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ABSTRACT

Changing Sex-Ratios among Immigrant Communities in the U.S.*

Marriage patterns of immigrants are an important indicator of the degree of immigrant integration into their host countries. Literature on the economics of the household has focused on the role of the sex-ratio as an important determining factor in marriage market outcomes. Therefore, it is important to understand if and how the sex-ratio has changed over time and the mechanisms that may drive that change. In this paper, we explore recent changes in the sex-ratio among immigrants to the United States. First, building upon previous research, we document the nongender neutral nature of declining immigration to the United States. We approach this study from two different dimensions to document some of the forces driving this change in the sex-ratio. The first approach, focusing on changes between birth cohorts, demonstrates that immigration is declining more quickly for men than it is for women, leading to a decrease in the sex-ratio from above 100 and thus bringing about more gender balanced migration. Second, we present results from an analysis of data on recently granted green cards, suggests that the sex-ratio among this population is increasing from below 100, also bringing about more gender-balance among immigrants.

JEL Classification: F22, J11, J12

Keywords: immigration, sex-ratios, demographic change

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1 Introduction

The ability of immigrants to integrate into the society of their host countries is an issue of importance to both immigrants as well as to the perceptions and attitudes of natives of the host country. In an era of globally increasing nativist sentiment and the corresponding rise in immigration restrictionist policies and policy proposals, understanding trends in factors affecting immigrant assimilation is of upmost importance. One key measure of integration which has significant impacts on labor market and other important outcomes of immigrants are their inter-marriage patterns (Meng and Gregory, 2005; Furtado and Theodoropoulos, 2010; Furtado and Trejo, 2013; Gevrek et al., 2013; Chi, 2015).

A key variable driving inter-marriage patterns is the sex-ratio among immigrant communities (Angrist, 2002; Meng and Gregory, 2005; Furtado and Theodoropoulos, 2011; Furtado and Trejo, 2013). The sex-ratio is the ratio of males to females in a population, scaled such that a ratio of 100 represents an equal number of men and women. While the natural sex-ratio at birth is typically greater than 100 (Jacobsen et al., 1999) a ratio of 100 is important for gender balance in marriage markets. In a standard model of a marriage market, females would have more bargaining power when the sex-ratio is above 100 and males would have the upper hand when the ratio is less than 100 (Grossbard, 2014). Thus, obtaining a better understanding of demographic patterns in the sex-ratio of immigrants is a key for a more general understanding of immigrant integration.

A body of work has documented evidence of slowing migration to the U.S. (Massey et al., 2014; Hanson et al., 2017; Hanson and McIntosh, 2010; Norlander and Sorensen, 2018). Other recent papers have presented evidence that immigration has not changed in a gender-neutral way. Norlander and Sorensen (2018) show that immigration has slowed at historic rates since the turn of the 21st century, and that the slow down since the 1990s has been steeper for men than for women. Donato et al. (2011) studies how gender migration patterns have changed to many sending countries around the world, and document that female migrants have relatively recently become a larger share of the foreign born in the U.S., causing sex-ratios to fall. Hofmann and Reiter (2018) explore variation across geography, finer than the state level, in the U.S. Their work finds that the sex-ratio for entire immigrant populations has trended downward between the 1990s and the 21st century.

We build upon this important work with two important pieces of analysis. First, unlike these prior works, we measure changes in the sex-ratio at the level of birth cohort and country of birth. These are two demographic dimensions at which sex-ratios may most strongly effect outcomes in marriage markets if immigrants have preferences for endogamy. We do so by compiling all data available on the foreign born population from each year of the 1% American Community Survey from 2005-2016 as well as the 2000 censusRuggles et al. (2017). Our use of data up through 2016 also allows us to better document changes taking place on account of the Great Recession than prior work. With the data aggregated at this level, we use a synthetic cohort approach (Borjas, 1985) to examine how immigration has changed for both men and women across cohorts. We find evidence of slowing migration for both men and women; the evidence suggests that migration is slowing at a faster rate for men than it is for women.

Our preferred estimates stem from a direct analysis of the sex-ratio. These results reveal that, holding age and country of birth constant, the sex-ratio has dropped by about 16 units between the 1970 and 1990 birth cohorts. In the context of a mean sex-ratio above 100 in the sample, implying a surplus of immigrant men, this change represents a significant convergence to more gender balanced migration in a relatively short period of time. Heterogeneity analysis reveals that important immigrant sending countries are driving this change and that the bulk of the change occurred with the recent birth cohorts of the mid to late 1980s corresponding to migration decisions that may have been altered differentially for males and females by the Great Recession.

Our second piece of analysis measures how the sex-ratio has changed among immigrants by the year that they were granted green cards. Data from 2002 to 2016 suggest that these immigrants are becoming less female dominated. A shift share analysis further reveals that variation over time in the sex-ratio is driven more by the change in the share of men or women obtaining green cards through each of the several channels (family based, employment based, diversity lottery, etc.) rather than changes in the relative importance between these channels. However, counterfactual analysis demonstrates that radical changes to the ways through which green cards are obtained would have non-negligible impacts upon the sex-ratios of the population of immigrants recently granted green cards.

The rest of the paper proceeds as follows. Section 2 briefly reviews the literature. Section 3 discusses our data construction and presents results from our analysis of census data. Section 4 describes patterns among the population of immigrants who have been recently granted green cards and Section 5 concludes.

2 Literature Review

There is a well established literature studying how immigrant labor market outcomes and social integration is affected by inter-marriage to natives (Meng and Gregory, 2005; Furtado and Theodoropoulos, 2010; Furtado and Trejo, 2013; Gevrek et al., 2013; Chi, 2015). Clearly, understanding which factors drive the marital decisions of immigrants is important for understanding their prospects in the labor market specifically and in the society of their host country generally.

