in 2000 (Yang and Liu (2014)). Moreover, because of the outmigration of women to the cities, the sex ratio imbalances have been severer in the rural areas.

For these reasons, Taiwanese men have started to seek brides from abroad. The two countries of origins which have the largest shares of foreign brides are mainland China and Vietnam. The number of cross-border marriages grew fast during the late 1990s and 2000s, when the matchmaking firms started 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 (Figure 1). Among all the cross-border marriages in Taiwan, 67% of foreign brides were from mainland China and 22% of them were from

Vietnam in 2003.

2.2 Vietnam (A bride-sending side)

Vietnam sent more than 130,000 brides between 2005 and 2010 (International Migration Organization, 2012), constituting one of the largest bride-sending countries in Asia. 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 populous country in the world. The sex ratio at birth was balanced until the mid-2000s. The population growth until 1990s made young women relatively abundant because Vietnamese men tend to marry a woman who is two to three years younger than themselves (Goodkind (1997), Bronson and Mazzocco (2015)).⁹ However, the sex ratios for the cohorts who were 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 1.01¹⁰.

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 volume of such marriages sharply increased in the late 1990s; the number of such marriages increased more than 20-fold, from around 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, women diversified their destination countries to include South Korea, Singapore and China¹¹. As of 2005, the share of cross-border marriages of all marriages is estimated to be 3% in Vietnam (International Migration Organization, 2015). While it is second to China in terms of the number of women who marriage migrated to Taiwan, Vietnam provides a more suitable setting to study the consequences of cross-border marriages on the sending side as the flow of women constitutes a meaningful share of women of marriage age in Vietnam but not in China.

3 Conceptual Framework and hypotheses

To analyze the patterns of cross-border marriage and to examine how changes in costs of cross-border marriage affect matching patterns, singlehood, and spousal welfare in each

⁹There existed 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)).

¹⁰Author's calculation using the Vietnamese census 1989. The Vietnamese census 1989 is used instead of 1999 to calculate cohort sex ratio due to the tendency of under-enumeration of men in their 20s (Mizoguchi (2010)).

¹¹However, there is no formal statistics to how many women marriage migrated to China or Singapore.

country, as well as who ends up marrying a foreigner, I build a two-country matching model where each person is endowed with two characteristics, continuous socioeconomic status (SES) and binary nationality. In the model, an agent can be matched to a person from the different country, but cross-border marriage incurs some costs (which include, for instance, bureaucratic requirements and cultural differences). This model extends the multidimensional matching model developed by Chiappori et al. (2017) by incorporating a different type of cost.

Specifically, I focus on fixed cost due to its higher relevance to my empirical setting. I use two cost-changing shocks to identify the impact of cost changes; the emergence of matchmaking firms decreased the costs of marriage visits and the up-front fee for the marriage. The visa tightening policy increased the cost of visa interviews. These costs are often incurred one-time and they are more or less fixed and not dependent on types of SES, which justifies the assumption. However, it is interesting to compare the results under the fixed costs with the results under the multiplicative costs that vary with surplus. I present the results from the multiplicative cost case, which is a slight modification of Chiappori et al. (2017), in the appendix.¹²

3.1 Model

3.1.1 Populations

The market is two sided (men and women) and each person is endowed with two characteristics, the first one being SES (e.g. income, earning abilities) and the other one being nationality. The type for each man (and woman) can be expressed by (x, X) ((y, Y)) where x and y are continuous and $X, Y \in \{A, B\}$. A and B denote a country A and a country B although they can be other categories in other applications.¹³ Without loss of generality, assume that the continuous type x and y are uniformly distributed on $[0, 1]$. Let $F(x, X)$ ($G(y, Y)$) denote the joint cumulative distribution function of male (female) characteristics (x, X) ((y, Y)) over the set $[0, 1] \times \{A, B\}$.

3.1.2 Surplus

The surplus function is given as follows:

¹²The traditional immigration selection literature on labor migration studied both fixed cost and skill-dependent cost and showed that depending on the nature of the cost, immigration selection can be different even when we hold wage structures of the two countries fixed. I explore how the selection would differ under different cost schemes when agents make migration decisions based on who they would be matched with instead of potential wages in the appendix.

¹³ A and B can be applied to any kind of different marriage (or one-to-one matching) markets. To name a few, different ethnicities, different religions, and different provinces can be other applications.

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

If the match is between different countries, there is a loss of fixed amount.

The function S is strictly increasing, continuously differentiable, and supermodular. Assume that any single gets 0 and $S(0, 0) \geq 0$. That is, any match is better than singlehood.

3.1.3 Stable matching

A matching is defined as a measure μ on the set $([0, 1] \times \{A, B\})^2$ and four value functions $u_A(x)$, $u_B(x)$, $v_A(x)$ and $v_B(x)$. 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 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 pairing. Stability can be summarized by the following set of inequalities: for any $(x, X), (y, Y)$, we require:

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

For couples matched with positive probability,

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

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 $([0, 1] \times \{A, B\})^2$ where marginal distributions are equal to the initial measures of men and women populations. A stable matching exists under mild continuity and compactness conditions.¹⁴

¹⁴See Chiappori et al. (2010), Chiappori et al. (2016a), Chiappori (2017).

3.1.4 General results under fixed cost

In this subsection, I present a set of results which hold true under any positive fixed cost, without any assumption on the exact distributions of men and women in each country and the specific form of the surplus function.

Proposition 1. *In the stable matching, if $(x, X), (y, Y)$ match and $x \geq x'$, the measure of couples $(x', X'), (y', Y)$ with $y' > y$ is 0. Similarly, in the stable matching, if $(x, X), (y, Y)$ match and $x \geq x'$, the measure of couples $(x', X), (y', Y')$ with $y' > y$ is 0.*

Proof. 1. When $X = X'$

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:

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

Switching the matching generates:

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

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

2. When $X \neq X'$

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:

$$\Sigma_1 = \Sigma_{XY}(x, y) + \Sigma_{X'Y}(x', y') = S(x, y) + S(x', y') - \lambda_1$$

Switching the matching generates:

$$\Sigma_2 = \Sigma_{XY}(x, y') + \Sigma_{X'Y}(x', y) = S(x, y') + S(x', y) - \lambda_1$$

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

The proof of second part is similar. □

Proposition 1 states that the stable matching is assortative on the continuous characteristics of men and women when holding one gender's nationality. For instance, for

any subset of agents in the stable matching including men from A country but *not* men from B country, the matching is assortative on SES regardless of the women's nationality. However, if we take a subset of agents in the matching including men from *both* A and B countries, there is no guarantee that the matching assortative on SES. If the cost is zero and free trade is possible so that the market is completely combined, the stable matching would be the matching which is positive assortative on SES regardless of nationalities, since that maximizes the total surplus. However, since the cost imposes a friction in the market, the fully assortative matching on SES is not maximizing the total surplus, and thus not stable anymore.

Let $p_X(x)$ denote the probability that a male from X country with SES x marries a female from B country. Similarly, $q_Y(y)$ denotes the probability that a female from Y country with SES y marries a male from B country. These probabilities are determined in the equilibrium.

Proposition 2. *Suppose an open set of males from X country are indifferent between marrying a woman from A country and a woman from B country so that $0 < p_X(x) < 1$ in the stable match for any x in the open set. If (x, X) is matched to either (y, A) or (y', B) , then we have $y = y'$. Moreover, $v_X(y) = v_{\bar{X}}(y) + \lambda$ where $\{\bar{X}\} = \{A, B\} - \{X\}$.*

Similarly, suppose an open set of females from Y country are indifferent between marrying a man from A country and a man from B country so that $0 < q_Y(y) < 1$ in the stable match for any y in the open set. If (y, Y) is matched to either (x, A) or (x', B) , then we have $x = x'$. Moreover, $u_Y(x) = u_{\bar{Y}}(x) + \lambda$ where $\{\bar{Y}\} = \{A, B\} - \{Y\}$.

Proof. Without a loss of generality, let X be A . Suppose a man x from country A is matched to either a woman y from country A or a woman y' from country B at the stable match. Let $U_A(x)$ be his utility. Then, by stability,

$$\begin{aligned} u_A(x) &= \max_s (S(x, s) - v_A(s)) \\ &= \max_{s'} (S(x, s') - \lambda - v_B(s')) \end{aligned}$$

where $v_A(s)$ ($v_B(s')$) is the utility of a woman from country A (a woman from country B) with the type s (s'); note that the maximum is reached at $s = y$ and $s' = y'$ respectively. By the envelope theorem:

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

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

From the stability conditions, we have

$$\begin{aligned} u_A(x) &= S(x, y) - v_A(y) \\ &= S(x, y) - \lambda - v_B(y) \end{aligned}$$

Thus, $v_B(y) + \lambda_1 = v_A(y)$.

Second part can be proved similarly. \square

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 result may appear to be surprising, but the form of the surplus function explains why this result holds. The surplus function consists of two parts, one relying on the complementarities generated from the continuous types of males and females, and the other depending only on discrete categories, and not the SES types of each agent. The continuous types of both females are equivalent in the equilibrium because they contribute to the first part in the exactly same way. However, because of the second part, the share of the female who is from the different country than her match is lower than that of the female who is from the same country. The difference is precisely λ , the female from the different country bearing all the cost.

Proposition 3. *Assume that there exists an open set O such that for all (x, A) where $x \in O$, $0 < p_A(x) < 1$. That is, (x, A) marries either a woman (y, A) or (y, B) with positive probability. Then, $q_A(y) = 0$ for almost surely.*

Proof. Suppose $q_A(y) > 0$. Then, (y, A) is matched to either (x, A) or (x, B) . The couples $(x, A), (y, B)$ and $(x, B), (y, A)$ 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. \square

Proposition 3 states that the direction of randomization is always one-sided for a given neighborhood. If there were randomizations 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.

3.2 Example: Taiwan and Vietnam

In this subsection, I present a particular example of Taiwan and Vietnam following my empirical applications. Specifically, I impose additional assumptions on populations to reflect the market conditions of the two countries and on surplus function to get a closed

form solutions. I derive the matching equilibrium under such market circumstances and present the comparative statics.

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

- *Taiwanese men (women) are uniformly distributed on $[A, B]$.*
- *Vietnamese men are uniformly distributed on $[A - \sigma, B - \sigma]$ where $\sigma > 0$.*
- *Vietnamese women are uniformly distributed on $[A - \sigma - \delta, B - \sigma - \delta]$ where $\delta \geq 0$.*
- *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 $v > 1$.*
- *$B - \sigma = B - r\sigma - r\delta$.*

The last assumption is just to simplify the analysis. The equilibrium can also be solved without this assumption.

Assumption 2. *Assume that the surplus function is given as follows:*

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

I use a quadratic surplus function in this example. This is a simple form of surplus function, but at the same time, micro foundations can be given for this form.¹⁵

Proposition 4. *Taiwanese men above $B - r\sigma - r\delta$ marry only Taiwanese. Taiwanese men with $[B - r\sigma - r\delta, B]$ are matched to Taiwanese women with $[B - \sigma - \delta, B]$.*

Proof. Suppose there exists a positive measure $O \subset [B - r\sigma - r\delta, B]$ of Taiwanese men who marry Vietnamese women. Then, there must exist a set O' of an identical measure for Taiwanese women above $B - \sigma - \delta$ who are *not* married Taiwanese men. Then either almost all Taiwanese females in O' are matched to Taiwanese men below $B - r\sigma - r\delta$, or a non-null subset of Taiwanese females in O' is matched with Vietnamese.

Let's consider the first case. Assume that almost all Taiwanese females in O' are matched to Taiwanese men below $B - r\sigma - r\delta$. Let $x \in O$ be matched with y_V , a

¹⁵See Browning et al. (2014), Chiappori et al. (2017)

Vietnamese, while $y' \in O'$ is matched to a Taiwanese husband $x' < B - r\sigma - r\delta$. The surplus generated is

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

If switching the match, the surplus becomes

$$\Sigma_2 = S(x, y') + S(x', y_V) - \lambda.$$

$\Sigma_2 > \Sigma_1$ because $x > x'$ and $y' > y_V$ (supermodularity).

Assume now the second case. Let $x \in O$ and he is matched to y_V , a Vietnamese. Let $y' \in O'$ be matched to a Vietnamese x' . The surplus generated is

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

If switching the match, the surplus is

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

$\Sigma_2 > \Sigma_1$ because $x > x'$ and $y' > y_V$ (supermodularity).

□

I consider three cases under different cost schemes: (1) autarky ($\lambda = \infty$), (2) complete integration ($\lambda = 0$), and (3) intermediate case. (1) and (2) cases are trivial. Under (1), the matching is positive assortative on SES within each country. Under (2), the matching is positive assortative on SES regardless of nationality. Interesting case is when the cost is in between. The equilibrium can be found by using the below proposition.

