

RESEARCH PAPER

Changes in assortative matching and educational inequality: evidence from marriage and birth records in Mexico

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Abstract

Over the past three decades, educational attainment in Mexico has grown substantially. This increase in educational attainment may affect marriage patterns through the growing supply of individuals with higher education and changing preferences over their partner's education level. We use administrative marriage and birth certificate records to quantify changes in the relative education levels for both married and unmarried couples. Our results suggest that individuals who marry outside their education category prefer to match with a partner with a similar education level. That is, college graduates prefer to match with individuals with a secondary education rather than those with a primary education. We also find that assortativeness among pairs which include college graduates has grown considerably over this time period. Our findings hold across both marriage records and birth certificate records, indicating a parallel increase in assortativeness regardless of marital status.

Keywords: Educational assortative matching; marriage; Mexico

JEL classification: J11; J12; I24

1. Introduction

In recent decades, Mexico has experienced both increases in per-capita income and declines in income inequality [Lustig *et al.* (2013)]. Despite these gains, income inequality remains considerably higher in Mexico compared to other OECD countries [OECD (2016)]. Educational attainment in Mexico has similarly grown over recent decades; however, a large share of the population still has less than a primary education. If couples sort by educational attainment, then the marriage market may amplify inequality across households.¹ Moreover, inequality due to

¹A large literature examines the relationship between educational assortative matching and income inequality across households. Breen and Salazar (2011), Greenwood *et al.* (2014), and Eika *et al.* (2018) are examples.

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assortative matching has the potential to impact future generations through intergenerational transfers of human capital.²

In this paper, we study educational assortative matching using administrative marriage and birth records. To better understand the Mexican context, we begin by documenting demographic trends over the past three decades in marriage, divorce, and fertility rates, as well as trends in educational attainment. We establish several stylized facts. First, we show that marriage rates have declined across all education levels, with both men and women marrying later on average. Second, the birth rate in Mexico has converged across education levels, decreasing for those with lower levels of education and increasing for highly educated individuals. Third, we observe a significant increase in educational attainment, especially for women. As a result, among newly married couples from 2007 onward, the spouse with higher levels of education is more likely to be the wife.

Unlike the above descriptive trends, measuring how assortative matching has changed over time is not straightforward [Chiappori *et al.* (2021)]. The main challenge is that the marginal distributions of education for men and women have shifted over time, and in particular, the distributions have become more similar. As a result, the prevalence of same-education couples has mechanically increased. We, and the literature at large, are primarily interested in identifying how preferences for same-education partners have evolved over this time period, *after accounting for these mechanical changes*.

Several methods have been developed to overcome this measurement challenge. We primarily rely on Chiappori *et al.* (2020)'s Separable Extreme Value (SEV) index, which measures assortativeness using an underlying structural model that builds upon Choo and Siow (2006).³ The key idea behind the model (and the resulting index) is that sorting is determined by the utility that spouses derive from matching with a particular type of partner. As a result, one can connect changes in preferences for a partner of the same education level to changes in assortativeness. Since changes in preferences over partners are precisely what we wish to capture, the use of the model to measure assortativeness is preferable to alternative methods.⁴ Nonetheless, we also employ [Shen (2020)]'s Perfect-Random Normalization measure of assortativeness in the Appendix as a robustness check. The Perfect-Random normalization has the advantage of being an intuitive measure that also accounts for changes in the distributions of men's and women's education levels over time.

We compute our measures of assortativeness using the full universe of administrative marriage records recorded in Mexico by the National Institute of Statistics and Geography (INEGI). Our results suggest that assortativeness has broadly increased over the past thirty years. In Mexico, it has become increasingly common for

²Recent work on the impact of assortative matching on child outcomes and intergenerational mobility includes Beck (2009), Kye and Mare (2012), and Bratsberg *et al.* (2018).

³A growing literature builds upon the Choo and Siow (2006) framework to examine marital matching. Recent contributions in this area include Dupuy and Galichon (2014), who extend the matching framework to allow for couples to match on multiple discrete and continuous characteristics. Galichon and Salanié (2021) similarly build upon Choo and Siow (2006) to allow for a more general form of unobserved heterogeneity. Other contributions in this area include Ciscato and Weber (2020), Dupuy and Weber (2022), Ciscato *et al.* (2020), to name several.

⁴Chiappori *et al.* (2020) discuss how other measures of assortativeness, such as the log-linear measure used in Schwartz and Mare (2005) or the likelihood approach in Eika *et al.* (2018), may lead to spurious conclusions regarding changes in assortativeness over time.

partners of similar education levels to marry one another, even after accounting for increases in educational attainment. Moreover, we find that this result is especially strong among the college educated.⁵

These findings, however, mask important heterogeneity that underlies our summary measures. In particular, assortativeness is a local property [Chiappori *et al.* (2020)], meaning that it is possible for assortativeness to be high within one pair of education categories (e.g., college and secondary), but low within other pairs (e.g., primary and middle). In our context, we divide individuals into four mutually exclusive education categories: primary or less, middle, secondary, and college. Allowing for multiple education categories is especially important in Mexico, where a high share of the population has less than a middle-school education (see Fig. A1 in the Appendix).

We find that the level of assortativeness is higher when focusing on non-adjacent versus adjacent education categories (i.e., primary-college versus secondary-college). This finding suggests that both men and women prefer partners who have slightly lower or higher education but not those with significantly different levels of education. Second, we find that the assortativeness of adjacent education categories has increased only slightly over the past three decades. However, we observe a large increase in assortativeness among college graduates. Moreover, this increase is greater when measuring assortativeness among college graduates and individuals in non-adjacent education categories.

We complement our primary analysis using marriage records by replicating the findings using annual birth records. Birth records allow us to examine both marital *and* parental matching. The benefit of using administrative birth records, which is not standard, is that it highlights the transmission of educational inequality across generations [Mare and Schwartz (2006)]. While computing assortativeness using marriage records captures a portion of this relationship, birth records are a more direct measure as not every marriage results in children, and not every child has married parents. The difference between these two data sources is especially relevant in Mexico, where it is increasingly common to have a first birth while cohabiting or being unmarried. However, the cost of using birth records is missing information on the father's education, which we discuss in Sec. B of the Appendix.

We find that the patterns are remarkably similar regardless of whether we use birth or marriage records. Both the relative magnitudes of assortativeness in a given year and the trends we observe over time are similar across marriages and births. If there is any meaningful difference, parental education may be slightly less assortative, but this result depends on the pair of education categories being considered. This similarity is perhaps unsurprising; childless couples in Mexico are rare, and it follows that marital and parental matching is similar. This result differs somewhat, however, from comparable work in the United States by Mare and Schwartz (2006), who find parental matches are more positively assortative than marriage matches.