The literature on household economics has established that sex-ratios have important impacts on marriage markets, including for the marriage market between immigrants and natives (Angrist, 2002; Meng and Gregory, 2005; Amuedo-Dorantes and Grossbard, 2007; Çelikaksoy et al., 2010; Furtado and Theodoropoulos, 2011; Furtado and Trejo, 2013). If a shortage of co-ethnic immigrants exists, individuals may substitute to marrying other individuals. The degree of inter-marriage may be characterized by the endogamy of the match. The most endogamous possible match would be a marriage to another immigrant from the same origin country. The most exogamous outcome would be a marriage to a native who is not a co-ethnic. Intermediary outcomes would include marriage to other immigrants who are not from the same origin country as well as marriage to co-ethnic natives (Angrist, 2002).

The relevant sex-ratio may depend upon factors such as education or the age gaps between potential male and female partners (Grossbard-Shechtman, 1993; Amuedo-Dorantes and Grossbard, 2007). In addition to the relevant sex-ratio, the size of the immigrant community matters as well, as previous research has suggested that networks are also an important determinant of partner selection (del Rey Poveda and de Vilhena, 2014). Many papers in this literature employ variation in the sex-ratio of potential partners within a population as a source of random variation in marital decisions (Angrist, 2002; Chi and Drewianka, 2014).

Clearly, possessing an accurate picture about the directions and trends of immigrant sex-ratios is very important for those who wish to understand the marriage market outcomes of immigrants and the corresponding effects of these outcomes on the labor market. As stated above, our study is motivated by previous findings in Norlander and Sorensen (2018), Donato et al. (2011) and Hofmann and Reiter (2018). These papers collectively show that immigration has slowed more for men than women, and that aggregate sex-ratios may have decreased in the U.S. among the immigrant population. However, until we examine changes in the sex-ratio at the birth country and birth cohort levels, it is unclear whether key sex-ratios that will affect marriage markets among communities with endogamous preferences have been altered.

3 Changing Sex-Ratios Among the Foreign Born Population

3.1 Data Construction

We now turn to the construction of the data that will be used in our analysis. Our analysis focuses on data from the 5% Integrated Public Use Micro-Sample (IPUMS) (Ruggles et al., 2017) of the U.S. census from 2000 as well as the American Community Survey (ACS), which is a 1% representative sample run by the US Census Bureau that is available annually from 2005 through 2016. To construct our measure of the sex-ratio, we limit our sample to individuals who were age 18 or older at the time of the sample and who were not residents of group quarters.

In total, this dataset includes over 37 million individual observations (including native born individuals) from 13 different survey years. One often voiced concern with using census data to study issues related to migration is that it may miss undocumented or unauthorized migrants. However, work by Passel et al. (2013) shows that the census actually has quite a high coverage rate of these individuals as a result of methodological changes developed in the early 2000s based on concerns of undercounting this population.

We measure our sex-ratio variables at the level of country of birth. Recall that the sex-ratio is the ratio of men to women among a given population. If the effective sex-ratio is greater than one, the number of potential male partners out numbers the number of potential female partners and thus men are relatively less scarce than women, which will cause women to have relatively more bargaining power over how surplus is split in the relationship. If the reverse is true, it is the men who will have more bargaining power (Grossbard-Shechtman, 1993). In our main analysis the denominator of the sex-ratio is the number of women of a given age, while the numerator is the number of men who are two years older. Grossbard-Shechtman (1993) shows that this is important because the modal marriage has an age gap of two years. Throughout the paper, we also conduct additional analysis on with sex-ratios based on different age gaps. We explore the levels of these gaps in our data below.

We now present some results on patterns related to the sex-ratios of immigrants. We conduct this analysis at the country level, and focus on 24 countries that provided the US with the largest number of immigrants who were between 20 and 30 in the 2000 census. These countries and their respective IPUMS ”bpld” country codes were Canada (15000), Mexico (20000), El Salvador (21030), Guatemala (21040), Honduras (21050), Cuba (25000), Dominican republic (26010), Haiti (26020), Jamaica (26030), Brazil (30015), Colombia (30025), Ecuador (30030), England (41000), Germany (45300), Poland (45500), Russia (46500), China (50000), Taiwan (50040), Japan (50100), Korea (50200), Laos (51300), Philippines (51500), Vietnam (51800), India (52100). Collectively, these countries accounted for around 80% of the foreign born population of these ages in the US in 2000. We assign all respondents to a birth year assuming that they had not yet had their birthday at the time of the march survey.

3.2 Gender Specific Patterns in Immigrant Populations

Our first piece of analysis is to separately examine how the stocks of male and female immigrants have changed over time. There is an emerging body of work documenting slowing immigration to the United States (Massey et al., 2014; Hanson et al., 2017; Hanson and McIntosh, 2010). As discussed above, recent work by Norlander and Sorensen (2018) has shown that since 2000, the US has experienced the fastest slowdown in the growth of the stock of foreign born individuals since at least 1880. In addition, they also document a faster decline for men than for women. We further their finding by examining how the stock of more recent male and female immigrants may have changed at differential rates.

While the repeated cross-section nature of our data does not allow us to observe the same individuals over their lifecycle, it does allow us to track the size of the immigrant population at the birth cohort level. Specifically, we use the repeated cross-section nature of our data to construct synthetic cohorts Borjas (1985) with the above described data. We focus on immigrants who were born between 1970 and 1990, were between the ages of 20 and 45 and from one the the 24 most common sending countries listed above.