Proposition 5. *For men with SES type $[A, B]$ and for women with SES type $[a, b]$ regardless of the countries, there is a unique equilibrium described as follows: There is a cutoff z_M for men and z_W for women where matching is positive assortative regardless of nationality for x above z_M for men and y above z_W for women. Taiwanese men above the cutoff mix between Taiwanese women with probability $p = \frac{r(1+v)}{r+v}$ and Vietnamese women with probability $1 - p$. Vietnamese women above the cutoff mix between Taiwanese men with probability $1 - q$ and Vietnamese men with probability $q = \frac{r+v}{1+v}$. Taiwanese women and Vietnamese women only marry people from same country. For the below cutoffs, the matching is positive assortative within each nationality.*

Proof. I make a conjecture that the equilibrium is as explained in the Proposition and verify that that equilibrium indeed satisfies stability conditions. The Proposition can be proved in four steps.

- Step 1 (Matching functions): For above cutoffs (above z_M for men and above z_W for women), $(1+v)(\frac{B-x}{B-A}) = (r+v)(\frac{b-y}{b-a})$, resulting in

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

Note that $z_W = \frac{1+v}{r+v}z_M + b - \frac{1+v}{r+v}B$. For below cutoffs, $\frac{z_M-A}{B-A}(1 - \frac{x-A}{z_M-A}) = r\frac{z_W-a}{b-a}(1 - \frac{y-a}{z_W-a})$ for Taiwan and $v\frac{z_M-A}{B-A}(1 - \frac{x-A}{z_M-A}) = v\frac{z_W-a}{b-a}(1 - \frac{y-a}{z_W-a})$ for Vietnam, resulting in

$$\begin{aligned} y &= \frac{1}{r}x - \frac{1}{r}z_M + \frac{1+v}{r+v}z_M + b - \frac{1+v}{r+v}B = \phi_T(x), \\ y &= x - z_M + \frac{1+v}{r+v}z_M + b - \frac{1+v}{r+v}B = \phi_V(x). \end{aligned}$$

Note that the last married Taiwanese man is $x_{0,T} = \phi_T^{-1}(a) = rA + \frac{1-r}{r+v}(z_Mv + rB)$. $x_{0,T} \in [A, B]$ given that $z_M \in [A, B]$. The last married Vietnamese man is $x_{0,V} = \phi_V^{-1}(a) = A + \frac{1-r}{r+v}(B - z_M)$. $x_{0,V} \in [A, B]$ given that $z_M \in [A, B]$. Note also that $x_{0,T} > x_{0,V}$.

- Step 2 (Individual utilities):

- Taiwanese men

$$u_T(x) = \begin{cases} \tilde{u}_T(x), & \text{if } x \geq z_M \\ \bar{u}_T(x), & \text{if } x_{0,T} \leq x \leq z_M \\ 0, & \text{if } x \leq x_{0,T} \end{cases}$$

- Taiwanese women

$$v_T(y) = \begin{cases} \tilde{v}_T(y), & \text{if } y \geq z_W \\ \bar{v}_T(y), & \text{if } a \leq y \leq z_W \end{cases}$$

- Vietnamese men

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

- Vietnamese women

$$v_V(y) = \begin{cases} \tilde{v}_V(y), & \text{if } y \geq z_W \\ \bar{v}_V(y), & \text{if } a \leq y \leq z_W \end{cases}$$

- For above cutoffs,

$$\begin{aligned}
\tilde{u}'_T(x) &= S_x(x, \phi(x)) \\
\tilde{u}_T(x) &= \int_{z_M}^x S_x(s, \phi(s))ds + K \\
\tilde{u}'_V(x) &= S_x(x, \phi(x)) \\
\tilde{u}_V(x) &= \int_{z_M}^x S_x(s, \phi(s))ds + K'
\end{aligned}$$

$$\begin{aligned}
\tilde{v}'_T(y) &= S_y(\phi^{-1}(y), y) \\
\tilde{v}_T(y) &= \int_{z_W}^y S_y(\phi^{-1}(t), t)dt + L \\
\tilde{v}'_V(y) &= S_y(\phi^{-1}(y), y) \\
\tilde{v}_V(y) &= \int_{z_W}^y S_y(\phi^{-1}(t), t)dt + L'
\end{aligned}$$

– For below cutoffs,

$$\begin{aligned}
\bar{u}'_T(x) &= S_x(x, \phi_T(x)) \\
\bar{u}_T(x) &= \int_{x_{0,T}}^x S_x(s, \phi_T(s))ds + S \\
\bar{u}'_V(x) &= S_x(x, \phi_V(x)) \\
\bar{u}_V(x) &= \int_{x_{0,V}}^x S_x(s, \phi_V(s))ds + S'
\end{aligned}$$

$$\begin{aligned}
\bar{v}'_T(y) &= S_y(\phi_T^{-1}(y), y) \\
\bar{v}_T(y) &= \int_a^y S_y(\phi_T^{-1}(t), t)dt + M \\
\bar{v}'_V(y) &= S_y(\phi_V^{-1}(y), y) \\
\bar{v}_V(y) &= \int_a^y S_y(\phi_V^{-1}(t), t)dt + M'
\end{aligned}$$

– The constants are:

$$\begin{aligned}
S &= 0 & K &= \int_{x_{0,T}}^{z_M} S_x(s, \phi_T(s)) ds \\
S' &= 0 & K' &= \int_{x_{0,V}}^{z_M} S_x(s, \phi_V(s)) ds \\
M &= S(x_{0,T}, a) & L &= \int_a^{z_W} S_y(\phi_T^{-1}(t), t) dt + S(x_{0,T}, a) \\
M' &= S(x_{0,V}, a) & L' &= \int_a^{z_W} S_y(\phi_V^{-1}(t), t) dt + S(x_{0,V}, a)
\end{aligned}$$

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 $\tilde{U}_T(x) + \lambda_1 = \tilde{U}_V(x)$. Thus, $K + \lambda_1 = K'$ and z_M can be found under regularity conditions. z_W can be found by plugging z_M in $z_W = \frac{1+v}{r+v}z_M + b - \frac{1+v}{r+v}B$.
- Step 4 (Verifying stability conditions): See Appendix.

□

Under the example of Taiwan and Vietnam, except for the high types of Taiwanese men and women who only marry within Taiwan, the equilibrium can be found by applying the above proposition to the rest of the population (men with $[A - \sigma, B - \sigma]$ and women with $[A - \sigma - \delta, B - \sigma - \delta]$). The resulting equilibria under the three types of cost schemes are given in the Figure 3.

3.2.1 Theoretical predictions

The theoretical predictions on matching patterns can be summarized as follows.

1. There exist Taiwanese men - Vietnamese women couples, but there do not exist Taiwanese women - Vietnamese men couples.
2. Taiwanese men are selected from them middle of the SES distributions of all Taiwanese men as long as the cost is greater than 0.
3. Vietnamese women are selected positively from the SES distributions of all Vietnamese women.

Table 1: The impacts of cost increases in Taiwan and Vietnam

	Taiwan		Vietnam	
	Male	Female	Male	Female
Number of singles	+	.	–	.
Matching patterns	–	+	+	–
Intra-household allocation	–	+	+	–
Volume of female migrants			–	
Avg. type of female migrant			+	
Avg. type of male marrying a migrant			+	

3.2.2 Impact of a change in cost of cross-border marriage

The comparative statics predictions can be derived under the fixed cost scheme and the varying cost scheme. These predictions are tested with the data from the both sides of the markets, Taiwan and Vietnam, in the next section.

Proposition 6. – *Cutoff:* $\frac{\partial z_M}{\partial \lambda} > 0$

– *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:* $\frac{\partial u_T(x)}{\partial \lambda} > 0$, $\frac{\partial u_V(x)}{\partial \lambda} < 0$, $\frac{\partial v_T(x)}{\partial \lambda} < 0$, $\frac{\partial v_V(x)}{\partial \lambda} > 0$

– *Average type of male involved in cross-border marriage:* $\frac{\partial(B-\sigma+z_M)}{\partial \lambda} > 0$

– *Average type of female involved in cross-border marriage:* $\frac{\partial(B-\sigma-\delta+z_W)}{\partial \lambda} > 0$

Proof. See Appendix. □

Table 1 summarizes the theoretical predictions on marital outcomes, intra-household allocations (individual utilities), and migration patterns when cost increases.

4 The Results on Matching Patterns

This section tests the theoretical predictions on the forms of cross-border marriage and selection of marriage migrants and grooms of marriage migrants given in subsection 3.2.1.

4.1 Data

To explore the matching patterns, I use Taiwanese census 2000, Vietnamese census 1999, Census of Foreign Spouses (CFS) from 2003 and yearly marriage statistics from the Ministry of Interior, Taiwan. For Vietnamese women, I focus on women who were aged 25-50 in 2003. For Taiwanese men, I focus on men who were aged 28-53 in 2003.

4.2 Empirical evidence on matching patterns

This section presents empirical evidence supporting the model predictions. The proposed model is a simplified view of the marriage markets of Taiwan and Vietnam. For example, there is no idiosyncratic preferences in the model whereas it is more natural to think that people have idiosyncratic preferences in the reality. Thus, we cannot expect to see the exact patterns of matching predicted by the model from the data. However, the *qualitative* patterns of the matchings from the model can be tested.

Hypothesis 1. (*The “mixed” couples are one kind*) *Taiwanese men and Vietnamese women (TV) couples should be more frequent 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 the Taiwan - Vietnam couples who married before 2003, the share of VT couples is less than 0.5%. The yearly marriage data from the Ministry of Interior, Taiwan bolsters this prediction. The number of VT couples are less than 1% during all the years available in the data (2004-2010). The gendered patterns of cross-border marriages in Asian countries has been numerous reported in the sociology, demographics, and economics literature. Here, I first show that this pattern can be explained as an *equilibrium* of the two marriage markets rather than a simply descriptive pattern.

Hypothesis 2. (*Selection of Taiwanese men involved in cross-border marriage*) *Taiwanese men who are involved in cross-border marriage 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, not the bottom given that the cost of cross-border marriage is not zero. In Taiwan, to marry a Vietnamese woman, Taiwanese men need to pay matching-making firms approximately \$10,000. This cost precludes the cross-border marriage of the lowest types. The high types do not marry Vietnamese women because they have strictly better Taiwanese alternatives.

The data confirms the prediction on 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 education, not in the group with primary or less than primary education. The share of people with junior high or senior high education were 87% for grooms of Vietnamese brides whereas in the entire population of Taiwanese men the share is only 57%.

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

In case of Vietnamese side, women with high SES among their population marry Taiwanese men. Again, because of the cost of cross-border marriage, women below certain types cannot be engaged in the cross-border marriage.

I test the positive selection using Kolmogorov-Smirnov test. I compare the educational distribution of Vietnamese women who marry Taiwanese men and that of the entire population of Vietnamese women and test whether the first distribution first order stochastically dominates the second distribution.

The data largely confirms the prediction on positive selection of Vietnamese women (Figure 5). Vietnamese women who migrated for marriage have higher education than their counterparts in Vietnam. The Kolmogorov-Smirnov test rejects the null hypothesis that the two distributions are equal (p-value: 0). However, the data also suggests that the highest types of women, women with college education, do not marry cross-nationally as much as women with junior high or senior high education. This departure from the model could be driven by the assumption of no multiplicative type of costs in the surplus function. When there exist positive multiplicative costs which are dependent on the size of the surplus, even if very small, the highest types would choose to stay in Vietnam because the loss from the cost is the largest for the highest types.

5 The Impact on the Bride-Receiving Side

In this section, I analyze the impact of increases in the cost of cross-border marriage on the bride-receiving side exploiting the visa tightening policy in Taiwan that phased in 2004 and 2005. First, I explain the visa tightening policy in Taiwan, which I exploit for the identification of the impact of costs on the bride-receiving country. Then, I explore four main outcomes: marriage rate, matching patterns, intra-household allocations, and migrant quality. Finally, I briefly discuss about the consequences of the visa tightening policy in Vietnam.

5.1 Visa tightening policy in Taiwan (phased in 2004 and 2005)

In Taiwan, the strikingly high share of foreign brides in the early 2000s raised concerns about national security and the demographic composition of the country. Out of these concerns, the government strengthened visa requirements by requiring compulsory interviews to screen mainland Chinese brides in September 2003. At first, the Immigration

Bureau started to interview 10% of all mainland spouses. However, the mandatory interview for all women from mainland was implemented in March, 2004 (Lu (2008)). As a result, the number of Chinese brides decreased by half between 2003 and 2004. Moreover, the Taiwanese government subsequently launched a similar policy in 2005 that involved changing bulk processing of visas to one-on-one interviews, to better screen Southeast Asian brides. This resulted in a further decrease in the number of foreign brides per year. The brides from Southeast Asian countries decreased about 40 percent in a year. The impact from the cost increase for mainland China women should be in the equal directions with the case of Vietnam as long as Taiwan has a higher sex ratio than mainland China, which was the case for the cohorts involved in the cross-border marriages. The sex ratio of mainland China increased only after 1980, and the population increase until 1975, meaning that male-biased sex ratio was unlikely. I ignore three country effects in this paper, and treat 2004 as a treatment year.