This paper makes three contributions to the existing literature. First, we measure the evolution of assortative matching in Mexico over the past 30 years, adding to the cross-sectional results in Choi and Mare (2012) and Torche (2010). While a large literature has examined changes over time in assortative matching in high-income countries, less is known about the dynamics in a country like Mexico, where educational attainment is rapidly growing and the patterns are different for men and

⁵Interpreting magnitudes of change in an index value is not straightforward. As a result, we provide numerical examples in Sec. 4.4 to provide additional context to our results.

women.⁶ For example, in the United States, the gender gap in education between men and women has reversed [Goldin *et al.* (2006); Fortin *et al.* (2015); Bavel *et al.* (2018)]. While this reversal has also occurred in some Latin American countries, it has not in Mexico [Duryea *et al.* (2007); Ganguli *et al.* (2014)]. These differing patterns may have implications for the marriage market, and therefore inequality as well.

Our second contribution is to measure parental matching using administrative birth records. In Mexico, where a majority of births are currently to unmarried couples, measuring matching patterns among parents is necessary to understand trends in intergenerational mobility. We, therefore, complement existing work by Mare and Schwartz (2006) and Shen (2020) who examine parental matching in the United States, as well as Krzyzanowska and Mascie-Taylor (2014) and Bratsberg *et al.* (2018) who study the relationship between assortative matching and fertility in the United Kingdom and Norway, respectively.

Finally, we deviate from the existing literature by measuring assortative marriage matching using administrative records of new marriages and births as opposed to using census data. The advantage of having the full universe of new marriages is that it allows us to detect immediate changes in the marriage market. Nonetheless, the use of data on new marriages and births has several disadvantages related to changes in the age at marriage over time and the relationship between divorce and assortativeness. We discuss these issues in more detail in Sec. 4.

The rest of the paper is organized as follows. In Sec. 2 we provide an overview of the related literature on assortativeness and discuss formal measures of assortative matching. Section 3 provides an overview of demographic trends in Mexico, and relates this to changes in assortative matching. We then present the results in Sec. 4. Section 5 concludes.

2. Assortative matching

This study primarily relates to research on assortative matching and how it has evolved over time. The extent to which individuals with similar characteristics marry has interested economists, sociologists, and demographers as it is relevant to intergenerational mobility, inter- and intra- household inequality, and more generally to how partners within the marriage interact.⁷

2.1. Previous work on assortative matching

A large literature has measured changes in matching patterns over time in the United States. While past research in this area has suggested that assortativeness has increased continuously in recent decades [Schwartz and Mare (2005); Hou and Myles (2008); Mare (2016); Eika *et al.* (2018)], there is a growing consensus that this was not necessarily the case.⁸ Gihleb and Lang (2017) highlight the measurement difficulties

⁶Notable exceptions include Park and Smits (2005) and Smits and Park (2009), who examine changes in assortative matching in East Asia. These studies find that in some contexts, educational homogamy has declined over time, while in others (such as South Korea), it has risen.

⁷See Kalmijn (1998) and Schwartz (2013) for an overview on research on assortative matching.

⁸Mare (1991), for example, finds that assortative matching stopped increasing in the 1980s. Similarly, Siow (2015) finds no increase in educational assortative matching between 1970 to 2000 despite an increase in homogamy rates.

inherent in such exercises and demonstrate that results are often sensitive to how education categories are chosen. Recent work by Shen (2020), building upon work by Liu and Lu (2006), has discussed the importance of differential changes in education rates by gender, and how this may also lead to incorrect conclusions. Shen (2020) suggests a measure of assortativeness that avoids these complications and finds that assortativeness declined in the United States prior to 2000, but has increased more recently. Finally, the more structural literature has consistently found little change in assortativeness over time in the United States (see, e.g., Siow, 2015; Chiappori *et al.*, 2017).

We are not the first study to examine assortative matching in Mexico. Choi and Mare (2012) study the relationship between US-Mexico migration and assortative matching and find that migration results in more heterogeneous couples as migration alters the pool of available spouses.⁹ Similar work by Solís *et al.* (2007) studies the relationship between migration and assortative matching over time in Monterrey, Mexico. Finally, Torche (2010) also measures assortative matching using the 2000 Mexico census. We differ from these studies in several important ways. First, unlike Choi and Mare (2012) and Torche (2010), we examine how assortative matching has changed over time. Second, unlike [Solís *et al.* (2007)], we focus on all of Mexico, and not just a single state. Moreover, we account for changes in the marginal distributions of male and female education. We also examine parental matching, which adds to our understanding of the role of assortative matching in intergenerational mobility.

2.2. Measuring assortative matching

The extent of assortative matching is determined by the number of individuals with similar characteristics (in our case education) marrying one another. While this concept is straightforward, there are several measurement challenges that researchers need to overcome. First, changes in the distributions of men's and women's education over time make intertemporal comparisons of assortativeness challenging. If these distributions grow more similar over time (as has been the case in Mexico), that mechanically increases the maximum degree of sorting. We wish to measure preferences for homogamous unions after accounting for changes in the underlying male and female education distributions.

A second challenge is defining education categories. Gihleb and Lang (2017) demonstrate that grouping college graduates and post-graduate degrees leads to different conclusions about how assortativeness has changed over time in the United States. This problem is more relevant in our context where education levels vary from post-college degrees to individuals with less than a primary education. We address this by using four education categories to flexibly measure assortativeness across the education distribution.

We begin by introducing the notation we use to measure assortativeness. We then discuss [Chiappori *et al.* (2020)], who provide a way of computing assortativeness that is robust to changes in gender-specific education rates across time, and is therefore ideal for the Mexican setting. The added benefit of Chiappori *et al.* (2020) is that it connects the level of assortativeness with an underlying structural, marriage matching model.

⁹Related work by Raphael (2013) examines how heterogeneous sex ratios driven by state-specific US-Mexico migration affect female welfare in Mexico.

Three parameters will govern our measures of assortativeness. Let m and n be the proportion of male and female college graduates, respectively. Let r denote the proportion of marriages where both spouses are college graduates. For now, we consider only two types of education levels (college and high school), but in our empirical analysis, we use four education categories: college, secondary, middle, and primary or less. If there were perfect assortative matching, then r would equal the minimum of m and n . If the matching were random, then r would equal the product of m and n .¹⁰ Where r falls in this interval determines the extent of assortative matching observed in the population. Table I illustrates the degree of assortative matching in matrix form. Panel A provides the notation for the observed values. Panel B illustrates the case of random matching, and Panel C presents the case of perfect matching, when there is an equal number of men and women with college degrees (i.e., $m = n$).