We test for changing migration patterns by regressing the log of the size of the synthetic birth-country-year cohort at a given age on a linear time trend for birth cohort. We run our regressions separately for male and female migrants, and use various controls for the applicable age and place of birth of the observation. Our results are presented in Table 1.

In addition to exploring heterogeneity in the growth of the immigrant population by gender, Table 1 also explores how growth rates have been changing by state of destination. Immigrants have traditionally been concentrated into a small set of U.S. states. Borjas (1999), page 10, states that in 1998, nearly 75% of immigrants, but only 33% of natives, lived in six states: California, Texas, New York, Florida, Illinois and New Jersey. During the 1990s and early 21st century, immigrants began to arrive in new places in the U.S. Other authors in the literature have noted the changing pattern of immigrant destinations, and have made similar distinctions between sets of states. For example, Massey and Hirschman (2008) cites the use by Portes and Rumbaut (1996) of the above six states, excluding New Jersey. Contributions to Doug Massey's 2008 book New Places New Faces suggest a diffusion of immigrants to the midwest (Massey and Hirschman, 2008; Donato and Carl L. Bankston, 2008; Fennelly, 2008; Griffith, 2008) and the south (Massey and Hirschman, 2008; Griffith, 2008; Marrow, 2008; Winders, 2008). Similar evidence, focusing on Mexican migrants in the 1990s, is also presented by Card and Lewis (2005). Using geography finer than the state level, Hofmann and Reiter (2018) examines geographic variation and changes in sex-ratios in immigrant communities, aggregated across age and place of birth. Their work notes that it is important to separately consider traditional and new immigrant receiving locations.

Here, we choose to focus on a set of traditional states which we define as California, Texas, New York, Florida, Illinois and New Jersey. Similar to figures from Borjas (1999), we find that these six states accounted for the residence of 66.25% of immigrants in our sample in 2000, the earliest census year in our data. The top panel in each half of Table 1 examines growth rates, constructing cells of the count of immigrants by gender, birth place, age and birth cohort using data from all states. The second panel in each half of the table then repeats our analysis, constructing these counts using only immigrants living in “Traditional Receiving States”. Finally, the third panel in each half of the table constructs our counts using only data from all other states.

Focusing on the results on males using data from all states, we observe a decline in the male foreign born population across birth cohorts in each of our five specifications, though the results are only statistically significant for three of the five specifications that we run. These specifications include our preferred specification as well as specifications that do not control for age. Controlling for place of birth, which would capture declines that may result from a shift in the source countries of migrants, does not seem to have a significant effect on the point estimates, though it does significantly improve the precision of these estimates. Controlling for the age of the migrant in the cell, however, appears to be crucial for obtaining a reliable estimate. The logic behind this is clear: if the stock of migrants for each birth cohort tends to grow over the life cycle, and we observe more recent birth cohorts for a shorter span of their lifecycle, then not controlling for the age associated with the observation will lead to a spurious negative correlation, overstating the true decline in migration.

For female migrants, we again observe that each point estimate is negative, suggesting declining rates of migration across cohorts. Results are only statistically significant for females when we do not control for the age structure, however. When we do control for age, we cannot reject a null of stable female migration across cohorts, and each of the three point estimates for females in these specifications is smaller in absolute value to the corresponding result for males.

In our preferred specification, male cohorts are declining at a significant .48 log points per year, nearly four times the rate of the .13 log point decline for females, which is not significant. These results suggest that, holding age and place of birth constant, the stock of male immigrants in the typical 1990 birth cohort was about 9% smaller than that of the 1970 birth cohort, while the same measure suggests only a 3% decline for females. Clearly this provides some evidence consistent with a changing sex-ratio among immigrants.

When we examine our results in our preferred fifth specifications for traditional states, we see nearly identical declines of around -0.7% to -0.8% for both males and females. However, when we focus on the results of the analysis using data from non-traditional immigrant receiving states, we see annual growth for women of nearly 1%, in contrast to a relatively stagnant male population. Thus, immigration by women is shrinking more slowly than immigration by men because while both groups are seeing declines at similar rates in traditional receiving states, female migration is actually increasing to new receiving states. In other words, the demographic changes outside of the six receiving states are what are driving the main results in this table.[1]

Even with the relatively large sample sizes in the ACS, estimating changes with cells constructed at the birth cohort, age and birth country level may simply be asking too much of the data. We note that our number of observations drops, though by less than 1%, when we cut our analysis by traditional and non-traditional receiving states. Thus, we now re-estimate these models with the inclusion of precision weights in order to ensure that our results are not being driven by some of our cells which may represent very few survey respondents. Our precision weights take the form of

[1] We thank an anonymous referee for the suggestion to explore heterogeneity in our results in this dimension.

a count of the total number of ACS survey respondents (male or female) present in a given birth cohort/age/birth country/state cell. While these weights may be considered endogenous, they are not perfectly correlated with the left hand side variable, as the sample weights in the ACS also determine the level of the dependent variable. In the bottom half of the table, we observe very similar qualitative results using this strategy.

As intra-ethnic marriage markets may operate on a more local level than the nation as a whole, we repeat our analysis at the state level Furtado and Theodoropoulos (2011). For these estimates, we add a sixth specification which includes state indicator variables. The results of this analysis, presented in Tables A1 and A2 reveal that once we weight our estimates to account for small cell issues, state level estimations yields qualitatively similar results as our national level analysis: male migration rates falling more than female migration rates.

In summary, Table 1, as well as supplementary analysis in the Appendix, show robust evidence that male migration is slowing more quickly than female migration, consistent with a sex-ratio which is decreasing over time. We now turn to an examination of the direct evidence of changing sex-ratios.