5.2 Data

5.2.1 Marriage data

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.¹⁶ For the yearly marriage data, the number of marriages are available by sex, education and nationality. Population data for the people above age 15 is available by sex, education and marital status. Using these datasets, I construct the marriage rate by education for Taiwanese male and females. The district level marriage rate for each education level is calculated by dividing the number of marriages that involve Taiwanese male (female) by the number of singles, defined as the sum of unmarried, divorced and widowed, all in the corresponding education level.

5.2.2 Matching pattern data

To evaluate the impact of visa tightening policy on matching patterns, the data should include information on the characteristics of the spouses and the year of marriage. I use 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 US) contains such information. The survey has been conducted every three

¹⁶The area of Taiwan is about 1.5 times of the state New Jersey in the US.

or four years starting from 1988¹⁷. The sample consists of women over 15 years old within representative sample of households. For this sample, the survey collects information on their characteristics such as age, educational attainment and marital status. Furthermore, for the currently married women, information on the characteristics of their spouses and the year of marriage is also collected. I use the WMFES 2006, 2010 and 2013, which also contains information on pre-marriage nationality¹⁸, and limit the sample to only include women whose pre-marriage nationality is Taiwanese.

5.2.3 Intra-household outcome data

For intra-household outcomes, I use the Panel Survey of Family Dynamics (PSFD). The PSFD includes two variables that I use as intra-household outcomes; it contains first, the information on weekly hours spent on household works and second, yearly clothing expenditure of the respondents and their spouses. It also surveys the year of marriage, which allows me to evaluate the impact of changes in visa policies on the relative status of women within households. I use 2007 data only because that is the only year when the survey collected information on spending for *both* husbands and wives.

5.2.4 Marriage migrants data

To understand the marriage migrant characteristics and how the selection of marriage migrants were affected by the changes in the visa policies, I use the Census of Foreign Spouses (CFS) from 2003 and the Foreign and Mainland Spouse Living Needs Survey (FMSLNS) in 2008 and 2013, both conducted by the Taiwanese Ministry of Interior. The CFS surveyed 240,837 residents who were married to Taiwanese citizens but who did not have Taiwanese citizenship at the time of marriage. The subsequent FMSLNS in 2008 and 2013 have smaller sample sizes of around 13,000 each year. While sample sizes differ, 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.

5.3 Impacts on marital outcome and intra-household allocation

In this section, I investigate the impact of visa tightening policy of Taiwan on marital outcomes, selection of cross-border couples, and intra-household allocations in Taiwan. In particular, I test the predictions of the model on comparative statics given in Table 1.

¹⁷The survey was first conducted in 1979. It was conducted annually between 1979 and 1988, but due to budget limitations, it is conducted every three or four years since then.

¹⁸The information on pre-marriage nationality is not available for the WMFES before 2006.

5.3.1 Marriage rate

Hypothesis 4. *When the cost of cross-border marriage increases, the marriage rate for Taiwanese males decreases overall. However, the decrease is concentrated among the males with low SES; the marriage rate of those with high SES is not affected.*

Hypothesis 5. *The marriage rate for Taiwanese females is not affected by the policy.*

The prediction from the model naturally leads to a difference-in-differences (DID) as an identification strategy. The Taiwanese men with high SES are not affected by the changes in the visa policy. Thus, they serve as a control group. The Taiwanese men with low SES are the treatment group because they are expected to be affected by the changes in the visa policies. I proxy SES with education. This is a better choice than other measures of SES including income or wages because education is a pre-determined variable, and is unlikely to be influenced by marriage or decisions after marriage. The model predicts that the increases in the cost of cross-border marriage do not affect the marriage rate of females; the same DID for females is conducted to test this hypothesis. I estimate the following regression, separately for Taiwanese men and women:

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

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 for the number of male and female single population at each education level in a given district and in a given year. $Post_y$ is one if year y is after the visa tightening policy. That is, $Post_y = 1$ for any $y \geq 2004$. $Treat_e$ is one when the education group is either primary or junior high. If the education level is higher than junior high (i.e., senior school or above), it is zero. I refer to the former as low-education group and the latter as high-education group. As a robustness check, different definitions of treatment group are also explored. The β is the coefficient of interest, and it is expected to be negative for Taiwanese males and zero for Taiwanese females.

The Figure 6 depicts the marriage rates for each education group in each year. The graphs confirm that the pre-trends are similar for the low-education group and the high-education group for both males and females. One notable feature in the graphs is that there are two dips for the marriage rate for the people with vocational education or uni-

versity education in 2004 and 2009, respectively. These years are superstitiously believed to be unlucky to get married, called ‘lonely-phoenix year’. As is shown in the graphs, the different education groups respond differently to superstitions. Therefore, including year-specific fixed-effects would not be sufficient to capture the full effect of such superstition on marriage rates. That is, since year-specific fixed-effect can only capture the education-invariant year-specific effects, it does not capture the different responses from different education groups, biasing my estimates. Moreover, since this superstition is widely known, people may show a forward-looking behavior and adjust their timing of marriage accordingly. To address this concern, I estimate the same equation excluding samples from 2004 and 2009 as well as the year 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 male decreased compared to the high-educated group after the visa tightening policy. The marriage rate for low-educated group decreased by 8 to 10 marriages per 1,000 singles, depending on whether unlucky years are excluded or not. This is equivalent to 23-29% decrease in marriage rate for low-educated males. Different definitions of low-education group give similar results; when the cutoff of low-educated group is smaller, the estimates of β gets larger. I find small coefficient size for female and it is essentially zero when the unlucky years and its windows are excluded, confirming the prediction from the model.

5.3.2 Matching patterns

Hypothesis 6. *When the cost of cross-border marriage increases, Taiwanese females are more likely to marry up, except for the females with high education. The matching of the females with high SES are not affected by the policy.*

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

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

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 year of marriage fixed effects. The control vector X_{mey} includes county fixed effects, husband age and wife age. Since I test whether the partner's education increases given female's education, I control for wife's education. The education-year level control vector Z_{ey} includes the excess share of males with education higher than e ¹⁹. $Post_y$ is one if y is 2004, when the visa tightening policy was implemented, or later. $Treat_e$ is one when the education group is below university education. If the education level is university or above, it is zero.

The Figure 7 plots the average years of education of husbands by wife's education level.²⁰ It shows that the pre-trends are similar across education groups, which validates the DID as an identification strategy. While the average education of husbands for wives with university education or above stay stable over time (if anything, a slight increase), the average education of husbands for wives with education lower than university increases after the visa tightening policy was implemented.

The Table 3 shows the results from the regression. After the visa tightening policy, the Taiwanese females with education below university marry a man with 0.2 years higher education. Alternative dependent variables including the probability of marrying up for females and the educational years of differences for couples also give similar results.

5.3.3 Selection of people who marry across country

Hypothesis 7. *When the cost of cross-border marriage increases, the average SES of Taiwanese male who marry foreign brides increases.*

Hypothesis 8. *When the cost of cross-border marriage increases, the average SES of foreign brides increases.*

Given that the cost associated with visa application process can be seen as 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 expensive for the marginal types. To test the predictions, I measure the SES of men and women by level of education and compare the educational level of marriage migrant women right before and right after the visa tightening policy. I estimate the following equation for female

¹⁹Specifically, it is calculated as the difference between the share of males with education higher than e and the share of females with education e or above. For university females, I use the difference of share of males with university or above education and the share of females with university or above education. This is based on the assumption that the matching would be assortative.

²⁰Due to small sample sizes, I aggregate education groups into two groups: group with university education and group without university education.

marriage migrants and their spouses to capture the changes in 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 (and also 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 above). Thus, the coefficient of interest β captures whether the share of each education decreased or increased after the stricter visa policies.

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

The patterns are similar for the Taiwanese spouses of foreign brides. One notable difference compared to the results on the foreign brides is that the average education level of Taiwanese males who marry Southeast Asian brides went up right after 2004, not 2005, although there is an additional increase of education level after 2005. This is because the average cost associated with marrying any foreign bride for Taiwanese men already went up in 2004.

The Table 4 and Table 6 shows the regression coefficients for each education level. The results on foreign brides show that the education level shifted towards higher education. The share of brides with primary school education decreased while the share of brides above that level of education increased. The results for Taiwanese groom reveal similar patterns. However, since the base education level of Taiwanese grooms marrying foreign brides is higher, share of people with education with primary or junior high decreased and the share of people above junior high education (i.e. senior high/vocational or university or above) increased.

One alternative hypothesis that could explain these results is that the educational level of *whole* mainland Chinese women/Vietnamese women or *whole* Taiwanese men may have increased over time. This can be tested by looking at the educational composition of

mainland Chinese women/Vietnamese women and Taiwanese men each year. If anything, there is an increasing trend for the education of mainland Chinese women/Vietnamese women, but the increase is so smooth that it is hard to think that the jump during 2004-2005 is driven solely by this trend. Similarly, the education of Taiwanese men has grown smoothly, which invalidates the alternative hypothesis.

5.3.4 Intra-household allocations

Hypothesis 9. *When the cost of cross-border marriage increases, the power within households for wives improves whereas the power of husbands decreases in Taiwan.*

For marriage rates and matching patterns, the changes in costs of cross-border marriage affect only a subset of populations. However, one of the powerful results in matching literature is that once market condition changes, the share of everyone changes. In the specific case of the visa tightening policy, the individual utilities of women increases for *all* women and the individual utilities of men decreases for *all* men. Thus, albeit interesting, it is difficult to test this prediction compared to marriage rates or matching patterns because there does not exist a natural control group. Instead, I compare men and women in terms of measures of bargaining power within households, which is proxied by weekly hours on household work and individual spending on clothing. Since the model predicts that the power of wives increases and that of husbands decreases, we would expect to see that the time spent on household work for husbands increases compared to for the wives and the spending on clothing of husbands decreases compared to that of wives.

$$Y_{igy} = \beta female_g \times Post_y + \gamma_g + \delta_y + \nu X_i + \varepsilon_{igy}$$

where i is an individual, g is gender, and y is the year of marriage. The controls include the ages of husbands and wives, and district fixed effects. For the spending on clothing, I also control for total expenditure of the household in the form of the product of level and log level in the spirit of Working-Leser model. This allows differential impact of total expenditure by its level.

The results are presented in Table 8. The results show that the weekly hours of household work decreases and the spending on clothing increases for wives compared to the husbands after the visa tightening policy although the result on spending on clothing is not significant. This suggests that the power of women within households is enhanced when it becomes more difficult for Vietnamese women to enter Taiwan, which is consistent with the theoretical prediction.

5.4 Responses in Vietnam

As suggested by the model, the changes in costs of cross-border marriage should affect the outcomes in Vietnam to the opposite direction of the impacts in Taiwan. However, it is difficult to test the outcomes in Vietnam using the visa tightening policy of Taiwan because Vietnamese women diversified the destination countries and migrated massively to South Korea after the visa tightening policy (Figure 2). The 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 led to an emergence of matchmaking firms operating in Vietnam and Korea. This lowered the cost of cross-border marriages between Vietnamese and Korean. The predictions of the model are less clear when the cost of cross-border marriage in one destination country increases and the cost of that in another country decreases. Thus, instead, I focus on the cost decrease of cross-border marriage between Vietnamese and Taiwanese during the late 1990s to identify the impact in Vietnam in section 6.

6 The Impact on the Bride-Sending Side

To evaluate the impact of changes in cost of cross-border marriage on intra-household allocations concretely and to explore the impact on the bride-sending side, I exploit a unique feature of Vietnamese setting, considerable geographic variation in the origin of Vietnamese marriage migrants. I use detailed household expenditure data containing gender-exclusive goods to measure intra-household power of husbands and wives. For Vietnam side, instead of the visa tightening policy, I use a fast expansion of matchmaking firms during the late 1990s. The primary reason is that the volume of marriage migration did not change much in Vietnam side after the visa tightening policy, because Vietnamese women changed the destination country to South Korea instead of Taiwan as explained in subsection 5.4. This is also an interesting margin of responses to the cost increases of cross-border marriage in one country on the other countries. However, it is theoretically less clear how intra-household allocations change when migrants just change their destination countries and the volume of migrants remains stable. Thus, I instead focus on a sudden increase of cross-border marriage during the late 1990s, which is likely to have reshaped the gender relations in the region.

6.1 Emergence and expansion of matchmaking firms

The sudden increases of cross-border marriage between Taiwan and Vietnam during the 1990s has to do with the lowered physical cost of cross-border marriage. The active eco-

economic interaction eased the travel between Taiwan and Vietnam. Moreover, the emergence of cross-border matchmaking firms in Taiwan and Vietnam facilitated efficient meetings of potential grooms and brides. It costed around US\$10,000-20,000 for the whole marriage packages in 2000, and this was usually paid by Taiwanese men. Although the matchmaking firm started to operate in the early 1990s, the quickest expansion was during the late 1990s and the matchmaking service was known to normal people in Taiwan only after the late 1990s (Tseng (2016)).