Chiappori *et al.* (2021) discuss several properties that any measure of assortative matching must satisfy. The first property, *Monotonicity*, requires that assortativeness is increasing in r when m and n are fixed. This intuitive property simply means that the level of assortative matching is higher if there are more couples that both have the highest education level. It follows that assortativeness is increasing in the number of non-college educated couples, given by $1 - m - n + r$. The second property, *Perfectly Assortative Matching*, states that the maximum level of assortativeness occurs when there are no couples of mixed education levels (when $m = n$). The third property is *Scale Invariance*, meaning that the size of the population should not affect the index measure. Finally, *Symmetry* requires that an index should treat the two categories identically. While these properties seem obvious, they are necessary to deal with the complexities of changing distributions of education levels over time.

2.3. The separable extreme value model

We use the SEV model following Chiappori *et al.* (2020) to measure assortativeness. As in Choo and Siow (2006), this model requires frictionless marital matching and a transferable utility setting.¹¹ Men match with women, and each match generates a marital surplus that is divided among the spouses. The matching is stable if there is no man and woman who would prefer to divorce their spouse and marry each other. With this being the case, we can infer the deterministic utility each spouse derives from being married by observing matching patterns, which we then use to infer the level of assortativeness.

We provide more details regarding the model derivation in Sec. D in the Appendix, and summarize the key elements here. Suppose there are X men, who are denoted by the subscript i , and Y women denoted by the subscript j in a marriage market. Men and women maximize their utility, and can either remain single or get married. A match generates a surplus s_{ij} that is divided among the spouses. With Transferable Utility, this gain is additively separable between spouses.¹² Let u_i be the man's utility from marriage, and v_j the utility of the woman. Then $s_{ij} = u_i + v_j$.

¹⁰If there were perfect negative assortative matching, r would equal $|m - n|$.

¹¹With search frictions, we may see less sorting since individuals may be less inclined to wait for a preferred match [Chiappori *et al.* (2016)].

¹²Without transferable utility, the marital surplus would be harder to share across spouses, thereby making hypergamous couples less common.

Table 1. Assortative matching in a two-education market

	College	High School
Panel A: Observed		
College	r	$m - r$
High School	$n - r$	$1 + r - m - n$
Panel B: Random		
College	mn	$m(1 - n)$
High School	$n(1 - m)$	$(1 - m)(1 - n)$
Panel C: Perfectly Assortative		
College	n	0
High School	0	$1 - n$

Note: In the above tables, r denotes the share of marriages where both spouses have a college degree, and m and n denotes the number of men and women with a college degree, respectively. In Panel C, we assume the education distributions for men and women are identical.

Under the SEV model, there are a small (relative to the size of X and Y) number of types of individuals $I \in \{1, \dots, N\}$. In our context these will be levels of education, and for simplicity we assume that $N = 2$ for now. The marriage surplus when man i matches with woman j is given by: $s_{ij} = Z^{IJ} + \gamma_{ij}$ where Z^{IJ} is the deterministic component of the surplus which only depends on individual education levels, and γ_{ij} is unobserved preference heterogeneity that reflects each spouse’s utility from marriage outside of what is driven by observable characteristics. Let the surplus for a man to remain single be given by $s_{i0} = \epsilon_i^0$ and similarly for women $s_{0j} = v_j^0$. Normalizing the deterministic part of the surplus to zero for singles means that we can interpret the matrix $Z = [Z^{IJ}]$ as the influence of education on matching patterns. With two levels of education, the *supermodular core* of Z is given by $S = Z^{11} + Z^{22} - Z^{12} - Z^{21}$. We can therefore think of S as a measure of complementarity. Moreover, the greater S is, the more gains there are from marrying a same-education level spouse. It follows that S will be a natural measure of positive assortative matching.^{13,14}

¹³The final two key assumptions of the SEV model is that the random component of the surplus γ_{ij} is additively separable between individual-specific preference terms, with $\gamma_{ij} = \epsilon_i^j + v_j^i$, and that these terms are independent of each other and Type 1 Extreme Value. However, the error terms do not have to follow a Type 1 Extreme Value distribution for identification [Galichon and Salanié (2015)]. This assumption is standard and made out of convenience. For more discussion of how this distributional assumption see Chiappori *et al.* (2020).

¹⁴In addition to assuming the distribution of unobserved preference heterogeneity is Type 1 Extreme Value, we are also implicitly assuming that the degree of unobserved heterogeneity is constant over time. This restriction matters as it implies any change in matching patterns over time is attributable only to observable preference changes. A more general model would incorporate a scaling parameter σ , so that the utility of men and women would be given by $u_i = U^{IJ} + \sigma_i \epsilon_i$ and $v_i = V^{IJ} + \sigma_j v_j$, respectively. This generalization is employed by Ciscato *et al.* (2020) and Ciscato and Weber (2020) who each attempt to account for changes in unobserved heterogeneity across marriage markets by normalizing the scaling parameter σ . For example, Ciscato *et al.* (2020) standardize the scaling parameter such that the average surplus of couples is the same across marriage markets.

Following Chiappori *et al.* (2020), the supermodular core in the two-education case is written as follows:

$$S = Z^{11} + Z^{22} - Z^{12} - Z^{21} = 2 \ln \left(\frac{r(1+r-m-n)}{(n-r)(m-r)} \right) \quad (1)$$

This result can then be used to write the SEV assortativeness index that we use in our analysis:

$$I_{SEV}(m, n, r) = \ln \left(\frac{r(1+r-m-n)}{(n-r)(m-r)} \right) \quad (2)$$

which can again be computed as r , m , and n are observable. One can understand this index by noting the sorting matrix given in Panel A of Table I. In effect, the SEV index is the sum of the logs of the diagonal elements of the sorting matrix (i.e., the homogamous matches) minus the sum of the logs of the off-diagonal elements (i.e., the hypergamous matches). Stated differently, a sorting matrix exhibits more assortative matching if there are more marriages along the main diagonal. When the matching is random, $I_{SEV} = 0$. If there is positive assortative matching, then $I_{SEV} > 0$. Finally, when there is negative assortative matching, $I_{SEV} < 0$. We discuss in more detail how to interpret the magnitudes of changes in the index in Sec. 4.4.

We also present an alternative measure of assortativeness, the Perfect-Random Normalization of Shen (2020), which normalizes the case of random matching ($r = mn$) to zero and perfect matching ($r = \min\{m, n\}$) to one. The index that ranks assortative matching is then given as follows where $m \geq n$:

$$I_{PRN}(m, r, n) = \frac{r - mn}{n - mn} \quad (3)$$

This normalization can be understood using Table I. The numerator is scaled by the random matching case (Panel B), while the denominator reflects the distance between the perfect matching case (Panel C) and the random matching case (Panel B).