3.3 Changes in Sex-Ratios

While the finding in Table 1 that female migration is declining more slowly than male migration is certainly suggestive of a changing sex-ratio among immigrants, a direct measurement is needed in order to arrive at a definitive conclusion about whether the sex-ratio has changed for immigrant marriage markets. It is clear from Table 1 that the differential declines are economically significant, it has not yet been shown that the difference is statistically significant. A direct examination of the sex-ratio will allow us to test for statistical significance.

Ex-ante, it is also unclear how the above described changes in migration patterns will affect this sex-ratio in marriage markets. If there are age gaps in marriages in this population, it is important to examine how what we term lagged sex-ratios have changed (e.g. the gap between the number of women and men who were born two years earlier. Using data from our sample on married immigrants, we are able to observe the age of both spouses in our data. Note that, given different average first ages at first marriage and unequal sex-ratios across immigrant communities, we do not expect these age gaps to be symmetric. We find that the mean difference between a married man in our sample and his spouse is 1.27 years (median of 1 year), with almost three of four men being married to a woman who is their own age or younger. For women in our sample, we find an average age difference of 3.7 years (median of 3 years), with nine in ten women being married to a man who was her age or older. Clearly, this evidence supports a focus on sex-ratios between women and men who are their own age or a few years older than them.[2]

It is straightforward to see that the faster decline in migration rates among male migrants would lead to a lower sex-ratio when we examine migrants who are the same age. However, once we introduce age differences in our measure of the sex-ratio, things become more complex. For example, consider the sex-ratio among men who are 10 years older than women. If factors such as decreasing fertility in sending countries lead to smaller pools of potential out-migrants, then the men used to calculate the numerator of this sex-ratio are from larger earlier cohorts and thus we would expect these sex-ratios to be larger. The expected change in sex-ratios over time for the lagged estimates is less clear, especially if there are non-linear changes in male and female migration between cohorts. Thus, the sign of the change in the sex-ratio across age gaps in the context of the demographic patterns we observe is an empirical question.

We report results from a regression of the sex-ratio in Table 2. All results use the controls from the fifth column of Table 1; i.e. indicator variables for both age and place

[2]For men, we find negative age gaps for only 26.13% of men and positive age gaps for only 9.99% of women. Men are married to women their own age, one, two and three years older to themselves at rates of 12.65%, 12.40%, 11.39% and 9.72%, respectively. For women, these figures are 10.56%, 10.74%, 10.38% and 9.49%. A histogram displaying these results is presented in the appendix in Figure A1.

of birth. The columns of the table explore heterogeneity by weighting and by state of destination. The rows correspond to different age gaps between males and females. The first row with no-lags represents the sex-ratio between men and women of the same age, while the last row represents the sex-ratio between women and men who are seven years older than the women. In our unweighted regressions, we do not see any statistically significant evidence of a decline in the sex-ratio (even among men and women of the same age).[3]

While the absence of negative and significant results for the unweighted regressions suggests that there has not been a statistically significant decline in the sex-ratio in the average marriage market, this does not necessarily imply that the average migrant has not faced such a decline in her or his own marriage market. To better measure the changes in the sex-ratio experienced by the typical migrant, we present results in the right half of the table, in which we include weights for the total number of men and women in the birth-country/age/birth-cohort cell that were used to calculate the sex-ratio. Here, lags of less than four years in the sex-ratio yield results more in line with the pattern that we had expected.

When examining the changes for all states, the sex-ratio is negative and significant for men and women of the same age. The change is less negative, but still significant, when considering a one, two, three or four year age gap, and negative but insignificant for a five year gap. The change in the sex-ratio is monotonically increasing with the gap, and becomes positive when we consider a six year age gap.[4]

As with the results in Table 1, here we also find significant heterogeneity by state of destination. Our weighted regressions find evidence of a declining sex-ratio for both traditional and new immigrant receiving states. However, the results are of a

[3]We do show that we can reject a null hypothesis of a constant sex-ratio at the 10% level for one or two year lags in our preferred specification in appendix Table A3, where instead of using a linear time trend for birth cohorts we instead run a regression with birth cohort indicator variables and present the p-values on an F-test of joint significance of these parameters.

[4]With the weighted regression, we show that we can reject a null hypothesis of a constant sex-ratio at the 1% level for zero up to three lags in appendix Table A4.

much greater magnitude for immigrants in the new arrival states; of three to five times the magnitude for the estimates for no age gap up to a two year age gap. Again, this suggests that immigration patterns have changed much more by gender in new immigrant destinations than in old immigrant destinations. Below, we explore possible reasons for this.[5]

The most important result in Table 2 is that there is a negative and significant coefficient on the birth year variable in our preferred specification when we look at a two year age lag. Indeed, this two year birth lag is widely considered the most important in the marriage market literature. In order to contextualize the economic significance of changes in the sex-ratio, it is worth noting that in the literature a change in the sex-ratio of 10 is often used as a standard size effect. The coefficient of -0.82 for the two year lag and our preferred specification implies a decline in the sex-ratio of around 16 units between the first and last birth-cohort that we examine across all states. The change is nearly twice this, over 30, when we restrict our analysis to new receiving states.

While these results are informative, they also pose many new questions, both in terms of which groups may be driving the results as well as to what possible factors may be causing these immigration patterns to change. To provide some suggestive evidence about these questions, we now examine heterogeneity in the change in the sex-ratio across a number of dimensions.

[5] As before, we also examine changes at the state level. In appendix Tables A5 through A8, we repeat our analysis at the state level. Tables A5 and A6 show that the expected pattern of a decline in the sex-ratio among similarly aged immigrants, coupled with an increase in the sex-ratio for large age gaps between men and women is not found in the average marriage market, but is found for the average immigrant when using variation at the state level. Tables A7 and A8 demonstrate that there is strong evidence for a changing sex-ratio in both the weighted and unweighted regressions, at least when focusing on sex-ratios with zero, one or two years of lags.

