The London School of Economics and Political Science

Essays on Marriage, Migration, and Integration

Shadi Farahzadi

A thesis submitted to the Department of Economics for the degree of Doctor of Philosophy

July 2024

To my parents, for their endless love.

Declaration

I certify that the thesis I have presented for examination for the Ph.D. degree of the London School of Economics and Political Science is solely my own work, other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I declare that my thesis consists of approximately 22,000 words.

Statement of conjoint work

I confirm that I am the sole author of all chapters of this thesis.

Statement of inclusion of previous work

I confirm that Chapter 3 of this thesis is a revised version of the paper I submitted at the end of my MRes in 2019.

Statement of use of third-party for editorial help

I confirm that I did not receive any third-party copyediting assistance with this thesis.

Acknowledgments

I am deeply grateful to my supervisors, Yona Rubinstein, Guy Michaels, and Alan Manning, whose guidance and encouragement sustained me through the highs and lows of my PhD journey. Under Yona's nurturing mentorship, I learned the essentials of being a researcher. Guy's generosity with his time and insightful feedback were a beacon of support, guiding me through the complexities of my work. Alan's unwavering assistance in tackling challenges touched me deeply. Additionally, I wish to express my heartfelt gratitude to Catherine Thomas for her kindness and support. Though not officially my supervisor, she greatly contributed to my progress.

Special thanks go to my husband, Ali Ebadi, provided unrelenting support in my PhD journey. In moments of stress and self-doubt, his belief in me provided the strength I needed to persevere. His encouragement and presence were invaluable, making this journey deeply fulfilling.

There are too many people to mention who have generously engaged with my work at the LSE and elsewhere. To name a few, I am extremely thankful to: Nava Ashraf, Oriana Bandiera, Philipp Barteska, Jordi Blanes-i-Vidal, Alix Bonargent, Paul Brandily, Gharad Bryan, Matthias Doepke, Magdalena Domínguez, Alessandro Gavazza, Maitreesh Ghatak, Michael Gmeiner, Cristina Gualdani, Erik Hurst, Camille Landais, Ethan Ilzetzki, Rocco Macchiavello, Stephen Machin, Kristóf Madarász, William Matcham, Robert Miller, Sidharth Moktan, Isabela Manelici, Martin Pesendorfer, Steve Pischke, Imran Rasul, Ricardo Reis, Rebecca Rose, Mark Schankerman, Marcia Schafgans, Pasquale Schiraldi, Johannes Spinnewijn, Daniel Sturm, Christiane Szerman, Veronica Rappoport, John Van Reenen, Jose Vasquez, Leeat Yariv, Alwyn Young and numerous seminar and conference participants, especially at the New York University Abu Dhabi, University of Liverpool, City University of London, VI Workshop on Immigration, Health and Wellbeing, Annual CEP Conference, IÉSEG Workshop on Migration and Family Economics, City/Royal Holloway Workshop on Family and Health Economics, AYEW Development Workshop, and IFS-UCL-LSE/STICERD Development WiP Seminar.

Abstract

This thesis comprises three chapters centered around immigrants and their integration, with a particular focus on the marriage market. In Chapter 1, I introduce a novel matching model that accounts for the potential of migration. Unlike closed-market models, this framework allows individuals to find matches beyond borders. By linking individual preferences within matches to the final observed matching outcomes in the market, I establish econometric specifications for identifying preferences from observed matching and migration data. Additionally, I conduct Monte Carlo simulations to evaluate the performance of the econometric methods employed.

In Chapter 2, I leverage the model developed in Chapter 1 to estimate preference parameters in the marriage market. I investigate whether the predominant driver of marriage migration is the desire to marry someone from the same cultural background (endogamy preferences) or the potential gains from migrating to a higher-income country (migration gains). Focusing on Muslims in the UK, where approximately half opt to marry someone from abroad, the findings show that the primary reason for the high incidence of marriage migration among Muslims is their preference for endogamous marriages, suggesting that increased migration costs imposed by the government would not substantially impact their integration.

Chapter 3 focuses on the impact of an exogenous shock to marriage preferences on the matching outcome, using the 9/11 attacks as an exogenous shock to preferences for mixing among Muslims and non-Muslims in the US. The results show that following 9/11, the probability of intermarriage among Muslims decreased by 10% compared to similar groups. Additionally, Muslims who chose to marry outside their group after 9/11 were found to match with higher-educated spouses than before the event. Conversely, non-Muslim Americans who married Muslims tended to match with lower-educated spouses post-9/11, suggesting an increase in the disutility of a mixed match among Muslims, but not among non-Muslims.

Table of Contents

List of Tables

List of Figures

Chapter 1

Open Matching Model

In this chapter, I introduce a novel matching model, termed the open matching model, designed to explain the cross-border matching mechanism. While the model is primarily tailored for the marriage market, it can be easily applied to other matching markets. I validate the model's predictions by conducting simulations to measure the effects of altering utility parameters on migration patterns. Additionally, I outline the methodology for parametric estimation of the model when data is confined to a single market, and I validate its efficacy through Monte Carlo simulations.

1.1 Introduction

Matching is the mechanism by which we obtain the various choices in life that must reciprocally select us. It plays a crucial role in essential aspects of people's lives, such as students gaining admission to schools, workers securing jobs, and individuals finding compatible partners. A market is matching whenever price is not the only determinant of who gets what (Roth, 2015).

Matching choices are equilibrium outcomes, shaped by the preferences of both players and the availability of diverse types. Exogenous shifts in the market impact both the demand and supply sides of the market. Consequently, a reduced-form partial equilibrium analysis falls short of comprehensively capturing all aspects of a matching market. Thus, a model is needed. A model also enables us to conduct counterfactual analyses, providing means to measure the impact of various (policy) changes on the matching equilibrium.

The foundational framework of matching models was established by the seminal works of Koopmans and Beckmann (1957); Gale and Shapley (1962); Shapley and Shubik (1971);

Becker (1973, 1974) and Kelso Jr and Crawford (1982). In recent years, there has been a renewed interest in matching models, particularly driven by the expansion of these models to encompass many-to-one and many-to-many matching as demonstrated by Hatfield and Milgrom (2005). Additional advancements in matching models have emerged, including the introduction of models with search frictions (Shimer and Smith, 2000; Eeckhout and Kircher, 2010), and models incorporating imperfectly transferable utilities (Legros and Newman, 2007; Chiappori and Reny, 2016; Galichon et al., 2019). However, the predominant focus within the matching literature revolves around closed local matching markets. These models implicitly assume that the cost of matching across borders is prohibitively high. Therefore, they are not able to explain and predict migration to find a match. Moreover, overlooking the potential for matches across borders introduces a bias in estimating match preferences, as it neglects the gains or costs associated with migration. The sparse literature that does consider migration predominantly focuses on motives such as unbalanced sex ratios and economic factors in the marriage market (Ahn et al., 2020; Dupuy, 2021).

In this chapter, I introduce an open matching model, which allows migration in the pursuit of a match. In this model, in addition to direct gains from migration, people can choose to marry across borders due to a higher abundance of more desirable matches outside. Specifically, I concentrate on the context of the marriage market, where only one-to-one matching is possible. The model can be applied to examine matches outside the marriage market, such as those between CEOs and firms. Additionally, it can be adapted to a one-to-many match framework (Corblet, 2021) to analyze matches between students and schools, or workers and firms. This extension is particularly relevant in situations where individuals relocate to secure a better match.

This chapter is structured as follows: Section 1.2 introduces the open matching model. In Section 1.3, outcomes of the model are simulated for a simplified version, aiming to elucidate the main mechanisms within the model. Section 1.4 introduces a methodology for the parametric identification of the model and tests this approach through Monte Carlo Simulations. Finally, Section 1.5 concludes.

1.2 Model

In this section, I introduce a static, frictionless, two-sided matching model with transferable utilities that incorporates the possibility of matching across borders. The main focus is on decision-making in one market (here called inside the country), as data availability

typically limits identification to a specific market context. I use the marriage market as an example, yet the model can be extended to other markets. The focus of the model is only on heterosexual marriages given its inherent nature as a two-sided matching framework.[1]

In frictionless matching, individuals have perfect and costless information about all potential partners. This is equivalent to assuming that each person selects from a representative distribution of the population. This assumption is suitable when the focus is on analyzing who marries whom rather than modeling search frictions.

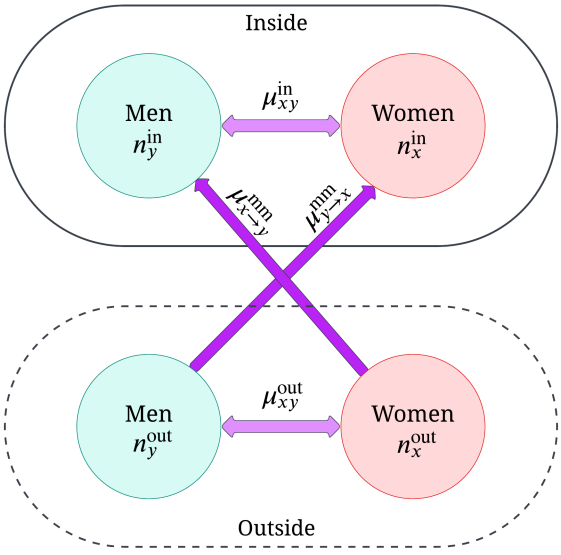
Transfers enable agents to bid for their preferred partners by accepting a reduction in their gains from the match, thus increasing their partner's welfare (Chiappori, 2017). These transfers can take various forms, including monetary exchanges like bride price or dowry, as well as non-monetary arrangements such as the allocation of time and expenses after marriage. The transferable utility model is a suitable choice for explaining the intricacies of the marriage market, as it considers the transfer of resources and benefits between partners, capturing the bargaining process intrinsic to marriages. Furthermore, the inclusion of transfers allows us to comprehensively analyze the costs and benefits associated with migration for marriage.

Each individual is characterized by a set of observable characteristics: x for women and y for men that determines their type. There are X types of women, each comprising n_x individuals, and Y types of men, with n_y individuals in each type. In addition to their type, each individual is associated with a location denoted as l, which can be either inside the country ($l = \text{in}$) or outside the country ($l = \text{out}$). Each type of individual has access to a different outside market; that is, the characteristics of the outside market are type-specific.

The distribution of types varies by location (n_x^l and n_y^l). Individuals inside the country can choose to (1) marry locally - with someone inside the country, (2) marry abroad - import their spouse, or (3) remain single. Individuals outside the country can choose to (1) marry locally - with someone outside the country, (2) migrate for marriage, or (3) remain single. Hence, I assume that marriage migration occurs only in one direction, from outside to inside the country, as the primary focus of the study revolves around immigration rather than out-migration.

[1]The analysis of same-sex marriages requires a different framework, such as the model proposed by Ciscato et al. (2020).

Figure 1.1: Matching Depiction



Notes. Matching is one-way; from outside to inside of the country. Only marriage migration and matching inside the country are observed.

A matching function shows who marries whom, inside or outside the country, and who remains single. The number of matches between women of type x and men of type y inside the country is represented by μ_{xy}^{in}, while the number of matches between the same types outside the country is denoted by μ_{xy}^{out}. $\mu_{x\to y}^{m}$ accounts for the number of matches in which women of type x from outside the country marry men of type y within the country (the woman as the migrant spouse). Similarly, $\mu_{y\to x}^{m}$ represents matches in which the husband is the migrant spouse. The number of single women and men inside and outside by type is, respectively, represented by μ_{x0}^{in}, μ_{0y}^{in}, μ_{x0}^{out}, and μ_{0y}^{out}. In this study, the analyst only observes distribution and matches that occur within the country, plus marriage migrations ($\mu_{x0}^{in}, \mu_{0y}^{in}, \mu_{xy}^{in}, \mu_{x\to y}^{m}, \mu_{y\to x}^{m}, n_x^{in}$, and n_y^{in} for each x and y).

In Figure 1.1, the matching function is illustrated. Feasible matching occurs when each individual is paired with a maximum of one partner. Therefore, the feasibility conditions are:

$$n_x^{in} = \sum_{y=1}^{Y} \mu_{xy}^{in} + \sum_{y=1}^{Y} \mu_{y\to x}^{m} + \mu_{x0}^{in}, \quad x = 1, ..., X \tag{1.2.1}$$

$$n_y^{in} = \sum_{x=1}^{X} \mu_{xy}^{in} + \sum_{x=1}^{X} \mu_{x\to y}^{m} + \mu_{0y}^{in}, \quad y = 1, ..., Y \tag{1.2.2}$$

A feasible matching is stable if (1) no pair of individuals prefer to match together rather than their current situation, and (2) no matched individuals prefer the outside option (remaining single).

The marriage payoff is a random utility function consisting of a deterministic part and a random unobserved taste shock (McFadden, 1974). Following the approach common in the literature, I assume that deterministic and stochastic components of utility are separable.[2] As a result, they enter the utility function in an additive form, with no interaction between the observable and unobservable factors. Therefore, the utility of the woman i of type x who matches a man of type y is:

$$U^l_{ixym} = U^l(x, y, m) + \varepsilon^l_{ixym}, \quad x = 1, ..., X; \ y = 1, ..., Y; \ l = \{\text{in}, \text{out}\} \tag{1.2.3}$$

Similarly, utility of the type y man j who marries type x woman is:

$$V^l_{jyxm} = V^l(y, x, m) + \eta^l_{jyxm}, \quad x = 1, ..., X; \ y = 1, ..., Y; \quad l = \{\text{in}, \text{out}\} \tag{1.2.4}$$

$U^l(x, y, m)$ and $V^l(y, x, m)$ are deterministic parts of the utilities that depend on the observed characteristics, the location of the individual, and whether their marriage involves marriage migration. m is a dummy variable equal to 1 if marriage involves migration and zero otherwise. The deterministic utility of remaining single is normalized to zero for each type: $U^l(x, 0, 0) = V^l(y, 0, 0) = 0$. ε_{ixy} and η_{jyx} are unobserved and idiosyncratic group-specific taste shocks. That is, ε_{ixy} is the idiosyncratic preference of woman i of type x for man type y, and η_{jyx} is the idiosyncratic preference of man j of type y for woman type x. Taste shocks are identically distributed and independent of the observable characteristics of the individuals (i.i.d.). Hence, the deterministic part of the utility function shows the relative importance of the observed characteristics to the unobserved part.

In the absence of any parametric distributional restrictions on unobserved heterogeneities, the model is under-identified with data only one large market (Galichon and Salanié, 2022a; Gualdani and Sinha, 2020). I follow the same approach as Choo and Siow (2006) by assuming that taste shocks are drawn from an extreme value type I distribution.[3] This assumption

[2]If individuals have idiosyncratic preferences for unobserved characteristics of their potential partner, this would go against the assumption. However, Chiappori et al. (2019) shows that even when the assumption is approximately correct, it can only generate small biases.

[3]The probability distribution function of random variable x with extreme value type I distribution is $f(x) = \exp(x)\exp(-\exp(x))$.

transforms the model into a convenient two-sided just-identified logit model, which is suitable for studying the primary mechanisms of marriage migration.

Galichon and Salanié (2017) demonstrates that the Logit assumption results in a modified Independence of Irrelevant Alternatives (IIA) for separable matching models: double odds ratios ($\mu_{xy}\mu_{zt}/\mu_{xt}\mu_{zy}$) are independent of all subpopulation sizes.[4] Further details and proofs are provided in Appendix 1.A. The implications of violating this assumption are discussed in the estimation section.

The deterministic part of the marriage payoff consists of three components: (1) The utility derived from observable characteristics of partners in the match. (2) An equilibrium transfer from woman x to man y, which can be positive or negative depending on the circumstances. Transfers depend on location and type. (3) A migration utility, applicable only when the marriage involves relocating. The main assumption is that the utility from observed characteristics is separable from the migration utility. That is, the endogamy preferences do not interact with the utility gain from migration. The implications of violating this assumption are discussed in the estimation section.

For a woman of type x located inside the country, her utility of a match is equal to:

$$U^{\text{in}}(x, y, m) = f(x, y) + b^1_{y\to x} \times m - \tau^{\text{in}}_{xy} \times (1 - m) - \tau^{\text{m}}_{y\to x} \times m$$

$f(x, y)$ is the utility of observable characteristics for women. $b^1_{y\to x}$ is the migration utility for the native partner (the partner inside the country). This utility is non-zero if the native spouse prefers someone who grew up outside the country. τ^{in}_{xy} is the equilibrium transfer from man y to woman x in a local match, and $\tau^{\text{m}}_{y\to x}$ is the transfer when the spouse is migrant.

If a woman of type x is located outside the country, her marriage utility is:

$$U^{\text{out}}(x, y, m) = f(x, y) + b^2_{x\to y} \times m - \tau^{\text{out}}_{xy} \times (1 - m) - \tau^{\text{m}}_{x\to y} \times m$$

The migration utility for the migrant spouse, $b^2_{x\to y}$, includes costs and benefits of relocating.[5] Benefits of migration mainly arise directly from the income gap between countries.

[4] In a one-sided logit model, single odd ratios are independent of size.

[5] The migration utility can be negative or positive.

Utility of marriage can be written similarly for men of type y inside and outside the country:

$$V^{\text{in}}(y,x,m) = g(y,x) + b^1_{x\to y} \times m + \tau^{\text{in}}_{xy} \times (1-m) + \tau^{\text{m}}_{x\to y} \times m$$
$$V^{\text{out}}(y,x,m) = g(y,x) + b^2_{y\to x} \times m + \tau^{\text{out}}_{xy} \times (1-m) + \tau^{\text{m}}_{x\to y} \times m$$

Where $g(y,x)$ represents the utility derived from the observed characteristics for men. Given that transfers occur between partners, transfers for men mirror those of women but with an opposite sign[6].

In the equilibrium, each individual maximizes their utility. The focus of this chapter is on the decision-making of people inside the country: whom they marry and whether they prefer marrying abroad. Thus, I only focus on the optimization problem for people inside the country. Following the same approach as McFadden (1974) and Choo and Siow (2006), I first calculate the probability of matches within the country when the random taste shock has an extreme-value type I distribution. The probability of a match between a woman type x and a man type y inside the country is:

$$\begin{aligned}
P\{y,0 = &\underset{z=1,\dots Y; m=0,1}{\arg\max} U^{\text{in}}_{ixzm}\} \\
&= P\{U^{\text{in}}(x,y,0) + \varepsilon^{\text{in}}_{ixy0} > U^{\text{in}}(x,z,m) + \varepsilon^{\text{in}}_{ixzm}, \forall z, m \neq y, 0\} \\
&= P\{\varepsilon^{\text{in}}_{ixzm} < U^{\text{in}}(x,y,0) - U^{\text{in}}(x,z,m) + \varepsilon^{\text{in}}_{ixy0}, \forall z \neq y \cup m \neq 0\} \\
&= \int_{-\infty}^{\infty} \prod_{z,m\neq y,0} F(U^{\text{in}}(x,z,m) - U^{\text{in}}(x,y,0) + \varepsilon^{\text{in}}_{ixy0}) f(\varepsilon^{\text{in}}_{ixy0}) d\varepsilon^{\text{in}}_{ixy0} \\
&= \int_{-\infty}^{\infty} \prod_{z,m\neq y,0} \exp\left[\exp[-(U^{\text{in}}(x,z,m) - U^{\text{in}}(x,y,0) + \varepsilon^{\text{in}}_{ixy0})]\right] \exp\left[-\varepsilon^{\text{in}}_{ixy0} - \exp[-\varepsilon^{\text{in}}_{ixy0}]\right] d\varepsilon^{\text{in}}_{ixy0} \\
&= \int_{-\infty}^{\infty} \exp\left[\sum_{z,m\neq y,0} \exp[-(U^{\text{in}}(x,z,m) - U^{\text{in}}(x,y,0))] \exp[\varepsilon^{\text{in}}_{ixy0}]\right] \exp\left[-\varepsilon^{\text{in}}_{ixy0} - \exp[-\varepsilon^{\text{in}}_{ixy0}]\right] d\varepsilon^{\text{in}}_{ixy0}
\end{aligned}$$

Defining $t \equiv \exp[-\varepsilon^{\text{in}}_{ixy0}]$ and $\alpha \equiv \sum_{z,m\neq y,0} \exp[-(U^{\text{in}}(x,z,m) - U^{\text{in}}(x,y,0))]$, simplifies the equation to:

$$\int_0^{\infty} \exp[-\alpha t] dt = \frac{1}{\alpha}$$

[6]The selection of the sign is arbitrary, as transfers can be either positive or negative for both men and women.

Therefore:

$$P\{y,0=\arg\max_{z,m} U^{\text{in}}_{ixzm}\} = \frac{1}{\sum_{z,m\neq y,0}\exp[-(U^{\text{in}}(x,z,m)-U^{\text{in}}(x,y,0))]}$$
$$= \frac{\exp\left[U^{\text{in}}(x,y,0)\right]}{\sum_{z=0}^{Y}\exp\left[U^{\text{in}}(x,z,0)\right]+\sum_{z=0}^{Y}\exp\left[U^{\text{in}}(x,z,1)\right]} \tag{1.2.5}$$

Similarly, the probability that woman x inside the country marries man y outside the country ($m=1$) is:

$$P_{y,1|x} \equiv P\{y,1=\arg\max_{z,m} U^{\text{in}}_{xzm}\} = \frac{\exp\left[U^{\text{in}}(x,y,1)\right]}{\sum_{z=0}^{Y}\exp\left[U^{\text{in}}(x,z,0)\right]+\sum_{z=0}^{Y}\exp\left[U^{\text{in}}(x,z,1)\right]} \tag{1.2.6}$$

The probability of remaining single for women type x is equal to:

$$P_{0,0|x} = \frac{1}{\sum_{z=0}^{Y}\exp\left[U^{\text{in}}(x,z,0)\right]+\sum_{z=0}^{Y}\exp\left[U^{\text{in}}(x,z,1)\right]} \tag{1.2.7}$$

By combining equations (1.2.5) and (1.2.7), and performing the same calculations for the supply side (men of type y), we obtain the following:

$$U^{\text{in}}(x,y,0) = f(x,y,0)-\tau_{xy,0} = \ln\left[\frac{P_{y,0|x}}{P_{0,0|x}}\right], \tag{1.2.8}$$

$$V^{\text{in}}(y,x,0) = g(y,x,0)+\tau_{xy,0} = \ln\left[\frac{P_{x,0|y}}{P_{0,0|y}}\right] \tag{1.2.9}$$

In the equilibrium, when supply and demand meet, a matching function determines who matches with whom and who remains single. The marriage market clears when, given equilibrium transfers, the demand for women of type x for men of type y is equal to the supply of men of type y for women of type x (for all x and y). The number of observed matchings, the matching function, is determined by the probabilities of matches derived from utilities. Therefore, from Equations (1.2.8) and (1.2.9), we have:

$$\frac{P_{y,0|x}}{P_{0,0|x}} = \frac{\mu^{\text{in}}_{xy}}{\mu^{\text{in}}_{x0}} \quad \text{and} \quad \frac{P_{x,0|y}}{P_{0,0|y}} = \frac{\mu^{\text{in}}_{xy}}{\mu^{\text{in}}_{0y}}$$

In equilibrium, transfers (prices) clear the market; therefore:

$$\Phi_{xy} \equiv U^{\text{in}}(x,y,0)+V^{\text{in}}(y,x,0) = f(x,y)+g(y,x) = 2\ln\left[\frac{\mu^{\text{in}}_{xy}}{\sqrt{\mu^{\text{in}}_{x0}\mu^{\text{in}}_{0y}}}\right] \tag{1.2.10}$$

Where Φ_{xy} is value of a match between a woman of type x and a man of type y when they marry locally. Φ_{xy} is identifiable from the relative share of local matches. In the case of marriage migration, additional migration utility is added to the value of the match. From Equations (1.2.9) and (1.2.9) we have:

$$\Phi^{\text{mm}}_{y\to x} \equiv \Phi_{xy} + b_{y\to x} = 2\ln\left[\frac{\mu^{\text{mm}}_{y\to x}}{\sqrt{\mu^{\text{in}}_{x0}\mu^{\text{out}}_{0y}}}\right]$$

$$\Phi^{\text{mm}}_{x\to y} \equiv \Phi_{xy} + b_{x\to y} = 2\ln\left[\frac{\mu^{\text{mm}}_{x\to y}}{\sqrt{\mu^{\text{out}}_{x0}\mu^{\text{in}}_{0y}}}\right]$$

Where $\Phi^{\text{mm}}_{y\to x}$ and $\Phi^{\text{mm}}_{y\to x}$ represent the match values when the husband and wife are migrants, respectively. Parameter $b_{y\to x}$ and $b_{x\to y}$ represent the joint migration utility of the migrant and the native spouse ($b_{y\to x} = b^1_{y\to x}+b^2_{y\to x}$ and $b_{x\to y} = b^1_{x\to y}+b^2_{x\to y}$). From this point forward, the joint migration utility will be referred to simply as migration utility. Combining the above equations with Equation 1.2.10 gives migration gains that are identifiable from data:

$$B_{y\to x} \equiv b_{y\to x} + \ln[\mu^{\text{out}}_{0y}] = 2\ln\left[\frac{\mu^{\text{mm}}_{y\to x}}{\mu^{\text{in}}_{xy}}\right] + \ln[\mu^{\text{in}}_{0y}] \tag{1.2.11}$$

$$B_{x\to y} \equiv b_{x\to y} + \ln[\mu^{\text{out}}_{x0}] = 2\ln\left[\frac{\mu^{\text{mm}}_{x\to y}}{\mu^{\text{in}}_{xy}}\right] + \ln[\mu^{\text{in}}_{x0}] \tag{1.2.12}$$

Migration gains, denoted as $B_{y\to x}$ and $B_{x\to y}$, encompass the combined impact of utility derived from relocation and access to a broader market (outside market). If a dataset includes observations of the outside market, the migration utility can be identified independently.

Endogamy preferences and migration gains contribute to the difference between the utility of marrying from abroad and local marriage. The utility gap can be directly measured by the following equations:

$$\Delta U^{\text{in}}(x,y) = U^{\text{in}}(x,y,1) - U^{\text{in}}(x,y,0) = b^1_{y\to x} + \tau_{xy,0} - \tau_{xy,1} = \ln\left[\frac{\mu^{\text{m}}_{y\to x}}{\mu^{\text{in}}_{xy}}\right], \tag{1.2.13}$$

$$\Delta V^{\text{in}}(y,x) = V^{\text{in}}(y,x,1) - V^{\text{in}}(y,x,0) = b^1_{x\to y} + \tau_{xy,1} + \tau_{xy,0} = \ln\left[\frac{\mu^{\text{m}}_{x\to y}}{\mu^{\text{in}}_{xy}}\right] \tag{1.2.14}$$

To summarize, the intuition underlying the equilibrium equations of the model is that people make choices among a set of alternatives based on the relative attractiveness of those options. The probability of choosing a spouse is determined by comparing the systematic utility of that choice to the sum of the systematic utilities of all available options. The decision to marry from abroad or locally is directly influenced by the relative utility that

individuals derive from each option. The gap in the utility is due to two main factors: migration gains, which encompass both the size of the outside market and the benefits associated with relocating, and endogamy preferences, which lead individuals to prefer marrying within their own group, hence marriage migration (as those in the outside market belong to the same group). These factors interact with each other, hence higher endogamy preferences amplify the influence of migration gains.

To examine the mechanisms of the model, it is essential to determine the matching equilibrium for various utility parameters. The following section provides a methodology for calculating the matching equilibrium based on specified preferences.

Calculation of Matching Equilibrium: IPFP Method

The primary challenge in finding a matching equilibrium arises from the unavailability of data on the distribution of characteristics outside of the country. Specifically, usually observations are confined to individuals inside the country and those who have migrated for marriage. I assume that the number of people outside the country compared to those who migrate for marriage is substantial enough that any alterations in the rate of marriage migration would not have a major effect on the distribution outside.

From the model, the equations that explain the equilibrium matching from the preference parameters are:

$$\Phi_{xy} = 2 \ln \left[\mu^{\text{in}}_{xy} / \sqrt{\mu^{\text{in}}_{x0} \mu^{\text{in}}_{0y}} \right] \tag{1.2.15}$$

$$\Phi_{xy} = 2 \ln \left[\mu^{\text{out}}_{xy} / \sqrt{\mu^{\text{out}}_{x0} \mu^{\text{out}}_{0y}} \right] \tag{1.2.16}$$

$$\Phi_{xy} + b_{y \to x} = 2 \ln \left[\mu^{\text{m}}_{y \to x} / \sqrt{\mu^{\text{in}}_{x0} \mu^{\text{out}}_{0y}} \right] \tag{1.2.17}$$

$$\Phi_{xy} + b_{x \to y} = 2 \ln \left[\mu^{\text{m}}_{x \to y} / \sqrt{\mu^{\text{out}}_{x0} \mu^{\text{in}}_{0y}} \right] \tag{1.2.18}$$

By rewriting these equations, the number of matches inside the country and the number of matches involving migration are equal to:

$$\mu^{\text{in}}_{xy} = \exp \left[\frac{\Phi_{xy}}{2} \right] \sqrt{\mu^{\text{in}}_{x0} \mu^{\text{in}}_{0y}}$$

$$\mu^{\text{m}}_{y \to x} = \exp \left[\frac{\Phi_{xy}}{2} \right] \exp \left[\frac{b_{y \to x}}{2} \right] \sqrt{\mu^{\text{in}}_{x0} \mu^{\text{out}}_{0y}}$$

$$\mu^{\text{m}}_{x \to y} = \exp \left[\frac{\Phi_{xy}}{2} \right] \exp \left[\frac{b_{x \to y}}{2} \right] \sqrt{\mu^{\text{out}}_{x0} \mu^{\text{in}}_{0y}}$$

Given the substantial size of the outside market, I can reasonably assume that alterations in counterfactual analysis that affect preferences and distributions inside the country do not change $b_{y\to x}$, $b_{x\to y}$, μ_{x0}^{out} and μ_{0y}^{out}. Therefore:

$$\mu_{y\to x}^{\text{m}} = \exp\left[\frac{\Phi_{xy}}{2}\right] A_{y\to x}\sqrt{\mu_{x0}^{\text{in}}}, \text{ where } A_{y\to x} \equiv \exp\left[\frac{b_{y\to x}}{2}\right]\sqrt{\mu_{0y}^{\text{out}}} \tag{1.2.19}$$

$$\mu_{x\to y}^{\text{m}} = \exp\left[\frac{\Phi_{xy}}{2}\right] A_{x\to y}\sqrt{\mu_{0y}^{\text{in}}}, \text{ where } A_{x\to y} \equiv \exp\left[\frac{b_{x\to y}}{2}\right]\sqrt{\mu_{x0}^{\text{out}}} \tag{1.2.20}$$

Where $A_{y\to x}$ and $A_{x\to y}$ can be estimated directly from the data:

$$\hat{A}_{y\to x} = \frac{\hat{\mu}_{y\to x}^{m}}{\hat{\mu}_{xy}^{\text{in}}}\sqrt{\hat{\mu}_{x0}^{\text{in}}}, \quad \hat{A}_{x\to y} = \frac{\hat{\mu}_{x\to y}^{m}}{\hat{\mu}_{xy}^{\text{in}}}\sqrt{\hat{\mu}_{0y}^{\text{in}}}$$

Hence, for any given preferences, n_x^{in} and n_y^{in} counterfactual matching can be found by solving the following equations simultaneously:

$$\begin{aligned}
\mu_{xy}^{\text{in}} &= \exp\left[\Phi_{xy}/2\right]\sqrt{\mu_{x0}^{\text{in}}\mu_{0y}^{\text{in}}} \\
\mu_{y\to x}^{\text{m}} &= \exp\left[\Phi_{xy}/2\right]\hat{A}_{x\to y}\sqrt{\mu_{x0}^{\text{in}}} \\
\mu_{x\to y}^{\text{m}} &= \exp\left[\Phi_{xy}/2\right]\hat{A}_{y\to x}\sqrt{\mu_{0y}^{\text{in}}} \\
n_x &= \sum_y \mu_{xy}^{\text{in}} + \sum_y \mu_{xy,\text{m}}^{y} + \mu_{x0} \\
n_y &= \sum_x \mu_{xy}^{\text{in}} + \sum_x \mu_{xy,\text{m}}^{x} + \mu_{0y}
\end{aligned}$$

These equations can be solved using standard optimization or equation-solving methods. However, one of the fastest ways to solve these equations simultaneously is the Iterative Projection Fitting Procedure (IPFP)[7]. I modify the IPFP algorithm developed by Galichon and Salanié (2022a) to make it suitable for the model with the possibility of marriage migration.

Stability conditions for the equilibrium matching of the model are:

$$\mu_{xy}^{\text{in}} = \sqrt{\mu_{x0}^{\text{in}}\mu_{0y}^{\text{in}}}\exp\left[\frac{\Phi_{xy}}{2}\right]$$

$$\mu_{y\to x}^{\text{m}} = \exp\left[\frac{\Phi_{xy}}{2}\right]\frac{\sqrt{\mu_{x0}^{\text{in}}}}{\hat{A}_{x\to y}}, \quad \mu_{x\to y}^{\text{m}} = \exp\left[\frac{\Phi_{xy}}{2}\right]\frac{\sqrt{\mu_{0y}^{\text{in}}}}{D_{xy}}$$

The feasibility conditions are:

$$\begin{aligned}
n_x &= \sum_y \mu_{xy}^{\text{in}} + \sum_y \mu_{y\to x}^{\text{m}} + \mu_{x0} \\
n_y &= \sum_x \mu_{xy}^{\text{in}} + \sum_x \mu_{x\to y}^{\text{m}} + \mu_{0y}
\end{aligned}$$

[7]See Galichon and Salanié (2022a) for the proof of convergence.

These equations can be combined and simplified to the following equations:

$$\mu_{x0}^{\text{in}} + \left(\sum_{y \in Y} \exp\left[\frac{\Phi_{xy}}{2} \right] \sqrt{\mu_{0y}^{\text{in}}} \right) \sqrt{\mu_{x0}^{\text{in}}} + \left(\sum_{y \in Y} \exp\left[\frac{\Phi_{xy}}{2} \right] C_{xy} \right) \sqrt{\mu_{x0}^{\text{in}}} = n_x$$

$$\mu_{0y}^{\text{in}} + \left(\sum_{x \in X} \exp\left[\frac{\Phi_{xy}}{2} \right] \sqrt{\mu_{0y}^{\text{in}}} \right) \sqrt{\mu_{0y}^{\text{in}}} + \left(\sum_{x \in X} \exp\left[\frac{\Phi_{xy}}{2} \right] D_{xy} \right) \sqrt{\mu_{0y}^{\text{in}}} = n_y$$

From these equations, unknowns μ_{x0}^{in} and μ_{0y}^{in} can be estimated using the following iterative proportional fitting procedure (IPFP):

$$\mu_{x0}^{\text{in},(2k+1)} = \left(\sqrt{n_x + \frac{A_x}{4}} - \frac{A_x}{2} \right)^2 \quad \text{with} \quad A_x = \sum_{y \in Y} \exp\left[\frac{\Phi_{xy}}{2} \right] \left(C_{xy} + \sqrt{\mu_{0y}^{\text{in},(2k)}} \right)$$

$$\mu_{0y}^{\text{in},(2k+2)} = \left(\sqrt{n_y + \frac{B_y}{4}} - \frac{B_y}{2} \right)^2 \quad \text{with} \quad B_y = \sum_{x \in X} \exp\left[\frac{\Phi_{xy}}{2} \right] \left(D_{xy} + \sqrt{\mu_{x0}^{\text{in},(2k+1)}} \right)$$

The IPFP method involves an iterative solution of the aforementioned system. Starting with an arbitrary guess $\mu_{x0}^{\text{in},(0)}$ and $\mu_{0y}^{\text{in},(0)}$, in each iteration, the equations are calculated and, subsequently, the values of $\mu_{x0}^{\text{in},(2k)}$ and $\mu_{0y}^{\text{in},(2k+1)}$ are updated. This process is repeated until convergence is achieved between the left-hand and right-hand sides of the equations.