3. Demographic trends in Mexico

Before we formally compute assortative matching, we document changes in marriages, divorces, and births by educational attainment. To examine these demographic trends, we use vital statistics data from the National Institute of Statistics and Geography (INEGI). The data include the full universe of marriages, births, and divorces from 1993 to 2019.¹⁵ We combine this administrative data with census data to show the transformation in educational attainment as well as to compute divorce, marriage, and birth rates. We discuss the data in more detail in Sec. D of the Appendix.

Educational attainment has risen dramatically in Mexico over the past 30 years.¹⁶ In 1990, roughly 60 percent of adults aged 25 to 54 had a primary school education or

¹⁵Births registered in a given year sometimes correspond to an earlier birth year. That is, children born in year t may be registered and therefore included in year $t + 1$ data. As a result, we limit our attention to the years 1993 to 2018 to minimize the number of missing births in our analysis.

¹⁶We illustrate these changes graphically in Fig. A1 in the Appendix.

less. This number has declined to just above 30 percent in 2015. Past work on changes in assortative matching has focused on the shift from high school to a college education, and the difference between past work and the present setting motivates how we measure assortativeness in Sec. 4. Moreover, men's and women's growth in educational attainment has followed a similar pattern. While the gender gap in education has converged over time, it has not reversed among the 25 to 54 population, as has been the case in other settings [Goldin *et al.* (2006); Duryea *et al.* (2007)].

We present changes in demographic trends by education in Fig. 1. Panel A presents marriage rates for those 15 to 54.¹⁷ We first see that marriage rates are highest among highly-educated individuals, those with a college or high school education. Second, marriage rates have been falling sharply, particularly among those with more education.¹⁸ Panel B of Fig. 1 reveals that falling marriage rates have coincided with rising divorce rates (across all levels of education).¹⁹ These dramatic shifts in the marriage market may have implications for how assortativeness has changed over the past three decades. Moving to birth rates in Panel C of Fig. 1, we see that couples are having fewer children, especially individuals with a middle and primary school education. In Appendix Fig. A2, we also show the birth rate by marital status. The birth rate is declining most dramatically for married couples while increasing for cohabitating couples. The increase in births to cohabitating couples highlights the importance of measuring assortative matching among parents and not just among married couples. Given that intergenerational mobility is one of the primary reasons we are interested in assortative matching, accounting for non-marital births is essential.

We conclude by examining which types of couples are marrying and having children. That is, do the majority of couples have the same level of education? And how has this changed over time? We present the trends in coupling by education for marriage and births in Fig. 2. The top of Fig. 2 plots changes in equal-education marriages and (first) births by level of education.²⁰ Unsurprisingly, we see that both the share of primary-primary marriages and births have declined dramatically, while college-college marriages and births have increased. In the bottom sub-figures, we plot non-homogamous marriages and births, where the partners have different education levels. We separately plot adjacent and non-adjacent marriages and births, where adjacency is defined by whether the difference in educational attainment across partners is "close" (i.e., adjacent) or not (i.e., non-adjacent). The trends suggest that adjacent-category matches are significantly more common than non-adjacent ones. Moreover, we again observe that in 1993, husbands typically have

¹⁷To calculate the marriage rate, we divide the number of new marriages of individuals with education e in year t by the total population in that year with that education level (divorce and marriage rates by education will be computed similarly).

¹⁸Because some of these patterns may be driven by age-specific educational attainment, we also show marriage rates by age in Fig. A3 in the Appendix. We show the marriage rate has fallen sharply across individuals younger than 25. We illustrate this differently in Fig. A4, which plots the frequency of marriage by the age of the wife and husband. Men and women are delaying marriage, though not necessarily enough to counteract an overall decline in marriage rates.

¹⁹Recent work by Liu (2018) has demonstrated that more liberalized divorce laws may increase assortativeness. If a high-educated spouse can unilaterally divorce their low-educated partner, the gains from marrying up and leaving the labor market may decline. See Hoehn-Velasco and Penglase (2021) for a detailed discussion of divorce in Mexico.

²⁰We use data on non-first births in the Appendix. We restrict our attention here to first births as we are interested in matching among parents, and do not want to count the same couple multiple times.

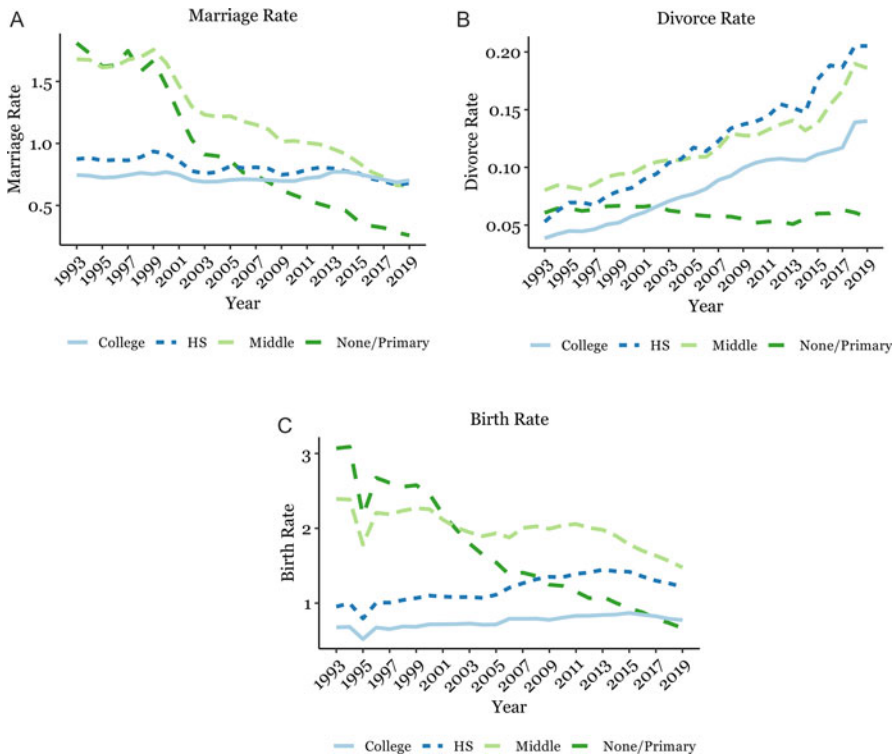


Figure 1. Marriage, Divorce, and Birth Rates by Education. Sources: INEGI marriage, divorce, and birth statistics. Mexican IPUMS data. Notes: The rates are per 1000 women 15–54 with each level of education. Less than primary education is either *sin escolaridad*, or education 1 a 3 años and 4 a 5 años. Primary education is *primaria completa*. Middle school education is *secundaria*. Secondary education is *preparatoria*. College is *greater professional*. Technical education is grouped with secondary. .

more education than their wives, and that by 2006, this is no longer the case. This pattern is even more pronounced among parental matches.²¹

4. Assortative matching over time

In Sec. 3, we document demographic trends, including changes in the frequency of homogamous marriages (see Fig. 2). These results, by themselves, do not demonstrate how assortative matching has changed over time. The reason for this is that educational attainment has changed, and importantly, the educational adjustments have not been identical for men and women. The descriptive results therefore confound changes in assortativeness coming from changes in the marginal distributions of education for men and women with changes in the underlying matching function. The more formal tools discussed in Sec. 2.2 help solve these issues, which we employ now.