3.4 Heterogeneity Analysis

3.4.1 Heterogeneity Across Birth Cohorts

The results presented up to now have suggested that immigration has been declining, more so for men than women. The differences between men and women in these declines have been large enough to have economically and statistically significant effects upon the sex-ratio faced by the typical foreign born individual in the marriage market. We now examine some patterns of heterogeneity in changes in the sex-ratio.

Figure 1 reports results from regressions of the sex-ratio on indicator variables for each birth cohort. In the Figure, we report results from both the unweighted regression as well as the regression in which observations are weighted by the number of individuals used in the construction of the sex-ratio. The model used in the regression corresponds to the fifth column in previous tables, with indicators as controls for both age and place of birth. We reject a null hypothesis of equality of the coefficient estimates for both the weighted and unweighted models. While the unweighted models are inherently noisier, putting equal weight on observations that likely contain more measurement error, we do see evidence of a decline in the sex-ratio for cohorts born in the late 1970s. This pattern is much more clearly seen in the results from the weighted regression. While results are only negative and significant, for the individual birth cohort coefficients representing 1982-1988, we can reject a null hypothesis of joint equality of the coefficients for both the weighted and unweighted regressions. While their appears to be some recovery in the sex-ratio above for the later cohorts, it is worth remembering that the estimates for these cohorts are both less precisely estimated, and also represent a smaller number of age bins.

3.4.2 Time Vs. Cohort Changes

Here, we re-frame our analysis to view gender-specific changes in migration and corresponding changes in the sex-ratio through the lens of changes over calendar time, rather than through changes between birth cohorts. Recall that we have variation in immigrant counts across birth year, age and birth place. As we are already controlling for both age and birth country fixed effects, our model would become fully saturated if we were also to include time indicator variables.

To best explore effects over calendar time, we drop the birth cohort variable from our model and instead include indicator variables for each calendar year in our sample. We continue to include place of birth and age indicators as controls; thus the coefficient on each time period indicator variable measures the average difference in our left hand side variable between the year in question and the base year, holding age and place of birth constant. In order to more clearly view the effects of the Great Recession, we choose 2008 as our omitted reference year.

Estimates are presented in Figure 2. The top panel of the figure reports results from estimations of the male and female population stock. Unsurprisingly, we see that the estimates for the size of the male and female population, holding constant age and place of birth, are higher in the pre Great Recession period. After 2006, the estimates become smaller through 2009 for both men and women, implying that the average immigrant count in a age/birth-cohort/place of birth cell in our sample was about 5% smaller in 2009 than it was in 2006, the year before the Great Recession began.

The male and female patterns diverge dramatically during the economic recovery. We see that female migration sharply recovers nearly to 2006 levels, where it remains to this day. Male migration continued to decline roughly through 2012, and has remained around 5% below the 2006 level, or 10% below the pre Great Recession peak in 2006.

The results in the bottom panel of the figure follow from the top: as immigration for men increased slightly more quickly leading up to 2006 and then decreased more quickly leading into the Great Recession, we see an inverse u-shaped relationship between 2000 and 2009. The sharp recovery of and stabilization in female migration, coupled with the non-recovery of male migration, yield a sex-ratio that is essentially constant at between 10 and 15 units below the 2008 sex-ratio.

The timing of these changes suggests that a great deal of the differences in the sex-ratio that we observe in our data may be related to changing labor demand. The data up through the Great Recession is consistent with more cyclical demand for male labor. However, the subsequent lack of recovery, even during the relatively strong labor markets of the mid 2010s, is not. The lack of recovery of male immigration may point to long term structural changes in labor demand, which may have been hastened by the onset of the Great Recession, and may also have disproportionately affected men.

In addition, the fact that female immigration has also remained constant during the recovery and expansion suggests that the supply of immigrants to the U.S. economy has become less cyclical. While identifying reasons for the change in this cyclicality is beyond the scope of this paper, it is clearly consistent with immigration enforcement increasing the costs of migration. It is also consistent with decreasing push factors from sending countries as long run fertility patterns have decreased the supply of immigrants.

3.4.3 Heterogeneity by Time in U.S.

Because we are not able to track the same individuals over time in our data, we cannot definitively conclude whether or not our estimates are driven by changing patterns in in-migration or changing patterns in out-migration. However, some features of the ACS/IPUMS data do allow us to examine suggestive evidence.

Since the 2000 census, the IPUMS data includes a variable giving the year of arrival of immigrants to the U.S.[6] Using this data, we repeat our analysis on 20 subsets of our data. The first comprises only immigrants who have been in the U.S. for a year or less. The subsample is made up of immigrants who have been in the U.S. for two years or less, etc.

In Figure 3, we report results from our main estimation (two-year lag, national level

[6]Prior data, such as the 1990 census, only provided an intervaled variable for arrival in the U.S. (e.g. 1980-1982. However, all data we employ here provides the exact year of arrival.

data using all states and controls for age and place of birth). Each pair of points and corresponding 95% confidence intervals in the figure represents one of our subsamples, with the exception of the furtherest right pair, which presents our main result on the entire sample. Because our subsamples become inclusive of more and more data as we move to the right on the figure, we expect convergence to our full sample result, which we do observe.