Being able to derive the matching equilibrium from preferences allows us to conduct counterfactual analyses and observe how changes in parameters would impact the equilibrium outcome. The following section demonstrates the impact of utility parameters on marriage migration and intermarriages, using a simplified version of the model.

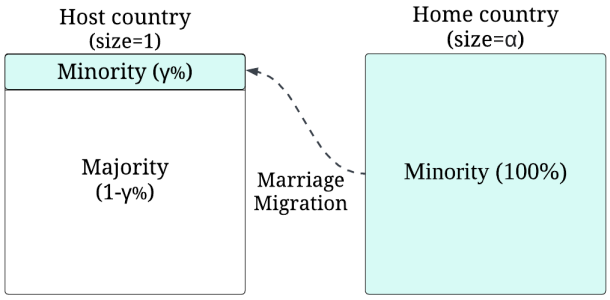
1.3 Simulations

In this section, I present a toy model to illustrate the primary mechanisms influencing marriage migration. The figures presented in this section are the outcomes of simulations based on a data-generating process rather than observations from real-world data.

I simplify the model to a case where the populations of men and women are symmetric, and I focus on a single characteristic: group = {majority, minority}. In this context, the variables x and y denote the group assignment for men and women, where M represents the majority group, and N shows the minority group. Inside the host country, $(1-\gamma)\%$ of the total population belongs to the majority group, while $\gamma\%$ are from the minority group. The minority group also has the option of marrying someone from their country of origin, which

is exclusively populated by minorities. The population of the host country is normalized to 1, and the population of the country of origin is equal to α (Figure 1.2).

Figure 1.2: Toy Model



Notes. The only characteristic is group = {majority, minority}.

The simplified deterministic utility function of marriage country is equal to:

$$\Phi(x, y, m) = a + bm - c(x - y)^2$$

The parameter a; marriage utility; signifies the benefits individuals receive from marriage compared to staying single, regardless of their partner's characteristics. The parameter b; migration utility; represents the utility generated from relocating. In other words, if an individual migrates for marriage ($m = 1$), the couple receives an additional utility. Last, the parameter c, which represents endogamy utility, captures the utility individuals gain from marrying within their group (or forfeit when intermarrying). The matching equilibrium can be found by simultaneously solving the following equations:

Stability constraints:

$$\begin{aligned}
\mu_{xy}^{\text{in}} &= \exp\left[\frac{a - c(x-y)^2}{2}\right]\sqrt{\mu_{x0}^{\text{in}}\mu_{0y}^{\text{in}}} \\
\mu_{xy}^{\text{out}} &= \exp\left[\frac{a - c(x-y)^2}{2}\right]\sqrt{\mu_{x0}^{\text{out}}\mu_{0y}^{\text{out}}} \\
\mu_{x\to y}^{\text{m}} &= \exp\left[\frac{a + b - c(x-y)^2}{2}\right]\sqrt{\mu_{x0}^{\text{out}}\mu_{0y}^{\text{in}}} \\
\mu_{y\to x}^{\text{m}} &= \exp\left[\frac{a + b - c(x-y)^2}{2}\right]\sqrt{\mu_{x0}^{\text{in}}\mu_{0y}^{\text{out}}}
\end{aligned}$$

Feasibility constraints:

$$
\begin{aligned}
n_x^{\text{in}} &= \mu_{x0}^{\text{in}} + \sum_{y=0,1} \mu_{xy}^{\text{in}} + \sum_{y=0,1} \mu_{y\to x}^{\text{m}} \\
n_y^{\text{in}} &= \mu_{0y}^{\text{in}} + \sum_{x=0,1} \mu_{xy}^{\text{in}} + \sum_{x=0,1} \mu_{x\to y}^{\text{m}} \\
n_x^{\text{out}} &= \mu_{x0}^{\text{out}} + \sum_{y=0,1} \mu_{xy}^{\text{out}} + \sum_{y=0,1} \mu_{x\to y}^{\text{m}} \\
n_y^{\text{out}} &= \mu_{0y}^{\text{out}} + \sum_{x=0,1} \mu_{xy}^{\text{out}} + \sum_{x=0,1} \mu_{y\to x}^{\text{m}}
\end{aligned}
$$

Where $n_x^{\text{in}} = n_y^{\text{in}} = (1-\gamma, \gamma)$ and $n_x^{\text{out}} = n_y^{\text{out}} = (0, \alpha)$. The main two equations resulting from the equilibrium equations are:

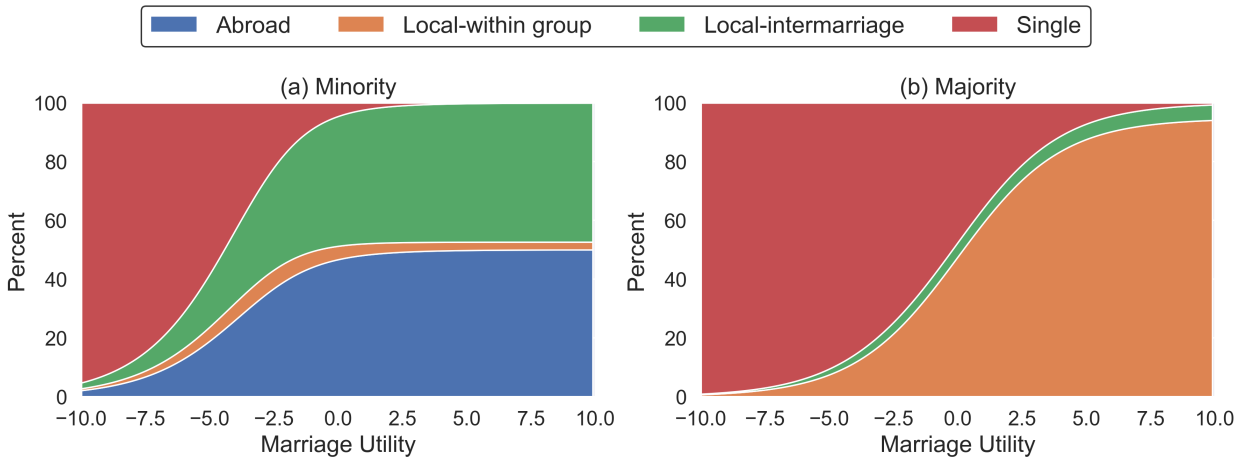
$$
\frac{\mu_{JN}^{\text{in}} \mu_{NJ}^{\text{in}}}{\mu_{JJ}^{\text{in}} \mu_{NN}^{\text{in}}} = \exp[c], \quad \frac{\mu_{NN}^{\text{mm}}}{\mu_{NN}^{\text{in}}} = \exp\left[\frac{b}{2}\right] \sqrt{\frac{\mu_{0N}^{\text{out}}}{\mu_{N0}^{\text{in}}}}
$$

The first equation illustrates that the relative ratio of inter-married to intra-married individuals indicates the extent of the utility of endogamy. The second equation demonstrates that the relative ratio of people marrying from abroad to those marrying locally encapsulates the combined impact of migration utility and the number of single individuals inside and outside. The number of single individuals inside the country is affected by endogamy preferences (c). Because I assume no gender heterogeneity, marriage migration and intermarriage rate of men and women are equal.

Through simulations of the model and aligning the equilibrium for various parameters, I can observe how the mechanisms within the model drive specific equilibrium outcomes. An increase in the baseline level of utility associated with marriage compared to remaining single (a) results in an increased marriage rate (the proportion of individuals who are married). However, this adjustment does not influence the distribution of married individuals across various marriage types (Figure 1.3). The effect is more pronounced among minorities compared to the majority, as the former have access to a larger marriage market.

In Figure 1.4, the impact of migration utility (b) on the equilibrium of the marriage market is illustrated under the condition of $a = c = 0$ (absence of endogamy preferences). When individuals experience substantial disutility from migration, they only match within the country. As the utility of migration rises, there is a corresponding increase in the proportion of minorities choosing to marry abroad, leading to a decline in the intermarriage rate between minorities and majorities. Additionally, a high migration utility increases the

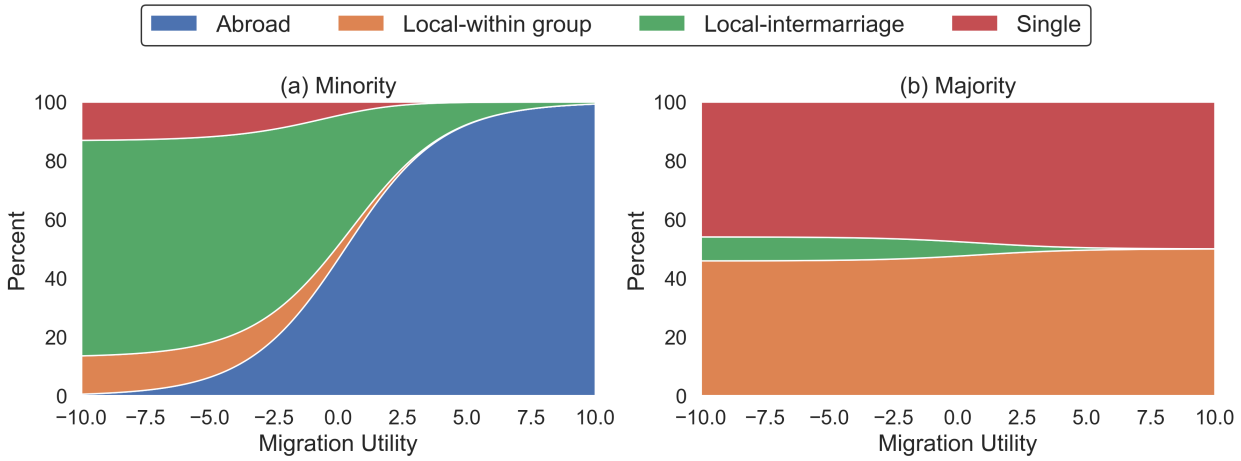
Figure 1.3: Equilibrium Matching Patterns Across Varied Levels of Marriage Utility



Notes. Utility function: $\Phi(x, y, m) = a + bm - c(x - y)^2$. The figure shows the response of the marriage equilibrium to changes in the marriage utility (a) when there is no utility from the characteristics of the partners ($b = c = 0$).

attractiveness of marriage compared to remaining single for minorities, consequently reducing the proportion of minorities who remain single. In cases where the benefit of migration is exceptionally high, almost all minorities opt for marriages abroad. In summary, the utility of migration acts as a deterrent to intermarriage rates, even in the absence of preferences for endogamy.

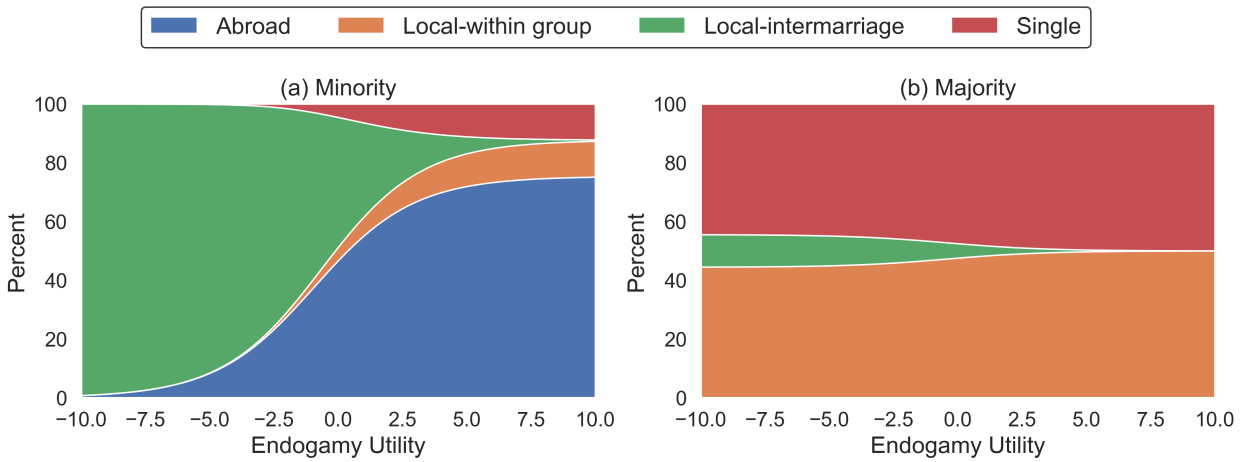
Figure 1.4: Equilibrium Matching Patterns Across Varied Levels of Migration Utility



Notes. Utility function: $\Phi(x, y, m) = a + bm - c(x - y)^2$. The figure shows the response of the marriage equilibrium to changes in the migration utility (b) when there is no utility from the characteristics of the partners ($a = c = 0$).

Figure 1.5 shows the effect of an increase in endogamy utility while maintaining a zero migration utility ($a = b = 0$). Negative endogamy utility implies a preference for mixing (intermarriage), whereas positive values indicate a preference for intragroup marriages. When the utility of endogamy is low, the share of people who marry abroad remains low, while the prevalence of intermarriage is high. However, when endogamy utility becomes positive, a pattern emerges wherein everyone primarily marries individuals from their own group. Notably, due to the greater availability of potential partners from their communities abroad, an increasing number of minorities opt for marrying abroad. Therefore, high endogamy preferences lead to higher marriage migration.

Figure 1.5: Equilibrium Matching Patterns Across Varied Levels of Endogamy Utility

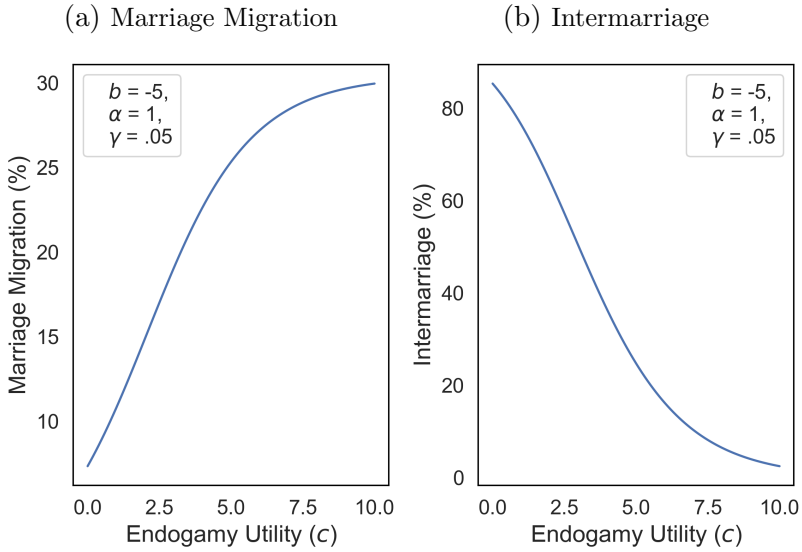


Notes. Utility function: $\Phi(x, y, m) = a + bm - c(x - y)^2$. The figure shows the response of the marriage equilibrium to changes in the endogamy utility (c) when there is no utility from the characteristics of the partners ($a = b = 0$).

In the final set of simulations, I concentrate on examining the impact of variations in different parameters on the marriage migration and intermarriage rate for minorities. Marriage migration arises either due to endogamy preferences or migration gains.

1. Endogamy preferences: An increase in the utility derived from marrying within one's group directly reduces the intermarriage rate. This is because individuals now require greater compensation to be willing to marry outside their group. Endogamy preferences affect marriage migration through the advantage gained from having access to a larger pool of individuals who share the same characteristics. A rise in endogamy utility leads to greater gains from marrying similar people across borders, consequently increasing the demand for marriage migration (Figure 1.6).

Figure 1.6: Effect of Endogamy Preferences



2. Migration gains: Migration gains represent gains from relocating, either direct effect on the utility of each partner or indirect effect through changing prices. Two key parameters in the model affect marriage migration (Figure 1.7):

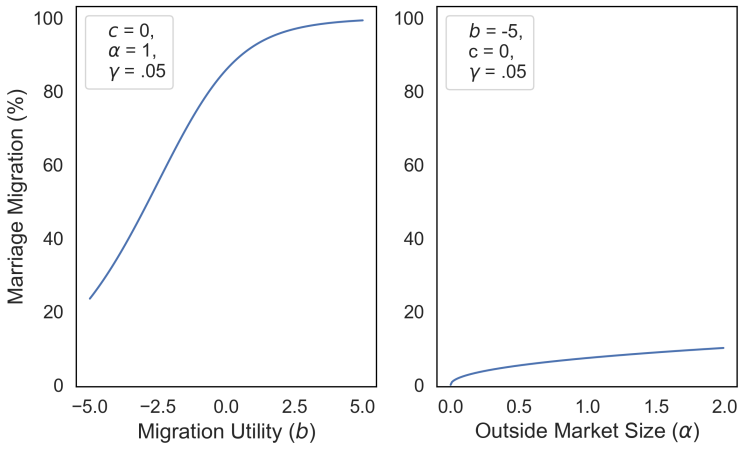
- Migration utility (b): Increased utility for migration, or stronger preferences for individuals who grew up in the country of origin, directly elevates the utility of marriage migration compared to local marriages. Consequently, marriage migration rises. When individuals marry partners from outside more frequently, it implies a higher likelihood of marrying within their ethnic groups. This, in turn, indirectly reduces the intermarriage rate, even in the absence of changes in preferences for endogamy.

- Outside market's size (α): A larger outside marriage market implies that minorities have access to a broader pool of potential spouses. Consequently, the cost associated with finding a spouse abroad decreases. Thus, even without preferences for endogamy, an increase in the size of the outside market increases marriage migration, albeit to a lower extent. Since minorities marry within their group more, intermarriage decreases.

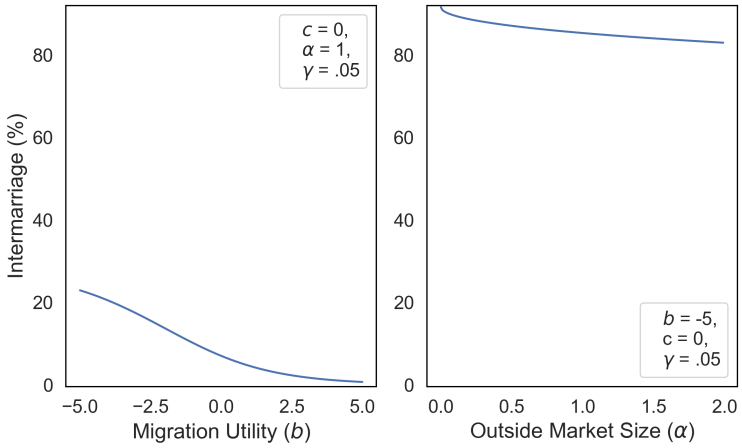
In summary, both a higher endogamy preference and higher migration gains lead to increased marriage migration and decreased intermarriage rates. However, the magnitude of these effects depends on which factor is affected.

Figure 1.7: Effect of Migration Utility

(a) Marriage Migration



(b) Intermarriage



1.4 Parametric Estimation

The preferences and price gaps in the model are directly derived from the relative distribution of observed matches across different types. The proportions of individuals in different types correspond to the probability of selecting each option, which, in turn, directly reflects their preferences. Therefore, by reversing this process, I can identify preferences. In sum, by accounting for the availability of different types, I can identify relative systematic preferences based on the relative distribution of matches.

In the first part of this section, I discuss the methodology for estimating preferences and migration gains from observed matching and availabilities. The second part presents Monte-Carlo simulations that check the accuracy of the suggested estimation strategy.

1.4.1 Estimation of Utility Parameters

One approach to parametrically estimate the model is through Entropic Regularization, which offers lower computational complexity and easy implementation, as recommended in optimal transport theory (Cuturi, 2013). Entropy regularization provides significant computational advantages, particularly for high-dimensional data. Under the model's assumptions, stable matching is unique and maximizes social surplus. As proved by Galichon and Salanié (2022a), stable matching solves the following welfare-maximizing problem:

$$\max_{\boldsymbol{\mu}} \left(\sum_{x,y} \mu_{xy} \Phi^{\boldsymbol{\beta}}_{xy} + \mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q}) \right)$$

Where $\boldsymbol{\beta}$ shows preference parameters. $\mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q})$ is the generalized entropy of the matching pattern that depends only on the matching patterns $\boldsymbol{\mu}$ and availabilities $\boldsymbol{q} = (\boldsymbol{n}, \boldsymbol{m})$. Generalized entropy quantifies the contribution of matching on unobservables to the social surplus, and its functional form depends on the distributional assumption of unobservables.

To maximize welfare, the following equation must be satisfied:

$$\Phi^{\boldsymbol{\beta}}_{xy} = -\frac{\partial \mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q})}{\partial \mu_{xy}}, \quad \forall x, y$$

The welfare maximization condition can serve as a basis for the implementation of Minimum Distance Estimation (MDE)[8] to estimate the parameters of the joint surplus function ($\boldsymbol{\beta}$). Given the availabilities ($\boldsymbol{q}$), the MDE technique estimates parameter values that best align with the welfare maximizing conditions:

$$\boldsymbol{D}^{\boldsymbol{\beta}}(\boldsymbol{\mu}, \boldsymbol{q}) \equiv \Phi^{\boldsymbol{\beta}} + \frac{\partial \mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q})}{\partial \boldsymbol{\mu}} = \mathbf{0}$$

The observed counterparts of the population values $\boldsymbol{\mu}$ and $\boldsymbol{q}$ are denoted as $\hat{\boldsymbol{\mu}}$ and $\hat{\boldsymbol{q}}$, respectively. With a known distribution of unobservables, the parameters $\boldsymbol{\beta}$ can be reliably estimated in a consistent manner using the subsequent procedure [9]:

1. Choose any positive definite matrix ($\boldsymbol{S}$) and minimize over $\boldsymbol{\beta} \in \mathbb{R}^d$ (d is the number of parameters).

$$\left|\left| \boldsymbol{D}^{\boldsymbol{\beta}}(\boldsymbol{\mu}, \boldsymbol{q}) \right|\right|^2_{\boldsymbol{S}} = \sum_{x,y,z,t} S_{xy,zt} \left(\Phi^{\boldsymbol{\beta}}_{xy} + \frac{\partial \mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q})}{\partial \mu_{xy}} \right) \left(\Phi^{\boldsymbol{\beta}}_{zt} + \frac{\partial \mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q})}{\partial \mu_{zt}} \right)$$

[8] Due to large number of types, MDE demonstrates superior fitting performance compared to the Moment-based Estimation by Poisson Regression (the alternative approach proposed by Galichon and Salanié (2022b))

[9] refer to Galichon and Salanié (2022b) for the formal proof

This gives a consistent estimator β^*.

2. Use the delta method to estimate the variance $\boldsymbol{\Omega}^*$ at $\boldsymbol{\beta} = \boldsymbol{\beta}^*$; let $\boldsymbol{S}^* = (\boldsymbol{\Omega}^*)^{-1}$

3. Repeat step 1 to obtain another consistent estimator $\hat{\boldsymbol{\beta}}$. The variance-covariance estimator of this estimator can be consistently estimated by $(\hat{\boldsymbol{F}}'\boldsymbol{S}^*\hat{\boldsymbol{F}})^{-1}$; where $\hat{\boldsymbol{F}}$ is the Jacobian of $\boldsymbol{D}^{\boldsymbol{\beta}}$ with respect to $\boldsymbol{\beta}$ at $\hat{\boldsymbol{\beta}}$.

Following the common approach in the literature, I assume that the joint surplus is linear in the parameters: $\boldsymbol{\Phi}^{\boldsymbol{\beta}} = \boldsymbol{\beta}\boldsymbol{\phi}$. This assumption simplifies the procedure mentioned above to a quasi-generalized least squares (QGLS). If I impose the logit assumption on the taste shock distribution, the generalized entropy is equal to:

$$\frac{\partial \mathcal{E}(\boldsymbol{\mu}, \boldsymbol{q})}{\partial \mu_{xy}} = -\ln\left[\frac{\mu_{xy}}{\mu_{x0}}\right] - \ln\left[\frac{\mu_{xy}}{\mu_{0y}}\right]$$

Since the general entropy for the logit distribution is independent of subpopulation sizes, the model can be estimated by dividing it into two parallel markets. The minimum distance estimator can be implemented on the local market to estimate the joint marriage surplus parameters from Equation (1.2.15). Therefore, the minimum distance estimation for estimation of preferences would simplify to the following least square regression: $2\ln\left[\hat{\mu}^{\text{in}}_{xy}/\sqrt{\hat{\mu}^{\text{in}}_{x0}\hat{\mu}^{\text{in}}_{0y}}\right]$ on ϕ_{xy} where observation are the complete set of combinations of x and y. Migration gains can be directly estimated from Equations (1.2.11) and (1.2.12) for each type combination (x and y).

One prevalent challenge associated with such estimations is the potential occurrence of cells that contain zero observations. This scenario leads to the calculation of partial derivatives of the generalized entropy that result in infinitive values, consequently making β non-existent. A straightforward solution is introducing a minor increment (δ) to the $\hat{\boldsymbol{\mu}}$ values. This adjustment is achieved by the following modification:

$$\tilde{\boldsymbol{\mu}} = \frac{\hat{\boldsymbol{\mu}} + \delta}{N + \delta} N$$

Where N represents the sample size. This modification ensures the conservation of the number of households within the sample. As demonstrated by Galichon and Salanié (2022b), this technique serves to correct for the finite-sample bias.

The model's key assumptions for estimation are: (1) Independence of Irrelevant Alternatives (IIA), followed by the logit assumption for heterogeneities, and (2) the separability of migration utility. If IIA does not hold, this implies that endogamy preferences might depend

on population sizes in addition to the ratio of inside versus outside group marriages. In other words, larger populations could suggest reduced endogamy preferences. The reasoning behind this is that in larger markets, it becomes easier for individuals to find partners with similar characteristics, potentially leading to lower endogamy preferences. Consequently, estimated endogamy preferences could represent an upper limit under these circumstances. When separability is violated, it suggests that endogamy preferences may either complement (resulting in a positive interaction) or substitute (yielding a negative interaction) with migration utility. Depending on the nature of this interaction, estimated endogamy preferences could be either under- or over-estimated.

1.4.2 Monte-Carlo Simulations

In this section, I use Monte Carlo simulation to assess the accuracy of the estimation method. This involves creating a simulated matching process based on predefined preferences and random utilities, and then iterating this process multiple times to estimate parameters using the proposed estimation strategy. The goal is to evaluate whether the estimation method provides unbiased estimates of parameters across numerous iterations.

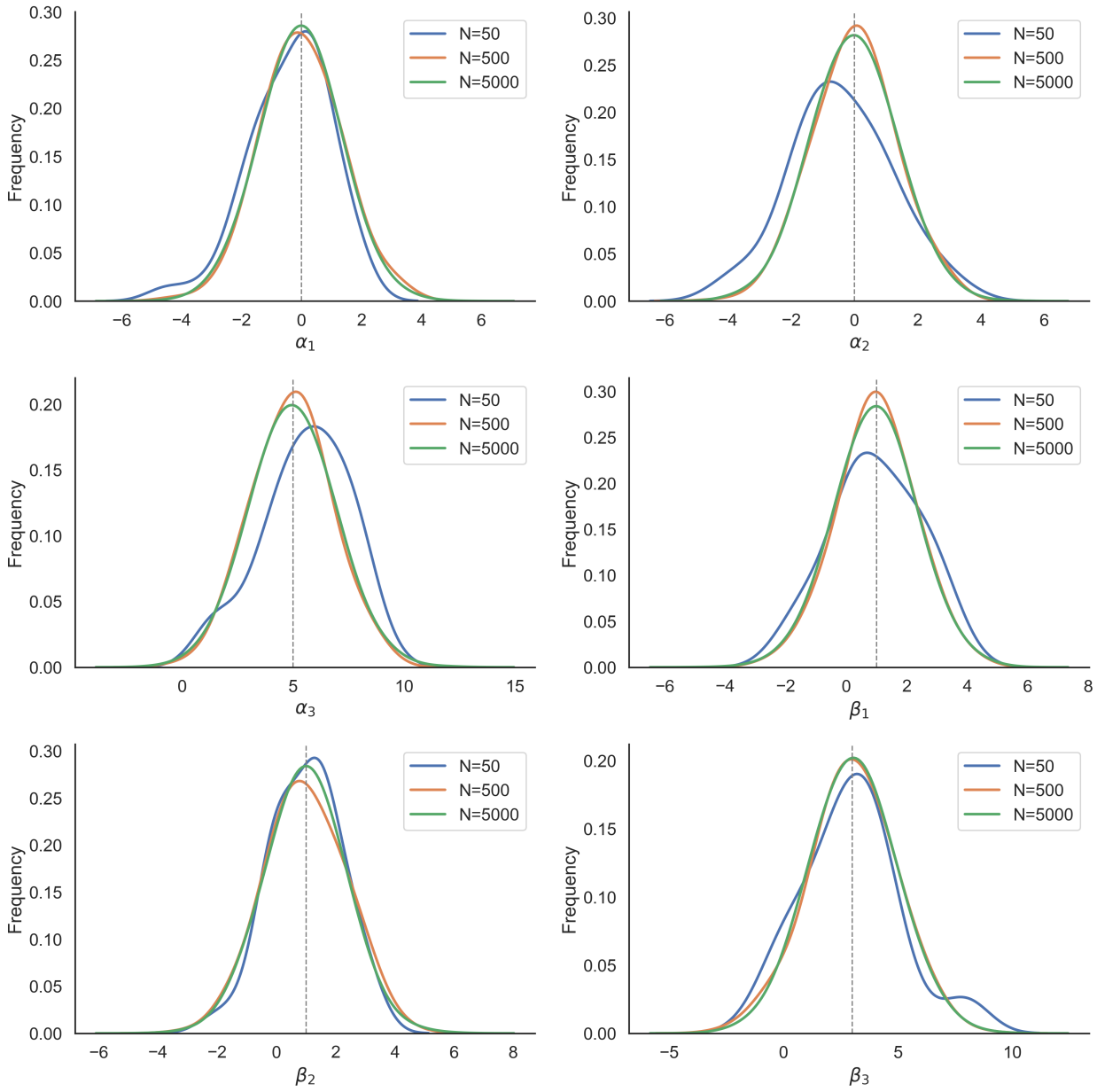
People are divided into two groups: Majority and minority. Minorities constitute 5% of the population. The utility of a match between woman i of type x_i and man j of type y_j is assumed to be:

$$\Phi = \alpha_0 + \alpha_1 r_i + \alpha_2 r_j + \alpha_3 r_i r_j + \beta_1 s_i + \beta_2 s_j + \beta_3 s_i s_j + \varepsilon_{x_i y_j}$$

where r represents education and s represents income of each person. Random shocks are type-specific. Minorities have the option of marrying someone from abroad. The size of the outside country is the same as the inside country, and the benefit of migration is b.

To generate a sample, I draw random utilities N times from a multinomial probability distribution. I then use minimum distance estimation on each sample. The minimum distance estimator employs linear regression. Figure 1.8 shows the estimates for $\alpha_1 = 0$, $\alpha_2 = 0$, $\alpha_3 = 5$, $\beta_1 = 1$, $\beta_2 = 1$, $\beta_3 = 3$, and $b = 2$. As the number of repetitions (N) increases, the accuracy of the estimates improves. This approach yields unbiased and consistent estimates of the endogamy preferences.

Figure 1.8: Monte-Carlo Simulation of Estimation Methodology



1.5 Conclusion

This chapter introduces a new matching model that incorporates migration. The focus of this chapter is on the applications of the model in the marriage market, but the estimation strategy can be easily generalized to other contexts. Monte Carlo simulations show that the econometric methodology performs quite well for the parametric estimation of utility parameters. Future research could explore relaxing the assumptions of this model regarding the distribution of taste-based shocks and the separability of migration utility.

1.A Implications of EV(1) Assumption

In this section, I provide the example provided by Galichon and Salanié (2017) to show the implications of the Independence of Irrelevant Alternatives (IIA) in the case of two-sided matching. Here, I consider a simplified model without the possibility of migration.

As shown in the model section, the logit assumption on unobserved heterogeneities results in the following equation:

$$\Phi(x,y) = 2\ln\left[\frac{\mu_{xy}}{\sqrt{\mu_{x0}\mu_{0y}}}\right]$$

For simplicity, let X and Y consist of types (groups), with two values M (Majority) and N (Minority). The number of majority women and men respectively are: n_M and m_M, and the number of minority women and men are n_N and m_N. Suppose that matrix Φ has:

$$\exp(\Phi_{MM}/2) = a;\ \exp(\Phi_{MN}/2) = \exp(\Phi_{NM}/2) = b;\ \exp(\Phi_{NN}/2) = c$$

Where a, b, and c are arbitrary numbers. The stability conditions for the equilibrium are:

$$\begin{aligned}
\mu_{MN} &= b\sqrt{\mu_{M0}\mu_{0N}} \\
\mu_{NM} &= b\sqrt{\mu_{N0}\mu_{0M}} \\
\mu_{MM} &= a\sqrt{\mu_{M0}\mu_{0M}} \\
\mu_{NN} &= c\sqrt{\mu_{N0}\mu_{0N}}
\end{aligned}$$

And the feasibility conditions are:

$$\begin{aligned}
n_M &= \mu_{M0} + \mu_{MM} + \mu_{MN} \\
n_N &= \mu_{N0} + \mu_{NM} + \mu_{NN} \\
m_M &= \mu_{0M} + \mu_{MM} + \mu_{NM} \\
m_N &= \mu_{0N} + \mu_{MN} + \mu_{NN}
\end{aligned}$$

Equilibrium equations can be summarized in four equations on the number of singles:

$$\begin{aligned}
n_M &= \mu_{M0} + (a\sqrt{\mu_{0M}} + b\sqrt{\mu_{0N}})\sqrt{\mu_{M0}} \\
n_N &= \mu_{N0} + (b\sqrt{\mu_{0M}} + c\sqrt{\mu_{0N}})\sqrt{\mu_{N0}} \\
m_M &= \mu_{0M} + (a\sqrt{\mu_{M0}} + b\sqrt{\mu_{N0}})\sqrt{\mu_{0M}} \\
m_N &= \mu_{0N} + (b\sqrt{\mu_{M0}} + c\sqrt{\mu_{0N}})\sqrt{\mu_{0N}}
\end{aligned}$$

Now we distinguish between two types of majority: type A (A) and type B (B). The numbers for women and men respectively are: n_A, n_B, m_A, and m_B. Let's assume that this difference is irrelevant to marriage surplus:

$$\exp(\Phi_{MA}/2) = \exp(\Phi_{MB}/2) = \exp(\Phi_{AM}/2) = \exp(\Phi_{BM}/2) = b$$
$$\exp(\Phi_{AA}/2) = \exp(\Phi_{BB}/2) = c$$

Similar to before, the equilibrium equations that define equilibrium for type A and B women are:

$$n_A = \mu_{A0} + (b\sqrt{\mu_{0M}} + c(\sqrt{\mu_{0A}} + \sqrt{\mu_{0B}}))\sqrt{\mu_{A0}}$$
$$n_B = \mu_{B0} + (b\sqrt{\mu_{0M}} + c(\sqrt{\mu_{0A}} + \sqrt{\mu_{0B}}))\sqrt{\mu_{B0}}$$

From these two equations, we find that $\sqrt{\mu_{0A}} = \frac{n_A}{n_B}\sqrt{\mu_{0B}}$. A similar equation can be found for men. In addition, stability equations $\mu_{AA} = c\sqrt{\mu_{A0}\mu_{0A}}$ and $\mu_{BB} = c\sqrt{\mu_{B0}\mu_{0B}}$. Putting all together, stability conditions can be summarized as:

$$\mu_{MN} = b\left(\frac{n_A + n_B}{\sqrt{n_A^2 + n_B^2}}\right)\sqrt{\mu_{M0}\mu_{0N}}$$
$$\mu_{NM} = b\left(\frac{n_A + n_B}{\sqrt{n_A^2 + n_B^2}}\right)\sqrt{\mu_{N0}\mu_{0M}}$$
$$\mu_{NN} = c\left(1 + \frac{2n_A n_B}{n_A^2 + n_B^2}\right)\sqrt{\mu_{N0}\mu_{0N}}$$
$$\mu_{MM} = a\sqrt{\mu_{M0}\mu_{0M}}$$

This is equivalent to changing the joint surplus from Φ to Φ':

$$\exp(\Phi'_{MM}/2) = a;\ \exp(\Phi'_{MN}/2) = \exp(\Phi'_{NM}/2) = \frac{b(n_A + n_B)}{\sqrt{n_A^2 + n_B^2}};\ \exp(\Phi'_{NN}/2) = c\left(1 + \frac{2n_A n_B}{n_A^2 + n_B^2}\right)$$

The natural measure of complementarity introduced by Choo and Siow (2006) is equal to the excess surplus from an endogamous match relative to an exogamous match, which is equal to the double odds ratio:

$$\mathcal{D} = \Phi_{MM} + \Phi_{MN} - \Phi_{NM} - \Phi_{NN} = 2\ln\left(\frac{ac}{b^2}\right)$$

Replacing Φ with Φ' will not change $\mathcal{D}$. Hence, estimates of assortative matching are not dependent on the market size and are not affected by type split and type aggregation in a two-sided matching model with extreme value type I taste shocks.