²¹We also summarize these changes in Table A1 for new marriages and Table A2 repeats the same analysis for *first* births. Here, we again see that education has increased, but also that the share of homogamous couples (the sum of the diagonal elements) is relatively constant.

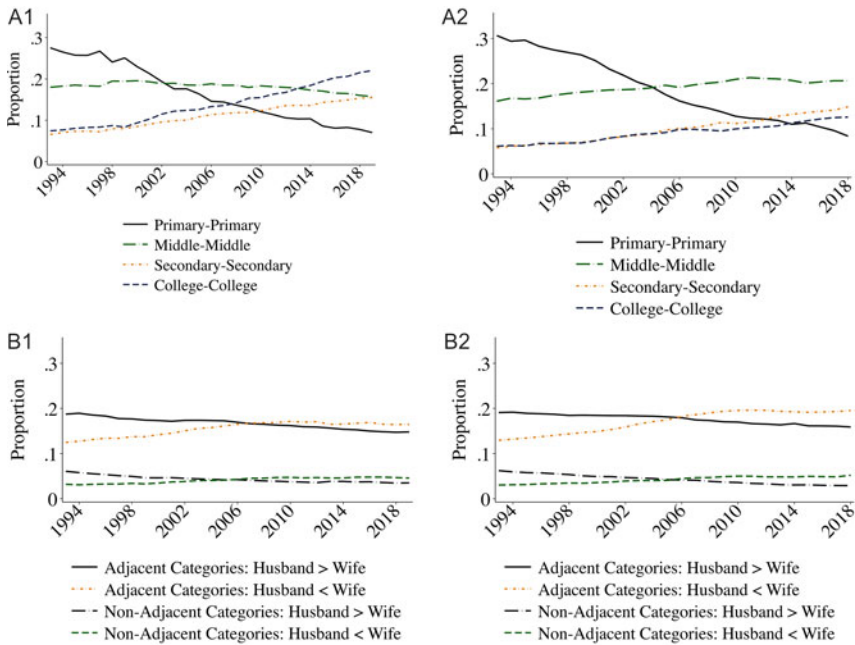


Figure 2. Matching Patterns (1993–2018), (A.1) Homogamous Marriages, (A.2) Homogamous Parents, (B.1) Non-Homogamous Marriages, (B.2) Non-Homogamous Parents. *Notes:* Vital Statistics Marriage and Birth Records. Men and women are divided into four mutually exclusive education categories: 1. Primary or Less, 2. Middle, 3. Secondary, 4. College. In Panel A, we plot the proportion of all marriages where couples have equal educational attainment. Each line represents the share of couples who both have education i . In Panel B, we plot the proportion of marriages where couples have different educational attainment. Adjacent categories are defined as pairs of categories that are either directly above or below education category i (e.g., college and secondary are adjacent). Non-adjacent categories are defined as pairs of categories that are different, but not directly above or below education category i (e.g., college and primary are non-adjacent).

We first describe the matching measures in more detail in Sec. 4.1. We then discuss the results using marriage and birth-records data in Sections 4.2 and 4.3, respectively. In Sec. 4.4 we provide additional details on interpreting the magnitudes of the changes in the SEV index. Finally, we conclude by discussing the implications of the results in Sec. 4.5.

4.1. Assortative measures

The marriage matching trends given in Fig. 2 consist of four education categories. To measure assortativeness using Equation (2), we focus on measuring assortativeness among 2×2 sub-matrices of the larger 4×4 matching matrix.²² This method results in six pairs of education categories in total. For example, to measure assortativeness among college graduates and those with a middle school degree, we compute r_1 (the share of college-college matches), r_3 (the share of middle-middle matches), f (the share of college-educated men matching with middle school-educated women), and d (the share of college-educated women matching with middle school-educated men).

²²This matrix is provided in Table A3 in the Appendix. Example matching matrices from 1993 and 2018 are also included in Tables A1 and A2 for marriages and births, respectively.

The SEV index for this pair is then computed as $I_{SEV} = \ln\left(\frac{r_1 r_3}{(f-r_1)(d-r_1)}\right)$, which is comparable to the SEV Index given in Equation (2), where r_1 , r_2 , d , and f are defined in Table A3.²³

The motivation for the 2×2 grouping is that, as discussed in Chiappori *et al.* (2020), assortativeness is a local property; college graduates may prefer partners with secondary education but rarely prefer partners with only a primary school degree. In this case, assortativeness would be high when comparing primary-college pairs, but low when considering secondary-college ones. With four education levels, there are six 2×2 sub-matrices along the main diagonal. This allows us to determine if there were differential changes in assortativeness at high and low levels of education, and if there were differences in adjacent pairs (i.e., college and secondary) and non-adjacent pairs (i.e. college and primary school).

4.2. Marriage matching

We begin by examining assortative marriage matching using administrative records of new marriages. In Panel A.1 of Fig. 3 we plot adjacent 2×2 education categories, while Panel B.1 presents the non-adjacent 2×2 ones. Several patterns are worth noting. First, the level of assortativeness is always positive, and somewhat flat across most pairs; there has not been any clear monotonic rise or fall in assortativeness over time. Nonetheless, assortativeness has increased among certain pairs of education categories, particularly among pairs which include college graduates. This result suggests that in 2018, college graduates preferred partners with more similar levels of education as compared to 1993, even after accounting for increases in educational attainment. This finding is consistent with what has been observed in other contexts (e.g., Chiappori *et al.*, 2020; Shen, 2020 in the United States)

The results also suggest that across all years, the level of assortativeness is significantly higher when we consider non-adjacent pairs of education categories (note that the y-axis range is different in Panel B). For example, the SEV index is above six when examining the level of assortativeness between college graduates and those with a primary education or less. This result means that the greater the “distance” between education categories, the less preference there is to match across pairs.

We next present the numerical values of the SEV index for the first and last years of data in our sample in Table II. These results follow Fig. 3, but are limited to the years 1993 and 2018. Here, we can more easily compare long-term trends in assortativeness for different pairs of education categories and observe the magnitude of any changes. We provide SEV measures for the 2×2 sub-matrices of the 4×4 matching matrix given in Table A3. Again, we can see that assortativeness has been largely constant, *except among college graduates*. For all education pairs that include college graduates, the SEV index has increased by at least 0.314. As a point of comparison, in the United States Chiappori *et al.* (2020) finds that the SEV index has increased by 0.580, 0.216, and 0.470 for college graduate pairs involving individuals with some college, a high school degree, and high school dropouts, respectively.²⁴

We preform several robustness checks to examine the sensitivity of the results. First, one concern regarding the use of administrative records of new births and marriages is

²³In Sec. C.1 of the Appendix, we measure assortativeness differently by selecting a single category k , and then merging the other three categories (i.e., category $-k$).