The most important observation from the top panel of the figure is that our results on the more recent subsamples are smaller. This implies that the results are being driven mainly by decreases in recently arrived migrants, which is inconsistent with en masse out-migration of established immigrants. However, this analysis is unable to distinguish whether the large declines for recent immigrants are a product solely of decreased in-migration, or of constant in-migration rates with a much higher out-migration rate of recently arrived immigrants on account of recent increases in deportations or other factors. Indeed we would expect more severe interior enforcement of immigration laws to on average have much smaller effects on immigrants who have been in the U.S. for 10 to 20 years, as their opportunities to have obtained citizenship would be much higher.

The results in the bottom panel of Figure 3 also suggest that changes in the sex-ratio are more negative among more recent immigrants. However, the inverse u-shaped relationship in the figures suggests that the sex-ratio may be decreasing among immigrants who have been in the country for around five years.

3.4.4 Heterogeneity by Country of Birth

In order to examine heterogeneity in changes in sex-ratio by country of birth, we repeat the analysis shown in Figure 1 at the individual country level. While the sex-ratio both declines and increases between birth cohorts for many of the countries that we examine, we see generally negative trends over time in important sending countries such as Mexico, China and India, Vietnam and the Philippines. [7]

We summarize the results of by country estimations in two figures. First, Figure 4 illustrates the magnitude and precision of estimates of a linear decline in the sex-ratio. The x-axis represents the T-statistic from a linear regression of the sex-ratio (with an age difference of two years between men and women), with controls for age in the form of indicator variables. The size of each point is proportional to the size of the immigrant community in the regression. In Figure 4, we see that we can reject a null of no linear decline in the sex-ratio for the following countries: Vietnam, the Philippines, China, Cuba and Mexico. For only three countries, Japan, Jamaica, and Guatemala, do we find both positive estimates on our birth cohort variable as well as t-statistics greater than two.

Figure 5 makes it clear that we have stronger evidence from our non-linear tests of changes in the sex-ratio (based on regressions of indicator variables for each birth-cohort and subsequent F-tests on a null hypothesis of joint insignificance of these parameters). Consistent with the Appendix Figures, here we see that we can reject the null for the majority of countries from these regressions.

As is clear from both the size and significance of the results, along with the size of the marker reflecting the weight of the population in 4, the results for Mexican migrants play an important role in driving our overall results. Given the importance of this population among immigrants to the U.S., it is important to understand what may be driving the decline in migration for this community. Both push and pull factors have been put forth to explain slowing overall migration from Mexico. Hanson and McIntosh (2010) has argued that relative cohort sizes between Mexico and the U.S.

[7] Details of each estimation are presented in appendix Figures A2 through A4. Together, the three figures present results from analysis conducted separately for each of the 24 countries that we examine. Cell sizes here are of course even smaller than in the above analysis, so we expect that there may be some large outliers, especially for the later cohorts. A note at the bottom of the figure for each country also reports a p-value on an f-test of equality in the birth year indicator variables. We observe that there has been significant variation at the 5% level in the sex-ratio between birth cohorts using our more reliable weighted regressions for 13 of the 24 countries that we examine: Mexico, Honduras, Cuba, Germany, Russia, Japan, China, Taiwan, Korea, Laos, the Philippines, Vietnam and India. In addition, we also reject our null at the 10% but not 5% level for Haiti and El Salvador.

drive migration rates. This push factor may explain slowing overall migration from Mexico, but it is less clear why smaller cohorts from Mexico would drive a change in the gender balance among those who do migrate. Villarreal (2014) attributes slowing migration to decreased labor demand for sectors employing a large share of Mexican men, for example construction. This seems to better explain our results, especially given the timing in the changes which coincide with the Great Recession.

4 Sex-Ratios among Immigrants Recently Granted Green-Cards

The evidence above makes it clear that there has been an important demographic change occurring among the population of immigrants to the United States. Sex-ratios have not been constant over time, and the typical migrant born in 1990 is facing a sex-ratio that is significantly lower than someone of the same age who was born in the same country twenty years earlier. As discussed, the empirical literature on marriage and inter-marriage makes it clear that this changing sex-ratio will have important ramifications for marriage market outcomes.

We now examine who how immigration policy in the United States, through the channel of the granting of green cards may also affect sex-ratios. While we are not able to determine whether individuals in our micro-data are green card holders, the Department of Homeland Security's annual Immigration Yearbook (SEC., 2002-2016) provides public aggregate data on the number of individuals who obtain permanent residency in the U.S. for the years 2002 to 2016. This data is broken down by gender, as well as by the immigrant channel through which the individual obtained permanent residency.

Using this data, we will be able to learn how sex-ratios among individuals who are newly granted green card holders is changing. This may be important for marriage markets as the longer planning horizon of permanent residents may have an important impact upon outcomes in marriage markets. In addition, because we are able to observe counts of green cards granted both by gender as well as by immigration channel, we will be able to examine the way in which men and women may be differentially affected by policy changes.

The data breaks granting of permanent residency down into six distinct categories. Family based green cards are specified as either Family-Sponsored Preferences, which we will refer to below as Family, as well as the narrower class of Immediate Relatives of U.S. Citizens, which we will refer to as Immediate Relatives. The third major category is for employment-based visas, and the first represents the Diversity Lottery program, which annually randomly grants around 50,000 green cards to applicants to individuals from historically under-represented source countries. Refugees and Asylees are combined into one major category. Our final channel is a catch all Other category.

4.1 Sex-Ratios Within Visa Categories

We begin our analysis of this data by first describing changes in the sex-ratios within each category of visa over time. A time series of the shares of visas granted in each category over time is displayed in Figure 6. Throughout the entire period, the least male-dominated visa category is the Immediate Relatives channel. Over our fifteen years of data, the sex-ratio among grantees of green cards in this category always ranges between 62 and 70. The Other visa category which has a sex-ratio below 100 for the entire period is the other family-based reunification category, ranging from 81 to 92. The figure seems to exhibit a slight upward trend in the sex-ratio for this category, which is confirmed in results from a simple linear regression from which we are able to reject a null of no change in the ratio at the 5% level. The point estimate indicates an economically significant annual increase in the sex-ratio within this category of around .54.