Chapter 2

Migration for Marriage

Policymakers are concerned about permanent migration and are enforcing policies to tighten it. Marriage migration, wherein a citizen marries a foreigner, is a significant driver of permanent migration to OECD countries. Notably, Muslims exhibit a significantly high marriage migration rate; for instance, about half of British Muslims marry someone from their ancestral country of origin. This trend could be rooted in the desire to marry within one's ethnicity or faith (endogamy preferences) or a pathway to gain residency in a developed country (migration gains). In this chapter, I use the open matching model developed in Chapter 1 to separately identify the main reasons behind marriage migration. I find that the high Muslim marriage migration rate is not mainly due to migration gains but rather the preference for endogamy, driven by the ease of finding partners who share the same ethnicity and religious background in the country of origin. Therefore, raising the costs of marriage migration by policymakers does not significantly impact inter-religious marriages. However, this leads to a reduced marriage surplus and a higher proportion of singles among Muslims.

2.1 Introduction

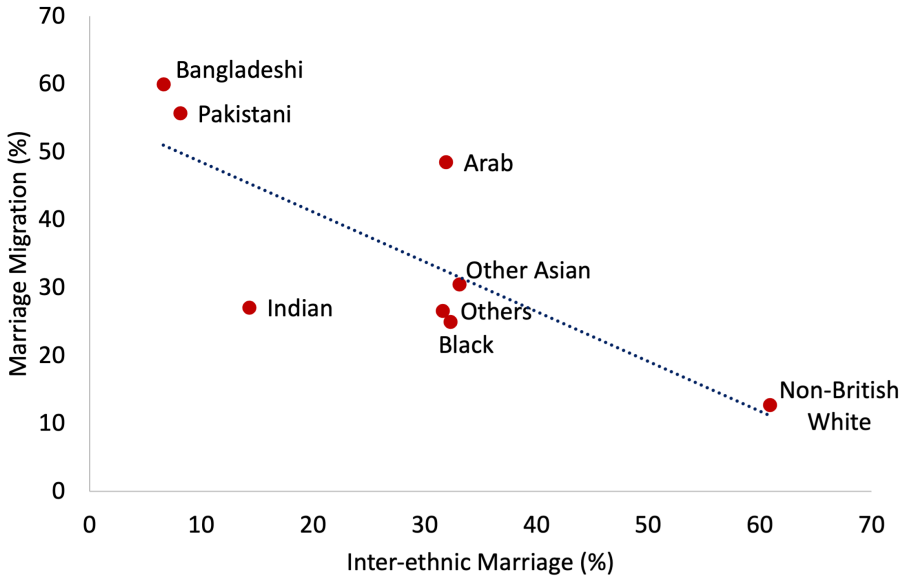
Migration for family formation, often referred to as "marriage migration", occurs when a citizen marries a foreigner. These marriages have significant implications for permanent migration, as they enable the foreign spouse to attain citizenship. Marriage migration is an increasingly important driver of migration in many OECD countries (OECD, 2017). For example, in the UK, approximately 30% of immigrants migrated for marriage purposes (Labour Force Survey, 2011).[1] One significant subset of marriage migration involves the

[1]Marriage migration accounts for less than 10% of the annual migration inflow (Figure 2A.1). However, the long-term stay rate for marriage migrants is 89%, in contrast to the rates of 18% for migrant students and 57% for migrant workers (Hall et al., 2023).

marriage of ethnic minorities with partners from their (ancestral) country of origin (Charsley et al., 2020).

Policymakers have expressed concerns about marriage migration, arguing that such marriages can slow integration down (Casey, 2016; Charsley et al., 2017; Goodhart, 2013). For example, groups exhibiting high rates of marriage migration also tend to have notably low rates of intermarriage (Figure 2.1). Consequently, several OECD countries have implemented strict marriage migration regulations, such as implementation of a minimum income requirement, entry tests, and higher fees to improve integration and reduce migration (Charsley, 2013; Eggebø and Brekke, 2019; Charsley et al., 2020). However, the impact of these policies depends on the primary motives driving marriage migration.

Figure 2.1: Marriage Migration and Inter-ethnic Marriages



Source. Census for England and Wales, 2011

If a high marriage migration rate primarily results from the benefits of relocating to a higher-income country (migration gains), implementing a tax on marriage migration would substantially decrease marriage migration and increase intermarriage rates. However, if the primary motivation for marrying someone from the country of origin revolves around preferences for marrying within one's ethnicity and religion (endogamy preferences), a marriage migration tax will have a more limited impact on overall marriage migration and might not necessarily lead to increased intermarriage. Moreover, the welfare effects of policies in these two scenarios differ significantly.

In this chapter, I address the question of how much of marriage migration is attributable to direct gains from migration and how much stems from endogamy preferences. Specifically, I focus on British Muslims, who stand out due to their significantly higher rate of marriage migration compared to other groups. About half of British Muslims marry partners born in their country of origin, in contrast to the rate of 20% or less from other religious groups. Examining this phenomenon is crucial, as Muslims are a significant and growing population that face challenges related to integration in Western countries (Adida et al., 2016).

Marriage choices occur in an equilibrium outcome of the preferences of both partners and the availability of various types. Therefore, a reduced-form partial equilibrium analysis is unable to capture all aspects of the marriage market. I use the open matching model developed in Chapter 1, to estimate the main reasons behind the high marriage migration rate of Muslims. Within this model, two crucial factors influencing marriage migration are "endogamy preferences" and "migration gains". Endogamy preferences arise from the preference to marry partners sharing the same religion and ethnicity. Migration gains arise from two factors: (1) Access to a large outside market, (2) Utility generated from relocating. This utility captures benefits linked to moving from lower-income countries to higher-income ones for the migrant spouse, leading them to accept trade-offs by sacrificing their marital benefits to improve those of their partner, and preferences among British individuals for partners who were raised in their country of origin.

To estimate the model, I use the Census for England and Wales in 2011. Unlike most countries, the UK collects information on ethnicity and religion, allowing me to separately estimate ethnic and religious preferences.[2] This distinction is important because the Muslim marriage market presents a high correlation between ethnicity and religion. Also, the study benefits from a significant sample size, as 4.8% of the UK population identifies as Muslim.[3]

The majority of Muslims in the UK originate from South Asian ethnic backgrounds (Pakistani, Bangladeshi, or Indian). Muslims show distinct marriage patterns compared to other religious groups: they have the highest marriage migration rate at 50%, the lowest inter-religious marriage rate at 5%, and the lowest inter-ethnic marriage rate at 12%. A reduced form analysis reveals that ethnic minorities from the bottom of the education distribution in the UK marry spouses from the top of the education distribution in their country of

[2]Previous research has typically focused on one aspect, either ethnicity or religion (Bisin et al., 2004; Fryer Jr, 2007; Banerjee et al., 2013; Anderberg and Vickery, 2021; Chiappori et al., 2012)

[3]This proportion has since increased to 6.7% in 2021.

origin, suggesting mutual benefits for both parties. British citizens can trade citizenship for the chance to marry someone with relatively higher educational qualifications from abroad, while migrants gain residency in the UK.

The results of the structural estimation confirm the well-established fact that individuals have strong preferences for endogamy (Siow, 2015). The novelty of my results is to show that couples gain a significantly higher surplus from marrying within their ethnic and religious group rather than marrying within the same age or education group. Religious minorities in the UK—Muslims, Hindus, and Sikhs—exhibit similar benefits from marrying within their respective religions compared to interfaith marriages. Hence, in terms of endogamy preferences, Muslims do not significantly differ from other religious minorities. However, these preferences are less pronounced among Christians and those without religious affiliation, who represent the majority groups in the UK.

Dividing the reasons behind marriage migration shows that only about 10% of the overall 50% Muslim marriage migration rate can be attributed to migration gains. Therefore, the primary factor driving significant Muslim marriage migration is not the benefits derived from relocation but rather a strong preference for shared ethnicity and religion. When comparing Muslims with Hindus and Sikhs, the primary difference is not their endogamy preferences but rather disparities in their migration gains. This could stem from Muslims' access to a larger population in their country of origin (stronger connections) or a higher utility of migration for Muslims.

The model results hold significant policy implications. In the UK, a series of policy reports have advocated for the need to restrict spousal immigration (Breta, 2002; Border and Agency, 2007; Casey, 2016). The government has responded by introducing several policies such as a minimum income requirement and the English language test, aimed at limiting marriage migration, particularly from non-European countries. These policies have been justified on the grounds of reducing abuse and fraud, promoting integration, and ensuring that immigrants are able to support themselves financially (Charsley et al., 2020). Such policies are not limited to the UK; many other OECD countries also have restrictions on marriage migration. For instance, the US has quotas on spouse visas.

I analyze the impact of policies implementing a lump-sum marriage migration tax by conducting counterfactual analyses that simulate varying levels of increased marriage migration costs. These taxes can affect migration gains but have no impact on preferences in the short run. As characteristics of the market in home countries are unobserved, I assume that the

country of origin is sufficiently large so that its distribution is unaffected by changes in the marriage migration rate. My findings show that the introduction of a marriage migration tax results in a slower decrease in the marriage migration rate among Muslims compared to non-Muslims. Moreover, due to strong endogamy preferences, the tax leads to only a minor rise in inter-religious marriage rates. When Muslims face higher costs in finding partners within their religion, they tend to compromise on other characteristics, leading to an increase in inter-ethnic marriages. On the other hand, inter-education marriages decline, because low-educated Muslims no longer have access to the cheap option of marrying high-educated individuals from their country of origin. Additionally, many Muslims prefer remaining single over compromising on their partner's characteristics, resulting in a notable increase in the number of single Muslims.

In my second set of counterfactual analyses, I explore the impact of changes in the Muslim population on the marriage market equilibrium. This investigation is crucial considering the considerably higher population growth rate of Muslims compared to other groups in several OECD countries. My findings indicate that an increase in the Muslim population significantly decreases the marriage migration rate. This trend emerges because individuals find it easier to locate partners with similar ethnicity and religion within the local market. However, despite the rise in the Muslim population, the rate of intermarriage remains relatively unchanged due to the strong endogamy preferences.

This study makes several contributions to various strands of literature. First, I introduce an open matching model that can explain and predict marriage migration of ethnic minorities to high-income countries, in contrast to the existing closed matching models that focus on closed markets. The model shows that considering a closed matching model would overestimate the endogamy preferences of ethnic minorities (Becker, 1974; Choo and Siow, 2006; Chiappori, 2017; Galichon and Salanié, 2022a; Adda et al., 2020), thereby necessitating the development of a new method for identifying the determinants of marriage migration.

Second, most of the existing papers on marriage migration have focused on brokered inter-ethnic marriage migrations in East Asia (Kawaguchi and Lee, 2017; Weiss et al., 2018; Ahn et al., 2020), which is mainly about rich men importing wives from poorer countries. Dupuy (2021) studies the advantages of marrying up and improving employment through internal migration in China. While the importance of intra-ethnic marriages from the country of origin has been discussed among sociologists (González-Ferrer, 2006; Beck-Gernsheim, 2007; Charsley, 2013; Charsley et al., 2020; Bryceson and Vuorela, 2020), this study is the first in the Economics literature to examine the determinants of this phenomenon.

Third, because the data has information on both ethnicity and religion, I am able to separately identify religious and ethnic preferences in marriage, and compare them with preferences for other characteristics, such as education. This approach advances the past literature, which predominantly emphasized matching based on other characteristics, such as education and income, by highlighting that religion and ethnicity carry significantly greater importance in the marriage decisions (Hitsch et al., 2010b; Banerjee et al., 2013; Eika et al., 2019; Chiappori et al., 2022; Anderberg and Vickery, 2021).

Last, within the extensive literature on integration, Muslims have been relatively underexplored. Manning and Roy (2010) and Georgiadis and Manning (2011) show that Muslims do not significantly differ from other groups in terms of identity assimilation. Identity assimilation, however, does not necessarily lead to cultural and social assimilation (Bisin et al., 2004, 2008; Gould and Klor, 2016; Jacquet and Montpetit, 2022). My research contributes to understanding how Muslims integrate into Western countries by examining their marriage patterns. The marriage market shows people's real preferences for mixing and integration, providing insights for policymaking regarding the impact of marriage migration policies on the integration of Muslims.

The chapter is structured as follows. Section 2.2 provides a background on marriage migration. Section 2.3 offers an overview of the data and presents a reduced-form analysis of marriage migration. Section 2.4 outlines the estimation method, followed by a discussion of the results in Section 2.5 and counterfactual analyses in Section 2.6. I present robustness checks in Section 2.7. Section 2.8 concludes.

2.2 Background on Marriage Migration

Marriage migration policies refer to governmental regulations and laws that govern the migration of individuals based on their marital status or intention to marry a citizen or resident of another country. These policies are designed to manage and control the entry, residence, and rights of individuals who migrate for the purpose of marriage.

Marriage migration has been a significant aspect of global migration patterns, with individuals relocating to join their spouses or to marry someone from another country. For example, 15% of migration to European countries is due to marriage (OECD, 2017). As such, governments have developed various policies to regulate and address the implications of such migrations.

The specifics of marriage migration policies vary widely from one country to another and often depend on factors such as the country's immigration laws, cultural norms, economic considerations, and national security concerns. These policies may include requirements for documentation, financial support, language proficiency, medical examinations, and background checks. Additionally, some countries impose waiting periods or quotas on marriage-related immigration.

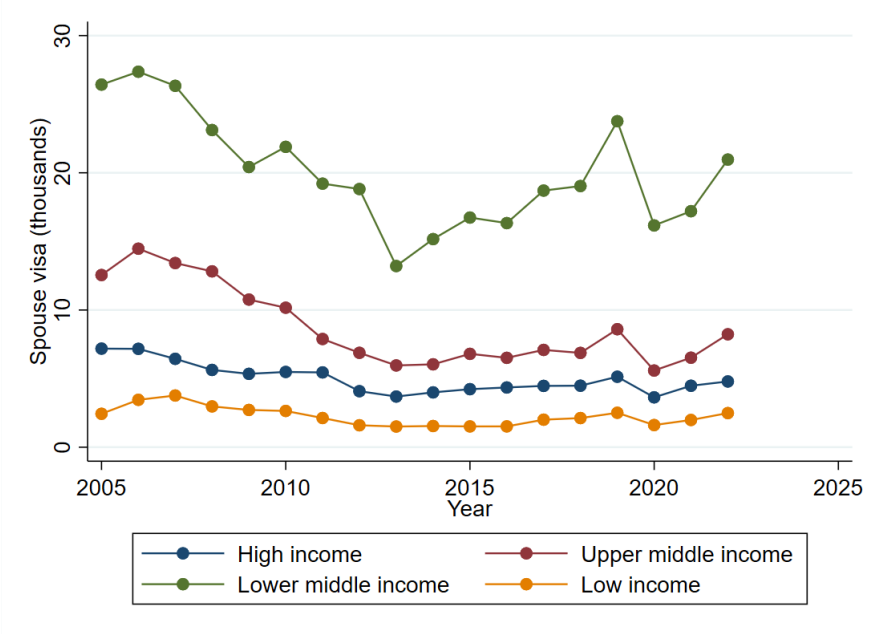
For example, in Denmark, to apply for a marriage visa, applicants must be at least 24 years old. Both partners, the applicant and the spouse or partner in Denmark, are subject to integration requirements, which consider factors such as education, work experience, and language skills. Both parties are required to declare their commitment to actively participating in efforts to learn Danish and integrate into Danish society as part of the visa application process. In the United States, a distinct policy approach is implemented in the form of a quota policy, as opposed to taxation. There exists a predefined numerical limitation for the immediate family of green card holders[4], with a maximum cap of 114,200 family preference visas that may be submitted annually.

In the past two decades, the United Kingdom has witnessed a notable surge in the implementation of stringent marriage migration policies. Dating back to the Primary Purpose Rule from 1983 to 1997, which required spousal immigration applicants to demonstrate that the primary motive behind the marriage was not solely for entry into Britain, the UK has continually tightened its regulations. Subsequent measures proposed in the 2010 Conservative Manifesto were implemented by the Home Office Family Migration Policy in 2011. This policy introduced various provisions such as extended probationary periods, elevated English proficiency standards, and the adoption of a Danish-style 'combined attachment' rule, necessitating couples to prove their stronger bond with the UK than any other country. Moreover, the UK government introduced a significant income threshold of £18,600 in 2012 for individuals wishing to sponsor a spouse from non-EU countries. This threshold was raised to £38,700 in 2024 and extended to include EU countries as well.

Figure 2.2 shows the time trend of number of spouse visas granted by income level of their countries of origin. Most marriage migrants arrive from middle-income countries, specifically lower-middle-income countries, such as Pakistan, India, and Bangladesh. People from these countries constitute the majority of non-EU immigrants in the UK. The tightening marriage migration policies had the largest impact on people from lower-middle-income countries.

[4]Spouses, minor children, and unmarried children aged 21 years and older

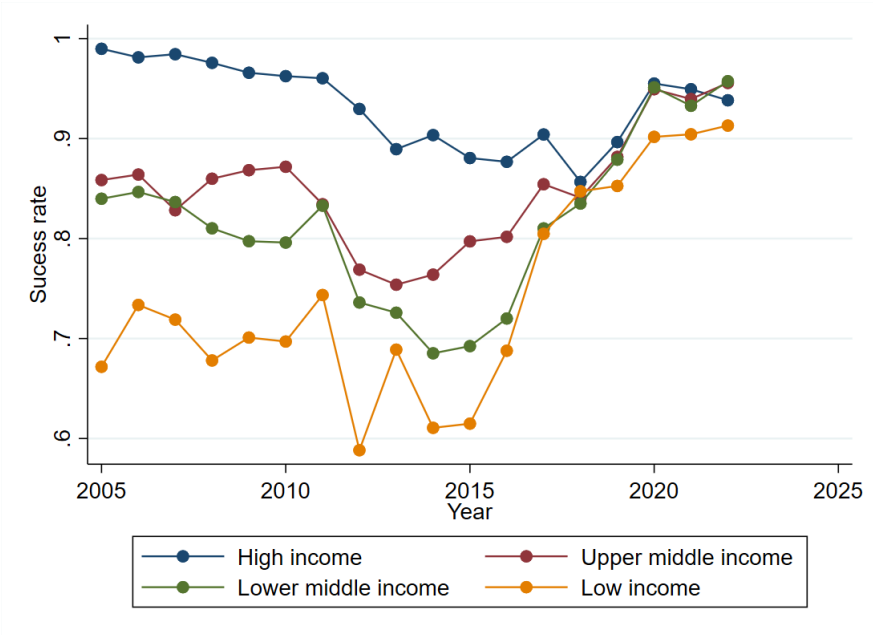
Figure 2.2: Trends in the Number of Spouse Visas Granted by Income Level of Country of Nationality



Source. Home Office immigration system statistics

However, they did not have any significant impact on people from two ends of the spectrum, low and high-income countries.

Figure 2.3: Trends in the success rate of spouse visa



Source. Home Office immigration system statistics

Before 2018, a significant disparity existed in the acceptance rates of spouse visas based on the income level of the applicant's country of origin, with acceptance rates for individuals from low-income countries falling below 70%. Since 2011, there has been a notable decline in acceptance rates coinciding with the tightening of spouse visa regulations. However, these rates eventually converged consistently, with no significant gap observed among countries. As depicted in Figure 2.3, since 2018, the rejection rate for spouse visas from countries across all income levels has remained below 10%.

2.3 Data

This study focuses on a data sample extracted from the 10% household-level sample of the 2011 Census for England and Wales.[5] The sample is limited to people of marriage age. To adjust for age gaps, it is restricted to women aged 23 to 53 and men aged 25 to 55 years. Also, to ensure that participants made their marital decision while living in the UK, it includes only those who were born in the UK or arrived in the UK before their 18th birthday. Cohabiting couples (Figure 2A.4) are considered single, while separated, divorced, and widowed individuals are excluded from the analysis.[6]

The Census for England and Wales includes an optional question regarding an individual's religion.[7] There is a potential concern regarding the use of self-reported religious affiliation in the study, as there may be attrition bias by which Muslims are less likely to report their religion. Approximately 7% of all individuals do not report their religion, but South Asians, who make up the majority of Muslims in the UK, have the lowest rate of non-reporting ($\sim 4\%$). Hence, it is improbable that attrition bias has a substantial impact on Muslims.

The reported religion does not necessarily represent the religion people practice and is sometimes an indicator of ethno-religious identity. A recent study by Humanists UK (2021) suggests that most people choose their reported religion based on their upbringing rather than their current religious practices. Furthermore, data from the Citizenship Survey (2010-11) indicate that 97.6% of people raised as Muslims report Islam as their religion, but only 76% of them practice their religion. Although the rate of practicing religion is higher for Muslims than Christians (Figure 2A.3), it is not significantly different from other religions, which cannot account for the large differences in intermarriage rates (62% for Buddhists,

[5]Source: Office for National Statistics licensed under the Open Government Licence v.1.0.

[6]In the robustness checks, results are estimated by including cohabiting couples in the married group.

[7]The question is phrased as follows: "What is your religion? (This question is voluntary)"

68% for Hindus, 62% for Sikhs and 43% for Jewish people).

One concern regarding religion and intermarriage is the potential endogeneity of religion in marriage. This issue is difficult to address with cross-sectional data, but Scotland's 2001 Census provides some insights. Among married Muslims in Scotland, 9.5% were married to a non-Muslim in 2001, but 16.7% of their non-Muslim spouses were raised Muslims. In contrast, among Muslims who married within their group, 5.3% had spouses who were not Muslims as children. It is not clear whether these individuals converted to Islam because of their marriage or married a Muslim because of their conversion to Islam. Therefore, to address this endogeneity issue, panel data on religion would be needed. Nonetheless, if England and Wales demonstrate comparable conversion rates to Islam as Scotland, and these rates have remained stable over the past decade, it is improbable that these rates alone can entirely elucidate the low inter-marriage rate observed among Muslims.

Table 2.1: Summary Statistics of the Sample

	Non-Muslim					
	White British		Other		Muslim	
	Male	Female	Male	Female	Male	Female
Age	39.1	36.9	37.3	35.0	35.2	32.4
College education (%)	34.4	36.8	46.8	51.7	38.5	36.9
UK-born (%)	98.4	98.3	73.7	74.0	54.2	62.0
Married (%)	52.1	53.1	41.5	37.7	64.6	66.5
Marriage						
Marriage migration (%)	0.0	0.0	22.8	19.5	49.6	51.5
Inter-religious marriage^{+} (%)	20.2	20.5	18.2	20.7	6.0	4.7
Inter-ethnic marriage^{++} (%)	1.9	1.3	19.3	19.9	12.4	12.0
Number of observations	666,377	646,837	57,328	60,178	20,181	20,498

Notes. $^{+}$Inter-religious marriage is measured based on the following religious groups: No religion, Christian, Buddhist, Hindu, Jewish, Muslim, Sikh, and others. $^{++}$Inter-ethnic marriage is measured based on the following ethnic groups: White, Black, Indian, Pakistani, Bangladeshi, Chinese, Other Asians, and Others. Mixed ethnicities are excluded. *Source.* Census for England and Wales, 2011

Table 3.2 presents summary statistics of the sample. Muslims in the UK are younger than the rest of the population (since Muslims migrated to the UK after the Second World

War and represent a more recent immigrant demographic compared to other groups). They have lower education than other minority groups and tend to marry younger compared to non-Muslims (90% of Muslims married at the age of 40 compared to 69% of non-Muslims).[8]

Marriage migration generally refers to a type of marriage in which the spouses are citizens of different countries. In this study, I define marriage migration as the union of a person born in the UK or someone who arrived in the UK before the age of 18 with someone who migrated to the UK after the age of 18.

One potential issue arising from this definition is the possible overestimation of marriage migration, given that it includes marriages where the immigrant partner was already residing in the UK before marriage. A comparison of this measure of marriage migration with estimates from the Labour Force Survey shows potential overestimation: approximately 4 percentage points (pp) and 14 pp for Muslim men and women, and 8 pp and 10 pp for Non-Muslim men and women, respectively. It is essential to note that some of the gender gap is due to men being less likely to report migrating for marriage, even if they did so. Additionally, even if the migrant spouse was residing in the UK before marriage, they still benefit from citizenship advantages and have the opportunity to attain settlement status. Hence, this definition holds relevance for policy considerations concerning long-term migration.

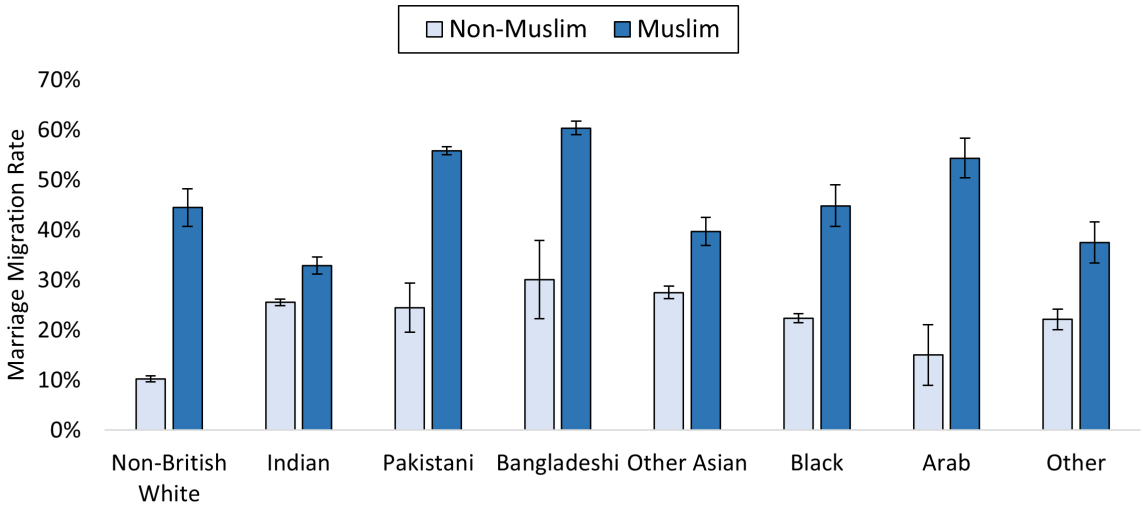
I exclusively focus on marriage migration that occurs within the same ethnic group for ethnic minorities.[9], given that the majority White British population within the UK lacks ties to other countries for importing spouses. The decision to limit marriage migration to intra-ethnic marriage is driven by the fact that roughly 93% of the estimated marriage migration takes place within the same ethnic group. Given that this study primarily focuses on marriages from one's country of origin, individuals are likely to share the same ethnic group.

Muslims have a significantly higher marriage migration rate, standing at approximately double the rate observed among non-Muslim ethnic minorities. This finding remains consistent even when controlling for ethnicity (Figure 2.4).

[8]Additionally, Muslim men marry spouses who are 4.5 years younger than themselves, while non-Muslim men marry spouses who are 2.4 years younger

[9]Ethnic minority $\equiv$ Not White British

Figure 2.4: Proportion Married to Migrants by Ethnicity and Religion



Notes. Each bar displays the percentage of married British individuals in the ethnic and religious group who entered a marriage migration. *Source.* Census for England and Wales, 2011

Research on marriage-related migration has primarily focused on migrant wives, with limited exploration of male marriage migration (Charsley and Liversage, 2015). However, the marriage migration rates for both Muslim men and women are not significantly different (Table 3.2). This pattern can be attributed to several factors that intersect:

1. Arranged Marriages: Arranged marriages mitigate the costs associated with marrying abroad, especially in cultural contexts where dating practices are less prevalent. This approach can provide a sense of security, given the availability of family connections and information about prospective spouses' families.

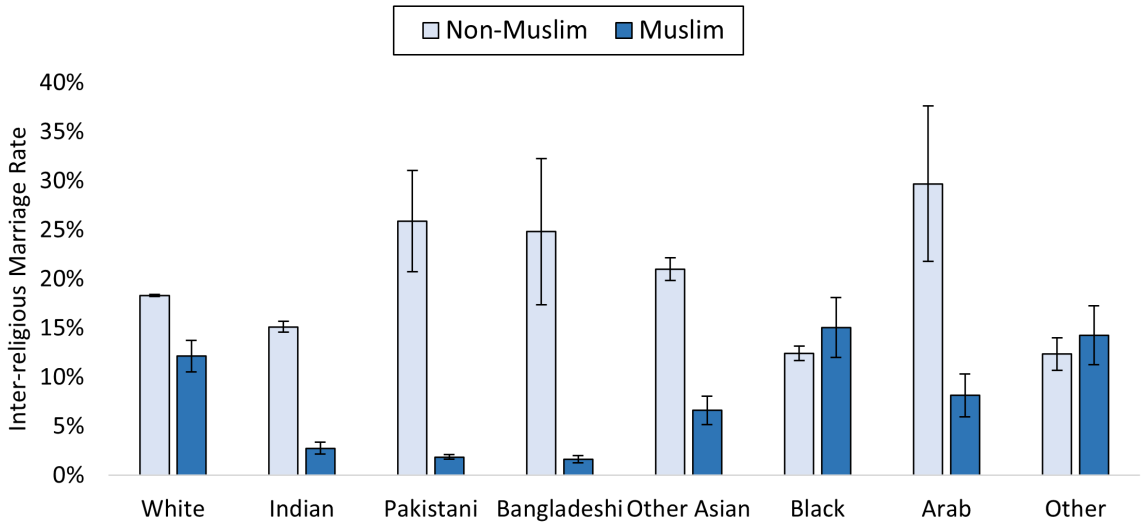
2. Preferences for Independence: Women can potentially benefit from a reduced influence of in-laws, a characteristic often observed within specific Muslim communities.

3. Availability: If a significant number of men or women in a minority group choose to marry from abroad, it reduces the pool of potential marriage prospects for the rest (who prefer to marry within their group). Consequently, individuals with endogamous preferences consider seeking potential spouses outside the country to avoid remaining single.

The marriage data presented in Table 3.2 suggest the presence of substantial endogamy preferences within the marriage market, characterized by a notable prevalence of marriages occurring within the same ethnic and religious groups. Muslims are less inclined to marry outside their religious group compared to non-Muslims. This finding remains consistent even

when controlling for ethnicity (Figure 2.5). The same results hold for inter-ethnic marriages (Figure 2A.2).

Figure 2.5: Proportion of Inter-religious Marriage by Ethnicity and Religion



Notes. Each bar displays the percentage of married British individuals in the religious and ethnic group who married someone with a different religion. *Source.* Census for England and Wales, 2011

Migration gains are primarily influenced by the disparity in income levels between the host and the home country.[10] A wider income gap corresponds to greater migration gains. This relationship is evident in Table 2.2, which outlines the proportion of individuals who opt to marry abroad based on their country of origin[11]. A lower income level in the country of origin corresponds to higher migration gains, resulting in an increased likelihood of individuals choosing to marry abroad. However, this figure does not reveal whether these patterns are due to supply or demand factors.

The majority of Muslims in the UK belong to the Pakistani, Bangladeshi, and Indian ethnic groups. For the remainder of this chapter, I combine the Pakistani and Bangladeshi populations due to the comparable share of the Muslim population, shared Islamic practices,

[10]There are additional factors influencing migration gains, including the social costs associated with being separated from family.

[11]The country of origin is determined from Understanding Society Survey (2010-11) as follows: it is the country of birth for individuals born outside the UK, the country of birth of the father for those born in the UK, and the country of birth of the grandfather in cases where both the father and the individual were born in the UK.

Table 2.2: Proportion Marrying Abroad by Income Level of the Country of Origin

Income level of ancestral country of origin	Marrying abroad (% of married)
Low income	49%
Lower middle income	41%
Upper middle income	27%
High income	12%

Notes. The sample is limited to people with a country of origin different from the UK. The country of origin is derived from the country of origin of the person, father or grandfather, whichever was born outside the UK. *Source.* Understanding Society, 2010-11, and World Bank Data, 2011

and similar income per capita in the past decades. This pooling is undertaken to enhance the statistical power of the study. Hence, the ethnic groups are: White British, Other White, Indian, Pakistani or Bangladeshi, and others.

The individuals who enter marriage migration are not random. People sort into marriage migration based on their characteristics. Table 2.3 compares the level of education of people who marry abroad with people who marry locally. Level of education is a binary variable that is equal to one if the individual has a college education and zero otherwise. Coefficients show that people who marry abroad, regardless of their religion or gender, have lower education than people who marry locally. This result holds even when controlling for the spouse's characteristics[12].

People who migrate for marriage are also not a random selection of people from their country. Focusing on India, Pakistan, and Bangladesh, a comparison of the educational background of marriage migrants with the educational distribution within their home countries reveals a significant pattern: Marriage migrants tend to have higher levels of education compared to the average educational attainment within their home countries. This disparity is particularly pronounced among women as compared to men.

[12]Table 2A.2 shows the full sorting table with all included controls.