Marriage process is efficient and quick, with the whole process of marriage taking at most a month. The matchmaking firms are located in both sides of the market. The ones in Taiwan recruit men who want to marry Vietnamese women. Then, matchmaking firms organize a trip to Vietnam to introduce a number of potential brides to the potential groom. If the marriage is successfully arranged, wedding in general takes place in Vietnam and the couple goes back to Taiwan together. The potential brides are recruited by small matchmakers in Vietnamese branches. These matchmakers actually visit the communities and recruit females who want to marry foreign men. As the internet was not so common in Vietnam until the early 2000s²¹, most cross-border marriages could only be made through the brokerage firms or networks of migrant brides, which is a notable difference with mail-order bride system operated online these days. This feature made cross-border marriages highly concentrated in certain regions where the network of matchmaking firms were located.

Given the structure of matchmaking services, where Taiwanese men who visit Vietnam chooses women, the variations in the number of cross-border marriages between Taiwan and Vietnam is primarily driven by the demand factor²², which is less predictable from Vietnam side, thus providing useful exogenous variations. I use the sudden increase in the late 1990s for identifying the impact of cross-border marriage on intra-household allocations.

The intensity of the sudden increase in cross-border marriages varied across regions as mentioned above.²³ Further, there existed a considerable variation in the number of marriage migrants within the regions; in 2003, the number of marriage migrants in the sixty four provinces varied from 0 to more than 2,000. The intensity is depicted in

²¹As of 2002, only 0.25 percent of population had an access to internet (Lam et al. (2004)) According to the Vietnam Internet Network Information Center (VNNIC), by the end of 2012, 35.40 percent of the population was the internet users.

²²It is difficult to find evidence that Taiwanese men could not find spouses in Vietnam because of short supply of potential brides.

²³Vietnam consists of eight regions, and sixty four provinces as of 2004. Currently, there are fifty eight provinces. Lower administrative tiers include districts and communes.

Figure 12. Such provincial differences in the intensity adds 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, it is imperative to understand why such geographic patterns appeared.

Marriage migration was highly concentrated in the southern regions of the country, particularly Mekong Delta region and certain provinces of the Southeast region; more than 99 percent of women who married Taiwanese men in 2003 were from either of the two regions (Nguyen and Tran (2010)). This is mainly driven by the locational decisions of marriage brokerage firms; in 2002, more than two hundred matchmaking agencies visited TECO (Taiwan Economic and Cultural Office)²⁴ in the south whereas only two in the north and none in the central Vietnam (Wang and Chang (2002)).

Extensive research on prior literature and institutional background suggests four potential drivers of the location of cross-border marriages. First, and one of the most important factors is the existence of Chinese (Hoa) population in those regions. Since the brokerage firms need to communicate both in Vietnamese and Chinese (Taiwanese), most matchmakers are ethnic Chinese (Wang and Chang (2002)). Ethnic Chinese are concentrated in the south part of the country. In the past, significant number of Hoa people resided in the north but more than 90 percent 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 less severe degree than in the north (Banister (1985)). As a result, vast majority of current Hoa population lives in the south Vietnam.

Second, foreign direct investment made by Taiwan could have played a role. It is easier for Taiwanese matchmaking firms to penetrate the province when there are established network of Taiwanese people. Taiwan was the biggest investor in Vietnam in terms of the total registered capital by the end of 2006. Two biggest destination of FDI by Taiwan were Hanoi and Ho Chi Minh city, with higher concentration in the south, especially in the initial years of investments (Minh (2011)).

Third potential driver is economic development of the provinces; that is, matchmakers may have selected the provinces that were economically less developed as this would make the financial benefits of international marriage further stand out. However, this is a limited possibility because Mekong Delta is not a very poor region; out of six regions included in the study, it had third largest average household expenditure.

Finally, marriage market conditions could have affected the locational decisions of brokerage firms. Sex ratio is one of the most important indicators of the marriage market

²⁴TECO is a representative office alternative to an embassy or a consulate. It handles visa related issues.

condition (Angrist (2002), Chiappori et al. (2002), Abramitzky et al. (2011)). If there is a considerable variation in sex-ratios across provinces, it could be the case that the matchmakers have selected into the provinces with more females. This selection can be especially problematic because sex ratios are known to be associated with the status of women. The comparison between sex ratios by age in two affected regions reveal that there is no systematic pattern of sex ratios especially for the cohorts who were likely to be affected.

To understand which of the above stated factors do affect geographic distribution of marriage migrants, I investigate the relationship between cross-border marriage intensity and potential drivers. Exploration of correlation between them would reveal which were indeed relevant; then I could assess whether these are concerns for the identification of the effect in question.

Table 9 indicates that Hoa population is the biggest predictor of the location choice of the brokerage firms, as predicted. FDI had no effect on the intensity of cross-border marriages, as was sex ratio. Further, the brokerage firms did not select into the poorest areas; rather, the provinces with higher intensity of outflow of women were slightly wealthier than the other areas.

While these findings alleviate many potential concerns, it leaves us with the question on the comparability of regions with/out Hoa population, especially in terms of the status of women itself or characteristics that are related. If the existence of Hoa population is systematically correlated with those factors, it would pose problems for the identification. However, it is not likely to be the case for several reasons. First, even in the provinces where Hoa population is relatively big, the proportion of the ethnic group is very low. The average proportion of Hoa population across all the provinces that sent any positive number of brides was 0.8 percent, while the major ethnicity is Kinh, as in any other areas. Even if Hoa population had different characteristics, the sheer population size makes it very unrealistic, if not impossible, to assume that the provinces with more Hoa population were different from other provinces regarding the status women.

Further, province-level characteristics do not move in the exact way the cross-border marriages are distributed. The variables used as covariates or dependent variables are fairly well-balanced across the areas (Table 10). The additional variables from the census also show that there are no systematic patterns of the geographic distribution of marriage migrants on many observables including industry composition and literacy rate. One concern is the lower education level in the areas with higher number of marriage migrants. However, relative education, which has been known to be critical in determining bar-

gaining positions of the couples (Browning et al. (1994), Oreffice (2011), Browning et al. (2014)), is fairly similar across areas since the educations of husbands and wives are *both* lower in the areas with many marriage migrants. This mitigates potential concerns regarding education levels, but I also control for the education levels of husbands and wives in the main analysis to capture any effects of education on bargaining measures.

There is little concern that the provinces with higher Hoa population are different in characteristics that are correlated with women’s status from the other regions. However, to address any possible time-specific effects of Hoa population, I control for the Hoa population in 1989, which is before the start of cross-border marriages, interacted with time fixed effects to capture any related idiosyncratic time effects. Moreover, 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.

6.2 Data

6.2.1 Data on household expenditures

The data on household expenditures is from the nationally representative household surveys: the Vietnam Living Standards Survey (VLSS) and the Vietnam Household Living Standards Survey (VHLSS). These surveys have been conducted as part of the Living Standards Measurement Survey of World Bank. The VLSS was first conducted in 1992-93 and another wave in 1997-98. The VHLSS have been collected every two years since 2002. The VHLSS maintains the structure of VLSS with some modifications. However, the expenditure sections are largely comparable across different waves of the VLSS and the VHLSS.

I use three waves of the survey, the 97-98 VLSS, the 2002 VHLSS and the 2004 VHLSS. As explained in the previous section, there was a large demand shock between 1998 and 2000 in the number of cross-border marriages. I compare the expenditure patterns before and after this shock. The 97-98 VLSS serves as pre-treatment period and the 2002 VHLSS and the 2004 VHLSS are used as post-treatment periods. I do not use 92-93 VLSS because there is no consumer price index covering this period, so it is difficult to construct a harmonized measure of expenditure. Moreover, although the flow of cross-border marriages started in the early 1990s, it was recognized as a new social phenomenon only in the late 1990s. Further, since I study the impact of cross-border marriages beyond that on the families who actually sent their daughters, the effect in the late 1990s is more relevant.

I focus on the samples of married couples whose age is between 20 and 60. I exclude

extended families and focus on nuclear families. I also restrict my sample to married couples who reside in rural areas because most marriage migrants have been from the rural areas and economic investment was active in the urban. Additionally, two regions in mountainous areas are excluded from the analysis because they have a very different ethnic composition from the rest of the country.²⁵ For a similar reason, I also exclude two provinces with less than sixty percent of Kinh, the major ethnicity in Vietnam.²⁶

As a measure of bargaining between couples, I use expenditure on gender-exclusive goods in the households. For women exclusive goods, the best candidate is *jewelry, watches, make-ups*. The survey questioned the spending on the group of those goods, not the spending on each item. In the VHLSS (2002, 2004), there was a slight modification in the listed items. For years that I use VHLSS, I combine two groups of items *jewelry, watches, glasses* and *cream, powder, lipsticks* to construct comparable spending items to earlier years. Tobacco is used as a men-exclusive good.

6.2.2 Data on the intensity of cross-border marriages in each province

I use the visa counting of 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. TECO keeps the province-level record on the number of people who got interviews from TECO, which are required for Vietnamese who want to migrate to Taiwan, as well as on the number of people who were granted Taiwanese visa for the cross-border marriage.²⁷ 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.²⁸

6.2.3 Data on other factors

The population size of 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 is from the Chamber of Commerce and Industry of Vietnam (VCCI) in the 1990s and

²⁵Two excluded regions are Northeast and Northwest regions. As of 2009, the fractions of Kinh were 51.28 percent and 19.51 percent, respectively. Other regions except for Central Highlands have at least 80 percent of Kinh. A province with very low fraction of Kinh in the Central Highlands, Kon Tum, is additionally excluded.

²⁶The excluded province is Kon Tum and Gia Lai in central Vietnam. The fractions of Kinh were 37.32 percent and 49.52 percent, respectively, as of 2009.

²⁷Since there is another TECO in Vietnam which is located in Hanoi, this number might underestimate the number of marriage migrants in the 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 there were more than 240 marriage agencies who registered at the TECO in HCMC while there were only two agencies who visited the TECO in Hanoi for migration documents in 2002.

²⁸It is difficult to know the number of marriageable women in each province accurately. As a proxy for that, I use the size of female population aged 21, which is the average age of first marriage for female.

from the General Statistics Office of Vietnam (GSO) for the 2000s.

The measure of gender-intensive agriculture, which is used as another distribution factor in the structural section, is obtained from the VLSS and the VHLSS. The VLSS and the VHLSS contain commune-level questions on the areas of each agricultural category. I define the intensity of male-dominant agriculture as the total areas of forest trees.

6.3 The impact on intra-household allocations

Hypothesis 10. *When the cost of cross-border marriage decreases, the power within households for wives improves whereas the power of husbands deteriorates in the bride-sending side.*

The hypothesis suggests that if the cost of cross-border marriage decreases, the power of women within households improves whereas that of men within households decreases in Vietnam. This is because given the male-skewed sex ratios in Taiwan and the balanced sex ratios in Vietnam, the sex ratio gets more male-skewed for Vietnam side when the markets are more integrated, which is favorable to women. I test this hypothesis in two steps, first providing reduced-form evidence and second estimating the impact on sharing rule of married couples with a structural framework.

6.3.1 Reduced form evidence

I begin by investigating the expenditure patterns in the affected areas compared to the unaffected areas before and after the large outflow of women in the late 1990s. More specifically, I compare before and after the sudden increase of cross-border marriages in 1998 and 2000. 1997-8 serves as pre-treatment and 2002 and 2004 are 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 marriage and 0 otherwise. X_{hpt} is a vector of control variables at the household level. It includes age, age squared, education, dummies of ethnicity of husband (or wife), total expenditure, and the number of children. Z_{pt} is a vector of time-varying characteristics at the province level that includes consumer price index and foreign direct investment. The regressions include province fixed effect δ_p and year fixed effect γ_t absorbing time-invariant province effect and province-invariant time

effects.

The coefficient of interest is φ . It measures whether provinces with larger outflows of women consumed larger amount of women-exclusive good or smaller amount of men-exclusive good.

The results in Table 11 indicate that the households located in the areas with more marriage migrants consume less tobacco but more jewelry/watch/make-up. In areas with ten percent outflow of women, the households on average spend approximately 24,000 VND less on tobacco and 22,000 VND more on jewelry, watch, make-up. The tobacco consumption decreased about one percent in the areas with one percentage point of marriage migration flows. The effect on women-exclusive good is slightly larger; one percentage point increase of outflow of women is associated with approximately five percent increase of women-exclusive good consumption. The results are similar when shares are used instead of the level of expenditures.

In order to show that the results are not entirely driven by the different time effects of the factor which determined the location of cross-border marriages, I run the following regressions. Below regression allows different time effects of predetermined Hoa population.

$$y_{hpt} = \delta_p + \gamma_t + X'_{hpt}\beta + Z'_{pt}\theta + \varphi Post_t * I_p + (S'_p * T_t)\rho_t + \varepsilon_{hpt}$$

The results shown in Table 12 corroborate the findings. Even after controlling for idiosyncratic effects of Hoa population, the coefficients of interest maintain the same signs. Although the sizes of coefficients decreased, the coefficient of women-exclusive good is still highly significant.