Three of our categories are male-dominated in the entire period. Of these, the most male dominated category throughout is the Diversity Visa, ranging from a low of 115 to a high of 133. This category also seems to exhibit a slight upward trend; the corresponding regression is not significant at conventional levels but yields a relatively large point estimate of 0.47. The Refugee and Employment based categories both display sex-ratios of similar magnitudes throughout the period, between the two categories the sex-ratio ranges from 101 to 114. Only the regression coefficient for the Refugee category approaches statistical or economic significance, with a point estimate of .27 and a p-value of 0.19.

Finally, our "Other" category is the only green card channel which switches from male-dominated to female-dominated throughout the period, ranging from a high of 115 to a low of 74, declining at a rate of over 2 units per year, with statistical significance exceeding the 1% level.

4.2 Importance of Different Visa Categories

In order to examine how the changes in visas categories may impact the overall sex-ratio of immigrants granted green cards, we of course need to account not only for how sex-ratios are changing within each group, but also for the relative importance of each group and how this may have changed over time. We do this in Figure 7. From the figure, the importance of the Family category is clear. This most female dominated visa category is also clearly the most important visa category in terms of magnitude for the entire period, ranging from between 39% and 48% of all green cards granted and exhibiting no statistical trend. The other family-based category, the Immediate Relative green card channel, is the second most important channel in all but one year and accounts for around 20% of green cards granted and exhibits no significant time trend. Increases in the number of males who are obtaining green cards through these channels will clearly have a positive effect on the overall sex-ratio.

The middle two categories in terms of shares of visas granted are the relatively male-dominated Refugee and Employment channels. The employment category exhibits significant variation over time, ranging from a low of less than 12% to a high of nearly 22% of green cards granted. Unsurprisingly, the two years in which employment based green cards were largest were during the strong labor markets immediately preceding the onset of the Great Recession. No clear time trend exists overall for this category. The refugee channel exhibits strong variation over time as well, with the highest share (17.1%) being nearly three times as large as the lowest share (6.4%) and evidence of a positive and statistically significant (at the 10% level) annual increase in the share of green-cards granted from this program of around 0.3%.

The two least important green card categories throughout nearly the entire period are the Diversity Visa and Other categories, with neither ever accounting for more than 7% of total green cards granted, and the Other category exhibiting a clear downward trend over the period.

4.3 Shift Share Analysis

Moving forward from the above analysis of the variation between programs in sex-ratios and over time in the importance of the programs, we now analyze overall changes in the sex-ratio and explore how factors related to these programs may affect these changes. To do so, we first conduct a shift share analysis. The change in the overall sex-ratio of individuals awarded green cards in each year will vary over time as the relative importance of each visa channel changes. It will also covary with changing sex-ratios within each program over time, i.e. the factors that we examined in Figures 6 and 7, respectively.

Figure 8 displays estimates that decompose overall changes in the green card sex-ratio into within and between channel changes by shutting down one channel at a time. For our within program change, we fix the share of total visas granted by each program to its 2002 level but allow the share of men and women receiving visas in each channel to vary across years. Conversely, for our between channel, we allow the share of total visas granted by each program to vary across years but fix the percentage of male and female recipients in each visa category to its 2002 level. Finally, Figure 8 also displays the realized sex-ratio of green-card recipients in each year. Note that the realized and two counterfactual sex-ratios will be identical in 2002, the year for which we fix parameters.

A casual observation of the figure reveals that the within counter factual covaries much more strongly with the actual data than does the between counterfactual. Overall, the sex-ratio among green card recipients is trending up at a rate of .16 per year, while the within counterfactual is trending up at a rate of .14 per year (both are significant at the 10% level), while in contrast the between counter factual is trending down at around a .03 statistically insignificant rate per year. In addition, the pairwise correlation between the within counterfactual at .77 is more than twice that of the between counter factual at .29.

While our earlier analysis found that there had been a decrease in the sex-ratio from a baseline of male-dominance between the birth cohorts of 1970 to 1990, in the context of new permanent residents in the U.S., there has been an increase in the sex-ratio from a baseline of female dominance. In other words, this provides some evidence that the sex-ratios of permanent residents and the total stock of the foreign-born population may be converging. Of course we are not able to draw any definitive conclusion in this dimension as the absence of micro-data on the green card recipients in our data source means that we are not controlling for birth cohort, age and country of origin as we did in the prior analysis.

This analysis also reveals that the observed shifts between the availability of visas in these different channels over time has not had a significant impact on the overall sex-ratio. However, shifts in the relative importance of these different channels to one another have been slight and marginal during the last 15 years. If there were to be a dramatic change in U.S. policy in the future which affects the availability of green cards through these different channels, there may be relatively large impacts upon the sex-ratio of green card recipients.

To examine this possibility, in Figure 9 we display the results from a number of different counterfactuals in which we make major changes to the availability of visas under each of the channels. Each panel represents the sex-ratio among green card recipients. The left panel represents the observed sex-ratio of 84. In the second bar, we eliminate the Diversity Lottery program. The loss of this male-dominated but relatively small program reduces the sex-ratio to 82. The third bar shuts off the refugee channel, which has a larger effect than the absence of the Diversity Lottery program, decreasing the sex-ratio to around 80. The fourth and fifth columns explore the impact of changing more male-dominated programs and shifting towards a immigration system focused more on employment than family. When we reduce the number of family visas given to non-immediate family by half, we see an increase in the sex-ratio. This may be counterintuitive, as this category is female dominated, however not when compared to the overall sex-ratio. Doubling the number of employment visas would significantly increase the sex-ratio to 86. Finally, the net effect of enacting all of these policies would be a decrease in the sex-ratio to 80.