Table 2.3: Sorting into Marrying Abroad

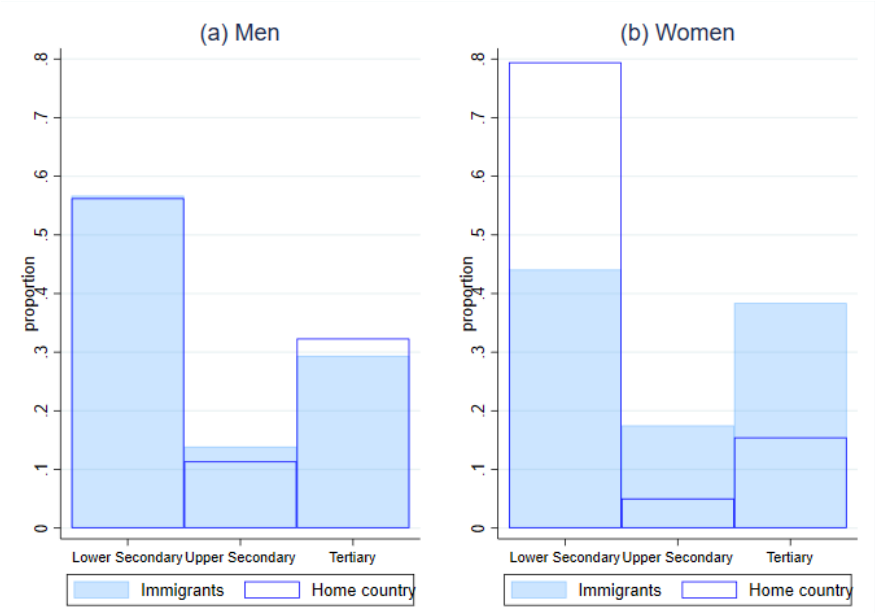
	Dependant variable: College education			
	Muslim		Non-Muslim	
	Male	Female	Male	Female
without controls				
Marriage migration	-0.097***	-0.137***	-0.052***	-0.114***
	(-11.4)	(-17.2)	(-6.3)	(-12.8)
Region & cohort FE	Y	Y	Y	Y
R^2	0.038	0.056	0.038	0.047
N	12,458	12,857	21,060	19,687
with controls				
Marriage migration	-0.090***	-0.121***	-0.052***	-0.083***
	(-10.3)	(-14.9)	(-6.0)	(-8.9)
Region & cohort FE	Y	Y	Y	Y
R^2	0.041	0.064	0.040	0.059
N	12,245	12,634	20,567	19,128

Notes. Table shows results of the linear regression of education level (dummy variable equal to one if individual has college education and zero otherwise) on marriage migration. All regressions control for ethnic group, region, and 10 year age cohort. Regressions with controls also control for age, spouse's religion and ethnicity. Sample is limited to ethnic minorities. t statistics in parentheses. *p<0.10, **p<0.05, ***p<0.001. *Source.* Census for England and Wales, 2011

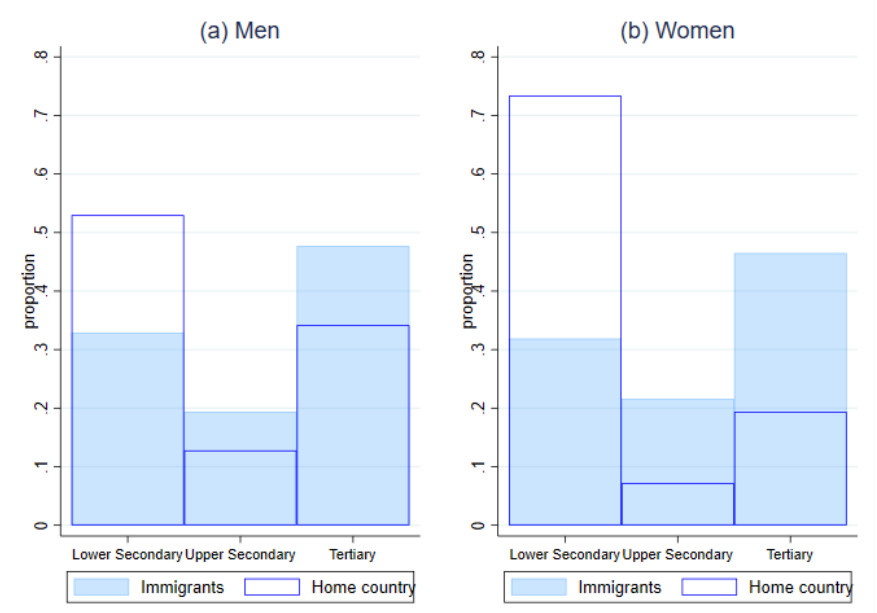
Less-educated individuals in the UK who marry a migrant tend to "marry up", selecting spouses with higher educational qualifications than those they could potentially match in local marriages. Table 2.4 provides a comparison of spouses' educational levels between individuals who engage in international marriages and those who marry locally. Those who marry a migrant demonstrate a 3 to 6% greater likelihood of marrying a spouse with a higher educational background. Notably, this pattern is more pronounced among non-Muslims. Conversely, highly educated individuals who opt for marriages from abroad tend to marry spouses with lower education in comparison to their counterparts with similar attributes who opt for local marriages. These findings remain even when controlling for other characteristics

Figure 2.6: Education Distribution of Marriage Migrants in the UK and country of origin

(a) Pakistani/Bangladeshi



(b) Indian



Notes. The figure compares the overall distribution of education of marriage migrants from India, Pakistan, and Bangladesh with their country of origin. *Source.* Census for England and Wales, 2011 & World Bank Data, 2011

of the spouses[13].

Table 2.4: Trade-offs in Marrying Abroad: Education

	Dependant variable: Spouse's college education			
	Muslim		Non-Muslim	
	Male	Female	Male	Female
without controls				
Marriage migration × High education	-0.095***	-0.057***	-0.036***	-0.044***
	(-7.1)	(-3.7)	(-3.4)	(-3.7)
Marriage migration × Low education	0.018	0.046***	0.062***	0.052***
	(1.8)	(4.6)	(5.9)	(4.5)
Region & cohort FE	Y	Y	Y	Y
R^2	0.135	0.118	0.171	0.158
N	12,450	12,847	21,042	19,668
with controls				
Marriage migration × High education	-0.080***	-0.046**	-0.037**	-0.042***
	(-5.9)	(-3.0)	(-3.3)	(-3.3)
Marriage migration × Low education	0.027**	0.048***	0.060***	0.054***
	(2.7)	(4.8)	(5.4)	(4.5)
Region & cohort FE	Y	Y	Y	Y
R^2	0.139	0.118	0.170	0.160
N	12,237	12,625	20,549	19,109

Notes. Table shows results of the linear regression of spouse's education on marriage migration interacted with own education, controlling for own education, ethnic group, region, and 10-year age cohort. Regressions with controls also control for spouse's religion, ethnicity, and age gap in the marriage. t statistics in parentheses. *p<0.10, **p<0.05, ***p<0.001. *Source.* Census for England and Wales, 2011

Furthermore, individuals who marry abroad tend to form couples characterized by a greater age gap compared to their counterparts in local marriages (Table 2.5)[14]. In marriage

[13]Table 2A.3 shows the full education trade-off table with all included controls.

[14]Table 2A.4 shows the full age trade-off table with all included controls.

migration for Muslims, it is observed that the husband is likely to be approximately 0.5 years older than the wife, relative to local marriages. For non-Muslims, the age gap varies notably based on whether the migrant partner is male or female. Specifically, when the migrant partner is the wife, the couple tends to exhibit an age gap approximately 1.5 years higher than that observed in local marriages. This finding aligns with insights from the psychology literature, suggesting that males generally prefer partners younger than themselves, while females prefer partners older than themselves (Buss, 1989; Kenrick and Keefe, 1992; Bech-Sørensen and Pollet, 2016).

Table 2.5: Trade-offs in Marrying Abroad: Age

	Dependant variable: Spouse's age			
	Muslim		Non-Muslim	
	Male	Female	Male	Female
without controls				
Marriage migration	-0.486***	0.579***	-1.679***	0.684***
	(-6.9)	(7.9)	(-26.1)	(9.6)
Region & cohort FE	Y	Y	Y	Y
R^2	0.72	0.688	0.724	0.729
N	12,458	12,857	21,060	19,687
with controls				
Marriage migration	-0.330***	0.488***	-1.594***	0.655***
	(-4.6)	(6.6)	(-23.3)	(8.8)
Region & cohort FE	Y	Y	Y	Y
R^2	0.724	0.691	0.726	0.732
N	12,237	12,625	20,549	19,109

Notes. Table shows results of the linear regression of spouse's age on marriage migration, controlling for age, ethnic group, region, and 10-year age cohort. Regressions with controls also control for spouse's religion, ethnicity, and education gap in the marriage. t statistics in parentheses. *p<0.10, **p<0.05, ***p<0.001. *Source.* Census for England and Wales, 2011

In sum, the empirical data highlights a pattern in which individuals residing in the UK leverage their nationality and the disparity in GDP between the two countries to secure a

"higher quality" spouse from their country of origin. However, identifying whether these observations are primarily a consequence of partner availability in the marriage market or driven by individual preferences is challenging. It is not feasible to control for these factors in a reduced-form study since marriage patterns arise from an equilibrium that results from the interplay of forces on both sides of the market. To disentangle the effects of market-level forces resulting from imbalances in the distribution of different groups and individual-level preferences, building a model is essential. The next section introduces the model.

2.4 Estimation

I employ a transferable utility model in which each individual is characterized by four observable attributes:

1. Age group, categorized in 10-year intervals: young (women aged 23-32 and men aged 25-33), middle-aged (women aged 33-42 and men aged 35-43), and old (women aged 43-52 and men aged 45-53).

2. Educational level, denoted by a binary variable indicating whether the individual possesses a college degree or higher. This factor is particularly significant in the marriage market, as Chiappori et al. (2017) has established its positive correlation with match payoff.

3. Ethnicity, represented by a categorical variable e with options including White British, Other White, Indian, Pakistani/Bangladeshi, or Other. White British are the majority of the people in the country and other groups are minority ethnic groups.

4. Religion, indicated by a binary variable whereby a value of one signifies the individual identifies as Muslim, and zero otherwise

Individuals belonging to minority groups (those not classified as White British) have the opportunity to access a marriage market beyond their country's borders, comprising individuals from their respective ethnic groups. Consequently, the characteristics of this outside market are ethnic group specific. As such, individuals from minority groups have three potential options in the marriage market: (1) local marriage, (2) marriage abroad, or (3) remaining single. These options are limited to local marriage and remaining single for the majority group (White British).[15]

[15]In data, less than 0.5% of White British people enter marriage migration.

Consistent with the framework established in Chapter 1, marriage migration is presumed to occur only in one direction: from outside to inside the country. Given the primary focus of this study on the importation of spouses, particularly from lower-income countries, it is reasonable to infer that individuals relocate to a higher-income country following marriage.

The deterministic component of the marriage surplus is assumed to be linear in parameters, taking the following form:

$$\Phi_{xy}^{\boldsymbol{\beta}} = \boldsymbol{\beta}\phi_{xy} = \beta_0 + \beta_1 a_x \# a_y \# r_x \# r_y + \beta_2 r_x \# r_y \# e_x \# e_y + \beta_3 s_x \# s_y \# r_x \# r_y$$

Where $x = \{a_x, s_x, e_x, r_x\}$, $y = \{a_y, s_y, e_y, r_y\}$, $\boldsymbol{\beta} = \{\beta_0, \beta_1, \beta_2, \beta_3\}$ and $\#$ represents full interactions between variables. Thus, the surplus function comprises baseline effects for each characteristic, interactions between the values of each trait between spouses, and interactions between age and religion, ethnicity and religion, and religion and education. These interactions are incorporated because religiosity can vary by education level and age cohort, and individuals from different ethnic groups may exhibit distinct religious practices, leading to variations in the effect of religion across ethnic groups.

The following equations from the model enable us to separately identify endogamy preferences and migration gains:

$$\Phi_{xy}^{\boldsymbol{\beta}} = \boldsymbol{\beta}\phi_{xy} = 2\ln\left[\frac{\mu_{xy}^{\text{in}}}{\sqrt{\mu_{x0}^{\text{in}}\mu_{0y}^{\text{in}}}}\right] \tag{2.4.1}$$

$$B_{y\to x} = b_{y\to x} + \ln[\mu_{0y}^{\text{out}}] = 2\ln\left[\frac{\mu_{y\to x}^{\text{mm}}}{\mu_{xy}^{\text{in}}}\right] + \ln[\mu_{0y}^{\text{in}}] \tag{2.4.2}$$

$$B_{x\to y} = b_{x\to y} + \ln[\mu_{x0}^{\text{out}}] = 2\ln\left[\frac{\mu_{x\to y}^{\text{mm}}}{\mu_{xy}^{\text{in}}}\right] + \ln[\mu_{x0}^{\text{in}}] \tag{2.4.3}$$

To estimate $\boldsymbol{\beta}$, I run a linear regression of $2\ln\left[\hat{\mu}_{xy}^{\text{in}}/\sqrt{\hat{\mu}_{x0}^{\text{in}}\hat{\mu}_{0y}^{\text{in}}}\right]$ on ϕ_{xy}. This approach is derived from minimum distance estimation when the error terms follow an extreme value type I distribution, as discussed in Chapter 1. Migration gains, $B_{y\to x}$ and $B_{x\to y}$, are directly estimated from Equations (2.4.2) and (2.4.3).

To separately identify the effects of preference parameters and migration gains, I conduct counterfactual analyses and calculate the matching equilibrium under different scenarios using the IPFP method. This allows me to isolate the impact of changes in each factor on marriage migration and intermarriage.

2.5 Results

This section starts with a review of the estimated preferences using the earlier described methodology. I compare the estimates among various religious groups and their evolution over time. Subsequently, I break down the observed marriage migration rate into its primary determinants: endogamy preferences and migration gains. The final subsection explores the distinctions between Muslims and other religious minorities.

2.5.1 Preferences

The estimated parameters ($\boldsymbol{\beta}$) of the joint marriage surplus show how various attributes increase the systematic component of the marriage payoff. That is, they show the significance of these attributes relative to idiosyncratic taste shocks, which encompass the effects of all unobservable variables, including love. Consequently, we can interpret the coefficients of the utility function as the marginal rate of substitution between an observable attribute in the marriage market and love. A higher coefficient implies that an individual demands a higher level of love to offset any compromise regarding that specific attribute of their partner.

Based on the estimated $\boldsymbol{\beta}$, I can quantify the value people place on endogamy. The surplus generated by an endogamous match between types z and z' versus an exogamous match can be measured using the following double differences:

$$\mathcal{D}_{zz'} = \Phi(x = z, y = z) + \Phi(x = z', y = z') - \Phi(x = z, y = z') - \Phi(x = z', y = z)$$

For instance, consider the case where z represents Muslims and z' represents non-Muslims. In this context, $D_{zz'}$ quantifies the surplus arising from Muslim-Muslim and non-Muslim-non-Muslim marriages in comparison to inter-religious marriages. It is important to note that it is not feasible to identify preferences separately for men and women. The observed probability of intermarriage is a result of the interaction between both partners, as they both need to agree on the match.

In Table 2.6, the analysis on age-based endogamy shows that Muslims have a stronger aversion to significant age gaps compared to non-Muslims. Comparison of endogamy based on other characteristics indicates that, on average, individuals prioritize matching by religion, followed by ethnicity, and then education. The surplus linked to ethnic endogamy is noticeably higher for non-Muslims compared to Muslims, suggesting a lower resistance to mixing based on ethnicity among Muslims. Additionally, aversion to mixing between White British and Other White individuals is the lowest, reflecting their higher ethnic similarity.

Table 2.6: Endogamy Preferences

	$\mathcal{D}_{zz'} = \Phi_{zz} + \Phi_{z'z'} - \Phi_{zz'} - \Phi_{z'z}$	
Groups (z & z')	Non-Muslim	Muslim
Age		
Young & Middle-aged	6.50	7.93
	(0.47)	(0.47)
Young & Old	9.89	9.73
	(0.47)	(0.47)
Middle-aged & Old	5.59	7.49
	(0.47)	(0.47)
Education		
Low & High	4.04	3.40
	(0.21)	(0.21)
Ethnicity		
Other White & White British	5.85	4.18
	(1.31)	(1.31)
Indian & White British	14.93	13.41
	(1.31)	(1.31)
Pak/Bng & White British	14.05	7.67
	(1.31)	(1.31)
Other & White British	10.11	2.82
	(1.31)	(1.31)
Religion		
Muslim & Non-Muslim	22.67	22.67
	(1.15)	(1.15)

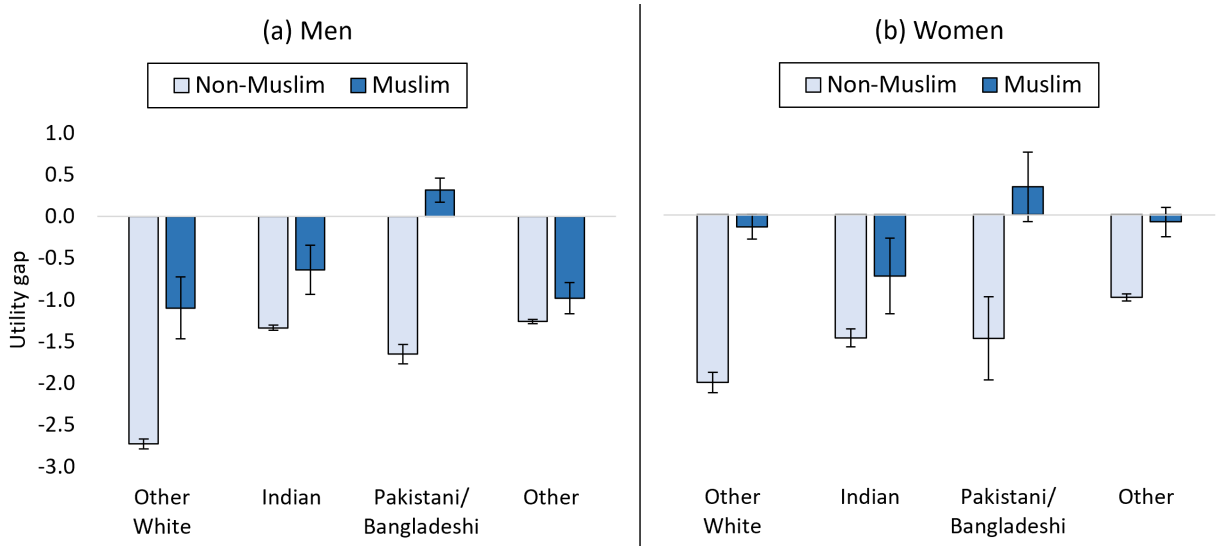
Notes. The table shows the estimated surplus generated from endogamous rather than exogamous marriage for different groups. Standard errors in parenthesis.

Table 2A.5 offers a comparative analysis between the model predictions and the observed matching outcomes, using the estimated parameters to assess the model's capacity to align with the observed matching equilibrium accurately. The parameters effectively capture all the main patterns discernible in the data.

The main contribution of the model presented in Chapter 1 is the incorporation of marriage migration. Neglecting this aspect introduces a bias in the estimation of marriage preferences among ethnic minorities. Table 2A.6 shows estimated preferences from a classical matching model without marriage migration. The estimated preferences exhibit a significant overestimation of utility derived from ethnic endogamy. This overestimation arises from the failure to consider that ethnic minorities have access to a cheaper external marriage market that

explains part of their intra-ethnic marriages.

Figure 2.7: Utility Gap Between Marrying Abroad and Locally by Religion and Ethnicity



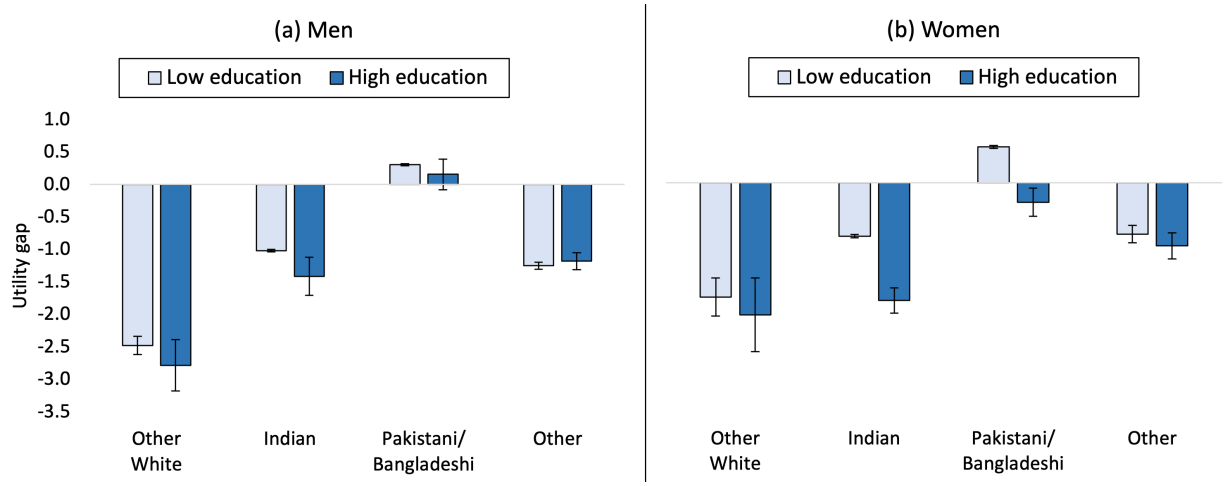
Notes. The figure illustrates the difference in utility of marrying from abroad and marrying locally while holding all other characteristics constant. Error bars show 95% confidence intervals.

Utility gaps – the difference between the utility of marrying abroad and marrying locally controlling for the effect of observed characteristics – are estimated using equations (1.2.13) and (1.2.14). They are presented in Figure 2.7. Muslims have a lower utility gap in comparison to non-Muslims. Specifically, for Pakistani and Bangladeshi Muslims, their first choice is to find a spouse from their country of origin rather than in the UK. Additionally, on average, women gain more from importing a spouse.

Since the 'Other' group combines multiple ethnicities, the disparity between Muslims and non-Muslims within the Other category is primarily driven by the distinction between individuals from Muslim-majority countries and those from non-Muslim-majority countries. Women from Muslim-majority countries find it significantly more beneficial than men to import spouses.

Some variations in utility gaps among ethnicities can be attributed to differences in their educational distributions. Individuals with lower levels of education gain more from marrying abroad, as depicted in Figure 2.8, due to their ability to find higher educated spouses abroad (as discussed in Section 2.3). Since Muslim Indians have higher education relative to Muslim Pakistani/Bangladeshis – 40% versus 35% college education – they marry abroad less.

Figure 2.8: Utility Gap Between Marrying Abroad and Locally by Education Level and Ethnicity



Notes. The figure illustrates the difference in utility of marrying from abroad and marrying locally while holding all other characteristics constant. High education is defined as a college education or more, while low education is defined as less than a college education. Error bars show 95% confidence intervals.

Temporal Comparison

In this subsection, I explore how preferences for endogamy vary between different cohorts and periods.

First, using data from the 2011 Census, I estimate coefficients by age cohort. This is done by introducing interactions between endogamy preferences and age. The results, as presented in Table 2.7, show a negative relationship between ethnic and religious endogamy and age; that is, younger people have stronger religious and endogamy preferences than older people. This could be attributed to either stronger preferences among young individuals or the selection of young individuals with stronger endogamy preferences to earlier marriages (Since in the model, I ignore heterogeneity in religious preferences within religious groups and only estimate the average effect).

The comparison over time is conducted by comparing the estimates obtained from Census 2011 and Census 2001. Since the 2001 Census lacks information about the year of migration, an adjustment is made to the definition of marriage migration to facilitate this comparison. Marriage migration is redefined as marriages between ethnic minorities who were born in the UK and those born outside the country. Table 2.8 displays the findings. Gains from religious endogamy in 2001 are smaller than in 2011, suggesting a rise in preferences for religious endogamy over time. This is consistent with the stronger observed endogamy preferences

Table 2.7: Endogamy Preferences by Age Cohort

	$\mathcal{D}_{zz'} = \Phi_{zz} + \Phi_{z'z'} - \Phi_{zz'} - \Phi_{z'z}$					
	Muslim			Non-Muslim		
Groups (z & z')	Young	Middle-aged	Old	Young	Middle-aged	Old
Education						
Low & High	5.74	5.93	5.30	5.10	1.94	4.66
	(0.59)	(0.59)	(0.59)	(0.59)	(0.59)	(0.59)
Ethnicity						
Other White & White British	8.03	7.04	7.26	6.35	5.37	5.59
	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)
Indian & White British	18.20	18.50	18.36	16.68	16.97	16.84
	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)
Pak/Bng & White British	17.48	14.07	15.68	11.10	7.70	9.30
	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)
Other & White British	13.07	13.78	12.47	5.78	6.49	5.18
	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)
Religion						
Muslim & Non-Muslim	24.46	23.62	22.45	24.46	23.62	22.45
	(1.43)	(1.43)	(1.43)	(1.43)	(1.43)	(1.43)

Notes. The table shows the estimated surplus generated from marrying within a group rather than mixing by age cohort. [1]Young: women aged 23-32 and men aged 25-33. [2]Middle-aged: women aged 33-42 and men aged 35-43. [3]Old: women aged 43-52 and men aged 45-53. Standard errors in parenthesis.

among the younger demographic. Another observation is the decreasing importance of having a partner with a similar educational background as time progresses. The increase in religious endogamy preferences over cohorts and time can be attributed to the rise in Islamophobia and recent terrorist attacks, leading to a backlash against Muslims in various Western countries (Gould and Klor, 2016; Allen, 2016).

2.5.2 Determinants of Marriage Migration

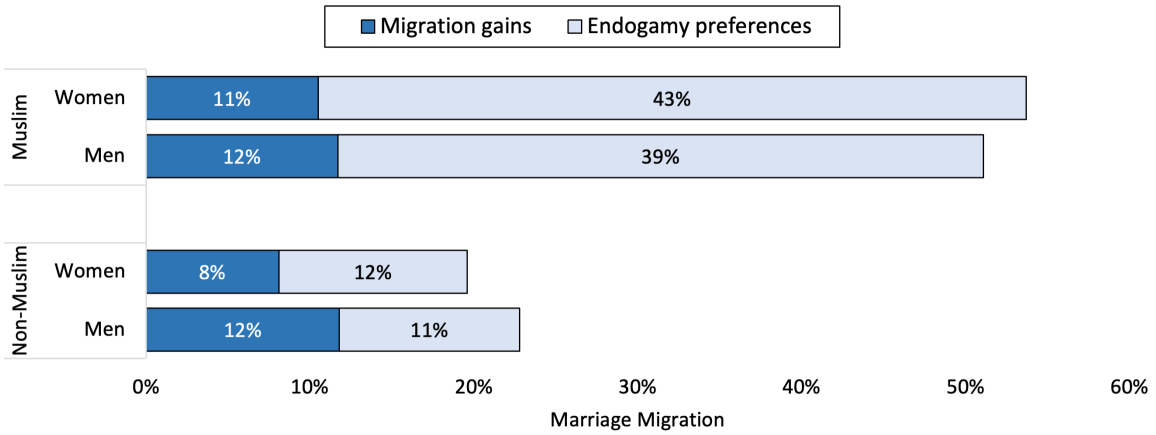
To separate the effect of endogamy preferences from migration gains, I compute marriage migration equilibrium assuming no preferences for the same ethnicity and religion. In this case, any instances of marriage migration are attributed to migration gains, with no influence from endogamy preferences. The difference between this rate and the observed marriage migration rate accounts for the effect of endogamy preferences.

Table 2.8: Endogamy Preferences by Year

	$\mathcal{D}_{zz'} = \Phi_{zz} + \Phi_{z'z'} - \Phi_{zz'} - \Phi_{z'z}$			
	2011		2001	
Groups (z & z')	Muslim	Non-Muslim	Muslim	Non-Muslim
Education				
Low & High	3.21	2.12	4.09	2.81
	(0.14)	(0.15)	(0.21)	(0.21)
Religion				
Muslim & Non-Muslim	22.31	22.31	20.9	20.9
	(0.76)	(0.76)	(1.19)	(1.19)

Notes. The table shows the estimated surplus generated from endogamy rather than mixing by year. For estimation, marriage migration is redefined as marriage between an individual born in the UK and an individual born outside the UK. Coefficients for ethnic endogamy preferences are not reported due to the low number of observations. Standard errors in parenthesis.

Figure 2.9: Determinants of Marriage Migration



Notes. Each bar shows the contribution of migration gains and endogamy preferences to the overall observed marriage migration rate. The sample is limited to ethnic minorities (not White British).

Figure 2.9 illustrate the contributions of migration gains and endogamy preferences to marriage migration of ethnic minorities. While only about 20% of Muslim marriage migration can be attributed to migration gains, this factor explains approximately half of the marriage migration rate among non-Muslims. The endogamy preferences are higher for women relative to men. If endogamy preferences were absent, marriage migration rates for both Muslims and non-Muslims would decline to about 11%.

Table 2A.8 provides extended results of the counterfactual analysis. In the absence of endogamy preferences, the utility gap for Muslims increases to a level similar to that observed for non-Muslims. Approximately 86% of Muslims would opt for interreligious marriages, and the rate of interethnic marriages among ethnic minorities would surge to a range between 80% to 90%. Thus, these findings suggest that the primary determinant behind the low incidence of intermarriages and the high rate of marriage migration among Muslims is attributed to their preference for endogamy rather than the gains derived from migration.

The definition of marriage migration provided in this chapter may potentially overestimate the marriage migration rate. This is because some immigrant individuals who married a British partner in the UK may have already had residency in the UK before the marriage. Consequently, these individuals gain fewer or no migration benefits compared to those who come to the UK solely for marriage. As a result, the migration gains estimated in the results section should be interpreted as an upper bound.

2.5.3 Comparison with Other Religious Groups

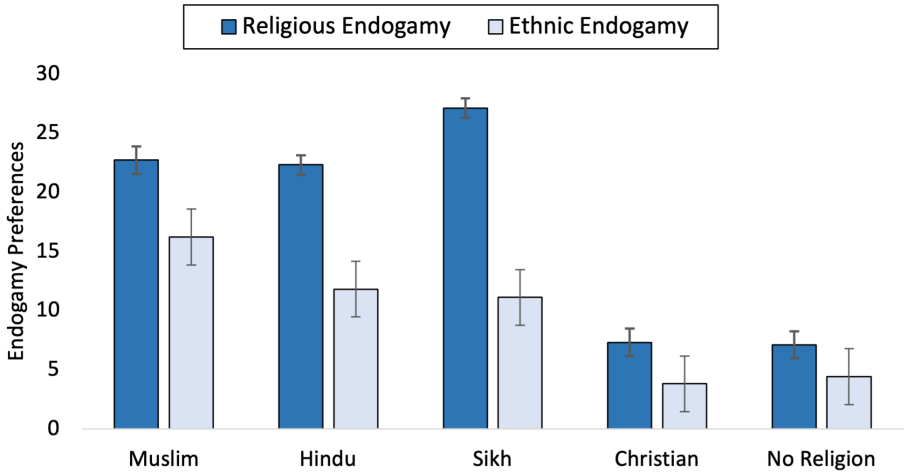
In order to compare the results for Muslims with other religious groups, I estimate the same model but change the religion variable accordingly for each religious groups: Christians, Hindus, Sikhs, and no religion[16]. In the UK, Hindus and Sikhs represent the two largest religious minority groups after the Muslim community.

The estimated preferences by religious group are presented in Figure 2.10 (Table 2A.7 represents regression results in detail). Religious majorities, including Christians and individuals with no religious affiliation, gain the lowest from marrying within their religion. On the contrary, gains from marrying within religion are significantly higher for religious minorities (Muslims, Hindus, and Sikhs).

The gap between the gains from marrying within ethnicity for minorities and non-minorities is smaller, but a similar pattern is observed: religious minorities gain more from ethnic endogamy. This is not surprising since religious minorities mainly belong to non-White groups, while most Christians and those with no religion are White, sharing more similarities with White British. Muslims have slightly higher gains from intra-ethnic marriages, but for Hindus and Sikhs, who mainly belong to the Indian ethnic group, these preferences are similar.

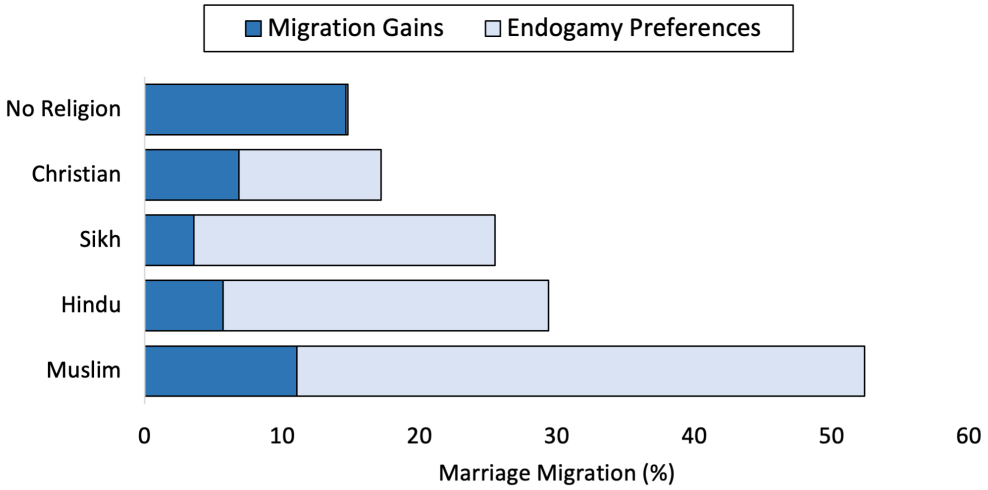
[16] Adding multiple religious categories to the model at the same time decreases estimation power significantly; therefore, I only focus on one religious group at a time.

Figure 2.10: Endogamy Preferences by Religion



Notes. Each bar shows estimated ethnic or religious endogamy preferences for the respective religious group.

Figure 2.11: Endogamy Preferences and Migration Gains by Religion

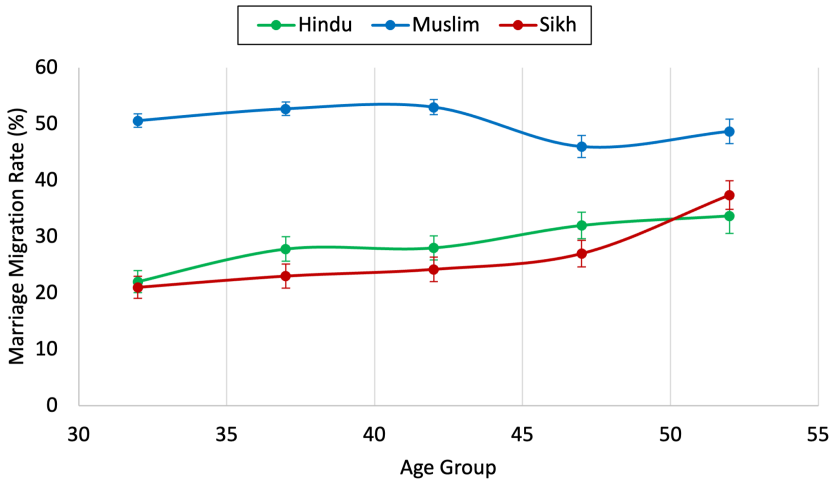


Notes. Each bar shows the contribution of migration gains and endogamy preference to the overall observed marriage migration rate. The sample is limited to ethnic minorities (not White British).

The contribution of migration gains to overall marriage migration varies significantly among different religious groups (Figure 2.11). For religious individuals, migration gains can only explain a small proportion of their marriage migration; however, for people who belong to no religious group, migration gains are the sole reason for marriage migration.