²⁴Chiappori *et al.* (2020) measure assortativeness across 1930-1939 and 1970-1974 birth cohorts.

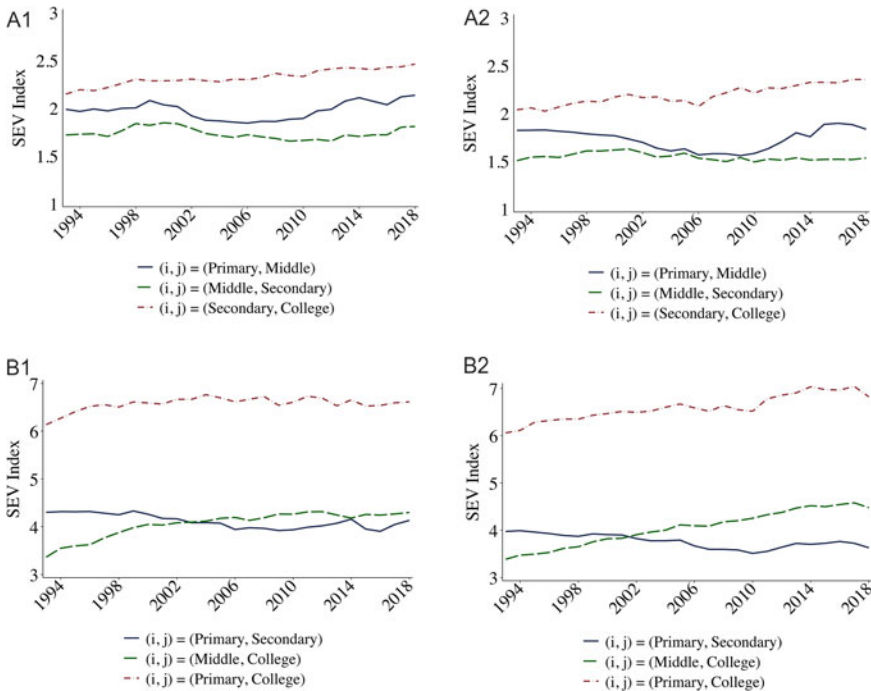


Figure 3. Assortative Marriage and Parental Matching, (A.1) Marriages: Adjacent Categories, (A.2) Births: Adjacent Categories, (B.1) Marriages: Non-Adjacent Categories, (B.2) Births: Non-Adjacent Categories. *Notes:* Vital Statistics Marriage and Birth Records. Men and women are divided into four mutually exclusive education categories: 1. Primary or Less, 2. Middle, 3. Secondary, 4. College. In Panels A and B, each figure plots assortative matching for the diagonal 2×2 sub-matrices of the full sorting matrix using the SEV index. Panel A plots adjacent education categories while Panel B plots non-adjacent categories. The weighted average curve is computed by averaging the assortative index across educational levels, where the weights are determined by diagonal value of the matching table given in Table A3.

that we may measure the match prior to one or both of the individuals completing their education. That is, one may get married in one year, and complete more schooling subsequently. To determine the extent to which this is a concern, we limit the sample to individuals age 25 to 54, who are more likely to have completed their education. We present these results in Fig. A5 in the Appendix. The levels are unsurprisingly somewhat different, as age of marriage is likely correlated with education. Nonetheless, the trends over time (which is what we are primarily interested in), are consistent with the results in our main analysis.

A second concern is that our use of administrative marriage records ignores divorce. If non-homogamous marriages are more likely to end in divorce, our use of administrative records for assortative matching may understate the degree of assortative matching in the population.

As a result of these limitations, we complement our main results by computing assortativeness using more standard IPUMS census data. Census data is unable to capture immediate changes in the marriage market, but it does offer us the ability to focus on individuals who's marital status is settled and who have completed their education. In the analysis, we use the 10 percent sample for the years 1970, 1990,

1995, 2000, 2010, and 2015. We compute the SEV index separately for different age groups, as combining adults of all ages would result in comparing very different cohorts together in a given year. That is, most new marriages involve couples who are young so comparing them to the marriage patterns of older adults is not as informative. The results are presented in Fig. A6 and are mostly consistent with our main results in the paper. We see similar levels of the SEV index for all education pairs, as well as similar trends over time. The results are most similar for the younger age groups (15-24 and 25-34) which are likely more comparable to the population we examine with the administrative records.

4.3. Parental matching

In addition to measuring assortativeness among married couples, we also examine parental matching using administrative birth records. As discussed in Sec. 3, there are differential trends in birth and marriage rates across education levels. There may then be differential trends in non-marital childbearing across education levels as well. Moreover, given that intergenerational mobility is a primary reason we study assortative matching, focusing on parental matching is, by itself, relevant.²⁵ We repeat our analysis in Sec. 4.2 using the universe of first births in Mexico.²⁶

First, Panels A.2 and B.2 of Fig. 3 and Columns 4 to 6 of Table II show that the overall trend in assortativeness across both adjacent and non-adjacent education categories is similar to what we observed using the marriage records. Moreover, the level of assortativeness is also largely similar whether or not we focus on marital or parental matching. Second, an advantage of the birth certificate records is the presence of both unmarried and married couples in the data. Observing marital status allows us to determine if we observe differential patterns in assortativeness across married and unmarried parents. The left half of Fig. 4 and Table III show that the level of assortativeness is mostly higher (five of the six comparisons) among married parents, but there is no systematic difference in trends over time. Why might assortativeness differ across married and unmarried parents? It's possible that marriage rates are simply higher when examining same-educated parents relative to parents with different education levels. Though, a definitive reason is difficult to determine without more information on the couples.

4.4. Understanding magnitudes of the SEV index

To better understand how to interpret the magnitudes of the SEV Index, we provide numerical examples of different sorting patterns, and compute what the resulting SEV index is for each of those cases. We limit our attention to two education categories (e.g., college and high school) for simplicity, and use the 2×2 measures of assortativeness. To illustrate how to interpret the index, we fix values of m and n ,

²⁵A limitation of this data is that the missing education, especially among fathers, is close to 25 percent depending on the year (see Fig. A8). To determine the severity of this problem, we place bounds on the maximum and minimum potential assortativeness depending on the characteristics of the couples with missing data. We discuss this in more detail in Sec. B in the Appendix.

²⁶We define first births as the first delivery to the mother. The first delivery to the mother is based on the parity question recorded on the birth certificate. We also show the same results with all (non-first) births in Sec. C.2.