One competing hypothesis would be that the results are mechanically driven by substitution arising from different expenditure growth path. However, this hypothesis can be ruled out for two reasons. First, tobacco and jewelry, watch, make-up are both normal goods in Vietnam. If the areas with larger outflow of women experienced higher (lower) income growth, consumption on both goods should increase (decrease). Second, more importantly, the income growth paths are not different for the areas with higher marriage migration. This can be tested by running the same regression with total expenditure as a dependent variable. The coefficient of interaction terms is insignificant in the fifth column in Table 12.

6.4 Heterogeneous effects

In this section, I explore potentially different impact of marriage migrant flows across different groups; the effects can be different for households with remittances, young couples and old couples.

I begin by examining the scope of the direct effect of the cross-border marriages. The first order impact of cross-border marriages would be on the households who sent their daughters to Taiwan. The significant amount of remittances sent back from the marriage migrants should affect the consumption patterns of these households. In order to see whether the impacts of cross-border marriages I found in the previous section were driven by the households who actually sent their daughters abroad, I repeat the same regressions only with the household samples that did not get any remittances from abroad. The results are shown in panel B. in Table 13. The results indicate that the impact of cross-border marriages is not solely driven by the households that were directly affected by marriage migration.²⁹ For the tobacco consumption, the effect is stronger than the estimate with the full sample. This can be explained by potential income effect of the households with remittances. As there is additional income that comes from the remittances, the tobacco consumption is less likely to be reduced despite husbands' decrease in power.

Next, I consider heterogenous effects for the younger and older couples. For older couples that were formed before the influence of the cross-border marriages, if the couples are fully committed on how to allocate the resources, the changes in marriage market conditions after the marriage should not affect the intra-household allocations. However, if they only have a limited commitment, the resource allocations can be more favorable to wives because outside option for husbands deteriorates after the introduction of cross-border marriages and resulting low supply of women. The results show that the consumption for women-exclusive good increased for old couples. The results suggest that the scope of the effect can be very broad. It not only affects migrant and young people who are on the market when the cross-border marriage is possible, but also affects the economic decisions of the couples who already formed even before the opening of the cross-border marriage markets. Younger couples also show the evidence of increase in women's power within the households; the consumption on women-exclusive good increased and the expenditure on men-exclusive good decreased, bolstering the hypothesis. However, the sizes of the effects are larger for the younger couples than older couples. This can be explained by more

²⁹However, one potential concern for this regression is that there can be a compositional change over time in the samples because the sample excludes the households with remittances from the foreign countries.

intense influence of cross-border marriage during when they were in the markets.

6.5 Structural model

In this section, stepping forward from showing the existence of the impact of cross-border marriages on female empowerment in the bride-sending country, I attempt to draw a broader implication on 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. Particularly, I make use of a *collective model* and the well-known identification result of Chiappori et al. (2002)³⁰ with a slight modification.

Unlike the unitary model which assumes a single utility function for each household, collective model allows multiple agents who have distinct utility functions. In particular, the household maximizes a welfare function that is a weighted sum of the individuals' private utility functions. Throughout my analysis, each household contains two decision makers, husband and wife, with respective utility functions. It is assumed that the decision process leads to Pareto-efficient outcomes. This assumption is not too far from the reality given that the married couples interact very frequently. It is very likely that husbands and wives know each other's preference well. Especially, 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.

For the preferences, I assume egotistic preferences where each agent only cares about his or her own consumption.³¹ More specifically, the utility function takes a form of $u^i(\mathbf{q}^i, \mathbf{z})$ where i indicates agent (i.e., $i = h, w$), \mathbf{q}^i indicates consumption of agent i and \mathbf{z} denotes preference factors such as ages and educations. \mathbf{q}^i can be either gender-exclusive goods or assignable goods which we can observe individual consumptions. I assume a well-behaved utility function which is strictly quasi-concave, increasing and continuously differentiable. In Vietnam, spacial price differences are relatively low. Accordingly, I assume that the agents face same prices.

The household solves the following program:

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

³⁰They focus on the labor supply decisions of married couples whereas I concentrate on consumption decisions.

³¹Given that my analysis focus on private consumption of households, this assumption is not too extreme. However, the model can be extended to have Beckerian "caring" preferences.

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 consumption³², respectively. 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 egotistic 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 $\phi^w(x, \mathbf{z}, \mathbf{s})$ such that $\phi^h + \phi^w = x$. Each member solves below program:

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

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 husband and one for wife. The demand functions are:

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

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

where C^i is a demand function for member i ($i = h, w$). These two equations allow me to

³²This 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.

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 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 $\frac{\partial c^h}{\partial x} \cdot \frac{\partial c^w}{\partial x} \neq 0$. For a moment, 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:

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

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

assuming that $A \neq B$.

There is a cross-derivative restriction which needs to be satisfied.

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

If there are more than one distribution factor, there are additional restrictions imposed by the model. Again, the distribution factors affect consumption choices only through the sharing rule. Thus,

$$\frac{c_{s_l}^h}{c_{s_1}^h} = \frac{\phi_{s_l}}{\phi_{s_1}} = \frac{c_{s_l}^w}{c_{s_1}^w}, \quad \forall l = 2, \dots, L. \quad (8)$$

Let $A_l = \frac{\partial c^h/\partial s_l}{\partial c^h/\partial x}$ and $B_l = \frac{\partial c^w/\partial s_l}{\partial c^w/\partial x}$. Then the above condition becomes:

$$\frac{A_l}{B_l} = \frac{A_1}{B_1} \quad l = 2, \dots, L. \quad (9)$$

The partials of sharing rule with respect to additional distribution factors are as follows:

$$\phi_{s_l}^h = \frac{A_l B_l}{B_l - A_l} \quad (10)$$

assuming that $A_l \neq B_l$.

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

6.5.1 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 by the unrestricted linear functional form with two distribution factors³³ given below:

$$TBC_{ipt} = \tau_0 + \tau_1 s_{1pt} + \tau_2 s_{2pt} + \tau_3 x_{ipt} + \mathbf{z}'_{ipt} \tau_4 + \varepsilon_{ipt} \quad (11)$$

$$JWM_{jpt} = \delta_0 + \delta_1 s_{pt} + \delta_2 s_{2pt} + \delta_3 x_{jpt} + \mathbf{z}'_{jpt} \delta_4 + \varepsilon_{jpt} \quad (12)$$

where s_1 and s_2 denote distribution factors. 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 (equation (8) or equation (9)). 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.

The restrictions imposed by the model (equation (9)) is as below:

$$\frac{\tau_1}{\delta_1} = \frac{\tau_2}{\delta_2} \quad (13)$$

Cross derivative restriction is automatically satisfied because both sides of equation (7) are zero.

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

$$\phi_x^h = \frac{\tau_3 \delta_1}{\tau_3 \delta_1 - \tau_1 \delta_3} \quad (14)$$

$$\phi_{s_1}^h = \frac{\tau_1 \delta_1}{\tau_3 \delta_1 - \tau_1 \delta_3} \quad (15)$$

$$\phi_{s_2}^h = \frac{\tau_2 \delta_2}{\tau_3 \delta_2 - \tau_2 \delta_3} \quad (16)$$

³³Any number of distribution factors can be incorporated.

Finally, the sharing rule equation is given by:

$$\phi^h = \frac{\tau_3\delta_1}{\tau_3\delta_1 - \tau_1\delta_3}x + \frac{\tau_1\delta_1}{\tau_3\delta_1 - \tau_1\delta_3}s_1 + \frac{\tau_2\delta_2}{\tau_3\delta_2 - \tau_2\delta_3}s_2 + \kappa(\mathbf{z}) \quad (17)$$

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

6.5.2 Distribution factors

I employ two novel distribution factors to identify the sharing rule of the married couples; they are the intensity of cross-border marriages and the intensity of male-dominant agriculture.

First distribution factor is the intensity of cross-border marriages. To be a valid distribution factor, it should affect sharing rules but not the budget constraint or preferences. I exclude the couples with remittances from abroad for this reason. That is, after excluding the families that were directly affected by cross-border marriages, it is unlikely that cross-border marriages affect the budget constraint. The intensity of cross-border marriages is not an argument of preferences. Thus, the intensity of cross-border marriages, which is new in the literature, qualifies as a valid distribution factor.

Moreover, the intensity of cross-border marriages is arguably exogenous, as explained in the previous section. Many of the suggested distribution factors in the literature, such as relative education, relative ages and relative incomes, were endogenous. It is difficult to get credible estimates with endogenous distributions factors. Here, I take advantage of the exogenous nature of the proposed distribution factor.

Next distribution factor, mainly for testing the efficiency assumption of the collective model, is the intensity of male-dominant agriculture. In particular, the area of forest trees is used as a measure of the intensity of male-dominant agriculture. Since forestry is male labor-intensive(Desai (1995)), the larger area of forest trees means more economic opportunities for men. This outside opportunity can impact the intra-household balance of power. Similar reasoning as above, it does not affect the preferences. Moreover, conditional on expenditures, it also does not affect budget constraint.

6.5.3 Sharing rule estimates

In this section, the results of empirical tests of collective model is presented and the sharing rule estimates are given. For the estimation, the samples on the younger couples³⁴

³⁴In the previous section, we have seen that the intensity of cross-border marriages does not explain tobacco consumption for older couples. Thus, it is not a good distribution factor for older couples. If the intensity of cross-border marriages is used as a distribution factor, $c_s^h = 0$ and equation (5) and equation (6) collapse into 1 and 0, respectively.

who have positive expenditure on both gender-exclusive goods are used.³⁵ First, the unrestricted equation (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 14. The proportionality restriction imposed by the model is not rejected. Thus, the efficiency assumption of the collective model is satisfied. 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 0.55 unit increase of husbands' share. When the expenditure increases, husbands take up approximately ten percentage point 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 193 (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. The last partial with respect to the areas of forest trees illustrate that the increase of forest tree areas is associated with the power increase of husbands.

Considering these estimates, the impact of cross-border marriages is substantial for women's power within the households. Further, the 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)).

7 Conclusion

This paper studies the economic impacts of marriage migration 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 show that the selection of migrants is governed by the demographic structures and economic conditions of the involved countries, and by the costs of cross-border marriage. The agents with low SES cannot engage in cross-border marriage due to the costs. The agents with high SES in the wealthier country also do not marry across borders because they can have strictly better domestic partners. I also find that the long sides of the marriage markets benefit and the short sides of them lose from the lowered cost of cross-border marriage on various margins. Surprisingly, the flows of marriage migrants not only affect direct marital outcomes but also affect the consumption choices of local men and women in both countries.

The situation in Taiwan and Vietnam may seem unique in several ways. However, there

³⁵This is because the model assumes interior solution. To incorporate the corner solution, the model needs to be extended. At this point, I disregard the selection bias that may arise by restricting the samples. However, this will be improved upon in the future.

are many other examples of marriage markets which 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 UK in 2009 (Charsley et al. (2012)). Other European countries including Spain, France, and Switzerland also have shown an increase in the number of cross-border marriages in the past two decades, which could be explained by almost zero cost 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 in this paper sheds light on why this phenomenon takes place, who becomes a marriage migrant and to what extent this can affect the welfare of local people.

This paper also illustrates the implications of cost-changing policies on marriage markets and women's power within households. Many countries including Taiwan, South Korea, Denmark and the Netherlands have implemented regulations on marriage migration when faced with a fast increase in marriage migrants. The results of this paper suggest that such policies can have broad influences on the population as they can affect the economic decisions of every man and woman in the involved countries, not just those who are in or considering cross-border marriages. In countries with male-skewed sex ratios, lowering the cost of the entry of 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. Moreover, integration of marriage markets may exacerbate inequality in marital gains across countries. These findings highlight that the costs and benefits should be carefully weighed when designing immigration policies.