Two factors contribute to migration gains: (1) higher migration utility and (2) availability of individuals in the outside market. For individuals from the same ethnic background (which can mean the same country of origin), part of the utility gain of migration, dependent on the income gap between countries, remains the same. The availability of potential partners from one's country of origin is not solely determined by the entire population of that country but depends on various factors, with a key one being the strength of an individual's connection to their country of origin. Muslims, who are relatively recent immigrants to the UK, have consistently chosen to marry individuals from their home countries. This enduring practice strengthens their connections with their country of origin over generations. In essence, it creates a "first generation within every generation," as mentioned by Goodhart (2013). This aligns with the trend in marriage migration rates over time. Marriage migration among Muslims has remained consistent across various age cohorts, while for Hindus and Sikhs, it decreases in younger generations (Figure 2.12).

Figure 2.12: Marriage Migration Across Age Cohorts for Religious Minorities in the UK



Source. Census for England and Wales, 2011.

2.6 Counterfactual Analysis

This section entails an examination of (1) the implications of policies that increase the cost of marriage migration on the equilibrium of the marriage market within the UK, and (2) the implications of an increase in the Muslim population. Since the available data is limited to the UK, I assume that the number of individuals residing outside the country, compared to those who migrate for marriage, is substantial. Thus, any alterations in the rate of marriage

migration are presumed to have a negligible impact on the distribution outside the country.[17]

2.6.1 Effect of Marriage Migration Tax

Governments are using integration concerns as a basis for implementing stricter rules for people seeking to migrate to their country for marriage (Bonjour and Kraler, 2015). Section 2.2 provided examples of these policies. In this section, I estimate the equilibrium matching in the counterfactual case where the government has introduced a marriage migration tax. Migration tax directly declines the migration utility and leaves endogamy preferences unchanged (at least in the short run). In the model, it has the following effects on Equations (1.2.19) and (1.2.20):

$$\mu^{\mathrm{m}}_{y\to x} = \exp\left[\frac{\Phi^{\boldsymbol{\beta}}_{xy}}{2}\right]\tilde{A}_{y\to x}\sqrt{\mu^{\mathrm{in}}_{x0}},\ \text{where } \tilde{A}_{y\to x} = \exp\left[\frac{b_{y\to x}-T}{2}\right]\sqrt{\mu^{\mathrm{out}}_{0y}} = \exp\left[\frac{-T}{2}\right]A_{y\to x}$$

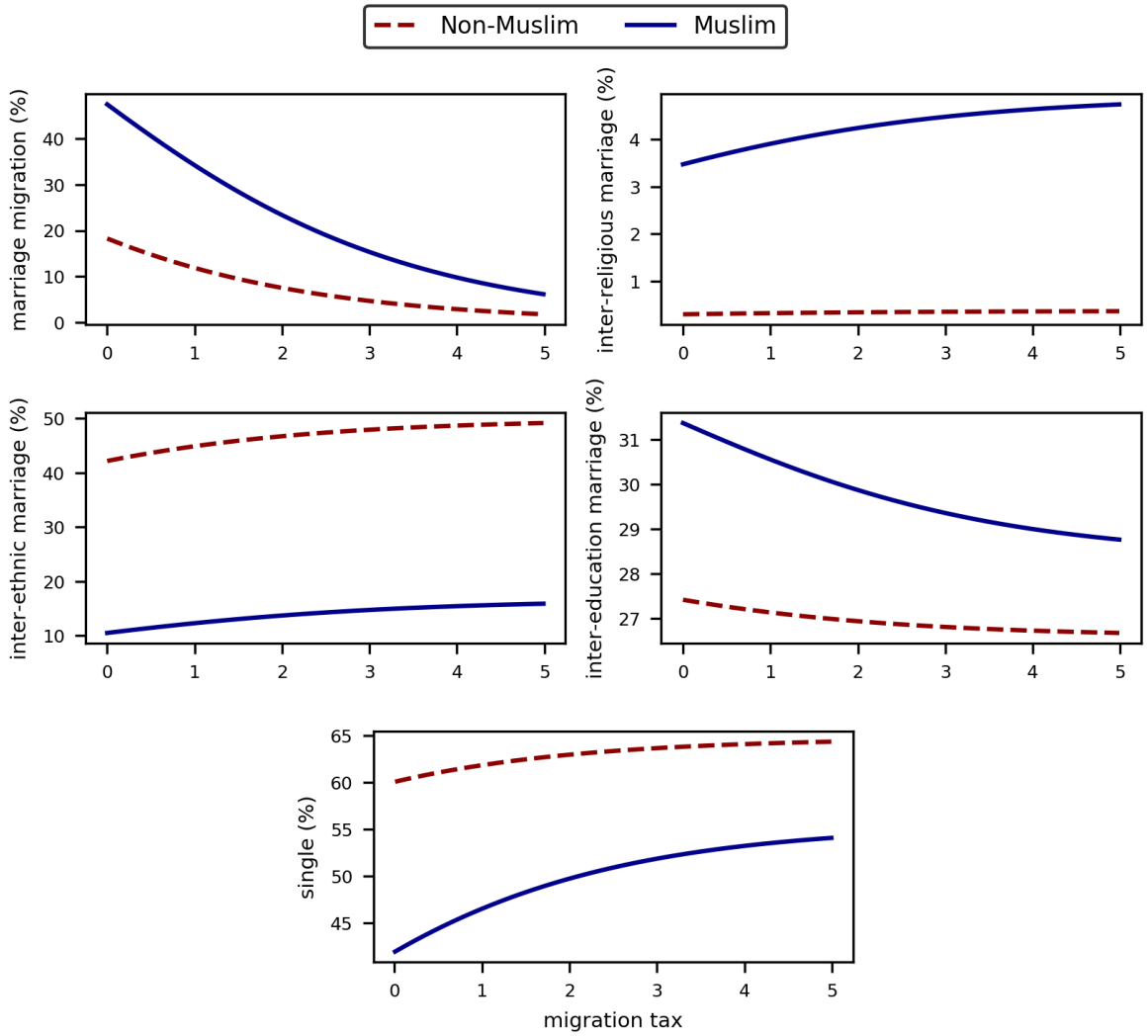
$$\mu^{\mathrm{m}}_{x\to y} = \exp\left[\frac{\Phi^{\boldsymbol{\beta}}_{xy}}{2}\right]\tilde{A}_{x\to y}\sqrt{\mu^{\mathrm{in}}_{0y}},\ \text{where } A_{x\to y} \equiv \exp\left[\frac{b_{x\to y}-T}{2}\right]\sqrt{\mu^{\mathrm{out}}_{x0}} = \exp\left[\frac{-T}{2}\right]A_{x\to y}$$

Where T represents a lump-sum tax, implemented by reducing the marriage surplus for all marriages involving a migrant partner. Since it is in the same unit as surplus, it does not have a monetary equivalent. It is worth noting that the decrease in migration benefits, or, to put it differently, the increase in migration costs, has consequences similar to a reduction in the number of available partners in the outside market.

To measure the impact, a counterfactual matching equilibrium is calculated for different levels of the migration tax, as depicted in Figure 2.13. When the opportunity to marry individuals from their country of origin becomes costly, there is a significant reduction in the degree of education-based mixing in the UK marriage market. This outcome can be linked to individuals with lower education levels previously having the chance to marry partners with higher educational qualifications from their country of origin, essentially trading a British passport for a more educated spouse. However, as migration costs increase, their options are limited to a smaller and costlier pool of potential partners, subsequently decreasing their chances of marrying someone with higher education. Unlike education, ethnic minorities tend to engage more in mixing based on ethnicity and religion. Among Muslims, the rise in the inter-ethnic marriage rate is notably higher than among non-Muslims, primarily because Muslims place less value on ethnic endogamy.

[17]The out-migration from Pakistan and Bangladesh, which exhibit the highest rate of marriage migration in the data, is less than 100,000 per year. This number is negligible when considering their large populations.

Figure 2.13: Effect of Migration Tax on Marriage Migration Equilibrium



Notes. Figures show the effect of an increase in immigration cost on marriage market equilibrium. The horizontal axis is a lump-sum migration tax.

The interreligious marriage rate among Muslims undergoes an increase of about 30% from the current low level, resulting in a final rate of 5%. This remains significantly lower than the rate of interreligious marriage in cases of random matching on religion (94%). Therefore, given the strong inclination toward intragroup marriages driven by endogamy preferences, the expected impact on the integration of Muslims within the marriage market is modest. Instead, as finding a spouse with the same ethnicity and religion became more expensive, a significant number of Muslims may opt to remain single.

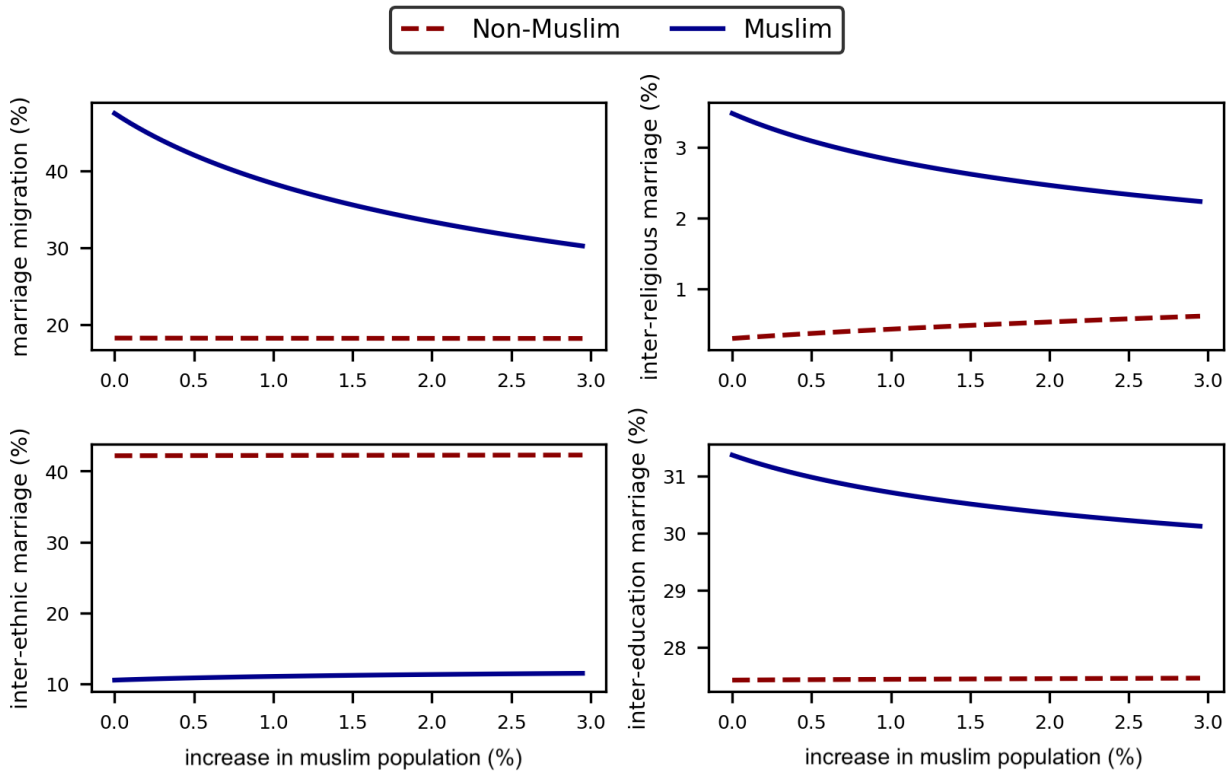
In my analysis of the effect of the migration tax, I made the assumption that preferences and endogamy preferences would remain constant. However, it is crucial to consider that

the migration tax could potentially influence individuals' preferences and weaken their ties to their country of origin over time. This could lead to a faster decline in the marriage migration rate than what is currently measured.

2.6.2 Effect of Increase in Muslim Population

The Muslim population in the UK has experienced a significant increase over the past decade, rising by 44% from 2011 to 2021.[18] This phenomenon can be attributed to the relatively young median age of the Muslim population, their higher fertility rates compared to other religious groups, and immigration from countries with Muslim majorities.[19] However, for the purposes of this study, the focus is primarily on self-identification. This demographic shift raises questions about the future of the Muslim marriage market in the UK.

Figure 2.14: Effect of Increase in Muslim Population on Marriage Migration Equilibrium



Notes. Figures show the effect of an increase in the Muslim population on marriage market equilibrium. The horizontal axis is the percent increase in the Muslim population from the current level.

[18] Based on census figures published by the Office for National Statistics.

[19] It is worth noting that part of this increase might be due to greater comfort among individuals in identifying themselves as Muslim.

To assess this effect, I conduct a counterfactual analysis where I hold preferences and migration gains constant while varying only the proportion of Muslims in the UK population. It is important to emphasize that this analysis assumes that as the number of Muslims in the population increases, their characteristics distribution and preferences remain unchanged. The outcomes of these analyses are shown in Figure 2.14.

If the Muslim population were to double from its 2011 level, several changes would occur in the marriage migration dynamics among Muslims. Firstly, their marriage migration would decline by 20%. The inter-religious marriages would decrease due to the increased availability of potential partners from the same religion among Muslims. Inter-educational marriages would also decrease, as individuals would have fewer reasons to compromise on educational qualifications to marry within their religion. However, there would be no significant change in the inter-ethnic marriage rate.

2.7 Robustness Checks

In this section, I present the results of the model using alternative methods for constructing the sample.

2.7.1 Cohabitation

For the main analysis, I categorized cohabiting individuals as single. However, cohabiting individuals form a substantial proportion of couples, particularly among younger non-Muslims (Figure 2A.4). In this section, I assume that individuals have the option to either marry or cohabit with someone within the country or marry someone from abroad. Given that presenting a marriage certificate is necessary for importing a partner, it is reasonable to disregard cohabitation in the case of marriage migration.

Comparing the results with those obtained from the original sample (Table 2.9), I find that preferences for endogamy remain robust. Due to the higher prevalence of mixing on religion among cohabiting couples, estimated religious endogamy preferences are 4% lower, but not significantly different from the previous results. Moreover, the overall marriage migration rate decreases by approximately 2 percentage points because the category of local couples includes cohabiting couples, thereby increasing their size. Despite these changes, the shares of endogamy and migration gains in the overall marriage migration rate remain consistent.

Table 2.9: Comparison of Results with and without Cohabitation

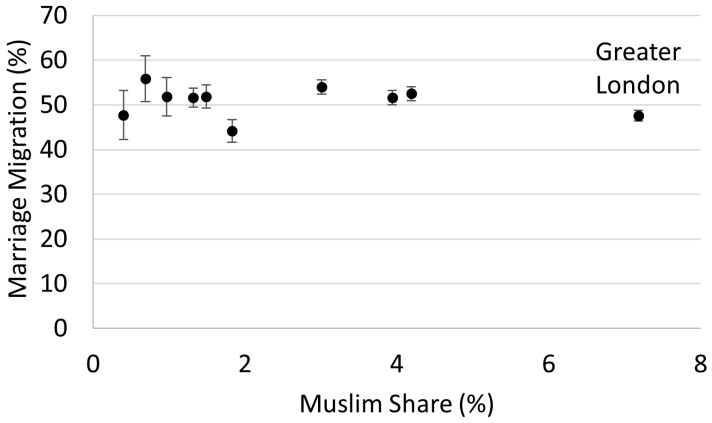
	With Cohabitation^{+}		Without Cohabitation^{++}	
	Non-Muslim	Muslim	Non-Muslim	Muslim
Endogamy preferences				
Ethnicity	10.2	7.3	10.4	7.4
Religion	21.9	21.9	22.7	22.7
Marriage migration (%)				
Overall	19.6	51.3	21.7	53.0
Migration gains	9.8	11.3	10.0	11.2
Endogamy preferences	9.8	40.1	11.8	41.8

Notes. The table shows the comparison of the results for the sample with and without cohabitation. $^{+}$ Cohabiting couples are included in the married groups. $^{++}$ Cohabiting individuals are considered single (original sample).

2.7.2 Geography

The main analysis assumes that everyone has access to all people in the UK, or equivalently, a representative distribution of the population, ignoring the geographical heterogeneities. Muslims in the UK are not evenly distributed; some areas have higher Muslim populations than others (Figure 2A.5). However, these heterogeneities do not pose an issue for studying marriage migration, as the share of the Muslim population does not predict marriage migration rates (Figure 2.15).

Figure 2.15: Regional Share of Muslims and their Marriage Migration



To address concerns about geographical distribution heterogeneities, I conduct a robustness check by focusing on regions with larger Muslim populations that are in close proximity. Specifically, the analysis concentrates on the East Midlands, West Midlands, East of England, Greater London, and South East of England regions. The overall estimates do not show significant differences when compared to the original sample. This suggests that the results remain robust, even when accounting for variations by geographical region (Table 2.10).

Table 2.10: Comparison of Results with and without Limitation on Geography

	Limited Geography^{+}		England & Wales^{++}	
	Non-Muslim	Muslim	Non-Muslim	Muslim
Endogamy preferences				
Ethnicity	10.5	7.4	10.4	7.4
Religion	23.1	23.1	22.7	22.7
Marriage migration (%)				
Overall	22.7	52.0	21.7	53.0
Migration gains	10.7	11.4	10.0	11.2
Endogamy preferences	12.0	40.6	11.8	41.8

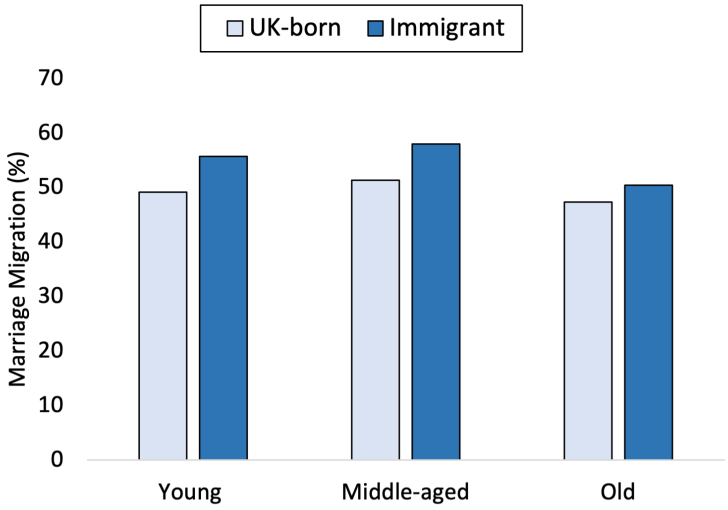
Notes. The table shows the comparison of the results for the model with and without limited geography. $^{+}$ Sample limited to East Midlands, West Midlands, East of England, Greater London, and South East of England. $^{++}$ Original sample.

2.7.3 UK-born vs First generation

In the sample, I focus on people who are either UK-born or UK-bred (who arrived in the UK before their 18th birthday). However, there might be concerns that the results of the estimates might be different for these groups. Marriage migration rate in data shows that there's not much variation between UK-born and UK-bred Muslims in different age groups by marriage migration rate (Figure 2.16).

There might still be differences in the preferences of UK-born and UK-bred Muslims. I compare the preferences of the original sample with a redefinition of marriage migration as marriage between UK-borns and first-generation immigrants. The results, presented in Table 2.11, show that religious endogamy preferences remain robust to this change. The new definition of marriage migration notably increases the overall marriage migration rate (2pp

Figure 2.16: Comparison of Muslim Marriage Migration for UK-born and UK-bred



for non-Muslims and 8pp for Muslims), as it includes instances where UK-born Muslims marry individuals who migrated to the UK before the age of 18. Moreover, the share of marriage migration explained by migration gains and endogamy preferences remains unchanged.

Table 2.11: Comparison of Results with and without UK-bred

	UK-born^{+}		UK-born or UK-bred^{++}	
	Non-Muslim	Muslim	Non-Muslim	Muslim
Endogamy preferences				
Ethnicity	10.2	6.1	10.4	7.4
Religion	22.4	22.4	22.7	22.7
Marriage migration (%)				
Overall	23.7	61.1	21.7	53.0
Migration gains	8.9	13.6	10.0	11.2
Endogamy preferences	14.8	47.4	11.8	41.8

Notes. The table shows the comparison of the results for UK-born versus UK-born or bred samples. $^{+}$ Sample is limited to UK-born. $^{++}$ Original sample.

2.7.4 Marriage Migration Definition: Sensitivity Analysis

In this subsection, I explore the sensitivity of the primary findings to variations in the definition of marriage migration. One concern regarding the definition is the inclusion of

individuals who arrived in the UK for purposes such as study or work and later married someone. Their migration gains might differ from those who migrated specifically for marriage. As a robustness check, I exclude marriages in which the migrant spouse holds a university degree in the UK from the marriage migration category, considering them local marriages instead. The results presented in Table 2.12 show that, with this adjusted definition, marriage migration decreases by about 3 percentage points. The endogamy preferences are robust. Moreover, the contribution of migration gains to overall marriage migration decreases, reaffirming previous findings that emphasize the significance of endogamy preferences in comparison to migration gains.

Table 2.12: Comparison of Results with Different Definitions of Marriage Migration

	Excluding Migrants with UK Degree^{+}		Original Definition^{++}	
	Non-Muslim	Muslim	Non-Muslim	Muslim
Endogamy preferences				
Ethnicity	10.6	7.9	10.4	7.4
Religion	22.6	22.6	22.7	22.7
Marriage migration (%)				
Overall	18.0	49.8	21.7	53.0
Migration gains	8.0	9.2	10.0	11.2
Endogamy preferences	10.0	40.6	11.8	41.8

Notes. The table shows the comparison of the results for UK-born versus UK-born or bred samples. $^{+}$ Immigrants who have a university degree from the UK are not included in marriage migration. $^{++}$ Original definition.

In this chapter, I defined marriage migration as a match between a UK-born individual or someone who arrived in the UK before turning 18 (UK-born or bred) and someone who migrated to the UK after reaching the age of 18. The age 18 threshold was chosen to ensure that individuals made their marriage decisions in the UK. However, It is possible that some individuals have marriage arrangements before reaching 18. Hence, Table 2.13 compares results with different age thresholds (16, 18, and 20). As the threshold age rises, the marriage migration rate decreases, as it excludes older Muslims who marry at younger ages. Nevertheless, the consistent proportionate contribution of migration gains to the overall marriage migration across these thresholds provides further reassurance regarding the robustness of

the main results. Religious endogamy preferences remain robust; however, as the threshold age increases, ethnic endogamy preferences increase. This is primarily due to the inclusion of interethnic marriages that were previously considered marriage migration and are now classified as local marriages.

Table 2.13: Sensitivity of Results to the Age Threshold for Marriage Migration Definition

	Threshold = 16		Threshold = 18		Threshold = 20	
	Non-Muslim	Muslim	Non-Muslim	Muslim	Non-Muslim	Muslim
Endogamy preferences						
Ethnicity	10.4	6.7	10.4	7.4	10.4	8.3
Religion	22.4	22.4	22.7	22.7	22.2	22.2
Marriage migration (%)						
Overall	22.1	58.1	21.7	53.0	20.6	39.5
Migration gains	10.0	12.0	10.0	11.2	9.7	7.9
Endogamy preferences	12.1	46.1	11.8	41.8	10.9	31.7

Notes. Marriage migration is defined as a union between a UK-born individual or someone who arrived in the UK before the age threshold and someone who migrated to the UK after reaching the age threshold.

2.8 Conclusion

This study uncovers the primary determinants of marriage migration, specifically focusing on understanding why there is a significantly higher rate of marriage migration among Muslims, to inform policies about the effect of marriage migration policies.

The predominant factor driving the notably high rate of marriage migration among Muslims in the UK is their considerable gains from endogamy, rather than the act of migration itself. A mere one-fifth of the total 50% marriage migration rate can be attributed to migration-related factors for Muslims. Therefore, the principal reason for substantial Muslim marriage migration is not associated with migration gains, but rather is rooted in a strong preference for shared cultural backgrounds.

The gains derived from marrying within religious and ethnic groups appear similar for all religious minorities. Consequently, Muslims do not significantly differ from Hindus and

Sikhs in this aspect. However, due to the larger migration gains experienced by Muslims, the interaction of these gains with the significantly high rates of within-group marriages leads to a notably higher marriage migration rate among Muslims. The higher migration gains of Muslims primarily stem from the increased availability of potential partners among Pakistani and Bangladeshi Muslims, likely due to their stronger connections with their country of origin.

A Strong connection to one's country of origin reduces the cost of marrying abroad, resulting in more individuals opting for marriage migration. This, in turn, intensifies their ties to their country of origin, contributing to increased marriage migration in the future. Consequently, this ongoing cycle could perpetuate a consistently high rate of marriage migration. A limitation of this study is its focus on a single snapshot in time, identifying the primary reasons for marriage migration. Future research can study the dynamics of marriage migration, examining the impact of network connections in the country of origin, and assessing its effect on integration.

Another aspect of marriage migration not explored in this study is the impact of search frictions or meeting rates. By utilizing more detailed regional data and considering variables affecting meeting rates, further research can explore the effects of search frictions on marriage migration.

2.A The Sample

In the 10% sample of the Census for England and Wales in 2011 there are 5,693,850 observations. In the process of matching spouses, the following people were excluded:

- partners could not be found (3,626 observations),
- same-sex couples (10,242 observations),
- divorced, widowed, or separated (815,349 observations).

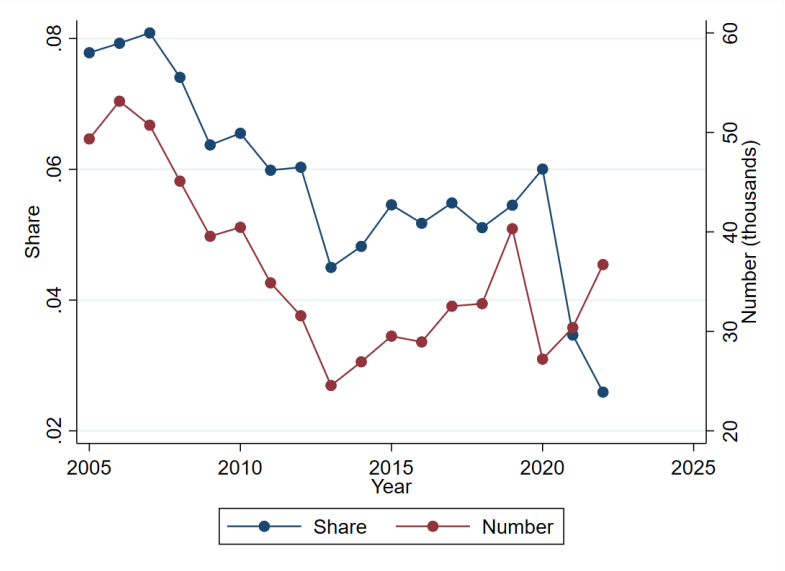
These adjustments reduce the number of observations by about 14.6%. In the next step, only men aged 35-55 and women aged 30-35 stayed in the dataset. For couples, if one of the partners is outside the range, the couple is removed from the sample. Thus, the number of observations becomes 1,850,766.

To deal with missing variables, I do not consider observations with missing education and their spouses (0.15% of observations) and people who refuse to report their religion (8.5% of observations). It would be a problem if Muslims with spouses who have missing religion intermarried. However, 45% of Muslim spouses who refuse to report their religion are Pakistani or Bangladeshi. Also, people from ethnic groups and countries with a high Muslim population are least likely to avoid reporting their religion.

Since we want to make sure that everyone in the sample made a marriage decision within the UK not before arriving in the UK, and many Muslims are first-generation immigrants; I limit the sample to non-Muslims plus Muslims who were born in the UK or arrived in the UK before their 18^{th} birthday. This excludes 54% of Muslim observations. Therefore, the final sample used to estimate the model comprises 1,423,555 observations, with 38,938 individuals (2.7%) identified as Muslim.

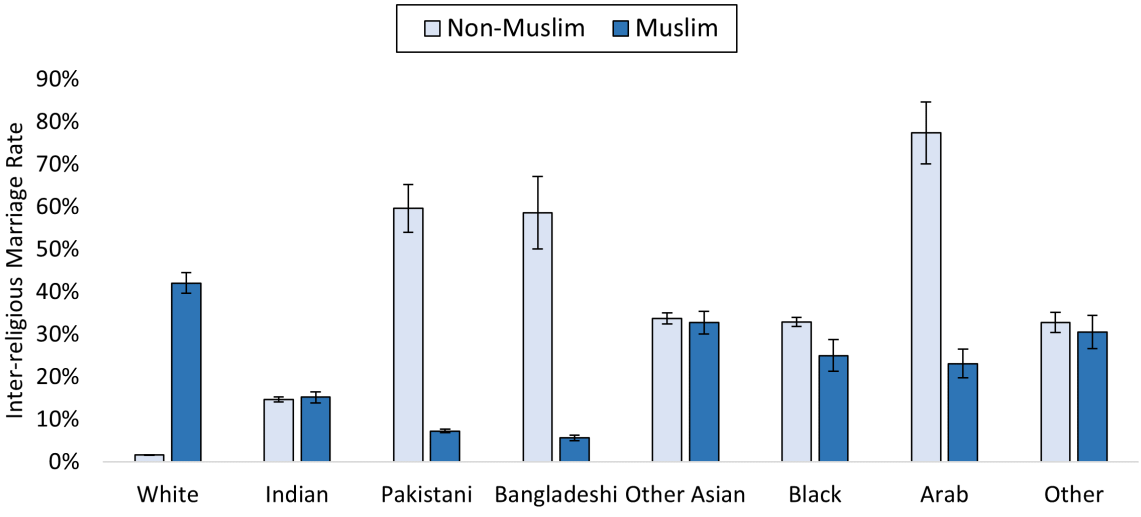
2.B Additional Figures

Figure 2A.1: Number and Share of Spouse Visas of Total Non-Temporary Visas to Enter UK



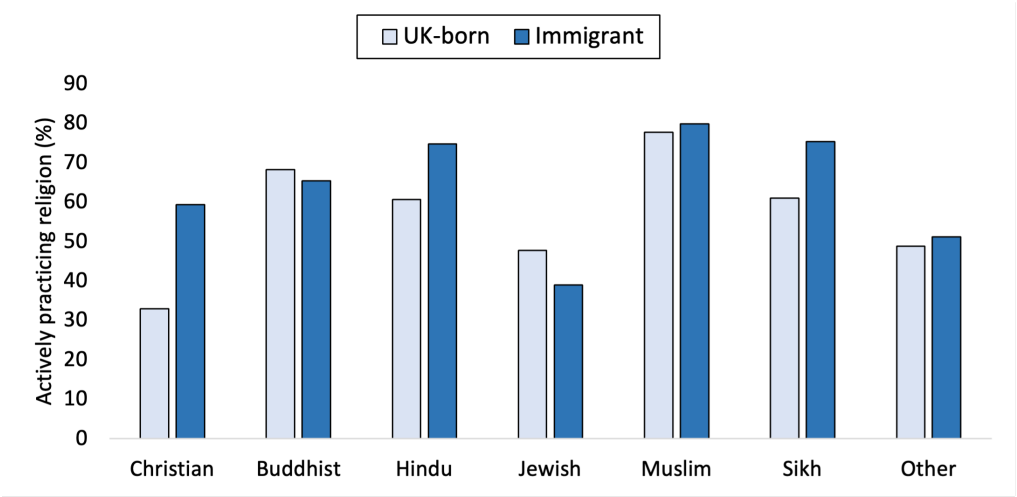
Source. Home Office Visa Statistics

Figure 2A.2: Proportion of Inter-ethnic Marriage



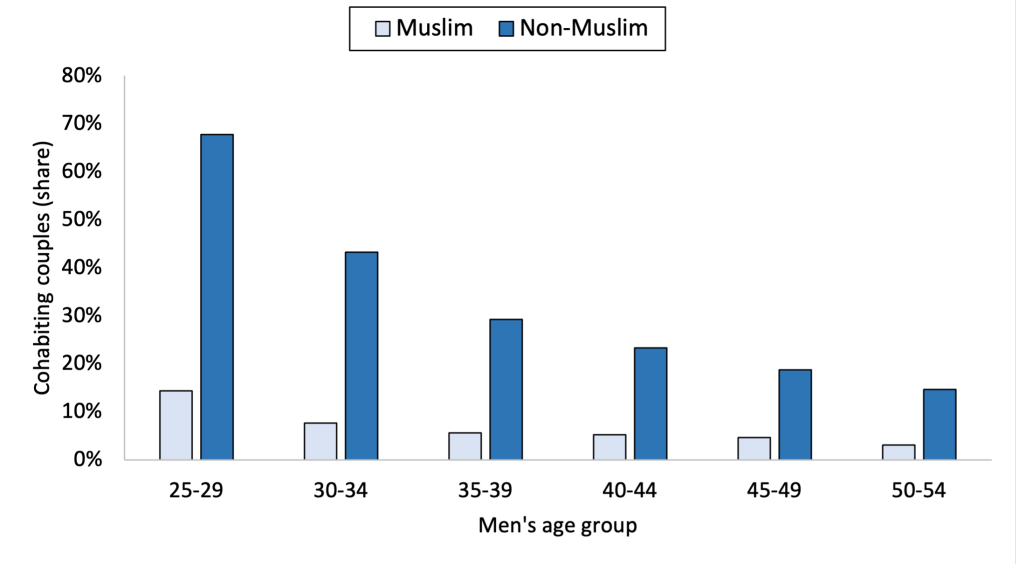
Notes. Each bar displays the percentage of married individuals in the ethnic group who married someone with a different ethnicity. *Source.* Census for England and Wales, 2011

Figure 2A.3: Share of Muslims Actively Practicing Their Religion



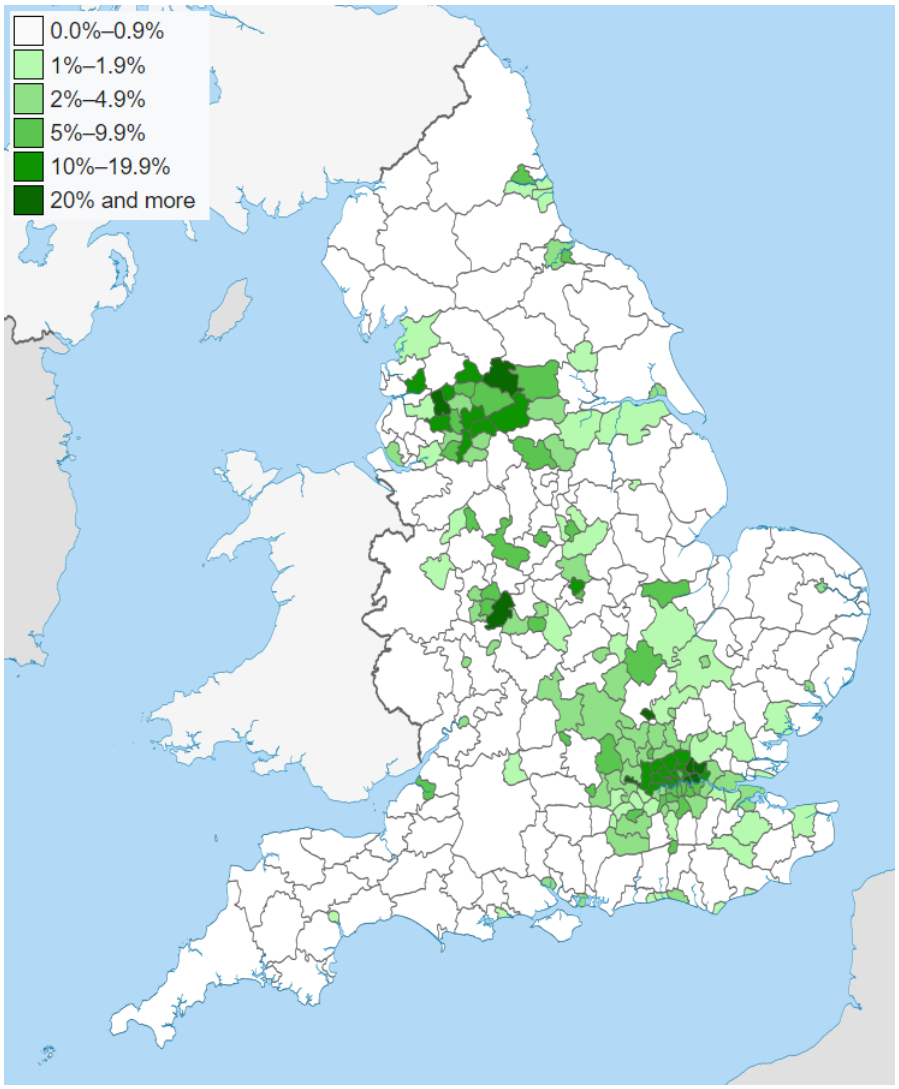
Source. Citizenship Survey, 2011

Figure 2A.4: Proportion of Cohabiting Couples



Notes. The figure shows the proportion of couples who are cohabiting, meaning they are living together but not married. *Source.* Census for England and Wales, 2011

Figure 2A.5: Proportion of Muslim Population in England and Wales



Source. Census for England and Wales, 2011

2.C Additional Tables

Table 2A.1: The Proportion of Marriage migration by Spouse's Reason for Immigration

	Male		Female	
	For Marriage	Other reasons	For Marriage	Other reasons
White	2%	2%	1%	1%
Indian	24%	5%	15%	8%
Pakistani/Bangladeshi	47%	7%	36%	19%
Others	11%	13%	10%	20%

Notes. The table shows the share of marriage migrations based on the primary reason for immigrants' arrival in the UK. marriage migration is defined as a union between a UK-born individual or an immigrant who arrived in the UK before turning 18 with an adult immigrant (i.e., an individual who arrived after their 18th birthday). *Source.* Labour Force Survey, 2011 - Question: What was your main reason for coming to the UK (most recent arrival)?