Table 2. Changes in assortativeness 1993–2018

2 by 2 Comparisons	Marriages			Births		
	1993 (1)	2018 (2)	Difference (3)	1993 (4)	2018 (5)	Difference (6)
(i,j) = (Primary, Middle)	1.986	2.133	0.147	1.821	1.833	0.012
(i,j) = (Middle, Secondary)	1.718	1.807	0.089	1.504	1.531	0.028
(i,j) = (Secondary, College)	2.145	2.459	0.314	2.035	2.353	0.317
(i,j) = (Primary, Secondary)	4.302	4.132	-0.171	3.975	3.630	-0.345
(i,j) = (Lower Secondary, College)	3.363	4.298	0.935	3.386	4.477	1.091
(i,j) = (Primary, College)	6.138	6.613	0.475	6.060	6.823	0.763
Observations	496358	358423		635126	510713	

Notes: Vital Statistics Marriage and Birth Records. Men and women are divided into four mutually exclusive education categories: 1. Primary or Less, 2. Middle, 3. Secondary, 4. College. Each row provides the assortative matching measure for the diagonal 2 × 2 sub-matrices of the full sorting matrix using the SEV index.

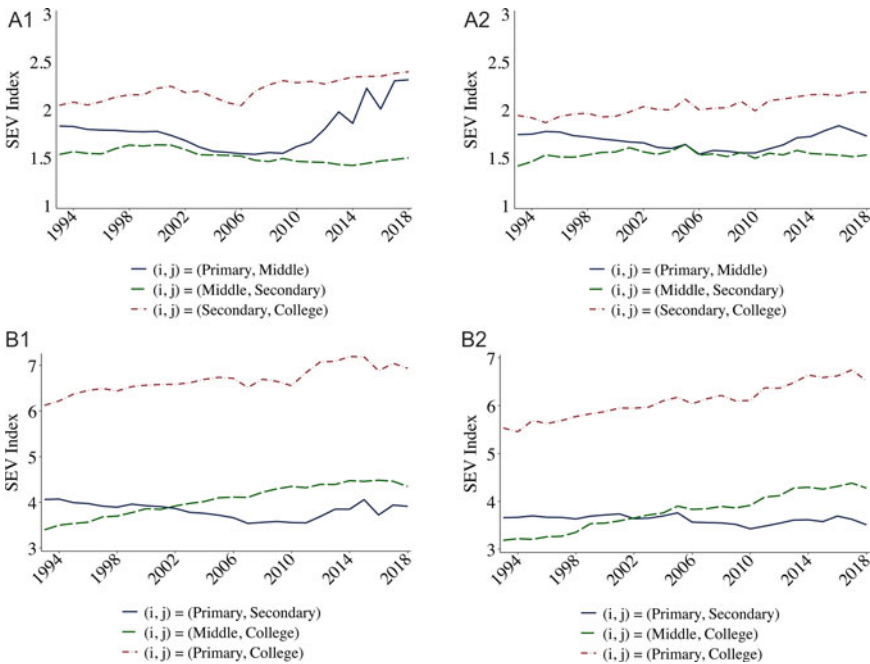


Figure 4. Assortative Parental Matching (Married vs. Non-Married), (A.1) Married: Adjacent Categories, (A.2) Unmarried: Adjacent Categories, (B.1) Married: Non-Adjacent Categories, (B.2) Unmarried: Non-Adjacent Categories. Notes: Vital Statistics Birth Records. Men and women are divided into four mutually exclusive education categories: 1. Primary or Less, 2. Middle, 3. Secondary, 4. College. In Panels A and B, each figure plots assortative matching for the diagonal 2 × 2 sub-matrices of the full sorting matrix using the SEV index. We plot married parents on the left, and unmarried (single and cohabiting) parents on the right. Panel A plots adjacent education categories while Panel B plots non-adjacent categories. The weighted average curve is computed by averaging the assortative index across educational levels, where the weights are determined by diagonal value of the matching table given in Table A3.

Table 3. Changes in assortativeness 1993–2018 (married vs. non-married)

2 by 2 Comparisons	Married Parents			Unmarried Parents		
	1993 (1)	2018 (2)	Difference (3)	1993 (4)	2018 (5)	Difference (6)
(i,j) = (Primary, Middle)	1.827	2.311	0.483	1.739	1.724	-0.015
(i,j) = (Middle, Secondary)	1.531	1.495	-0.035	1.411	1.526	0.115
(i,j) = (Secondary, College)	2.044	2.393	0.349	1.939	2.182	0.243
(i,j) = (Primary, Secondary)	4.063	3.912	-0.151	3.661	3.512	-0.149
(i,j) = (Lower Secondary, College)	3.398	4.347	0.948	3.187	4.280	1.093
(i,j) = (Primary, College)	6.124	6.937	0.812	5.533	6.521	0.987
Observations	404003	147120		221463	358,133	

Notes: Vital statistics birth records. Men and women are divided into four mutually exclusive education categories: 1. Primary or Less, 2. Middle, 3. Secondary, 4. College. Each row provides the assortative matching measure for the diagonal 2 × 2 sub-matrices of the full sorting matrix using the SEV index.

which denote the share of men and women with a college degree as a percentage of men and women with either a college or high school degree, respectively. We then vary r , which measures the share of marriages where both spouses have a college degree. As r increases, there is more assortativeness.

Suppose that we observe 100 married couples. Further, suppose that 40 men have a college degree ($m = 0.40$), 40 women have a college degree ($n = 0.40$), and that all other individuals have a high school education. Thus, there can be anywhere from 0 to 40 marriages where both spouses have a college degree. If the 40 college-educated men match with the 40 college-educated women, then the share of college-college matches is $r = 0.40$, and there is perfect assortative matching (i.e., $I_{SEV} = \infty$). If there are 16 college-college matches out of 100 ($r = mn = 0.16$), then there is random matching, and $I_{SEV} = 0$. If there are no college-college matches, then there is perfect negative assortative matching and $I_{SEV} = -\infty$.

Table A4 further illustrates how the SEV index changes as the rate of homogenous marriages increases. Consistent with the above setup, we fix m and n , and vary r . We see that increasing the share of homogenous marriages does not result in a linear increase in the SEV index. For example, increasing the share of college-college matches from 24 to 28 results in a smaller change ($1.42 \rightarrow 2.23$) in the SEV index compared to going from 28 to 32 ($2.23 \rightarrow 3.26$).

To relate these hypothetical values to the actual results, it is useful to note that the highest magnitude for the SEV index that we observe is approximately 6.8, where the comparisons are between college graduates and those with only a primary education in 2017. Assuming that $m = 0.4$ and $n = 0.40$, that would require that $r \approx 0.38$, so that with 100 married couples, 38 would be college educated men matching with college educated women, and there would be four instances of a college educated man or woman matching with a primary educated partner. The lowest magnitude that we observe is roughly 1.5, where the comparisons are between those with a middle or secondary education in 1993. If m and n were to both equal 0.40, then that would imply that out of 100 couples, around 25 would be homogenous matches.