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Figure 1: Number and shares of cross-border marriages in Taiwan

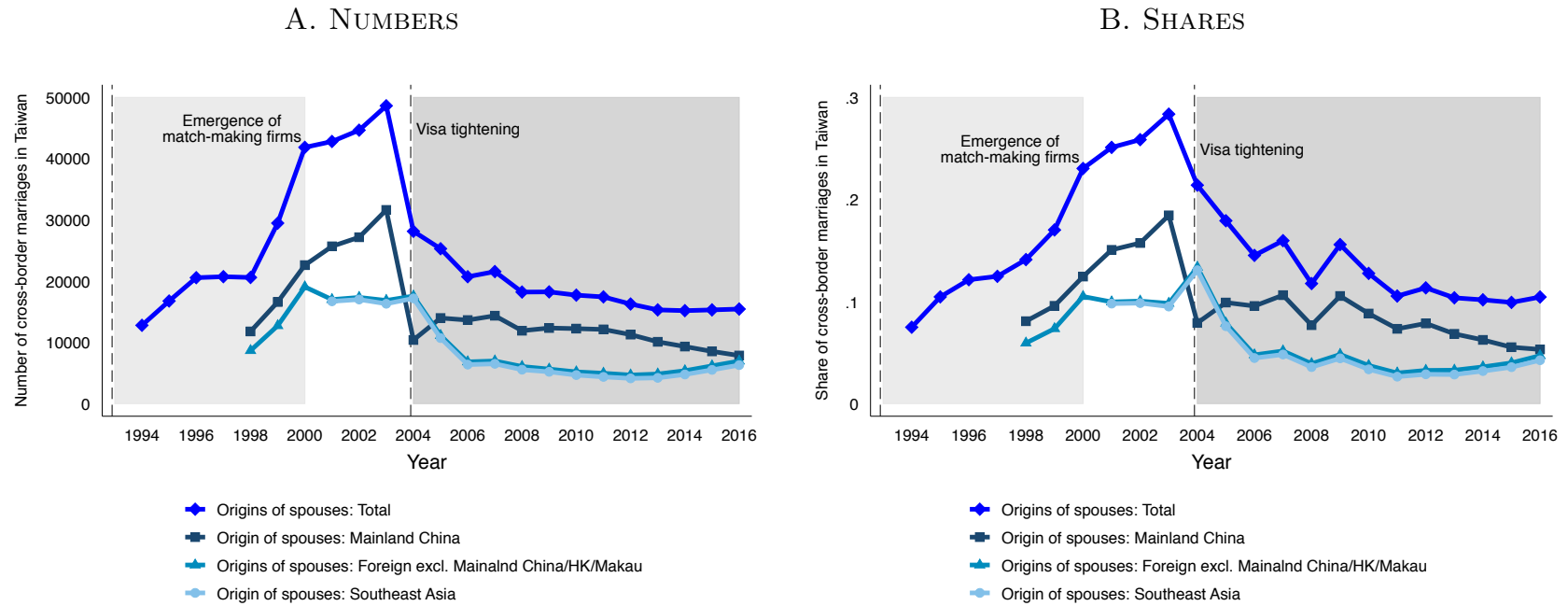


Figure 2: Number cross-border marriages in Vietnam

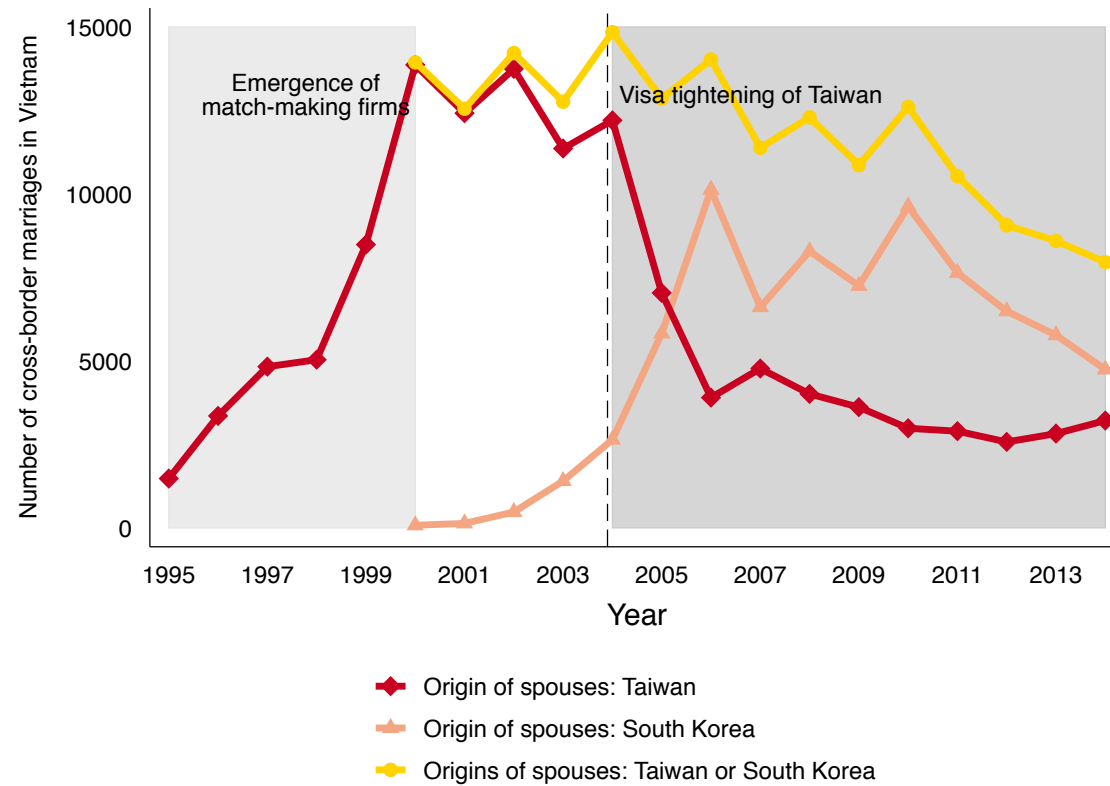


Figure 3: Matching equilibria under different costs

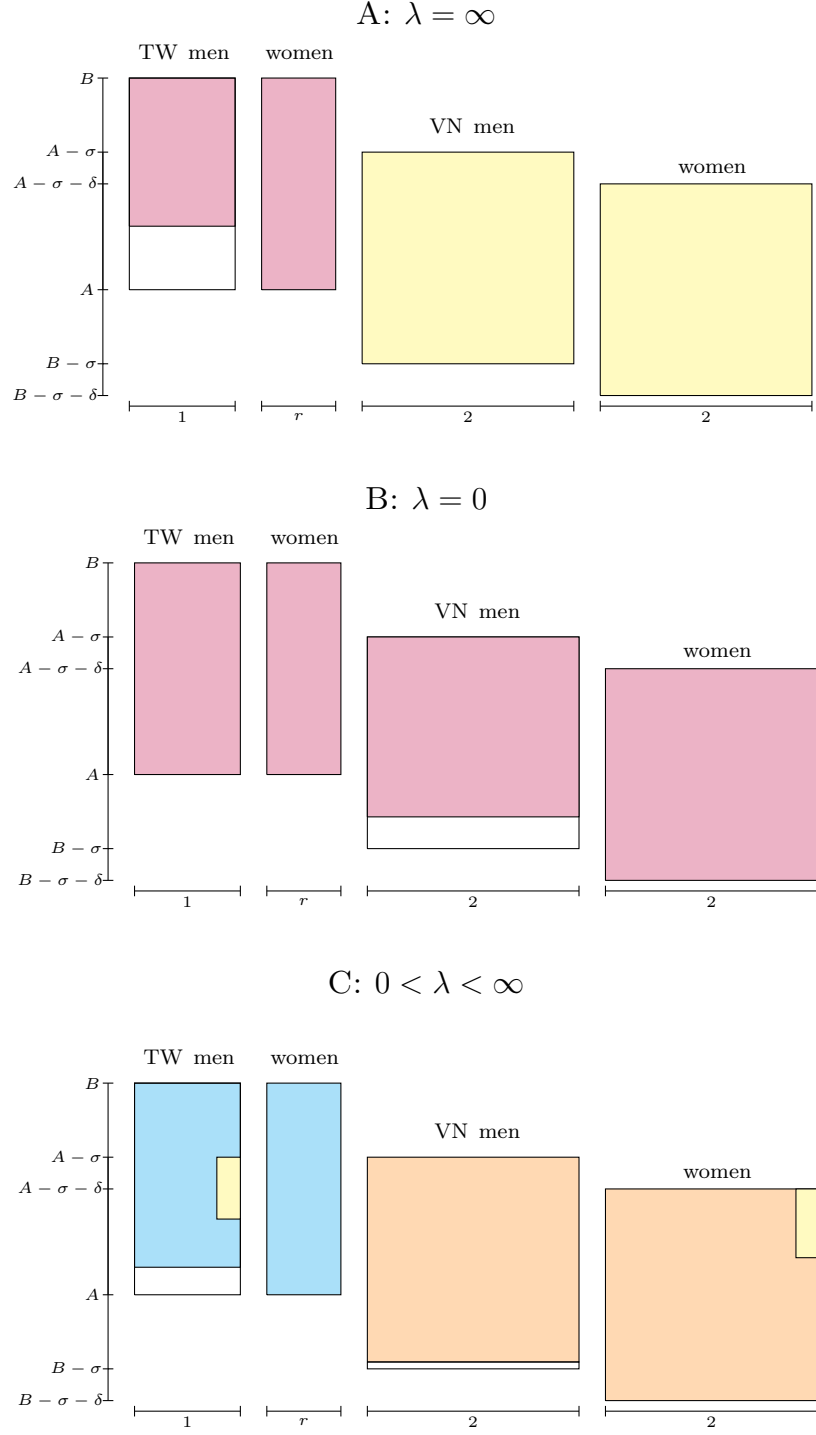
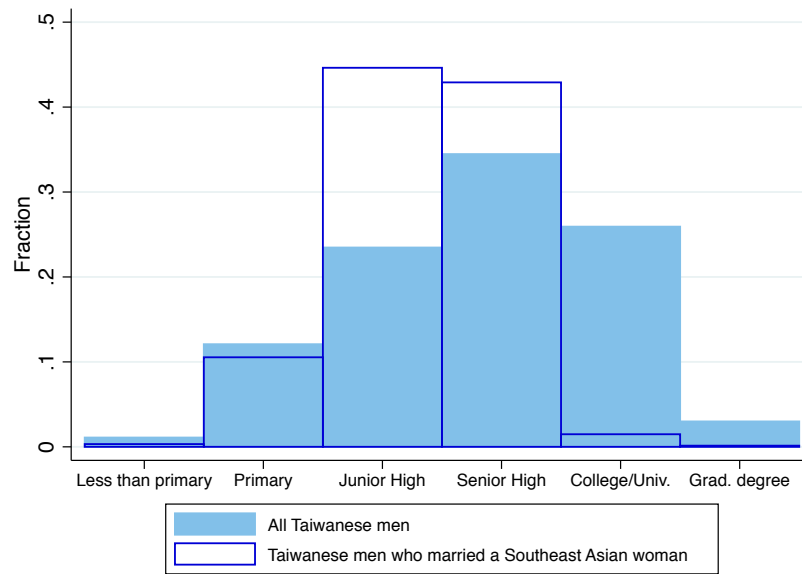
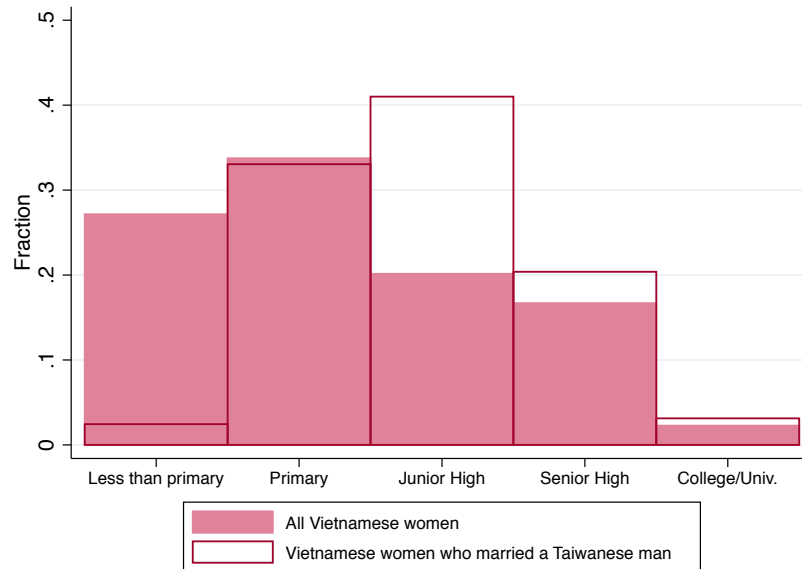


Figure 4: The selection of Taiwanese men who marry Vietnamese women



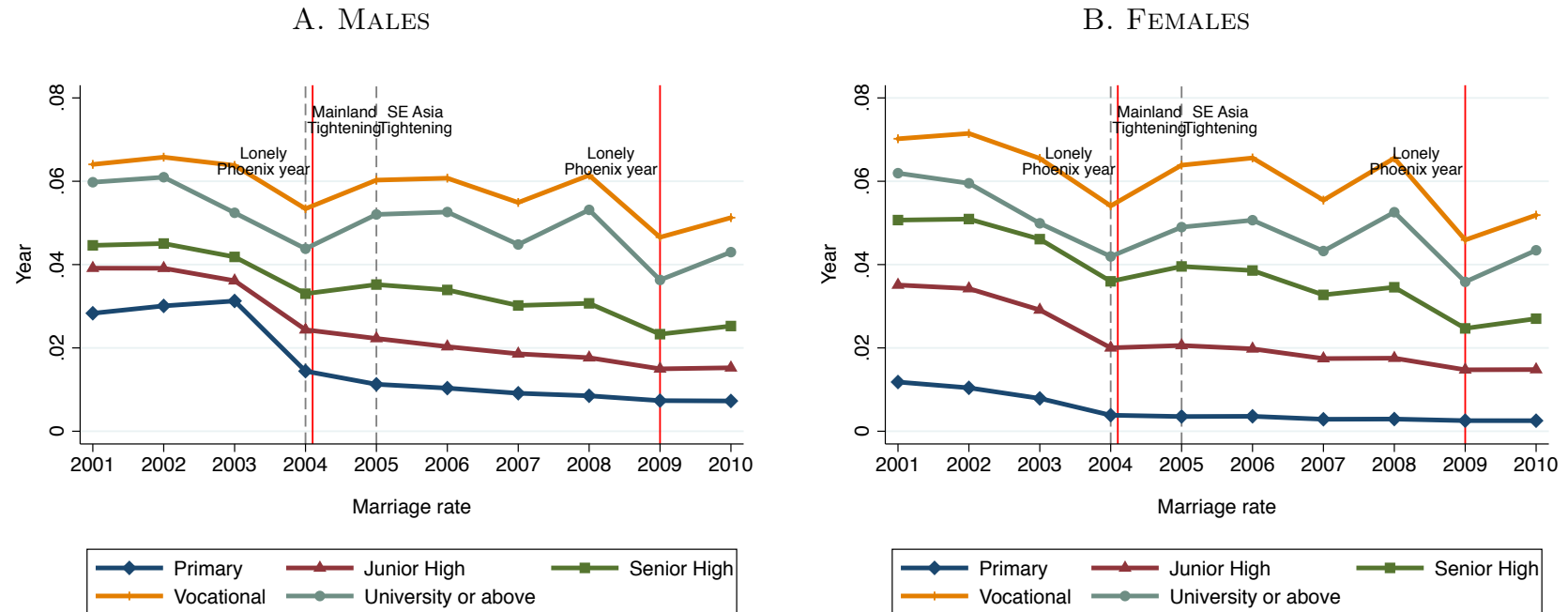
Notes: Source: Taiwanese census 2000 and CFS 2003.