Table 2A.2: Sorting into Marrying Abroad

	Dependant variable: College education			
	Muslim		Non-Muslim	
	Male	Female	Male	Female
Marriage migration	-0.090***	-0.121***	-0.052***	-0.083***
	(-10.3)	(-14.9)	(-6.0)	(-8.9)
Spouse is White British	0.045	0.216***	-0.003	0.119***
	(-1.5)	(-6.9)	(-0.3)	(-12.9)
Spouse is non-Muslim	0.090***	0.136***	0.02	0.046
	(-3.4)	(-4.8)	(-0.6)	(-1.5)
Age	-0.002	0.000	-0.008***	-0.010***
	(-1.2)	(-0.3)	(-6.5)	(-8.1)
Constant	0.435***	0.266***	0.788***	0.728***
	(-7.0)	(-4.8)	(-12.8)	(-12.4)
Region & cohort FE	Y	Y	Y	Y
R^2	0.041	0.064	0.04	0.059
N	12,245	12,634	20,567	19,128

Notes. Table shows results of the linear regression of education level (dummy variable equal to one individual having college education and zero otherwise) on marriage migration and spouse's characteristics. Sample is limited to ethnic minorities. t statistics in parentheses. *p<0.10, **p<0.05, ***p<0.001. *Source.* Census for England and Wales, 2011

Table 2A.3: Trade-offs in Marrying Abroad: Education

	Dependant variable: Spouse's college education			
	Muslim		Non-Muslim	
	Male	Female	Male	Female
Marriage migration × High education	-0.082***	-0.041**	-0.036**	-0.031*
	(-6.0)	(-2.6)	(-3.2)	(-2.5)
Marriage migration × Low education	0.027**	0.050***	0.061***	0.053***
	(-2.7)	(-5.0)	(-5.5)	(-4.5)
Own education	0.353***	0.371***	0.381***	0.388***
	(-30.2)	(-28.9)	(-51.6)	(-51.0)
Spouse is White British	-0.009	0.048	-0.008	0.023**
	(-0.3)	(-1.4)	(-0.9)	(-2.6)
Spouse is non-Muslim	0.137***	0.094**	0.016	0.079**
	(-5.5)	(-3.2)	(-0.5)	(-2.7)
Age gap	-0.001	0.001	0.001	-0.003***
	(-0.6)	(-0.6)	(-1.2)	(-3.3)
Constant	0.258***	0.207***	0.357***	0.236***
	(-6.5)	(-5.2)	(-7.9)	(-5.4)
Region & cohort FE	Y	Y	Y	Y
R^2	0.139	0.118	0.170	0.160
N	12,237	12,625	20,549	19,109

Notes. Table shows the results of the linear regression of the education gap (spouse's education - own education) and age gap (husband's age - wife's age) on marriage migration and other observable marriage characteristics. t statistics in parentheses. *p<0.10, **p<0.05, ***p<0.001. *Source.* Census for England and Wales, 2011

Table 2A.4: Trade-offs in Marrying Abroad: Age

	Dependant variable: Spouse's age			
	Muslim		Non-Muslim	
	Male	Female	Male	Female
Own age	0.790***	0.802***	0.790***	0.787***
	(-61.6)	(-59.6)	(-79.6)	(-76.6)
Marriage migration	-0.330***	0.488***	-1.594***	0.655***
	(-4.6)	(-6.6)	(-23.3)	(-8.8)
Spouse is non-Muslim	1.158***	-0.175	1.032***	0.538*
	(-5.3)	(-0.7)	(-3.7)	(-2.2)
Spouse is White British	1.097***	-0.640*	0.281***	-0.066
	(-4.4)	(-2.2)	(-4.1)	(-1.0)
Education gap	0.169**	0.480***	-0.097*	0.183***
	(-2.6)	(-7.3)	(-2.0)	(-3.6)
Constant	4.496***	9.226***	5.038***	8.720***
	(-9.6)	(-20)	(-10.4)	(-18.7)
Region & Cohort FE	Y	Y	Y	Y
R^2	0.724	0.691	0.726	0.732
N	12,237	12,625	20,549	19,109

Notes. Table shows the results of the linear regression of the education gap (spouse's education - own education) and age gap (husband's age - wife's age) on marriage migration and other observable marriage characteristics. t statistics in parentheses. *p<0.10, **p<0.05, ***p<0.001. *Source.* Census for England and Wales, 2011

Table 2A.5: Goodness of Fit of the Model

	Observed Matching		Simulated Matching	
	Non-Muslim	Muslim	Non-Muslim	Muslim
Inter-education (%)				
Low-educated	23.8	26.6	22.7	26.9
High-educated	37.9	40.3	31.0	39.7
Inter-ethnic (%)				
White British	4.1	72.5	2.5	68.1
Other White	63.3	25.4	73.0	42.1
Indian	14.3	14.8	16.8	13.0
Pakistani/Bangladeshi	58.7	5.6	75.1	4.6
Other	30.8	22.4	37.2	39.3
Inter-religious (%)				
All	0.3	3.3	0.1	3.6
Marriage Migration (%)				
Other White	10.5	45.9	10.0	34.9
Indian	25.9	33.3	20.9	27.5
Pakistani/Bangladeshi	27.1	57.5	12.7	52.3
Other	24.9	44.6	23.3	35.3
Single (%)				
All	48.9	34.4	51.8	42.6

Notes. The table compares observed matching with the simulated matching from the model using estimated parameters.

Table 2A.6: Comparison of Estimated Preferences for Models with and without Migration

	With Migration^{+}		Without Migration^{++}	
	Non-Muslim	Muslim	Non-Muslim	Muslim
Age				
Young & Middle-aged	6.54	7.59	6.5	7.93
	(0.47)	(0.47)	(0.47)	(0.47)
Young & Old	9.9	9.66	9.89	9.73
	(0.47)	(0.47)	(0.47)	(0.47)
Middle-aged & Old	5.81	7.28	5.59	7.49
	(0.47)	(0.47)	(0.47)	(0.47)
Education				
Low & High	3.78	3.41	4.04	3.4
	(0.21)	(0.21)	(0.21)	(0.21)
Ethnicity				
Other White & White British	6.59	7.06	5.85	4.18
	(1.31)	(1.31)	(1.31)	(1.31)
Indian & White British	16.1	14.88	14.93	13.41
	(1.31)	(1.31)	(1.31)	(1.31)
Pak/Bng & White British	16.3	9.97	14.05	7.67
	(1.31)	(1.31)	(1.31)	(1.31)
Other & White British	11.35	5.20	10.11	2.82
	(1.31)	(1.31)	(1.31)	(1.31)
Religion				
Muslim & Non-Muslim	22.59	22.59	22.67	22.67
	(1.10)	(1.10)	(1.15)	(1.15)

Notes. The table shows the estimated surplus generated from endogamy rather than mixing for different groups for the model with and without the possibility of marriage migration. $^{++}$ Classic Choo and Siow (2006) model. $^{+}$ Model presented in Chapter 1.

Table 2A.7: Endogamy Preferences by Religious Group

	$\mathcal{D}_{zz'} = \Phi_{zz} + \Phi_{z'z'} - \Phi_{zz'} - \Phi_{z'z}$				
Groups (z & z')	Muslim	Hindu	Sikh	Christian	No Religion
Age					
Young & Middle-aged	7.93	3.20	3.80	5.71	5.54
	(0.47)	(0.34)	(0.38)	(0.47)	(0.47)
Young & Old	9.73	5.28		7.97	7.74
	(0.47)	(0.34)		(0.47)	(0.47)
Middle-aged & Old	7.49	2.78	5.31	4.79	5.03
	(0.47)	(0.34)	(0.38)	(0.47)	(0.47)
Education					
Low & High	3.40	2.07	1.98	3.13	3.49
	(0.21)	(0.18)	(0.22)	(0.21)	(0.21)
Ethnicity					
Other White & White British	4.18			6.70	3.18
	(1.31)			(1.32)	(1.3)
Indian & White British	13.41	10.71	11.93	13.71	11.37
	(1.31)	(0.94)	(0.91)	(1.32)	(1.3)
Pak/Bng & White British	7.67			18.31	14.3
	(1.31)			(1.32)	(1.3)
Other & White British	2.82	5.30	10.97	11.15	10.01
	(1.31)	(0.94)	(0.91)	(1.32)	(1.3)
Religion					
Different religions	22.67	22.27	26.87	7.66	7.43
	(1.15)	(0.83)	(0.84)	(1.16)	(1.14)

Notes. The table shows the estimated surplus generated from endogamous versus exogamous marriage. Coefficients are estimated by structural estimation of the model for different groups separately. Empty cells are not reported due to a low number of observations. Standard errors in parenthesis.

Table 2A.8: Full Results of the Counterfactual with No Preferences for Same Religion or Ethnicity

		Counterfactual		
	Original	No Ethnic Preferences	No Religious Preferences	No Ethnic or Religious Preferences
Non-Muslims				
Price Gap				
Other White	1.9	2.7	1.9	2.7
Indian	1.4	3.3	1.5	3.3
Pakistani/Bangladeshi	1.7	3.4	0.7	2.8
Other	1.0	2.3	0.9	2.1
Mariage Migration	18.3	7.6	19.4	8.4
Inter-religious Marriage	0.3	0.2	15.7	6.3
Inter-ethnic Marriage				
White British	2.5	11.3	2.6	14.6
Other White	73.0	90.3	72.4	90.4
Indian	16.8	92.1	15.1	91.7
Pakistani/Bangladeshi	75.1	94.0	10.1	89.3
Other	37.2	84.7	35.4	82.8
Muslims				
Utility Gap				
Other White	0.3	1.7	2.2	2.9
Indian	1.1	2.4	2.0	3.8
Pakistani/Bangladeshi	-0.1	0.6	0.0	2.2
Other	0.2	0.9	0.7	1.8
Mariage Migration	47.4	29.2	41.0	10.0
Inter-religious Marriage	3.5	0.5	26.6	86.0
Inter-ethnic Marriage				
White British	68.1	88.7	2.8	18.5
Other White	42.1	80.1	71.9	90.6
Indian	13.0	77.5	15.9	92.9
Pakistani/Bangladeshi	4.6	31.1	8.2	86.5
Other	39.3	59.7	32.2	78.3

Chapter 3

Preference Shocks in the Marriage Market

September 11th terrorist attack generated a negative sentiment towards Muslims in the United States. The rise in bias and discrimination affected the economic and social aspects of Muslims' lives. The intermarriage market as an unregulated market provides the opportunity to estimate the consequences of this discrimination. Therefore, in this chapter, I focus on the effect of 9/11 on the Muslim intermarriage market. I decompose the impact into an extensive margin (impact on intermarriage rate) and an intensive margin (impact on intermarriage prices). The Current Population Survey data is used for the estimation. Results indicate a decrease of approximately 10% in the rate of Muslims marrying non-Muslims after 9/11. Before this, Muslims tended to marry partners of lower educational attainment, while non-Muslims tended to marry partners with higher educational attainment. However, after 9/11, this vertical ordering disappears, transitioning through a more horizontal disutility from mixing, suggesting an increase in the disutility of intermarriage among Muslims.

3.1 Introduction

The rise of backlash against a minority group within society, manifested as a shock to preferences for mixing, can impede integration. This phenomenon typically involves the majority exhibiting taste-based discrimination against the minority, leading to resistance from the minority to integrate with the majority. A key indicator of social integration is intermarriage, defined as marriage between individuals of different races, castes, or religions. Employment discrimination laws are designed to curb bias based on ethnicity and religion, thus limiting the impact of discrimination in the job market. However, the marriage market, being largely unregulated, can illustrate the effects of discrimination without constraints.

The impact of a shock to mixing preferences on the marriage market is twofold: first, some individuals may choose to abstain from intermarriage (extensive margin), and second, the intermarriage price changes for those who do intermarry (intensive margin). Intermarriage price refers to how individuals weigh the option of marrying outside their group against other valuable attributes of a potential spouse. Essentially, it quantifies the relative utility loss associated with intermarriage. Building on this economic logic, this paper investigates the effect of the September 11$^{\text{th}}$, 2001 terrorist attacks (hereinafter referred to as '9/11') on the intermarriage market of Muslim and non-Muslim Americans, examining the impact across both the extensive and intensive margins.

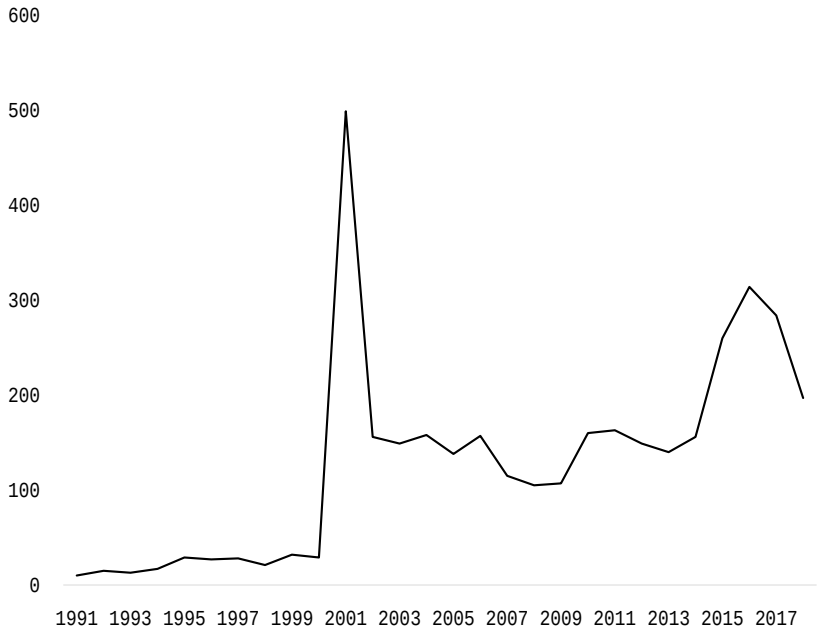
The 9/11 attacks, occurring in 2001, involved a coordinated series of terrorist actions that included the hijacking of four airplanes. These attacks resulted in the destruction of the World Trade Center, the Pentagon, and a field in Pennsylvania. These attacks claimed the lives of 2,977 individuals. Anti-Muslim motivated hate crimes in the US spiked right after the event: From 21 reported cases in 2000 to 499 in 2001 (Figure 3.1). As a consequence, 55% of Muslims believe that being Muslim in the United States became more challenging after 9/11, with a higher rate (73%) reported among non-immigrant Muslims (Pew Research Center, 2017). Muslims are the world's second-largest religious group, comprising about 25% of the global population, and they are the fastest-growing religious group worldwide, with a notable presence in the United States. The recent surge in Islamophobia, escalation of anti-Muslim hate crimes, and the implementation of policies such as the Muslim Ban[1] by President Trump emphasize the significance of studying discrimination against Muslims.

To estimate the extensive margin, namely the impact of 9/11 on the intermarriage rate, I employ a differences-in-differences approach to measure its effect on intermarriage among first and second-generation immigrant Muslims, using other immigrant groups as a control. To study the intensive margin, I extend Chiappori et al. (2012) marriage market model of matching to the intermarriage market. I introduce measurable intermarriage prices for both Muslims and non-Muslims. Analyzing post-9/11 changes in prices identifies which group is more affected by the change: Are Muslims less inclined to marry non-Muslims, or vice versa?

I use data from the Current Population Survey (CPS) for estimation. To focus on individuals who made their marriage decisions in the US, I exclude those who migrated after the age of 18. The effects of 9/11 extend beyond individuals practicing Islam and encompass

[1]Executive Order 13769, titled Protecting the Nation from Foreign Terrorist Entry into the United States, banned people from six Muslim-majority countries from entering the USA, and halted all refugee admissions.

Figure 3.1: Number of Reported Anti-Muslim Hate Crime Incidences in the US



Source. Hate Crime Statistics, FBI

anyone perceived to be Muslim. Many non-Muslim immigrants sharing the same ethnicity, language, and names as Muslims are erroneously identified as Muslim. In Western countries, the term "Muslim" is often used as an ethnic marker rather than solely denoting religious affiliation. Hence, discrimination against Muslims can affect all individuals originating from Muslim-majority countries. Accordingly, in the dataset, I identify first and second-generation immigrants from Muslim-majority countries as Muslims.

Results indicate a significant decline in the intermarriage rate of Muslims post-9/11, dropping by approximately 10% compared to other immigrant groups. This decline is attributed to a shift from marrying outside their group to marrying within their group, rather than an increase in remaining single or experiencing a higher divorce rate. Hence, the joint utility of a match between Muslims and non-Muslims declines due to the negative shock to mixing preferences. In the intensive margin, before 9/11, on average, intermarried Muslims married partners with lower educational attainment, whereas non-Muslims married individuals with higher educational levels. This pattern suggests a vertical ranking of religion in the marriage market. However, after 9/11, this vertical ordering disappeared, transitioning to a more horizontal disutility from mixing. This change indicates that the decline in the joint utility of a mixed match is primarily driven by a decrease in the utility of a mixed match for Muslims.

The labour market does not exhibit similar significant changes post-9/11. While there is no notable shift in the rate of participation in the labour market among Muslims, the overall increase in unemployment rates after 9/11 affects all Americans, including Muslims. However, the rise in unemployment rates among Muslims is not significantly different from that observed among other groups. One area where discernible changes are observed is in patterns of self-employment. Following 9/11, Muslims are less likely to engage in incorporated self-employment, which typically denotes entrepreneurship. Instead, there is a notable increase in unincorporated self-employment among Muslims, indicating a greater tendency toward owning small businesses.

In summary, this study reveals significant shifts in the intermarriage market in contrast to the labour market, where regulations may constrain expressions of true preferences. Both Muslims and non-Muslims have experienced a noteworthy decrease in intermarriage rates, reflective of diminished preferences for cultural mixing. The increase in intermarriage prices for Muslims indicates that the change in preferences is more pronounced among Muslims than among non-Muslims.

The chapter is structured as follows. Section 3.2 provides a review of the economic literature on Muslim assimilation in Western countries and the impact of 9/11. Following this, Section 3.3 outlines the marriage model and econometric specifications utilized in the analysis. Section 3.4 details the data used and the methodology for identifying Muslims within the dataset. Subsequently, Section 3.5 presents the findings of both the intensive and extensive margins, alongside the estimation of the effect on the labour market. Finally, Section 3.6 discusses the results and §concludes.

3.2 Related Literature

While there is a wealth of research on discrimination in economics, religious discrimination is under-explored (Becker, 2010; Lang and Spitzer, 2020; Rodgers, 2009). In 2018, approximately 18% of hate crimes in the US and 8% in the UK were rooted in religious bias, particularly affecting Muslims. One of the most significant shocks to religious discrimination was the unexpected 9/11 terrorist attacks. Several papers in the economics literature have addressed the impact of 9/11 on the lives of Muslims in the United States and some European countries. Regarding the economic effects, they find mixed, but overall modest impacts on the Muslim labour market outcomes (Davila and Mora, 2005; Kaushal et al., 2007; Cornelissen and Jirjahn, 2012). However, the impact is not limited to economic life; 9/11 has also

affected the health outcomes of Muslims. Johnston and Lordan (2012) shows discrimination worsens blood pressure, cholesterol, BMI, and self-assessed general health. Discrimination affects health through various channels, including employment, perceived social support, and health-related behaviors.

The impact of 9/11 on Muslims extends to their social lives, particularly in terms of social integration. Existing literature on the integration of Muslims into Western societies is limited. Some evidence suggests that Muslim minorities show lower levels of integration with Western society compared to other migrant groups (Bisin et al., 2008). However, Georgiadis and Manning (2011) demonstrates a convergence in behavior over time. Following the terrorist attacks, there was an observable increase in social and geographic segregation between Muslims and non-Muslims. According to Elsayed and De Grip (2018), low-educated Muslims experienced heightened geographic segregation and increased unemployment after the attacks, while high-educated Muslims were most adversely affected in terms of their perceived integration. Post-terrorist attacks, landlords exhibit a reduced likelihood of contacting Muslim applicants (Ahmed and Hammarstedt, 2008). Additionally, there is a documented negative impact on house prices associated with Muslims residing in a neighborhood (Gautier et al., 2009).

In an assessment of the impact of anti-Muslim hate crimes on Muslim assimilation, Gould and Klor (2016) observes that immigrant Muslims in the US exhibit higher fertility rates, lower female labour force participation, and diminished English proficiency. The study also delves into the effects of 9/11 on the Muslim intermarriage market. Focusing on first-generation immigrants, it identifies an increased rate of intramarriage among Muslim immigrants in response to the surge in hate crimes post-9/11. This increased intramarriage rate primarily occurs at the expense of marrying outside the ethnic group, rather than indicating a general rise in the overall marriage rate. However, the study faces limitations as it cannot differentiate between immigration effects and hate crime effects by exclusively focusing on first-generation immigrants. Additionally, the analysis is confined to the extensive margin of intermarriage, lacking an examination of changes in the characteristics of individuals who choose to intermarry after 9/11.

To estimate the impact of a discrimination shock on the marriage market, given that any shock can alter the general equilibrium of the marriage market, it is crucial to adopt an econometric framework that appropriately captures the intricacies and dynamics inherent in studying the effects of changes on the marriage market. Most existing literature on the marriage market primarily focuses on one-dimensional matching (Becker and Becker,

2009; Choo and Siow, 2006), where spouse selection is predominantly based on a single characteristic, simplifying the explanation of assortative matching. However, in practice, the marital matching process is multidimensional, involving various factors such as age, education, race, religion, and anthropometric characteristics (Fisman et al., 2008; Hitsch et al., 2010a; Banerjee et al., 2013). Consequently, there is a necessity to account for the observed imperfect matching in the data. In such cases, a trade-off in matching may occur, wherein individuals sacrifice certain valuable characteristics in their partners to achieve the best overall match. This trade-off concept was initially introduced by Merton (1941) and Davis (1941) through the formulation of social exchange theory. Subsequent studies by Chiappori et al. (2012), Dupuy and Galichon (2014), and Galichon and Salanié (2010) further model these trade-offs in the marriage market.

This study significantly contributes to the existing literature in several ways. it advances the marriage market literature by introducing measurable intermarriage prices for the first time. Typically, preferences in the marriage market change gradually, making it challenging to identify the effects of sudden preference shocks. However, the events of 9/11 provide a unique opportunity to measure the impact of an exogenous preference shock on the marriage market using the change in intermarriage prices.

Second, this study introduces and estimates prices associated with inter-religious marriages for the first time. The value of religion in the marriage market has been understudied in the economics literature. However, as demonstrated in Chapter 2, it emerges as one of the most significant factors in partner selection.

Third, this study provides new insights into the assimilation of immigrants, particularly Muslims, in Western countries, a topic understudied in the economics literature. By examining the marriage patterns, this study sheds light on the social assimilation process of Muslims in Western societies.

3.3 Econometric Specification

In this study, the focus is specifically on the heterosexual matching market, due to data limitations on homosexual matches. The market is comprised of a fixed number of men and women. Each male individual, denoted as i, possesses a vector of observable characteristics $y_i = (y_i^1, ..., y_i^K)$, where K represents the number of observable attributes for men. Additionally, there is a vector of unobservable characteristics, denoted as $\eta_i \in \mathbb{R}^M$, with M denoting

the number of unobservable attributes for men. Similarly, each female individual, denoted as j, is characterized by a vector of observable attributes $x_j = (x_j^1, ..., x_j^L)$, with L being the number of observable attributes for women. Additionally, there exists a vector of unobservable characteristics, denoted as $\varepsilon_j \in \mathbb{R}^N$, where N represents the number of unobservable attributes for women. It is important to note that these unobservable characteristics are not accessible to the econometrician, but potential matches within the market are assumed to observe them.

I adopt a similar methodology to Chiappori et al. (2012), relying on two crucial assumptions. Firstly, All observable characteristics of a potential spouse contribute to the marriage utility through a one-dimensional index: $I_i = I_i(x_j^1, ..., x_j^L)$ shows the utility index of woman j for man i, and $J_j = J_j(y_i^1, ..., y_i^K)$ is the utility index of man i for woman j. This index, representing attractiveness in the marriage market, transforms the multidimensional model into a one-dimensional framework. Consequently, a woman would be indifferent between marrying two men with different characteristic vectors but the same index. This approach is versatile and applicable to various matching mechanisms, including frictionless matching models with or without transferable utility functions and search models.

Secondly, I assume that, given this index of observable characteristics, the distributions of unobservable characteristics are atomless and independent of observable characteristics. Consequently, the distribution of unobservable characteristics for two individuals with the same index is identical. As noted by Chiappori et al. (2020), an additional assumption is necessary to ensure the uniqueness of the stable matching. Thus, I consider a specific case where the marriage surplus is bilinear, and the distribution of characteristics follows a normal distribution.

In the marriage market, there are two distinct groups of individuals, denoted as group A and group B, differing primarily in their religious affiliation. I introduce the binary variable D_i, which is equal to 0 if the spouse belongs to the same group (intermarriage) and 1 if the person is marrying outside their group (intermarriage). The revised indices of characteristics are $I_i = I_i(x_j^1, ..., x_j^L, D_j)$ for male individual i and $J_j = J_j(y_i^1, ..., y_i^K, D_i)$ for female individual j. The partial derivative $\partial I_i/\partial D_j$ for men and $\partial J_j/\partial D_i$ for women reflects how marrying outside the group influences the respective index. This derivative shows the (dis)utility of intermarriage. If marrying outside the group has a lower utility, for an individual in group A, a potential spouse in group B should have characteristics associated with a higher marriage surplus to be on the same iso-attractiveness curve as someone in group A. This can be interpreted as *intermarriage price*.

The intermarriage price is the marginal rate of substitution between valuable characteristics in the marriage market and intermarriage. Mathematically, this is expressed as

$$P_i^s \equiv MRS_i(x_j^s, D_j) = \frac{\partial I_i/\partial x_j^s}{\partial I_i/\partial D_j}, \quad P_j^s \equiv MRS_j(y_i^s, D_i) = \frac{\partial J_j/\partial y_i^s}{\partial J_j/\partial D_i}$$

Where P_i^s denotes the intermarriage price for man i, that is, how they trade off intermarriage and characteristic s. Similarly, P_j^s denotes the intermarriage price for woman j. Intermarriage price can be defined for all valuable characteristics. The signs of these prices are not constrained; they can be positive if a group favors intermarriage and positive if the preference is against it. Intermarriage prices can be exactly identified from matching patterns (see Chiappori et al. (2012) for the proof).

Individual choices shape the equilibrium matching in the market. Considering the perspective of someone in group B, the demand for intermarriage is influenced by the prices associated with it. Higher intermarriage prices make individuals in group B less inclined to marry outside their group. A shock to the mixing preferences disrupts the intermarriage equilibrium for both groups, leading to shifts in the demand and supply curves in the intermarriage market.

This framework is applicable in understanding the Muslim intermarriage market. Considering group A as non-Muslims and group B as Muslims, in the presence of intermarriage disutility for each group, they should have a positive price for intermarriage. This implies that they would be willing to marry outside the group if the potential spouse possesses, on average, superior characteristics compared to potential partners within the group.

The 9/11 terrorist attack acts as an exogenous shock to intermarriage preferences for both groups, keeping preferences for other characteristics constant. While it has the potential to decrease the overall intermarriage rate, the impact on intermarriage prices may vary depending on which side is more affected by the shock. Estimating the changes in prices post-9/11 provides a means to identify the shifts in intermarriage preferences within each group.

Based on the predictions of the model, empirical specifications can be derived. For simplification, the assumption is made that indices are a linear function of characteristics:

$$I_i = \sum_k^K f_k x_j^k + d_x D_j, \quad J = \sum_l^L f_l y_i^l + d_y D_i$$

Where coefficients f_k and g_l indicate the extent to which one unit in the valuable characteristics k and l change the index. d shows the change in the index in the case of intermarriage. d_x represents this coefficient for women and d_y for men. From these indices, we can find the intermarriage prices:

$$P_y^s = \frac{\partial I/\partial x_j^s}{\partial I/\partial D_j} = \frac{f_s}{d_y}, \quad P_x^s = \frac{\partial J/\partial y_i^s}{\partial J/\partial D_i} = \frac{f_s}{d_x}$$

In order to estimate marginal rates of substitution, one can simply regress the various characteristics of husbands over the characteristics of wives in the sample of married couples, using the following regressions:

$$x_j^s = \alpha_0 + P_y^s D_j + \alpha_1 Z_i + e_i, \quad i = 1, ..., N_y$$
$$y_i^s = \beta_0 + P_x^s D_i + \beta_1 Z_j + e_j, \quad j = 1, ..., N_x$$

Where Z is a matrix of other confounding variables in the marriage market. To assess the impact of 9/11, an event study can evaluate the change in intermarriage price (marginal rates of substitution).

$$x_j^s = \alpha_0 + P_y^s D_j + \alpha_1 T_i + \Delta P_y^s T_i \times D_j + \alpha_2 Z_i + e_i, \quad i = 1, ..., N_y$$
$$y_i^s = \beta_0 + P_x^s D_i + \beta_1 T_j + \Delta P_x^s T_j \times D_i + \beta_2 Z_j + e_j, \quad j = 1, ..., N_x$$

Where T is a dummy variable that shows whether the person is observed before or after 9/11. P_x^s shows how much husband of women j should compensate being in other group by increasing value of y^s. ΔP_x^s represents the change in this price after 9/11. ΔP_y^s can be interpreted similarly. By separately estimating ΔP_x^s and ΔP_y^s for Muslims and non-Muslims, I can measure the relative changes in their preferences for intermarriage and compare how these changes impact each group.

3.4 Data

According to the Pew Research Center, the estimated number of Muslims residing in the US in 2017 was approximately 3.45 million, constituting 1.1% of the total population. However, the distribution of Muslims across the country is not uniform, with places such as New York City, Dearborn, and Los Angeles having the highest Muslim population concentrations. In terms of demographic characteristics, Muslim Americans exhibit a younger age profile and greater racial diversity compared to the general population (Pew Research Center, 2017).

This demographic pattern stands in contrast to Muslim communities in European countries, where there are often large concentrations of specific national groups (Gillum, 2018).

Almost six in ten U.S. Muslim adults are first-generation immigrants, with the majority having arrived in the United States after 2000 (Pew Research Center, 2017). The Asian-American community, representing the fastest-growing Muslim population in the US, constitutes approximately 25% of the country's Muslim population. This group primarily originates from countries such as Pakistan, India, Bangladesh, and Afghanistan. Another quarter of Muslim Americans comprises Arab Americans, despite more than half of Arab Americans in the US adhering to the Christian faith. Additionally, Iranians, who began migrating to the US after the 1979 Islamic revolution, constitute a significant portion of the Muslim population in the country (Gillum, 2018).

On average, Muslim Americans attain a higher level of education than their non-Muslim counterparts: 47% of individuals aged 25 and older in the Muslim American community possess at least a college degree, compared to the 30% national average for Americans [2]. The income distribution among Muslims exhibits a bimodal pattern (Figure 3A.1). There is notable poverty within the Muslim population, but there is also a higher percentage of affluent individuals. The poor Muslim population primarily includes refugees who have arrived in the US in recent decades. While the overall employment rate for Muslim Americans is nearly equivalent to the general public, their unemployment and underemployment rates are comparatively higher (Pew Research Center, 2011).

Approximately 60% of Muslim Americans actively engage in religious practices as a fundamental aspect of their lives[3]. A similar proportion of Muslims adhere to daily prayers, with first-generation immigrants often demonstrating greater adherence to all five daily prayers. Furthermore, 80% of Muslims observe fasting. Among women, 42% of immigrants and 35% of non-immigrants choose to wear the hijab. Regarding intermarriage[4], a 2017 Pew Research Center report indicates that 25% of non-immigrant Muslims and 13% of first-generation immigrants were married to non-Muslims. This suggests that the interfaith marriage rate among Muslims is roughly comparable to that of other Americans. The degree of religiosity

[2]US Religious Landscape Study, Pew Research Center, 2014

[3]Survey of US Muslims, Pew Research Center, 2017

[4]Sharia law stipulates that Muslim men are allowed to marry women from the people of the book (Quran 5:5), but Muslim women cannot marry non-Muslim men (Quran 60:10). Marriage is possible if the man converts, facilitated by reciting the Testimony of Faith (Shahada). However, not all Muslims strictly adhere to this rule.

significantly influences Muslims' views on intermarriage; while 84% of those identifying as "not very religious" find interfaith marriage acceptable, less than half of "devout" respondents share this perspective (Riley, 2013).

Identifying Muslims residing in the US through surveys with large sample sizes poses challenges, as none of them explicitly inquire about religious affiliation. A common approach for identification involves utilizing country of birth[5]. This method operates under the assumption that individuals from Muslim-majority countries are likely to be Muslim. While this serves as a practical proxy for identifying Muslims, it is not entirely accurate, given that many migrants from Muslim-majority countries to the US may adhere to non-Islamic faiths. For instance, despite approximately 90% of Jordan's population being Muslim, a significant proportion of Jordanian Americans are Christian. I contend that employing birthplace as a reasonable proxy for identifying Muslims in this study is justified due to the following reasons:

1. Muslims identified by religion surveys predominantly consist of practicing Muslims; however, discrimination against Muslims extends beyond the realm of religious observance. As highlighted by Ruthven (2006).