An important limitation of the above discussion of SEV magnitudes is that we fix men's and women's education levels (i.e., m and n). Since m and n change over time, the way in which homogamy rates r translate to the SEV index also changes. This is precisely why homogamy rates are an inadequate measure of assortativeness, but we ignore this fact here in order to provide a rough sense of the relationship between homogamy rates and the SEV index.

4.5. Discussion

To this point, we've established three main results: 1.) assortative matching is highest in non-adjacent education categories, 2.) over time, assortativeness has increased the most among college graduates, and 3.) the patterns in assortativeness do not depend on whether we use marriage records or birth records. We now discuss potential explanations for these findings and their implications.

There are several potential factors that explain the increase in educational assortativeness. First, there may have been reductions in the search costs to finding a spouse due to increased female labor force participation. If women, particularly highly-educated women, are entering the labor market, there are less search frictions in terms of finding a similarly-educated spouse. Given that female labor force participation has grown over the past three decades [Gasparini and Marchionni (2017)], it is not surprising that assortativeness has increased. This mechanism is consistent with recent work by Mansour and McKinnish (2018), who demonstrate that individuals in the United States who share the same occupation prefer a spouse with the same occupation.²⁷ More generally, the growing acceptance of women entering the labor force and obtaining a college degree may have shifted norms, resulting in educated men placing greater value in having an educated partner. This mechanism is discussed by Goldin and Katz (2002), who examine how family formation for college educated women was affected by the introduction of the pill. Second, recent work suggests that marriage market segmentation reinforces assortative preferences [Jaffe and Weber (2019); Ciscato (2021)]. Thus, if more women enter college and the labor force, this may increase the segmentation of the marriage market by education.

Third, changes in legislation governing the marriage market may have also resulted in an increase in assortativeness. Over the past 30 years, Mexico has liberalized its divorce laws, and unilateral divorce is now legal in all 32 states. Recent work by Hoehn-Velasco and Penglase (2021) has found that these laws resulted in a large increase in divorce rates, which suggests that the marriage market was affected more generally. If divorce is easier, this lowers the gains to specializing in home production, since leaving the labor market may have a negative effect on future income, should a divorce occur. Given that this type of specialization is likely most common in negative-assortative marriages, we may expect assortativeness to increase due to liberalized divorce laws.²⁸ This mechanism is explored in Liu (2018), who finds that the introduction of unilateral divorce in the United States increased the correlation in both income and education between spouses. A similar pattern may be present in Mexico.

²⁷Online dating could similarly reduce search frictions [Hitsch *et al.* (2016)]. It is unclear, however, how important online dating is for increased assortative matching in Mexico as internet access is less widespread relative to the United States.

²⁸While divorce rates increased, additional work by Hoehn-Velasco and Penglase (2021) found no corresponding changes in women's labor supply, suggesting the effect may not be large.

Fourth, Fernández *et al.* (2005) and Chiappori *et al.* (2017) suggest that increases in the returns to education (or skill premium) incentivize highly educated individuals to match with one another, as parental education is an input in child human capital production. Given that the returns to education have risen in Mexico [López-Acevedo (2004)], this mechanism may apply to our context as well.

Fifth, changes in gender-specific migration patterns may have contributed to the growth in assortativeness. Men in Mexico are much more likely to migrate than women. Migration affects both the marriage outcomes of the migrant, but also the matching patterns of the “sending” community. Choi and Mare (2012) find evidence that return migrants are more likely to marry outside their education category, and attribute this change to increased income. Moreover, Choi and Mare (2012) find that in communities where migration is common, there is less assortative matching. It is therefore plausible that the decline in Mexico–U.S. migration over the past decade explains some of the increase in assortativeness.

Finally, an important caveat to our results is that we are restricting the degree of unobserved heterogeneity in preferences to be constant over time. Thus, it may not be the case that preferences for similarly educated partners has increased, but instead preferences for other unobserved factors correlated with education have changed. More general frameworks, such as those employed by Ciscato *et al.* (2020) or Ciscato and Weber (2020), are necessary to determine the extent to which this is the case.

Regarding the data used in our analysis, our results are largely independent of whether we use administrative records of newly formed marriages, or birth records; Looking at Table II, the signs of the differences in Panel A are constant across columns (3) and (6). One reason for this, is that the assortativeness of married parents is largely similar to that of unmarried parents (see Table III). Given the prevalence of cohabitation, the importance of marriage on fertility behavior may be minimal compared to other contexts. However, an important caveat to the similar results is that they occur when we use *first* births to measure parental matching. As shown in Fig. A11 and Table A9, the results slightly differ when looking at non-first births. This suggests that there are minimal differences in the probability of having children, conditional on matching, but the number of children a couple has depends on the characteristics of the couple.

5. Conclusion

We study educational assortative matching in Mexico. Understanding who marries whom is essential for uncovering the causes of inequality across households. If both high and low-educated individuals only match within the same education category, the marriage market has the potential to increase income inequality. Moreover, since education is highly correlated across generations, positive assortative matching may exacerbate inequality across time.

Using administrative records on marriages and births, we quantify changes in assortative matching over the past three decades. We focus both on marriage matching, as well as *parental* matching. This distinction is especially important in a country like Mexico, where not every couple formally marries. To measure assortativeness, we rely on recent work by Chiappori *et al.* (2020) who demonstrate how one can identify changes in assortativeness over time in such a way that accounts for mechanical increases in homogamous marriages due to converging distributions of male and female education.

Our findings suggest three main patterns. First, we find a moderate increase in average assortativeness across the three decades considered. Moreover, the increase is greatest among college graduates. Second, the level of assortativeness is considerably higher when focusing on non-adjacent versus adjacent education categories; individuals who marry outside their education category are most likely to do so with someone with a similar education level. This suggests that the incidence of college-educated individuals marrying those with less than a high school degree has declined, but this change in assortativeness does not hold when looking at the frequency of college graduates marrying those with a high school degree. Finally, we find that the overall patterns are consistent whether we use data on newly formed marriages, or from birth records. Our results have implications for understanding between-household inequality and child human capital development.

Future work can incorporate singlehood into the analysis. Because we employ birth and marriage records, we do not observe those who are not getting married, or having children. This does not impact the measures of assortativeness [Chiappori *et al.* (2020)], but it does limit our ability to measure how marital surplus has evolved over time. Moreover, our analysis suggests potential drivers of changes in assortativeness. Further research into several of the potential causes would add to our understanding of marriage market dynamics in Mexico.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/dem.2022.27>

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