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



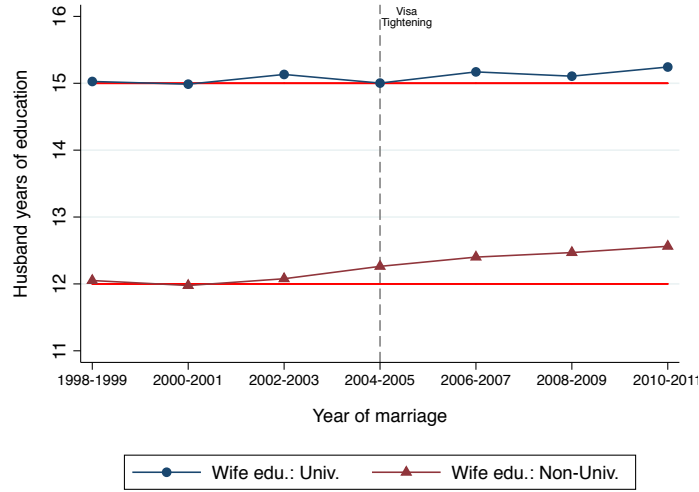
Notes: Source: Vietnamese census 1999 and CFS 2003.

Figure 6: Marriage rates of Taiwanese men and women



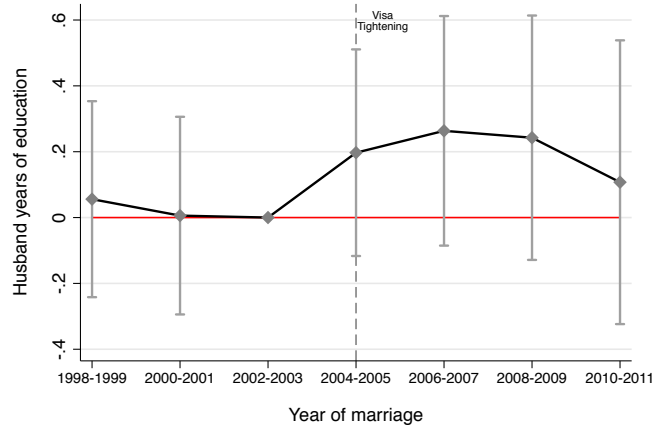
Notes: The figures plot the average of district-level marriage rate (defined as the number of marriages of Taiwanese divided by the number of single population) by education for each gender. The grey lines indicate the implementation of the visa tightening policies in 2004 and 2005, respectively. The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

Figure 7: The average level of husbands' education by the level of wives' education



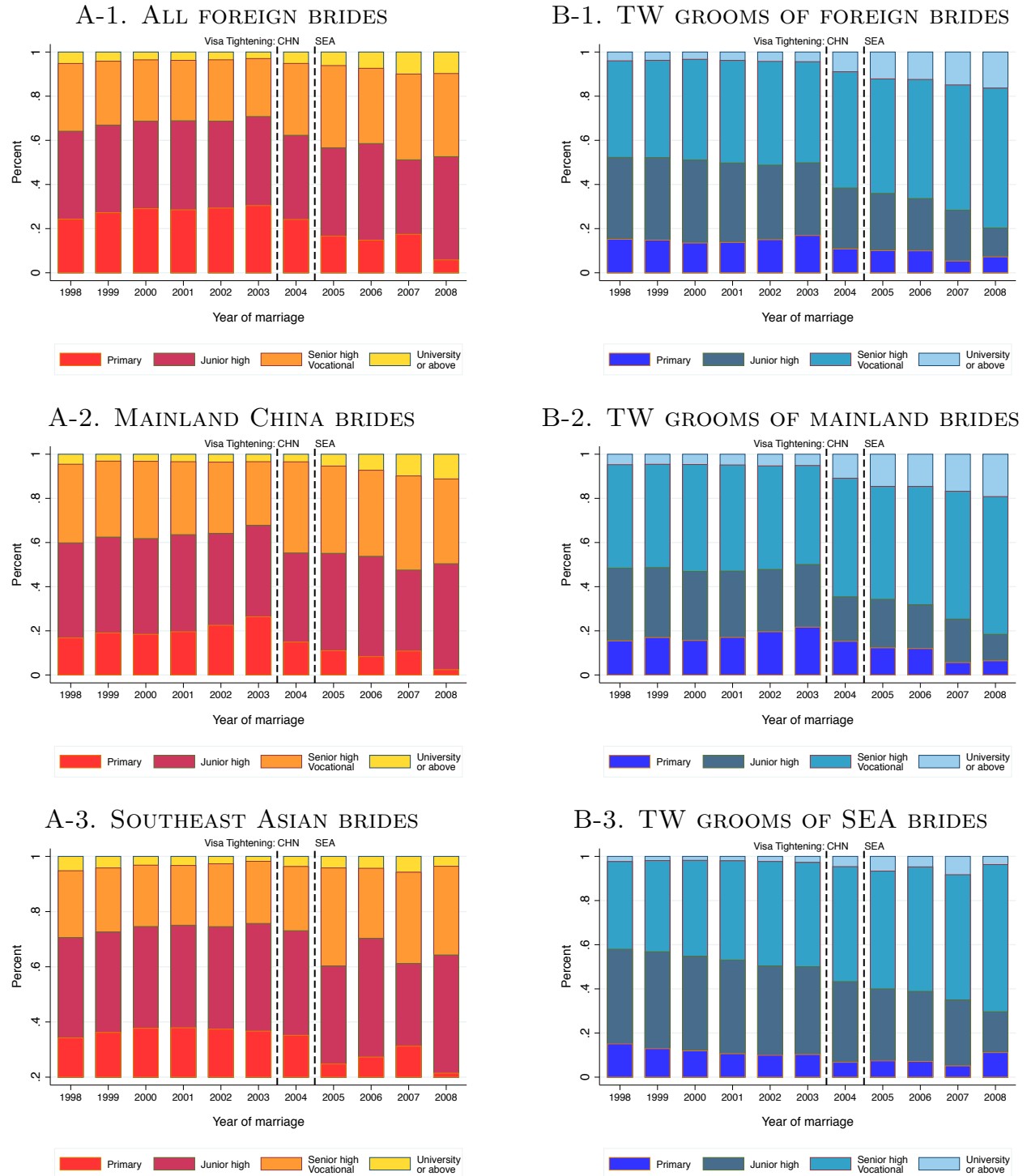
Notes: This figure plots the average level of husbands' education by education of wives in Taiwan. The grey dashed line indicates the implementation of the visa tightening policies in 2004-2005. Source: The Women's Marriage, Fertility and Employment Survey 2006, 2010, 2013. The couples who married in 1998 or after are used as samples. Only Taiwanese women are used as samples.

Figure 8: The impact of the visa tightening policy on matching patterns in Taiwan



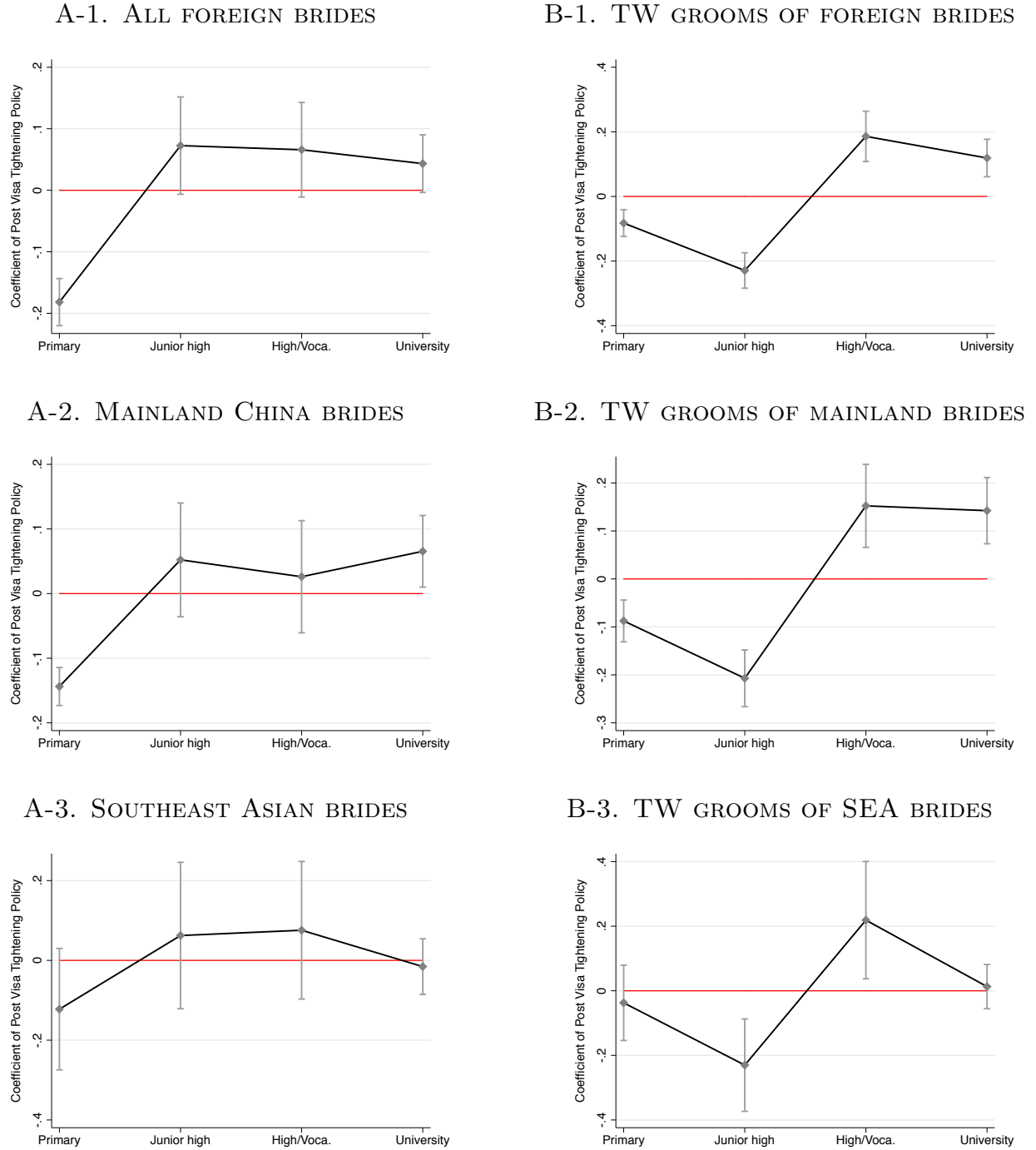
Notes: This figure plots the coefficients of event-study version of equation (Number). Control variables include age of husband, age of wife, county fixed effects and the excess share of males with education higher than the education of given wife. The grey dashed line indicates the implementation of the visa tightening policies in 2004-2005. The grey bars represent 95% confidence intervals. Source: The Women's Marriage, Fertility and Employment Survey 2006, 2010, 2013. The couples who married after 1997 are used as samples. Only Taiwanese women are used as samples.

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



Notes: These figures depict the composition of education for foreign brides and Taiwanese grooms of them. The left column is for the foreign brides and the second column is for the Taiwanese grooms. The second row only uses the subsample of mainland brides and their grooms. The third row uses the subsample of Southeast Asian brides and their husbands. The black dashed lines indicate the implementation of the visa tightening policies in 2004 and 2005, respectively. Since 2008 data does not contain the origins of countries, it is impossible to draw this figure by each individual country level. 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.