2. Discrimination against Muslims post-9/11 is not confined to individuals who are practicing or culturally Muslim; it also impacts non-Muslims with similar ethnicities or names. For instance, the first victim of backlash was a Sikh who was mistakenly identified as Muslim due to his turban and beard, despite Sikhs being neither Muslim nor Arab (Bakalian and Bozorgmehr, 2009). Further evidence from the Detroit Arab American Survey (Baker et al., 2003) indicates that in the Arab community in the Detroit area, 12% of Christian Arab Americans and 14% of Muslim Arab Americans have faced personal challenges post-9/11 due to their ethnicity (see Table 3.1).

3. Although a substantial number of migrants from Muslim countries in the first[6] and second[7] waves of migration were Christian, and the majority of immigrants after the

[5]It is essential to note that birthplace does not definitively signify the person's current religious affiliation; however, the two are highly correlated.

[6]The initial wave of migration from the Middle East occurred in the mid to late nineteenth century. The majority of immigrants were Christians from rural areas of the Ottoman Empire, which now includes Syria, Jordan, Palestine, and Lebanon.

[7]Due to the US quota immigration system (The Immigration Act of 1924), these immigrants were primarily relatives of those who had already emigrated.

Table 3.1: Discrimination Experienced by Arab Americans due to their Race, Ethnicity, or Religion

	Christian	Muslim
Verbal insults or abuse	20%	24%
Threatening words or gestures	10%	14%
Physical attack	1%	3%
Vandalism or destruction of property	3%	5%
Loss of employment	2%	6%

Notes. Numbers show the percentage of Arab Americans who personally, or someone in their household, experienced discrimination/hate crime from 2001 to 2003.
Source. Detroit Arab American Study (DAAS), 2003

abolition of immigration quotas in 1965 were Muslims[8]. Therefore, the majority of immigrants in the marriage market during the study period are likely to be Muslim.

The primary dataset utilized in this study is the US Current Population Survey (CPS), spanning from 1995 to 2023. Conducted monthly by the Bureau of Census of the United States, the CPS has been gathering data through repeated cross-sections since 1976. However, a notable revision occurred in the CPS survey in 1994, which introduced inquiries about birthplaces. The 1994 CPS dataset lacks information on some countries of birth due to the introduction of codes for certain countries in 1995. Therefore, to ensure a comprehensive measure of parents' country of birth, this study focuses on data starting from 1995.

I categorize individuals as "Muslim" if they are first-generation immigrants born in a Muslim-majority country or second-generation immigrants whose fathers were born in a Muslim-majority country [9]. The identified Muslim-majority countries, defined as those with over 70% Muslim population and with existing codes in the CPS, include Iran, Iraq, Palestine, Jordan, Saudi Arabia, Syria, Turkey, Egypt, Morocco, Indonesia, Afghanistan, Bangladesh, and Pakistan. Additionally, individuals reporting the Middle East or North Africa as their father's birthplace are included.

[8]Following the Immigration and Nationality Act of 1965, immigration from the Middle East and Asia increased significantly, with over half of the newcomers being Muslim (Smith, 2010)

[9]Robustness checks using mothers' birthplace are discussed in Appendix 3.A.

Table 3.2 provides summary statistics of the sample, comparing characteristics of different groups. Muslims are slightly younger, primarily due to a higher share of first-generation immigrants. They exhibit significantly higher levels of education compared to other groups, while their female labour force participation rate is lower. On average, immigrants have lower labour force participation rates and higher unemployment rates compared to non-immigrants.

One notable difference in the characteristics of Muslims before and after 9/11 is the share of first-generation immigrants. The decline in Muslim immigration to the US has led to a decrease in this share over time. Additionally, the increase in the unemployment rate across all groups after 9/11 can be attributed to the financial crisis. Another notable difference is the decline in the marriage rate over time, as more people choose to remain single.

The Muslim sample used for estimation comprises second-generation immigrants and pre-18 first-generation immigrants (those who arrived before their 18th birthday).[10] This ensures that individuals in the sample made their marriage decisions in the US, rather than before arriving in the country. For brevity, I will henceforth refer to this group as immigrants. The immigrant control group is divided into six categories: Muslim, White (European, Canadian, or Australian), Central American, South American, African, or Asian.

Table 3.3 presents characteristics of married individuals in different marriage types. If someone marries within their group, it is called an intra-marriage, and if they marry outside their group, it is called an intermarriage. The rate of intermarriage is higher among Muslims compared to non-Muslims; however, there is a significant gender gap, with men being more likely to marry outside their group. Among those who marry within their group, approximately 80% marry someone from the same country of origin. Moreover, about half of those who intermarry marry white Americans, but this rate is higher for non-Muslims.

For Muslims, the age gap between husband and wife is larger, and husbands tend to have higher education levels than their wives, whereas the opposite is observed for non-Muslims. This contrast may be attributed to differences in education distribution within these groups. Individuals who marry outside their group have, on average, higher education levels and tend to marry spouses with higher education as well.

[10]Other Muslims are not identifiable due to data limitations.

Table 3.2: Summary Statistics

	Second generation[a] + Pre-18 first-generation immigrant[b]				Non-Immigrant	
	Muslim		Non-Muslim			
	Pre 9/11	Post 9/11	Pre 9/11	Post 9/11	Pre 9/11	Post 9/11
Share (%)	0.2	0.5	9.0	14.0	90.8	85.5
Male (%)	50.2	49.6	48.8	49.2	48.5	49.0
Age	33.7	34.6	36.1	36.3	38.8	39.2
First-generation immigrant	63.4	56.0	50.3	50.7	0.0	0.0
Married (%)	57.1	53.9	60.3	53.8	63.7	56.9
College education (%)	78.0	79.7	56.6	59.9	57.2	64.3
Years of schooling[c]	14.8	15.0	13.1	13.5	13.5	13.9
Female participation rate (%)	72.2	69.4	74.9	74.8	78.5	77.7
Male participation rate (%)	91.7	88.0	92.0	90.0	91.5	88.4
Female unemployment rate (%)	2.9	4.4	3.7	4.2	3.0	3.9
Male unemployment rate (%)	3.7	5.3	3.6	5.0	3.1	4.5
Number of observations	6,498	45,085	339,364	1,410,447	3,757,509	10,985,960

Notes. The sample is limited to men aged 25-55 and women aged 23-53.

[a] Second-generation immigrants are individuals born in the United States whose fathers were born outside the country.

[b] Pre-18 first-generation immigrants are individuals born outside the US who migrated before their 18th birthday.

[c] The variable "Years of schooling" is constructed based on respondents' educational attainment, determined by the highest year of school completed or the degree achieved.

Source. Current Population Survey (CPS), 1995-2023.

Table 3.3: Characteristics by Marriage Type

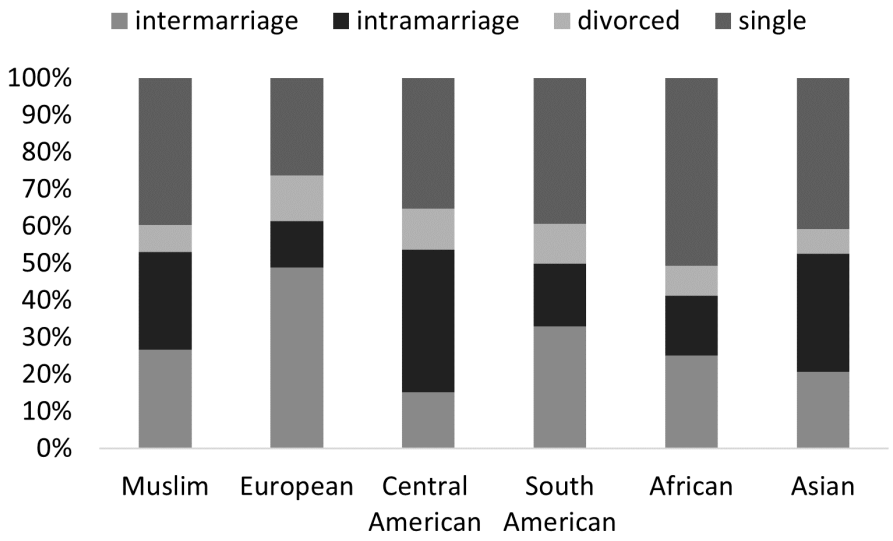
	Male		Female	
	Intra-marriage	Inter-marriage	Intra-marriage	Inter-marriage
Muslims				
Share (%)	48.5	51.5	53.8	46.2
Spouse is White American	0.0	55.5	0.0	59.7
Spouse is from same country	85.3	0.0	89.0	0.0
Spouse is first-generation immigrant	81.9	26.3	88.4	20.6
Age	37.9	39.1	35.0	37.2
Age gap	-3.1	-1.5	5.2	2.6
Years of schooling	15.1	15.5	14.4	15.7
Years of schooling gap	-0.6	-0.2	0.6	-0.2
Labour force participation	93.3	95.5	51.9	76.6
Spouse's labour force participation	46.4	69.5	92.0	94.0
Number of observations	5,691	6,996	6,962	7,191
Non-Muslims				
Share (%)	55.8	44.2	54.6	45.4
Spouse is White American	0.0	68.4	0.0	67.3
Spouse is from same country	75.5	0.0	78.4	0.0
Spouse is first-generation immigrant	68.8	13.1	72.1	13.1
Age	38.3	40.6	36.3	38.7
Age gap	-1.4	-1.4	3.0	2.5
Years of schooling	12.4	14.3	12.8	14.6
Years of schooling gap	0.2	0.1	-0.4	-0.1
Labour force participation	93.8	94.7	66.2	76.5
Spouse's labour force participation	62.6	75.3	92.9	93.5
Number of observations	234,741	229,927	243,174	238,146

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. *Source.* Current Population Survey (CPS), 1995-2023.

In the labour market, Muslim women who marry within their group exhibit a significantly lower labour force participation rate compared to non-Muslims. Interestingly, this gap disappears for Muslim women who marry outside their group, aligning their participation rate with that of non-Muslims. A similar pattern is observed in their educational attainment. However, for men, there is no difference in labour force participation between those who marry within their group and those who marry outside it, although their level of education is different.

Figure 3.2 provides a breakdown of marital status by group. It reveals a significant disparity in the intermarriage rates among different groups. White individuals exhibit the lowest probability of marrying outside their group, whereas Africans and Central Americans have the highest probability. Additionally, the rate of singlehood varies significantly among different groups, with White individuals having the lowest and Africans having the highest rate of singlehood. Divorced or separated individuals constitute approximately 10% of the sample, with Muslims having the lowest rate (about 7%).

Figure 3.2: Individuals by Ethnic Group and Marital Status



Notes. The sample is limited to men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. *Source.* Current Population Survey (CPS), 1995-2023.

Based on the data introduced in this section and the specified econometric model, the following section delves into identifying the impact of 9/11 on the marriage market dynamics of Muslims.

3.5 Results

The effect of 9/11 on the Muslim marriage market can be decomposed into two parts: the extensive and the intensive margins. The first part of this section, focusing on the extensive margin, explores the change in the intermarriage rate after 9/11. The second part, centered on the intensive margin, investigates the changes in sorting and tradeoffs in intermarriages. The final part of this section estimates the effect of 9/11 on Muslims' labour market outcomes.

3.5.1 Extensive Margin

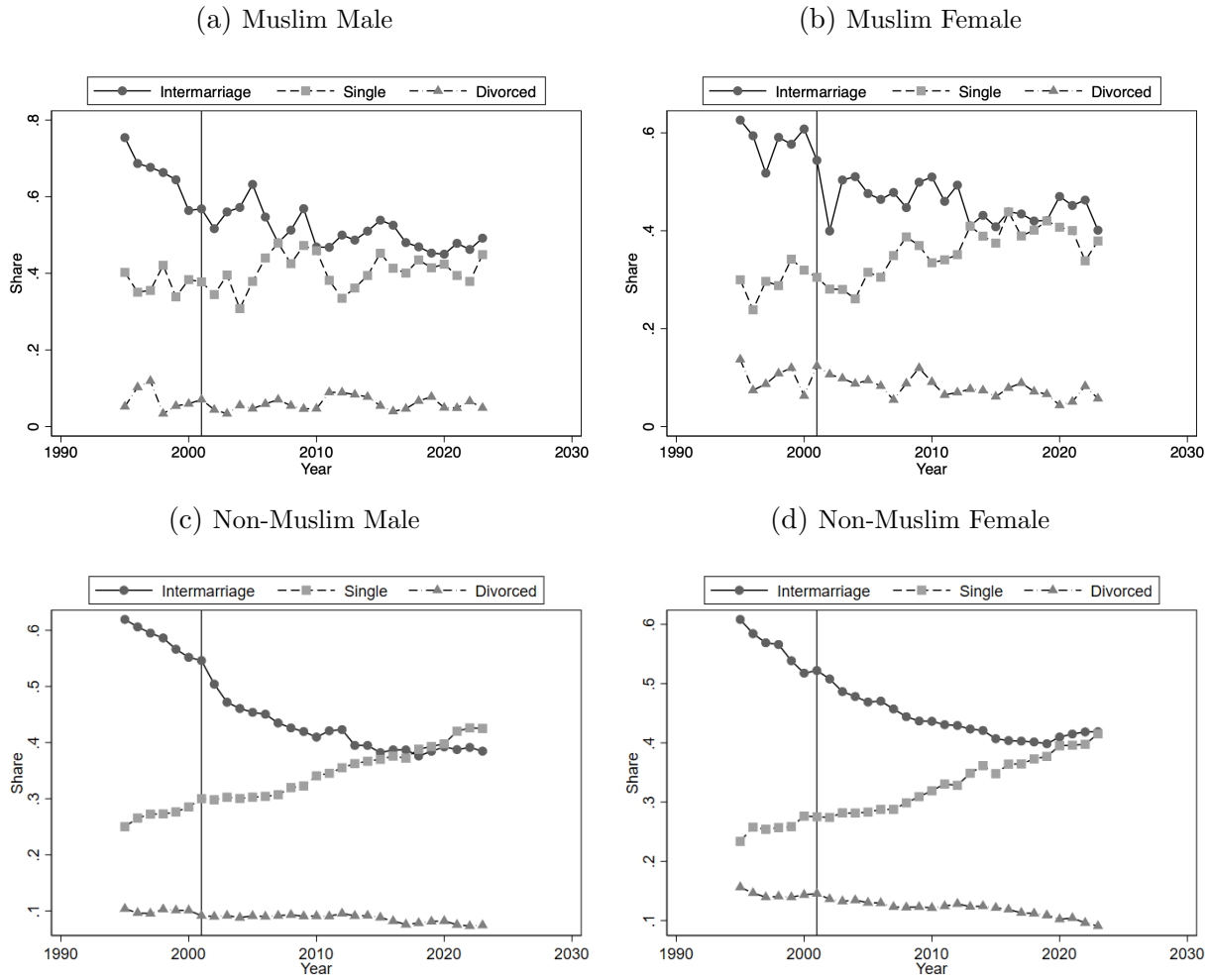
The extensive margin measures the effect of 9/11 on the probability of entering different types of marriages. In studying intermarriage probability, I focus on currently married individuals. Figure 3.3 depicts changes in intermarriage, singlehood, and divorce (or separation) rates of individuals. There has been a significant decline in the intermarriage rate and an increase in the rate of singlehood. However, confounding factors such as age, education, and the proportion of different groups in the region can influence this rate. Hence, comparing changes for Muslims and non-Muslims would be difficult without controlling for confounding factors.

Comparing the intermarriage rate of Muslims before and after 9/11 is not sufficient for identifying the impact of 9/11 on the intermarriage rate among Muslims. The impact of 9/11 might extend beyond Muslims and affect all intermarriages. Therefore, to accurately measure the effect of 9/11 on the intermarriage rate among Muslims, I run a differences-in-differences regression: comparing Muslims with other immigrants who originate from countries with low Muslim populations (including White (European, Canadian, or Australian), Central American, South American, African, and Asian) as the control group. The regression equation is as follows:

$$\text{intermarriage}_i = \gamma_0 + \gamma_1 \text{post-9/11}_i + \gamma_2 \text{Muslim}_i + \gamma_3 \text{Muslim}_i \times \text{post-9/11}_i + \theta X_i + \varepsilon_i$$

Where intermarriage is a binary variable equal to 1 if the individual i intermarried and 0 otherwise, post-9/11$_i$ is equal to one if individual i is observed after 9/11 and 0 otherwise, and X is a matrix of other possible confounders, such as education, age, state's group share, group's sex ratio in the state, and fixed effects. Controlling for the population share and sex ratio of different groups is necessary since it determines how easily they can find potential partners from the same group. For the estimation, I use the linear probability model. I control for the group fixed effect to account for different characteristics associated with the region of origin.

Figure 3.3: Time Trend of Marital Status



Notes. The sample is limited to men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. *Source.* Current Population Survey (CPS), 1995-2023.

Columns (1) and (2) of Table 3.4 show the linear probability model estimates of Equation 3.5.1, respectively for men and women. The regressions are conducted separately by gender to account for potential variations in the valuation of valuable attributes in the marriage market between men and women. Controlling for other confounders, Muslims tend to intermarry more than non-Muslims, especially Muslim men marry out 16 pp more than non-Muslims. Intermarriage is more common among individuals with higher levels of education, particularly those with college education. Additionally, second-generation immigrants are more likely to marry outside their group compared to first-generation immigrants. This is expected, as second-generation immigrants are more integrated with the culture and language of their host country.

Table 3.4: Linear Probability Model Estimate of the Probability of Intermarriage

	Intermarriage		White American spouse	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	-0.016*	-0.019**	-0.009	-0.009
	(-1.68)	(-2.08)	(-0.96)	(-1.01)
Muslim	0.165***	0.099***	0.071***	0.090***
	(13.39)	(8.29)	(5.52)	(7.47)
Post 9/11 × Muslim	-0.070***	-0.104***	-0.065***	-0.117***
	(-5.35)	(-8.22)	(-4.90)	(-9.34)
Years of schooling	0.015***	0.017***	0.009***	0.009***
	(53.11)	(56.02)	(34.97)	(32.69)
College education	0.064***	0.095***	0.025***	0.062***
	(29.96)	(45.25)	(12.60)	(32.36)
Age	0.004***	0.005***	0.004***	0.005***
	(41.15)	(56.08)	(45.31)	(56.97)
First-generation immigrant	-0.153***	-0.128***	-0.124***	-0.099***
	(-95.85)	(-83.83)	(-81.89)	(-68.74)
Group fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
Population controls	✓	✓	✓	✓
Observations	435,784	460,713	435,784	460,713
R^2	0.275	0.258	0.252	0.236

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. White American refers to White US-born individuals whose parents were born in the US as well. The population controls include the share of the group from the state's population and the sex ratio of the group in the state. Groups are Muslim, White non-American, Central American, South American, African, and Asian. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

The results indicate a significant decline in the intermarriage rate of Muslims compared to other groups after 9/11. This impact is larger for women (10.4 pp decline) relative to men (7.0 pp decline). There is a slightly negative impact of 9/11 on non-Muslim groups, which confirms the results of Wang and Lofstrom (2020) that show 9/11 affected all immigrants, not only Muslims, due to changes in immigration laws. Figure 3A.2 illustrates how the

impact changes over time. Since the data represent the stock of all marriages rather than the flow of marriages, the impact is increasing over time.

It is not clear whether this decline in intermarriage is due to lower intermarriage with other ethnic minorities or with white Americans.[11] Columns (3) and (4) of Table 3.4 show the results of the same regression but limiting intermarriage to marrying a White American. The coefficients are similar to those for intermarriage, indicating that the decrease in intermarriage among Muslims is primarily attributable to reduced intermarriage with White Americans, rather than with other ethnic groups. As a robustness check, Table 3A.7 presents results of the same regressions using the Logit model instead of the linear probability model. These results confirm the findings obtained from the linear estimation.

The intermarriage rate only focuses on the married population. However, the selection of individuals into marriage might also be affected. Therefore, 9/11 may not only influence intermarriage rates but also the proportion of individuals remaining single or separating/divorcing. To measure this effect, I run the same regression as before with the probability of singlehood and separation as the dependent variable. Results are shown in Table 3.5. The probability of remaining single decreases as age increases. Additionally, more educated people are more likely to remain single, particularly women. While the trend of remaining single is generally on the rise, there was a notable decrease in the rate of singlehood among Muslims after 9/11. Hence, the decrease in intermarriage rates cannot be attributed to a decline in the overall marriage rate; rather, it reflects a shift from intermarriage to intra-marriage among Muslims.

Columns (3) and (4) of Table 3.5 show the effect of 9/11 on the share of divorced or separated people. Generally, higher education is associated with a higher separation rate, and first-generation immigrants are less likely to separate. The rate of separation among Muslims is about 1 percentage point higher than among others, but 9/11 does not significantly impact this rate. Hence, the change in intermarriage rate cannot be attributed to a higher separation rate among Muslims.

3.5.2 Intensive Margin

The extensive margin only examines the variation in the number of individuals within different marriage types, but it does not consider changes in the quality of various types of

[11] White US-born individuals whose parents were born in the US as well.

Table 3.5: Linear Probability Model Estimate of Probability of Singlehood and Separation.

	Single		Divorced/Separated	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	0.007	-0.005	-0.003	0.006
	(0.99)	(-0.79)	(-0.65)	(1.01)
Muslim	0.034***	-0.008	0.011**	0.016***
	(3.96)	(-1.02)	(2.18)	(2.63)
Post 9/11 × Muslim	-0.058***	-0.019**	-0.006	-0.009
	(-6.32)	(-2.23)	(-1.23)	(-1.54)
Years of schooling	-0.002***	0.002***	-0.002***	-0.006***
	(-6.51)	(7.07)	(-13.10)	(-31.78)
College education	0.233***	0.359***	0.008***	-0.015***
	(46.27)	(76.76)	(2.77)	(-4.65)
Age	-0.019***	-0.016***	0.005***	0.006***
	(-189.54)	(-166.44)	(71.56)	(76.57)
First-generation immigrant	-0.091***	-0.075***	-0.007***	-0.007***
	(-78.39)	(-69.16)	(-9.12)	(-8.77)
Group fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
Population controls	✓	✓	✓	✓
Observations	782,427	855,562	782,427	855,562
R^2	0.181	0.192	0.026	0.038

Notes. The sample is limited to men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. The population controls include the share of the group from the state's population and the sex ratio of the group in the state. Groups are Muslim, White non-American, Central American, South American, African, and Asian. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

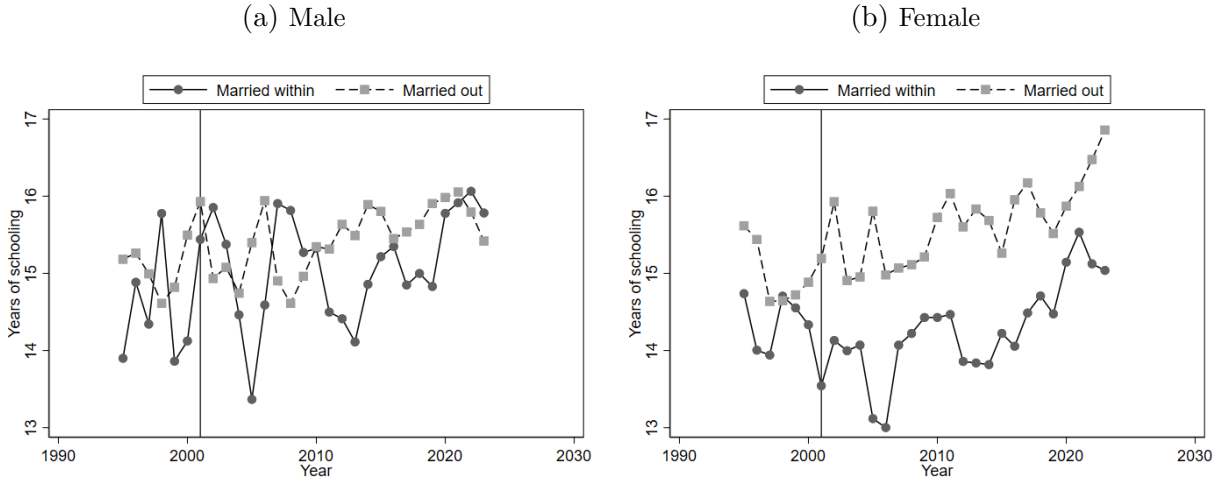
marriages or the selection of individuals into different marriage types. In this section, I examine the changes in the sorting of individuals into intermarriages and intermarriage prices following the events of 9/11.

Sorting

People who marry outside of their group are not a random representative of their group's population; they may have different characteristics than the average. This section focuses on the education level of individuals and examines whether the education level of those who choose to intermarry differs from those who marry within their group. CPS measures education by the highest year of school or degree completed. Based on that, I assign each person a number for years of schooling.

Figure 3.4 displays the years of schooling of Muslims who marry within their groups compared to those who marry outside of their groups. The level of education exhibits an increasing trend, mirroring the global trend where individuals tend to attain higher levels of education over time. Additionally, many first-generation immigrants possess high levels of education. Individuals who intermarry, on average, have a higher level of education than those who marry within their group. This gap is larger for Muslim women.

Figure 3.4: Education of Inter-married versus Intra-married Muslims



Notes. The sample is limited to married Muslim men aged 25-55 and Muslim women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. *Source.* Current Population Survey (CPS), 1995-2023.

To control for the impact of other confounders and measure changes after 9/11, I conduct a regression of each individual's education on marriage type while controlling for their characteristics. The impact of 9/11 is measured from the coefficient of interaction of post-9/11

with other characteristics.

$$\text{husband's education}_j = \delta_0^y + \delta_1^y \text{husband's age}_j + \delta_2^y \text{ intermarriage} \times \text{post } 9/11_j \times \text{Muslim}_j + \text{baselines} + \text{controls} + \nu_j^y$$

$$\text{wife's education}_i = \delta_0^x + \delta_1^x \text{wife's age}_i + \delta_2^x \text{ intermarriage}_i \times \text{post } 9/11_i \times \text{Muslim}_i + \text{baselines} + \text{controls} + \nu_i^x$$

Table 3.6 presents the results of the education sorting regressions. On average, individuals who intermarry have higher education than those who marry within their group. However, this gap is smaller for Muslims compared to non-Muslims. The impact of 9/11 on Muslim men and women is different. Muslim women who intermarry after 9/11 have higher education compared to those who intermarry before 9/11, but the opposite is true for Muslim men.

Intermarriage Price

In this section, I measure changes in intermarriage prices after 9/11 by examining how the marginal rate of substitution between intermarriage and other valuable attributes of their spouse changes. I focus on education as one of the valuable characteristics in the marriage market. As suggested by Chiappori et al. (2009), who argue that higher education is associated with a higher earning capacity and better job opportunities in the labour market. Therefore, marrying a person with higher education increases the prospects of marriage. Additionally, Lafortune (2013) demonstrates that second-generation immigrants trade off education with marrying outside their ethnic group. Another advantage of using education is that, unlike income, which can be endogenous to marriage, the education level of many individuals is determined before their marriage occurs. Another observable valuable attribute in the marriage market is age. Studies in psychology indicate that women are attracted to men older than themselves, whereas men are attracted to relatively younger women (Kenrick and Keefe, 1992). Furthermore, research on Muslim marriage preferences in the US finds that men seek mates younger than themselves (Badahdah and Tiemann, 2005). From the CPS data, I am unable to observe variables related to physical attractiveness and income before marriage. Therefore, I focus solely on education and age as observable valuable attributes in the marriage market for both men and women.

Figure 3.5 education gap of the couple for Muslims by marriage type. The education gap is measured by the spouse's years of schooling minus one's own years of schooling in a match. The results differ for men and women. On average, Muslim men who marry outside their group tend to marry partners with higher education ('marry up'), whereas Muslim women

Table 3.6: Effect of 9/11 on Sorting by Education into Intermarriage

	Intermarriage		White American spouse	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	0.205***	0.012	0.162**	0.038
	(2.98)	(0.19)	(2.36)	(0.64)
Intermarriage	1.064***	0.994***	0.554***	0.629***
	(41.96)	(45.52)	(23.65)	(30.84)
Post 9/11 × intermarriage	0.049*	0.193***	0.141***	0.156***
	(1.79)	(8.10)	(5.48)	(6.90)
Muslim	0.598***	0.435***	0.269**	0.329***
	(4.11)	(3.45)	(2.47)	(3.12)
Post 9/11 × Muslim	-0.141	-0.773***	-0.094	-0.743***
	(-0.93)	(-5.80)	(-0.82)	(-6.68)
Intermarriage × Muslim	-0.758***	-0.539***	-0.054	-0.381***
	(-4.46)	(-3.66)	(-0.35)	(-2.88)
Post 9/11 × Intermarriage × Muslim	-0.298*	0.416***	-0.468***	0.488***
	(-1.65)	(2.61)	(-2.82)	(3.34)
Group fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
Additional controls	✓	✓	✓	✓
Observations	435,784	460,713	435,784	460,713
R^2	0.269	0.243	0.257	0.228

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. Groups are Muslim, White non-American, Central American, South American, African, and Asian. Additional controls include age, whether the person is a first-generation immigrant, the share of the group from the state's population, and the sex ratio of the group in the state. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source. Current Population Survey (CPS), 1995-2023.

who marry outside their group tend to marry partners with lower education ('marry down'). From the figure, it is evident that the education gap widens after 9/11.

Figure 3.6 illustrates the age gap (husband's age minus wife's age) for intermarried versus intramarried Muslims. On average, in all types of marriages, the husband is older than the wife. In intermarriages, the age gap is smaller relative to matches where both husband and

Figure 3.5: Education Gap for Inter-married versus Intra-married Muslims

(a) Male (b) Female

Notes. The education (years of schooling) gap is equal to the spouse's years of schooling minus one's own years of schooling. The sample is limited to married Muslim men aged 25-55 and Muslim women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. *Source.* Current Population Survey (CPS), 1995-2023.

Figure 3.6: Age Gap for Inter-married versus Intra-married Muslims

(a) Male (b) Female

Notes. The age gap is equal to the spouse's age minus one's own age. The sample is limited to married Muslim men aged 25-55 and Muslim women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. *Source.* Current Population Survey (CPS), 1995-2023.

wife are Muslim. The asymmetry between men and women who married within their group is due to the possibility of marriage with first-generation immigrants who arrived after the age of 18.

To identify the change in intermarriage prices for Muslims and White Americans, I estimate the following regressions (from section 3.3):

$$x_j^s = \alpha_0 + P_y^s D_j + \alpha_1 T_i + \Delta P_y^s T_i \times D_j + \alpha_2 Z_i + e_i, \quad i = 1, ..., N_y$$
$$y_i^s = \beta_0 + P_x^s D_i + \beta_1 T_j + \Delta P_x^s T_j \times D_i + \beta_2 Z_j + e_j, \quad j = 1, ..., N_x$$

Where T is the treatment dummy variable which is equal to 1 after 9/11 and zero otherwise. The regressions are estimated for two variable attributes and their corresponding intermarriage prices: $s = \{\text{education}, \text{age}\}$.

Table 3.7: Effect of 9/11 on Education Price of Intermarriage

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Years of schooling	0.613***	0.604***	0.515***	0.590***
	(55.84)	(59.49)	(887.09)	(903.92)
Post 9/11	-0.299	-0.134	0.022*	-0.008
	(-0.89)	(-0.43)	(1.77)	(-0.56)
Intermarriage	-0.288**	-0.795***	0.735***	1.551***
	(-2.12)	(-6.00)	(12.26)	(27.12)
Post 9/11 × Intermarriage	0.966***	0.529***	-0.089	-0.585***
	(6.69)	(3.77)	(-1.27)	(-8.89)
Controls	✓	✓	✓	✓
Observations	9,812	11,538	3,440,699	3,555,520
R^2	0.388	0.386	0.335	0.314

Notes. The Muslim sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. The sample of White Americans is restricted to individuals born in the US whose parents were also born in the US. Controls include age, whether the person is a first-generation immigrant, the share of the group from the state's population, the sex ratio of the group in the state, and year fixed effects t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source. Current Population Survey (CPS), 1995-2023.

Table 3.7 shows the estimated regressions for intermarriage price using education as the valuable attribute for birth Muslims and White Americans. Results demonstrate assortative matching in education as discussed in the literature (Becker, 1973): a high correlation

between the years of schooling of husbands and wives. The education price of intermarriage is negative for Muslims and positive for White Americans, indicating a vertical ordering where Muslims gain utility from marrying White Americans but not vice versa. However, after 9/11, the utility of intermarriage significantly declines for Muslims. Conversely, for non-Muslims, the disutility of marrying a Muslim declines. Hence, the vertical ordering in the marriage market between Muslims and non-Muslims declines.

It might be the case that people care more about the college education of their spouse than the number of years of schooling. Table 3A.8 reestimates the tradeoff regression using the college graduation binary variable as the dependent variable. The results confirm the findings of Table 3.7.

Table 3.8: Effect of 9/11 on Age Price of Intermarriage

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Age	0.848***	0.980***	0.917***	0.966***
	(117.61)	(133.98)	(2589.95)	(2583.20)
Post 9/11	1.089	-0.315	0.077**	-0.044
	(1.34)	(-0.43)	(2.56)	(-1.36)
Intermarriage	1.916***	-3.125***	-0.399**	0.327**
	(6.74)	(-11.34)	(-2.46)	(2.40)
Post 9/11 × Intermarriage	-0.081	0.899***	-0.247	0.015
	(-0.27)	(3.01)	(-1.36)	(0.09)
Controls	✓	✓	✓	✓
Observations	9,812	11,538	3,440,699	3,555,520
R^2	0.651	0.683	0.732	0.722

Notes. The Muslim sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. The sample of White Americans is restricted to individuals born in the US whose parents were also born in the US. Controls include years of schooling, whether the person is a first-generation immigrant, the share of the group from the state's population, the sex ratio of the group in the state, and year fixed effects t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

Table 3.8 displays the regression results for age. A notably high correlation exists between the ages of spouses, approximately 0.9. Similar to the education findings, the age price of intermarriage is negative for Muslims and positive for non-Muslims. Specifically, Muslim men who intermarry tend to marry older wives, while Muslim women who intermarry tend to marry younger husbands. Conversely, the opposite trend is observed for White Americans. The change in age prices aligns with the changes in education prices, albeit significant only for Muslim women.

3.5.3 Labour Market

The effect of 9/11 might not be limited to the marriage market. In the case of the labour market, both the demand and supply sides might be affected: (1) Supply side: Despite the existence of employment discrimination laws, some firms decrease their demand for hiring Muslims, and (2) Demand side: Due to an increase in discrimination and hate crimes, fewer Muslims are willing to work, especially women. In this section, I measure the effect of 9/11 on the labour market outcomes for Muslims compared to others. The following regression estimates the effect of 9/11 on Muslims' labour market outcomes:

$$\text{outcome}_i = \lambda_0 + \lambda_1 \text{post } 9/11_i + \lambda_2 \text{Muslim}_i + \lambda_3 \text{post } 9/11_i \times \text{Muslim}_i + \xi X_i + \rho_i$$

Where outcome_i represents the labour market outcome for individual i, Muslim_i is a binary variable equal to 1 if individual i is Muslim, and 0 otherwise; $\text{post } 9/11_i$ is a binary variable equal to 1 if the person is observed after 9/11, and 0 otherwise; and X_i is a matrix of controls including age, education levels, marital status, and fixed effects.

Muslims, particularly Muslim women, have a lower participation rate compared to non-Muslims. After 9/11, all immigrants experience higher unemployment rates, with the change being more pronounced for Muslim men. However, overall, the impact of 9/11 on labour force participation is marginal.

Another labour market outcome that could be impacted by the backlash against Muslims after 9/11 is the self-employment rate. Two opposing effects may arise: (1) Employers may be less inclined to hire Muslims, leading them to opt for self-employment; (2) Fewer customers may be willing to interact with Muslims, such as purchasing groceries from their shops, thus prompting them to leave self-employment. The CPS data categorizes self-employment into two groups: incorporated and unincorporated self-employment. Incorporation provides benefits like limited liability and a distinct legal identity. Table 3.10 estimates the effect of

Table 3.9: Effect of 9/11 on Labour Force Participation and Unemployment

	Participation		Unemployment	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	-0.008***	0.001	0.007***	0.004***
	(-5.49)	(0.32)	(7.67)	(5.61)
Muslim	-0.024**	-0.042***	0.001	0.007
	(-2.39)	(-3.80)	(0.15)	(1.51)
Post 9/11 × Muslim	-0.006	0.005	0.012**	0.002
	(-0.57)	(0.38)	(2.38)	(0.31)
Controls	✓	✓	✓	✓
Observations	9,112,009	9,739,057	9,112,009	9,739,057
R^2	0.057	0.048	0.020	0.012

Notes. The sample is limited to people aged 18-55 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. Groups are Muslim, White non-American, Central American, South American, African, and Asian. Controls include age, years of schooling, whether the person is a first-generation immigrant, state, year, and group fixed effects. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

9/11 on the probability of incorporated and unincorporated self-employment for Muslims, using other second-generation individuals as the control group.

The findings indicate that 9/11 had a negative effect on the rate of incorporated self-employment among Muslims, while it has led to an increase in their unincorporated self-employment. Incorporated business owners are typically associated with entrepreneurship, whereas unincorporated individuals are more likely to own small businesses such as shops. Consequently, the level of entrepreneurship among Muslim women has decreased, and more of them have opted to start their own small businesses instead of working for others.

3.6 Discussion and Conclusion

This chapter estimates the effect of an exogenous shock on preferences for mixing between Muslims and non-Muslims in the UK after the 9/11 terrorist attack. The effect can be observed through both the extensive and intensive margins. In the extensive margin, the intermarriage rate of both Muslims and non-Muslims significantly declines after 9/11, and

Table 3.10: Effect of 9/11 on Self-employment

	Incorporated		Unincorporated	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	0.008*	0.009*	-0.011*	-0.003
	(1.94)	(1.88)	(-1.92)	(-1.20)
Muslim	0.026***	0.037***	0.011	-0.002
	(4.32)	(4.84)	(1.57)	(-0.54)
Post 9/11 × Muslim	-0.001	-0.024***	0.018**	0.017***
	(-0.20)	(-3.05)	(2.48)	(4.47)
Controls	✓	✓	✓	✓
Observations	416,294	388,437	417,357	387,783
R^2	0.0322	0.0164	0.0198	0.0140

Notes. The sample is limited to married men aged 25-55 and Muslim women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. Groups are Muslim, White non-American, Central American, South American, African, and Asian. Controls include age, years of schooling, whether the person is a first-generation immigrant, the share of the group from the state's population, and the sex ratio of the group in the state. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

this trend is consistent when compared to similar non-Muslim groups (control group). This impact cannot be attributed to an increase in the number of singles or separations; rather, it occurs due to a shift towards intramarriage rather than intermarriage.

In the intensive margin, this study investigates changes in intermarriage prices. Intermarriage prices represent the change necessary in other valuable attributes so that individuals remain on the same indifference curve after intermarriage (marginal rate of substitution with intermarriage). The valuable attributes focused on are education and age. The price of intermarriage for Muslims is positive, while it is negative for White Americans, suggesting that Muslims gain utility from intermarriage while White Americans lose utility. After 9/11, this gap becomes smaller, with a significant drop in Muslims' utility from intermarriage. Hence, Muslims require a higher quality spouse to marry outside of their group after 9/11. This indicates that the primary reason for the decrease in intermarriage rate is a decline in the utility of intermarriage for Muslims, rather than for non-Muslims.

Additionally, I utilize the data and Muslim identification in this study to investigate the effect of 9/11 on the labour outcomes of Muslims. This allows for a comparison of results with previous studies that have explored similar questions about labour market outcomes (Davila and Mora, 2005; Kaushal et al., 2007; Cornelissen and Jirjahn, 2012). In contrast to previous findings, I observe no negative effect on the participation rate and unemployment of Muslims. However, 9/11 demonstrates a significantly negative effect on the probability of Muslims being unincorporated self-employed.

Some assumptions were made by the model to derive the intensive margin results: (1) Homogeneity: Trade-offs, or intermarriage prices, are perceived identically by people in society; (2) Observable valuable characteristics in the marriage market only matter through a one-dimensional index; and (3) The index is a linear function of characteristics. Although these assumptions simplify the real world and limit the ability to identify heterogeneous effects, they allow for the identification of the main important effects on the marriage market given the data availability.

For identifying Muslims in the data, I employ the following definition: A person is considered Muslim if they were born in a Muslim-majority country or, if born in the US and their father was born in a Muslim-majority country. As a robustness check, I extend this definition to include the mother's birthplace alongside the father's. Thus, a person is classified as Muslim if either they were born in a Muslim-majority country or if both their parents were born in such countries. Appendix 3.A shows the main estimations. With this stricter definition of Muslims, the external margin becomes larger and stronger, but the internal margin becomes marginally weaker.

In response to the 9/11 attack, the United States implemented several changes to immigration policies, including the creation of the Department of Homeland Security, dismantling the Immigration and Naturalization Service, and tightening rules and enforcement provisions for immigrants, all aimed at preventing potential terrorists from entering the country (Donovan, 2005). These policy shifts could have influenced the first-generation immigrant population in the US. Consequently, the impact of 9/11 on their marriage market reflects a combination of immigration-related effects and changes in intermarriage preferences. However, the population of second-generation immigrants is less likely to be directly affected by alterations in immigration policies. To specifically isolate the immigration effect, I conduct a robustness check of the results focusing only on second-generation immigrants in Appendix 3.B. Although the number of observations declines significantly as a result of this limitation, all the main results remain robust.

The low number of observations due to Muslims accounting for only about 1% of the US population poses a potential issue for this study. One approach to address this challenge is to utilize data from countries with higher Muslim populations, such as certain European countries. However, this introduces a trade-off since the Muslim population in Europe may not be as diverse as in the US, with a significant proportion being Pakistani and Bangladeshi in the UK, for example. Another strategy to overcome data limitations is to leverage marriage registry data. This type of data offers a larger number of observations and provides insights into the dynamic changes within the marriage market over time, as opposed to static snapshots. Nonetheless, marriage registry data may lack some useful demographic and educational information, and some people might not officially register their marriage. Future research with higher-quality data can address these concerns.

3.A Robustness Check: Including Mother's Birthplace

In this section, I present the findings derived from Table 3.4, Table 3.7, and Table 3.8 employing an alternative definition of Muslim identity. Results are shown respectively in Table 3A.1, Table 3A.2, and Table 3A.3. With the new definition, individuals born in the US are classified as Muslim only if both parents hail from a Muslim-majority country. This more stringent criterion results in a reduced count of Muslims. However, the ensuing outcomes closely mirror those obtained previously. Notably, no substantial deviations are observed in the principal findings. Hence, these results confirm the robustness of the preceding analyses.

Table 3A.1: Probability of Intermarriage with Revised Definition of Muslim

	Intermarriage		White American spouse	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	-0.023**	-0.020*	-0.010	-0.012
	(-2.15)	(-1.87)	(-0.99)	(-1.24)
Muslim	0.140***	0.098***	0.056***	0.076***
	(8.99)	(6.97)	(3.70)	(5.64)
Post 9/11 × Muslim	-0.063***	-0.138***	-0.071***	-0.140***
	(-3.83)	(-9.38)	(-4.59)	(-10.09)
Group fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
Population controls	✓	✓	✓	✓
Observations	339,213	361,277	339,213	361,277
R^2	0.258	0.245	0.245	0.230

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. White American refers to White US-born individuals whose parents were born in the US as well. The population controls include the share of the group from the state's population and the sex ratio of the group in the state. Groups are Muslim, White non-American, Central American, South American, African, and Asian. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

Table 3A.2: Education Price of Intermarriage with Revised Definition of Muslim

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Years of schooling	0.599***	0.598***	0.515***	0.590***
	(47.90)	(54.57)	(886.61)	(903.39)
Post 9/11	-0.145	-0.101	0.023*	-0.009
	(-0.38)	(-0.29)	(1.81)	(-0.62)
Intermarriage	-0.252*	-0.939***	0.584***	1.620***
	(-1.65)	(-6.39)	(8.25)	(24.81)
Post 9/11 × Intermarriage	0.933***	0.815***	0.002	-0.600***
	(5.61)	(5.15)	(0.02)	(-7.82)
Controls	✓	✓	✓	✓
Observations	9,812	11,538	3,440,699	3,555,520
R^2	0.388	0.386	0.335	0.314

Notes. The Muslim sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. The sample of White Americans is restricted to individuals born in the US whose parents were also born in the US. Controls include age, whether the person is a first-generation immigrant, the share of the group from the state's population, the sex ratio of the group in the state, and year fixed effects t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023..

Table 3A.3: Age Price of Intermarriage with Revised Definition of Muslim

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Age	0.830***	0.977***	0.917***	0.966***
	(99.44)	(114.88)	(2588.84)	(2582.05)
Post 9/11	1.057	0.070	0.078**	-0.044
	(1.22)	(0.09)	(2.57)	(-1.37)
Intermarriage	2.621***	-3.585***	-0.234	0.049
	(8.51)	(-12.47)	(-1.11)	(0.33)
Post 9/11 × Intermarriage	-0.491	1.049***	-0.265	0.444**
	(-1.45)	(3.27)	(-1.09)	(2.45)
Controls	✓	✓	✓	✓
Observations	7,991	9,319	3,438,282	3,553,339
R^2	0.620	0.672	0.731	0.722

Notes. The Muslim sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. The sample of White Americans is restricted to individuals born in the US whose parents were also born in the US. Controls include years of schooling, whether the person is a first-generation immigrant, the share of the group from the state's population, the sex ratio of the group in the state, and year fixed effects t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

3.B Robustness Check: Only Second-generation Immigrants

This appendix exclusively examines second-generation immigrants, excluding pre-18 first-generation immigrants. This exclusion is motivated by the potential influence of post-9/11 changes in immigration policies on the selection of individuals immigrating, a factor less likely to impact second-generation immigrants.

Regarding the effect on intermarriage, a noticeable gender gap emerges, with the impact being more pronounced for women and comparatively lesser for men (Table 3A.4). It also shows a more pronounced effect on the intensive margin for both Muslims and White Americans (Table 3A.5 and Table 3A.6).

Table 3A.4: Probability of Intermarriage Focusing on Second-generation Immigrants

	Intermarriage		White American spouse	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	-0.015	-0.021	-0.006	0.003
	(-1.11)	(-1.64)	(-0.39)	(0.20)
Muslim	0.195***	0.182***	0.136***	0.169***
	(12.04)	(11.59)	(6.25)	(7.99)
Post 9/11 × Muslim	-0.050***	-0.144***	-0.078***	-0.133***
	(-2.86)	(-8.37)	(-3.39)	(-5.97)
Group fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
Population controls	✓	✓	✓	✓
Observations	194,311	208,964	194,311	208,964
R^2	0.196	0.202	0.205	0.201

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. White American refers to White US-born individuals whose parents were born in the US as well. The population controls include the share of the group from the state's population and the sex ratio of the group in the state. Groups are Muslim, White non-American, Central American, South American, African, and Asian. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

Table 3A.5: Education Price of Intermarriage Focusing on Second-generation Immigrants

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Years of schooling	0.619***	0.671***	0.515***	0.590***
	(37.45)	(38.41)	(887.09)	(903.92)
Post 9/11	-0.715	-0.158	0.022*	-0.008
	(-0.92)	(-0.33)	(1.77)	(-0.56)
Intermarriage	-0.644*	-0.916***	0.735***	1.551***
	(-1.79)	(-2.92)	(12.26)	(27.12)
Post 9/11 × Intermarriage	1.251***	0.518	-0.089	-0.585***
	(3.36)	(1.60)	(-1.27)	(-8.89)
Controls	✓	✓	✓	✓
Observations	3,300	4,215	3,440,699	3,555,520
R^2	0.444	0.380	0.335	0.314

Notes. The Muslim sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants. The sample of White Americans is restricted to individuals born in the US whose parents were also born in the US. Controls include age, the share of the group from the state's population, the sex ratio of the group in the state, and year fixed effects t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

Table 3A.6: Age Price of Intermarriage Focusing on Second-generation Immigrants

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Age	0.910***	1.020***	0.917***	0.966***
	(79.22)	(90.61)	(2589.95)	(2583.20)
Post 9/11	1.094	2.457**	0.077**	-0.044
	(0.78)	(2.03)	(2.56)	(-1.36)
Intermarriage	0.843	-0.703	-0.399**	0.327**
	(1.13)	(-1.54)	(-2.46)	(2.40)
Post 9/11 × Intermarriage	0.164	-0.987**	-0.247	0.015
	(0.21)	(-2.04)	(-1.36)	(0.09)
Controls	✓	✓	✓	✓
Observations	3,300	4,215	3,440,699	3,555,520
R^2	0.744	0.761	0.732	0.722

Notes. The Muslim sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants. The sample of White Americans is restricted to individuals born in the US whose parents were also born in the US. Controls include years of schooling, the share of the group from the state's population, the sex ratio of the group in the state, and year fixed effects t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

3.C Additional Tables

Table 3A.7: Logit Model Estimate of the Probability of Intermarriage

	Intermarriage		White American spouse	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Post 9/11	-0.093*	-0.096*	-0.046	-0.046
	(-1.81)	(-1.95)	(-0.93)	(-0.94)
Muslim	0.620***	0.427***	0.225***	0.278***
	(10.59)	(7.68)	(4.02)	(5.21)
Post 9/11 × Muslim	-0.233***	-0.460***	-0.229***	-0.506***
	(-3.81)	(-7.88)	(-3.86)	(-8.91)
Years of schooling	0.091***	0.101***	0.066***	0.066***
	(50.04)	(52.38)	(35.76)	(33.92)
College education	0.298***	0.459***	0.129***	0.383***
	(25.17)	(39.59)	(10.51)	(31.31)
Age	0.021***	0.027***	0.022***	0.028***
	(40.16)	(54.37)	(42.05)	(55.66)
First-generation immigrant	-0.808***	-0.680***	-0.719***	-0.580***
	(-96.61)	(-84.77)	(-84.94)	(-71.08)
Group fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
Population controls	✓	✓	✓	✓
Observations	435,784	460,713	435,784	460,713

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. White American refers to White US-born individuals whose parents were born in the US as well. The population controls include the share of the group from the state's population and the sex ratio of the group in the state. Groups are Muslim, White non-American, Central American, South American, African, and Asian. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

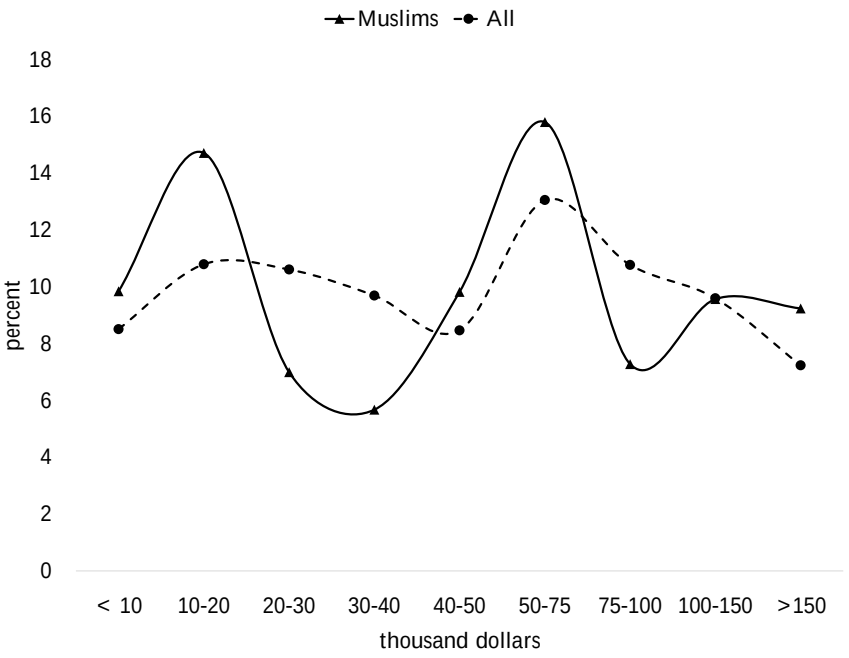
Table 3A.8: Effect of 9/11 on Education Price of Intermarriage: College Education

	Muslim		White American	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
College education	0.434***	0.449***	0.429***	0.459***
	(34.41)	(40.31)	(741.17)	(777.96)
Post 9/11	-0.024	-0.042	0.007**	-0.008***
	(-0.38)	(-1.02)	(2.37)	(-2.85)
Intermarriage	-0.013	-0.135***	0.147***	0.205***
	(-0.48)	(-6.19)	(13.06)	(27.43)
Post 9/11 × Intermarriage	0.082***	0.164***	-0.076***	-0.062***
	(2.97)	(7.21)	(-6.31)	(-7.12)
Controls	✓	✓	✓	✓
Observations	9,812	11,538	3,440,699	3,555,520
R^2	0.196	0.230	0.226	0.210

Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. Groups are Muslim, White non-American, Central American, South American, African, and Asian. Additional controls include age, whether the person is a first-generation immigrant, the share of the group from the state's population, and the sex ratio of the group in the state. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source.* Current Population Survey (CPS), 1995-2023.

3.D Additional Figures

Figure 3A.1: Annual income distribution in the US

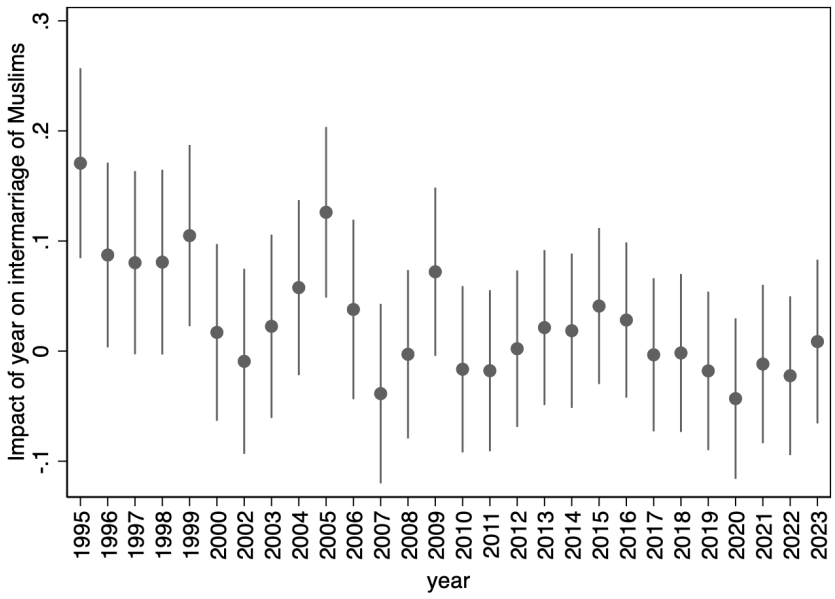


Notes. Sample includes people aged 20+.

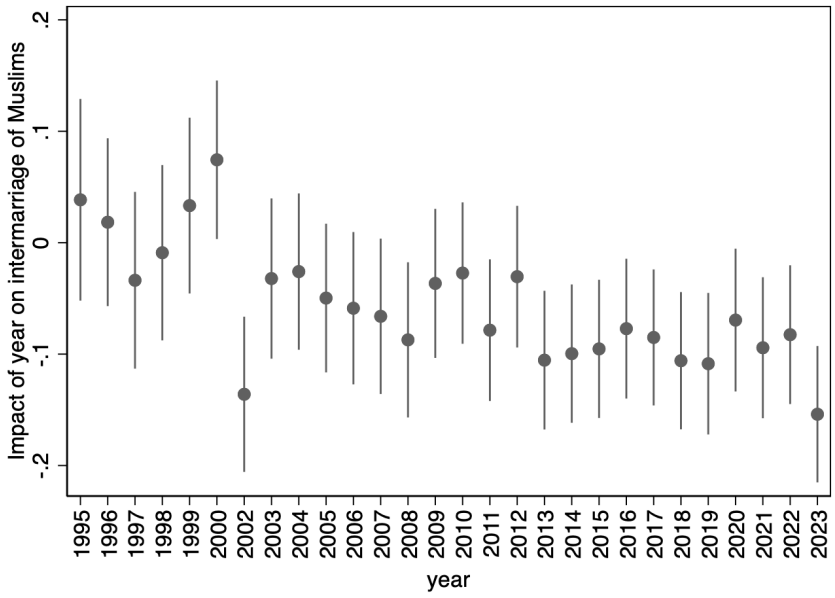
Source. US Religious Landscape Study, Pew Research Center, 2014

Figure 3A.2: Marginal Effect of Year on Probability of Intermarriage

(a) Male



(b) Female



Notes. The sample is limited to married men aged 25-55 and women aged 23-53 who are either second-generation immigrants or first-generation immigrants who arrived before the age of 18. White American refers to White US-born individuals whose parents were born in the US as well. The population controls include age, years of schooling, immigration status, the share of the group from the state's population and the sex ratio of the group in the state, and group fixed effects. Groups are Muslim, White non-American, Central American, South American, African, and Asian. *Source.* Current Population Survey (CPS), 1995-2023.

Bibliography

Adda, J., Pinotti, P., and Tura, G. (2020). There's more to marriage than love: the effect of legal status and cultural distance on intermarriages and separations.

Adida, C. L., Laitin, D. D., and Valfort, M.-A. (2016). *Why Muslim integration fails in Christian-heritage societies*. Harvard University Press.

Ahmed, A. M. and Hammarstedt, M. (2008). Discrimination in the rental housing market: A field experiment on the internet. *Journal of Urban Economics*, 64(2):362–372.

Ahn, S. Y. et al. (2020). Matching across markets: An economic analysis of cross-border marriage. *University of Illinois mimeo*.

Allen, C. (2016). *Islamophobia*. Routledge.

Anderberg, D. and Vickery, A. (2021). The role of own-group density and local social norms for ethnic marital sorting: Evidence from the uk. *European Economic Review*, 138:103774.

Badahdah, A. M. and Tiemann, K. A. (2005). Mate selection criteria among muslims living in america. *Evolution and Human Behavior*, 26(5):432–440.

Bakalian, A. and Bozorgmehr, M. (2009). *Backlash 9/11: Middle Eastern and Muslim Americans Respond*. Univ of California Press.

Baker, W., Stockton, R., Howell, S., Jamal, A., Lin, A. C., Shryock, A., and Tessler, M. (2003). Detroit arab american study (daas). ann arbor, mi: Inter-university consortium for political and social research [university of michigan]. `https://doi.org/10.3886/ICPSR04413.v2`.

Banerjee, A., Duflo, E., Ghatak, M., and Lafortune, J. (2013). Marry for what? caste and mate selection in modern india. *American Economic Journal: Microeconomics*, 5(2):33–72.

Bech-Sørensen, J. and Pollet, T. V. (2016). Sex differences in mate preferences: A replication study, 20 years later. *Evolutionary Psychological Science*, 2:171–176.

Beck-Gernsheim, E. (2007). Transnational lives, transnational marriages: a review of the evidence from migrant communities in europe. *Global networks*, 7(3):271–288.

Becker, G. S. (1973). A theory of marriage: Part i. *Journal of Political economy*, 81(4):813–846.

Becker, G. S. (1974). A theory of marriage: Part ii. *Journal of political Economy*, 82(2, Part 2):S11–S26.

Becker, G. S. (2010). *The economics of discrimination*. University of Chicago press.

Becker, G. S. and Becker, G. S. (2009). *A Treatise on the Family*. Harvard university press.

Bisin, A., Patacchini, E., Verdier, T., and Zenou, Y. (2008). Are muslim immigrants different in terms of cultural integration? *Journal of the European Economic Association*, 6(2-3):445–456.

Bisin, A., Topa, G., and Verdier, T. (2004). Religious intermarriage and socialization in the united states. *Journal of political Economy*, 112(3):615–664.

Bonjour, S. and Kraler, A. (2015). Introduction: Family migration as an integration issue? policy perspectives and academic insights. *Journal of Family Issues*, 36(11):1407–1432.

Border and Agency, I. (2007). Marriage to partners from overseas: A consultation paper.

Breta, G. (2002). *Secure Borders, Safe Haven: Integration with Diversity in Modern Britain*. Stationery Office.

Bryceson, D. and Vuorela, U. (2020). *The transnational family: New European frontiers and global networks*. Routledge.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and brain sciences*, 12(1):1–14.

Casey, L. (2016). The casey review: A review into opportunity and integration.

Charsley, K. (2013). Transnational marriage. In *Transnational marriage*, pages 12–31. Routledge.

Charsley, K., Bolognani, M., Ersanilli, E., and Spencer, S. (2020). *Marriage migration and integration*. Springer.

Charsley, K., Bolognani, M., and Spencer, S. (2017). Marriage migration and integration: Interrogating assumptions in academic and policy debates. *Ethnicities*, 17(4):469–490.

Charsley, K. and Liversage, A. (2015). Silenced husbands: Muslim marriage migration and masculinity. *Men and Masculinities*, 18(4):489–508.

Chiappori, P.-A. (2017). *Matching with transfers*. Princeton University Press.

Chiappori, P.-A., Fiorio, C. V., Galichon, A., and Verzillo, S. (2022). Assortative matching on income. Technical report, JRC Working Papers in Economics and Finance.

Chiappori, P.-A., Iyigun, M., and Weiss, Y. (2009). Investment in schooling and the marriage market. *American Economic Review*, 99(5):1689–1713.

Chiappori, P.-A., Nguyen, D. L., and Salanié, B. (2019). Matching with random components: simulations. *Work. Pap., Columbia Univ., New York Google Scholar Article Location*, 5.

Chiappori, P.-A., Oreffice, S., and Quintana-Domeque, C. (2012). Fatter attraction: anthropometric and socioeconomic matching on the marriage market. *Journal of Political Economy*, 120(4):659–695.

Chiappori, P.-A., Oreffice, S., and Quintana-Domeque, C. (2020). Erratum: Fatter attraction: Anthropometric and socioeconomic matching on the marriage market. *Journal of Political Economy*, 128(12):4673–4675.

Chiappori, P.-A. and Reny, P. J. (2016). Matching to share risk. *Theoretical Economics*, 11(1):227–251.

Chiappori, P.-A., Salanié, B., and Weiss, Y. (2017). Partner choice, investment in children, and the marital college premium. *American Economic Review*, 107(8):2109–67.

Choo, E. and Siow, A. (2006). Who marries whom and why. *Journal of political Economy*, 114(1):175–201.

Ciscato, E., Galichon, A., and Goussé, M. (2020). Like attract like? a structural comparison of homogamy across same-sex and different-sex households. *Journal of Political Economy*, 128(2):740–781.

Corblet, P. (2021). Education expansion, sorting, and the decreasing wage premium.

Cornelissen, T. and Jirjahn, U. (2012). September 11th and the earnings of muslims in germany—the moderating role of education and firm size. *Journal of Economic Behavior & Organization*, 81(2):490–504.

Cuturi, M. (2013). Sinkhorn distances: Lightspeed computation of optimal transport. *Advances in neural information processing systems*, 26.

Davila, A. and Mora, M. T. (2005). Changes in the earnings of arab men in the us between 2000 and 2002. *Journal of Population Economics*, 18(4):587–601.

Davis, K. (1941). Intermarriage in caste societies. *American Anthropologist*, 43(3):376–395.

Donovan, T. W. (2005). Immigration policy changes after 9/11: Some intended and unintended consequences. *The Social Policy Journal*, 4(1):33–50.

Dupuy, A. (2021). Migration in china: To work or to wed? *Journal of Applied Econometrics*, 36(4):393–415.

Dupuy, A. and Galichon, A. (2014). Personality traits and the marriage market. *Journal of Political Economy*, 122(6):1271–1319.

Eeckhout, J. and Kircher, P. (2010). Sorting and decentralized price competition. *Econometrica*, 78(2):539–574.

Eggebø, H. and Brekke, J.-P. (2019). Family migration and integration. *Nordic Journal of Migration Research*, 9(4):425–444.

Eika, L., Mogstad, M., and Zafar, B. (2019). Educational assortative mating and household income inequality. *Journal of Political Economy*, 127(6):2795–2835.

Elsayed, A. and De Grip, A. (2018). Terrorism and the integration of muslim immigrants. *Journal of Population Economics*, 31(1):45–67.

Fisman, R., Iyengar, S. S., Kamenica, E., and Simonson, I. (2008). Racial preferences in dating. *The Review of Economic Studies*, 75(1):117–132.

Fryer Jr, R. G. (2007). Guess who's been coming to dinner? trends in interracial marriage over the 20th century. *Journal of Economic Perspectives*, 21(2):71–90.

Gale, D. and Shapley, L. S. (1962). College admissions and the stability of marriage. *The American Mathematical Monthly*, 69(1):9–15.

Galichon, A., Kominers, S. D., and Weber, S. (2019). Costly concessions: An empirical framework for matching with imperfectly transferable utility. *Journal of Political Economy*, 127(6):2875–2925.

Galichon, A. and Salanié, B. (2010). Matching with trade-offs: Revealed preferences over competing characteristics.

Galichon, A. and Salanié, B. (2017). Iia in separable matching markets.

Galichon, A. and Salanié, B. (2022a). Cupid's invisible hand: Social surplus and identification in matching models. *The Review of Economic Studies*, 89(5):2600–2629.

Galichon, A. and Salanié, B. (2022b). Estimating separable matching models. *arXiv preprint arXiv:2204.00362*.

Gautier, P. A., Siegmann, A., and Van Vuuren, A. (2009). Terrorism and attitudes towards minorities: The effect of the theo van gogh murder on house prices in amsterdam. *Journal of Urban Economics*, 65(2):113–126.

Georgiadis, A. and Manning, A. (2011). Change and continuity among minority communities in britain. *Journal of Population Economics*, 24(2):541–568.

Gillum, R. M. (2018). *Muslims in a Post-9/11 America: A Survey of Attitudes and Beliefs and Their Implications for US National Security Policy*. University of Michigan Press.

González-Ferrer, A. (2006). Who do immigrants marry? partner choice among single immigrants in germany. *European Sociological Review*, 22(2):171–185.

Goodhart, D. (2013). *The British dream: Successes and failures of post-war immigration*. Atlantic Books Ltd.

Gould, E. D. and Klor, E. F. (2016). The long-run effect of 9/11: Terrorism, backlash, and the assimilation of muslim immigrants in the west. *The Economic Journal*, 126(597):2064–2114.

Gualdani, C. and Sinha, S. (2020). Partial identification in matching models for the marriage market.

Hall, T., Manning, A., and Sumption, M. (2023). Projecting uk net migration.

Hatfield, J. W. and Milgrom, P. R. (2005). Matching with contracts. *American Economic Review*, 95(4):913–935.

Hitsch, G. J., Hortaçsu, A., and Ariely, D. (2010a). Matching and sorting in online dating. *American Economic Review*, 100(1):130–63.

Hitsch, G. J., Hortaçsu, A., and Ariely, D. (2010b). What makes you click?—mate preferences in online dating. *Quantitative marketing and Economics*, 8:393–427.

Humanists UK (2021). New survey reveals how census question leads people to tick a religious answer. `https://humanists.uk/2021/03/04/new-survey-reveals-how-census-question-leads-people-to-tick-a-religious-answer/`.

Jacquet, A. and Montpetit, S. (2022). Veiling and economic integration of muslim women in france.

Johnston, D. W. and Lordan, G. (2012). Discrimination makes me sick! an examination of the discrimination–health relationship. *Journal of Health Economics*, 31(1):99–111.

Kaushal, N., Kaestner, R., and Reimers, C. (2007). Labor market effects of september 11th on arab and muslim residents of the united states. *Journal of Human Resources*, 42(2):275–308.

Kawaguchi, D. and Lee, S. (2017). Brides for sale: Cross-border marriages and female immigration. *Economic Inquiry*, 55(2):633–654.

Kelso Jr, A. S. and Crawford, V. P. (1982). Job matching, coalition formation, and gross substitutes. *Econometrica: Journal of the Econometric Society*, pages 1483–1504.

Kenrick, D. T. and Keefe, R. C. (1992). Age preferences in mates reflect sex differences in human reproductive strategies. *Behavioral and Brain Sciences*, 15(1):75–91.

Koopmans, T. C. and Beckmann, M. (1957). Assignment problems and the location of economic activities. *Econometrica: journal of the Econometric Society*, pages 53–76.

Lafortune, J. (2013). Making yourself attractive: Pre-marital investments and the returns to education in the marriage market. *American Economic Journal: Applied Economics*, 5(2):151–78.

Lang, K. and Spitzer, A. K.-L. (2020). Race discrimination: An economic perspective. *Journal of Economic Perspectives*, 34(2):68–89.

Legros, P. and Newman, A. F. (2007). Beauty is a beast, frog is a prince: Assortative matching with nontransferabilities. *Econometrica*, 75(4):1073–1102.

Manning, A. and Roy, S. (2010). Culture clash or culture club? national identity in britain.

McFadden, D. (1974). The measurement of urban travel demand. *Journal of public economics*, 3(4):303–328.

Merton, R. K. (1941). Intermarriage and the social structure: Fact and theory. *Psychiatry*, 4(3):361–374.

OECD (2017). International migration outlook 2017. `http://dx.doi.org/10.1787/migr_outlook-2017-en`.

Pew Research Center (2011). Muslim americans: No signs of growth in alienation or support for extremism. https://www.pewresearch.org/wp-content/uploads/sites/4/legacy-pdf/Muslim-American-Report-10-02-12-fix.pdf.

Pew Research Center (2017). Us muslims concerned about their place in society, but continue to believe in the american dream. https://www.pewresearch.org/wp-content/uploads/sites/7/2017/07/U.S.-MUSLIMS-FULL-REPORT.pdf.

Riley, N. S. (2013). *'Til Faith Do Us Part: How Interfaith Marriage is Transforming America*. Oxford University Press.

Rodgers, W. M. (2009). *Handbook on the Economics of Discrimination*. Edward Elgar Publishing.

Roth, A. E. (2015). *Who gets what–and why: the new economics of matchmaking and market design*. Houghton Mifflin Harcourt.

Ruthven, M. (2006). *Islam in the World*. Granta.

Shapley, L. S. and Shubik, M. (1971). The assignment game i: The core. *International Journal of game theory*, 1:111–130.

Shimer, R. and Smith, L. (2000). Assortative matching and search. *Econometrica*, 68(2):343–369.

Siow, A. (2015). Testing becker's theory of positive assortative matching. *Journal of Labor Economics*, 33(2):409–441.

Smith, J. I. (2010). *Islam in America*. Columbia University Press.

Wang, C. and Lofstrom, M. (2020). September 11 and the rise of necessity self-employment among mexican immigrants. *Eastern Economic Journal*, 46(1):5–33.

Weiss, Y., Yi, J., and Zhang, J. (2018). Cross-border marriage costs and marriage behavior: Theory and evidence. *International Economic Review*, 59(2):757–784.