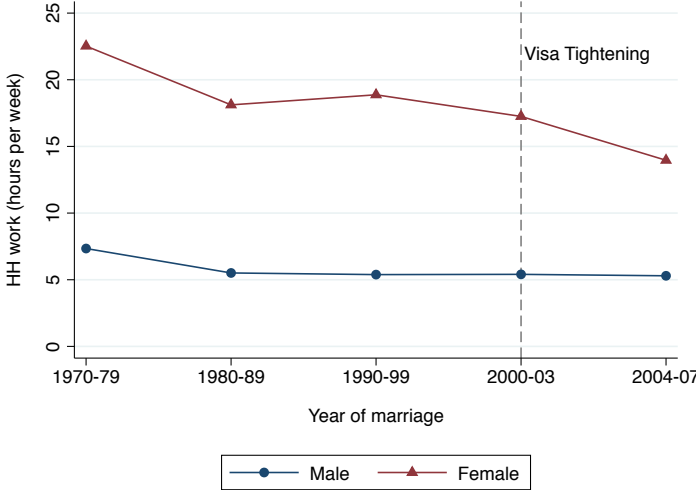
Figure 10: The impact of the visa tightening policy on the qualities of foreign brides and Taiwanese grooms of them



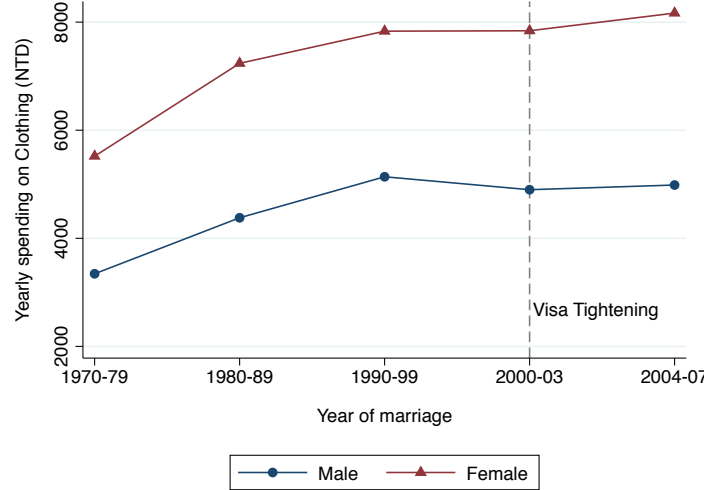
Notes: These figures show the coefficients on *Post* from the regressions of a dummy for being in a given education group (i.e. primary, junior-high, senior-high/vocational, and university or above) on a dummy for post visa tightening policies and controls (marriage year fixed effects and county city fixed effects). The robust standard errors are used. The left column is for the foreign brides and the second column is for the Taiwanese grooms. The second row only uses the subsample of mainland brides and their grooms. The third row uses the subsample of Southeast Asian brides and their husbands. Since 2008 data does not contain the origins of countries, it is impossible to draw this figure by each individual country level. 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 11: The impact of the visa tightening policy on intra-household allocations in Taiwan

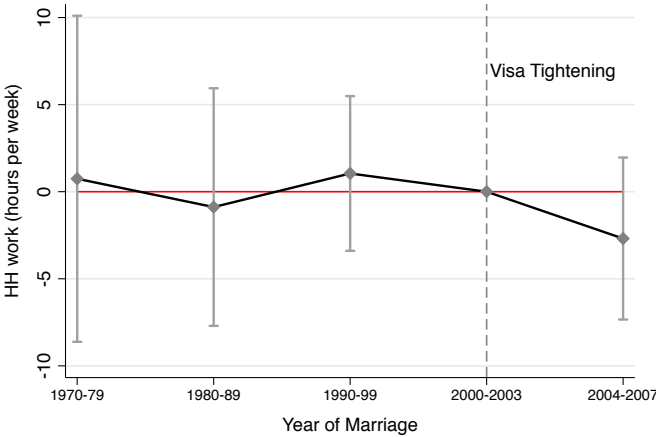
A-1. HOUSEHOLD WORK (HOURS PER WEEK)



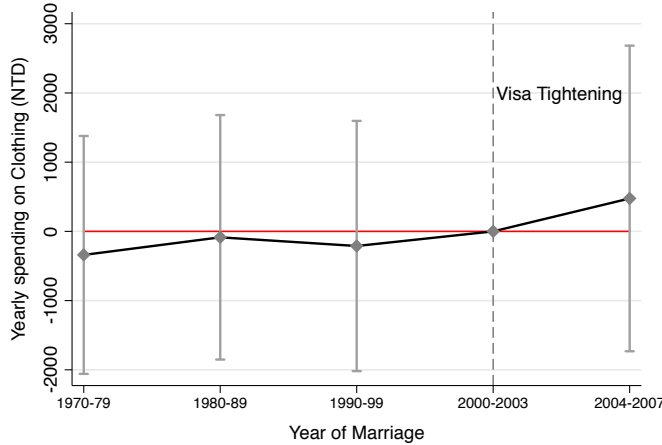
B-1. YEARLY SPENDING ON CLOTHING (NTD)



A-2. HOUSEHOLD WORK (HOURS PER WEEK)



B-2. YEARLY SPENDING ON CLOTHING (NTD)



Notes: The top figures show the average hours of household work and yearly spending on clothing for each gender. The bottom figures display the event-study type version of equation subsection 5.3.4. Control variables include the education of husband, education of wife, age of husband, age of wife and dummies for district. For spending on clothing, I also control for total expenditure multiplied by log total expenditure in the spirit of Working-Leser specification. For household work, gender-specific trend is included. Source: Panel Survey of Family Dynamics 2007.

Figure 12: Geographic distributions of cross-border marriages.

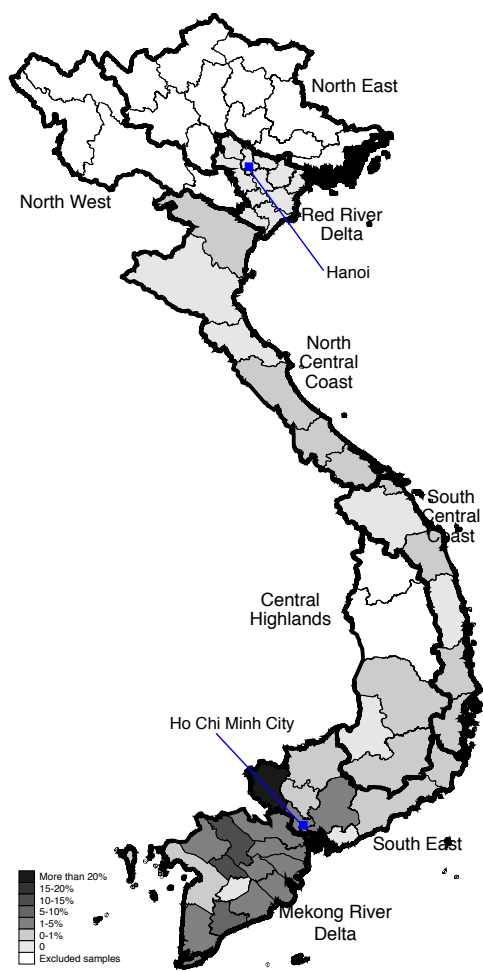


Table 2: The impact of the visa tightening policy on marriage rate

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: Low edu. represents people with primary education or junior high education. 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: 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 samples. Only Taiwanese women are used as samples.

Table 4: The impact of visa tightening policies on quality 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 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 used as the samples.

Table 5: The impact of visa tightening policies on quality 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 6: The impact of visa tightening policies on quality 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 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 used as the samples.

Table 7: The impact of visa tightening policies on quality of Taiwanese grooms of foreign brides by origins

Sample:	Taiwanese Grooms of Mainland Brides				Taiwanese Grooms of Southeast Asian Brides			
Dependent variable (=1):	Pri.	JH	SH/ Voca.	Univ./ above	Pri.	JH	SH/ Voca.	Univ./ above
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 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 8: The impact of visa tightening policies on intra-household allocations

Dep. var.:	HH work (hours per week)			Yearly clothing spending (NTD)		
	(1)	(2)	(3)	(4)	(5)	(6)
Female X Post	-5.00*** (1.72)	-4.98*** (1.62)	-2.95 (1.91)	546.6 (1011.8)	669.2 (864.9)	410.1 (996.5)
Controls	No	Yes	Yes	Yes	Yes	Yes
Gender trend	No	No	Yes	Yes	Yes	Yes
Dep. var. mean (male)	4.79	4.79	4.79	4580.14	4580.14	4580.14
Dep. var. mean (female)	14.35	14.35	14.35	7234.55	7234.55	7234.55
R-squared	0.247	0.330	0.331	0.092	0.375	0.375
Observations	3,034	3,032	3,032	2,017	2,015	2,015

Notes: This table show the results from regression in subsection 5.3.4. Control variables include the education of husband, education of wife, age of husband, age of wife and dummies for district. For spending on clothing, I also control for total expenditure multiplied by log total expenditure in the spirit of Working-Leser specification. Robust standard errors are used. Significance levels: * 10%, ** 5%, *** 1%. Source: Panel Survey of Family Dynamics 2007. Only Taiwanese couples who married in 1970 and after are used as samples.

Table 9:
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 female population of aged 21, at the province level. Hoa population is calculated from the 1989 Vietnamese census, which is pre-period of cross-border marriages. For the sex ratios, it is not entirely clear which cohorts should be chosen. In terms of brokerage firms' perspective, the abundance of girls aged 15-20 would be the most important because they are the ones who potentially can marry foreigners. I select the cohorts who were in their marriageable ages in the late 1990s, the peak years of cross-border marriages. I calculate the sex ratios of teenagers aged 15-17 using 1999 Vietnamese census, which are the measures not contaminated by the marriages because 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.

* significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 10:
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: The data is from VLSS 97-98, which is before the sharp increase of cross-border marriages, until the row of jewelry, watch, make-up. In column (2), the dependent variable is all the covariates and dependent variable used in the regression analysis. The coefficients are obtained by regressing each covariate and dependent variable on intensity of cross-border marriages.

* significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 11:
Cross-border marriages and gender-exclusive expenditures of married couples in Vietnam

Dep. var.	(1) Tbc exp.	(2) JWM exp.	(3) Tbc share	(4) JWM share
Intensity of CBM \times Post	-2.47* (1.45)	2.24** (0.94)	-0.000179* (0.000108)	0.000210** (0.000106)
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Mean dep. var. (before the shock)	263.80	46.48	0.023	0.007
N	14,631	14,631	14,631	14,631

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 12:
Cross-border marriages and gender-exclusive expenditures of married couples with extensive controls in Vietnam

Dep. var.	(1) Tbc exp.	(2) JWM exp.	(3) Tbc exp.	(4) JWM exp.	(5) Total exp.
Intensity of CBM \times Post	-2.47* (1.44)	2.24** (0.94)	-1.62 (1.10)	1.80** (0.86)	-53.88 (34.17)
Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Extensive controls	No	No	Yes	Yes	Yes
Hoa \times Year FE	No	No	Yes	Yes	Yes
Mean dep. var. (before the shock)	263.80	46.48	263.80	46.48	12850.76
N	14,631	14,631	14,631	14,631	14,631

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 13:
Cross-border marriages and gender-exclusive expenditures of married couples: heterogeneous effects in Vietnam

Dep. var.	Model w/o $S'_p * T_t$		Model w/ $S'_p * T_t$	
	(1) Tbc exp.	(2) JWM exp.	(3) Tbc exp.	(4) JWM exp.
A. All samples (N=14,631)				
Intensity of CMB \times Post	-2.47* (1.44)	2.24** (0.94)	-1.62 (1.10)	1.80** (0.86)
B. HHs w/o remittances (N=14,114)				
Intensity of CMB \times Post	-2.78* (1.43)	2.31** (0.94)	-1.99* (1.06)	1.86** (0.78)
C. HHs w/o remittances (Husb age<40) (N=6,691)				
Intensity of CMB \times Post	-4.20** (1.93)	1.80 (1.29)	-3.56** (1.81)	1.56* (0.84)
D. HHs w/o remittances (Husb age \geq 40) (N=7,423)				
Intensity of CMB \times Post	-1.19 (2.09)	2.94** (1.36)	-0.20 (2.25)	2.32* (1.22)

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 14:
Sharing rule estimates in Vietnam

	Unrestricted Model		Sharing Rule
	Wives	Husbands	
Total private expenditure	0.028*** (0.002)	0.031*** (0.002)	0.552*** (0.162)
Intensity of Cross-border marriages	12.01** (5.32)	-10.83** (5.37)	-193.25*** (68.08)
Intensity of forest areas	-0.021 (0.019)	0.034* (0.020)	0.45* (0.28)
Proportionality test	p=0.6924		-
N	1,598	1,598	1,598

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.