5 Conclusion

In this study, we have examined changes in sex-ratios among immigrants using two distinct datasets. First, employing individual level data from the 5% micro-sample of the 2000 Census as well as the 2005-2016 American Community Surveys, we constructed counts of the immigrant population by sex, age, birth cohort and country of birth. With this data, we expand upon recent work by Norlander and Sorensen (2018), Donato et al. (2011) and Hofmann and Reiter (2018) by using a synthetic cohorts approach to examine changes in migration stocks and sex-ratios between the 1970 and 1990 birth cohorts.

We find evidence of significant decreases in immigration between birth cohorts, with male migration decreasing at a faster rate than female migration. This result suggests a decreasing sex-ratio, which we confirm with our finding that younger cohorts are less male dominated than older cohorts, holding constant age and place of birth. The timing of our results suggest that the Great Recession differentially affected male and female migrants consistent changes in the sex-ratio were largely driven by changes in labor demand. While migration diminished for both groups during the depths of the economic crisis, migration stagnated for men while sharply recovering for women in the years after. We also find different patterns between "traditional receiving states," which until recently accounted for 66.25% of all immigrants living in the United States, and all other states. Our results reveal that while there was a decline in the stock of immigrants in the traditional states for both men and women, the stock of women is increasing in areas outside of the traditional receiving states.

Our next piece of analysis examines changes in sex-ratios among immigrants recently granted green cards, accounting for heterogeneity in the immigration channel through which a green card was obtained. Here, we also find results consistent with changing sex-ratios, but in the opposite direction: green-card grantees are becoming less-female dominated over time. Most of the variation in the sex-ratio among this population can be attributed to changes within the channel through which the green card was obtained, rather than to changes in the relative importance of the different channels over time.

This finding, however, does not imply that radical changes to U.S. immigration policy would not change the sex-ratio among the flow of new green card recipients. We conduct several counterfactual calculations such as eliminating the Diversity Visa program, eliminating the refugee, asylee channel, and shifting to a more employment based rather than family based immigration regime. We find that such changes would have non-negligible effects upon the sex-ratios of the population who have recently been granted green cards.

In summary, our results suggest that immigration has recently become more gender balanced, with the overall stock of immigrants becoming less male dominated, and the flow of new permanent residents becoming less female dominated. This is a first step towards understanding changes in the sex-ratio, a fundamental component of the marriage market. However, this is simply one factor influencing marriage and therefore, integration outcomes of immigrants in the U.S. A marriage market affected not only the number of men to women in and individual's network but the quality and desirable demographic characteristics of potential partners such as age, education, and income Grossbard-Shechtman and Grossbard-Shechtman (2003). The current degree of policy uncertainty surrounding immigration that exists in the U.S. clearly motivates further study of how these other important factors in marriage markets may be changing as well.

Our synthetic cohorts approach has generated aggregate count data that could be applied to other important questions that are beyond the scope of this paper. Given the demonstrated importance of inter-marriage outcomes on immigrant assimilation, further research could use this approach on recent data to directly study how these outcomes have changed. Linking any sex-ratio driven changes in marital outcomes of immigrants to the post Great Recession results revealed in this paper may help to unravel whether changes in immigration policy or changes in labor demand are the key driver of outcomes that may be affected by the changing sex-ratios that we have found in this work.

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Tables

Table 1 Male and Female Growth Rates; National Level

	(1)	(2)	(3)	(4)	(5)
Unweighted					
Data from All States					
Birth Year (Males)	-0.0288***	-0.0295***	-0.0036	-0.0040	-0.0048***
	(0.0024)	(0.0009)	(0.0037)	(0.0037)	(0.0013)
Birth Year (Females)	-0.0355***	-0.0361***	-0.0003	-0.0006	-0.0013
	(0.0022)	(0.0009)	(0.0033)	(0.0034)	(0.0012)
N	5,776	5,776	5,776	5,776	5,776
Data from Six Traditional Sending States					
Birth Year (Males)	-0.0280***	-0.0311***	-0.0037	-0.0041	-0.0073***
	(0.0024)	(0.0009)	(0.0038)	(0.0038)	(0.0013)
Birth Year (Females)	-0.0364***	-0.0395***	-0.0043	-0.0046	-0.0077***
	(0.0023)	(0.0009)	(0.0036)	(0.0036)	(0.0013)
N	5,745	5,745	5,745	5,745	5,745
Data from All Other States					
Birth Year (Males)	-0.0221***	-0.0239***	0.0045	0.0042	0.0030
	(0.0026)	(0.0012)	(0.0042)	(0.0042)	(0.0018)
Birth Year (Females)	-0.0299***	-0.0315***	0.0109**	0.0106**	0.0097***
	(0.0025)	(0.0012)	(0.0039)	(0.0039)	(0.0017)
N	5,735	5,735	5,735	5,735	5,735
Weighted					
Data from All States					
Birth Year (Males)	-0.0216*	-0.0189***	-0.0248	-0.0259	-0.0061***
	(0.0096)	(0.0010)	(0.0171)	(0.0171)	(0.0015)
Birth Year (Females)	-0.0267**	-0.0235***	-0.0180	-0.0186	-0.0002
	(0.0085)	(0.0012)	(0.0156)	(0.0155)	(0.0013)
N	5,776	5,776	5,776	5,776	5,776
Data from Six Traditional Sending States					
'Birth Year (Males)	-0.0267**	-0.0228***	-0.0302	-0.0313	-0.0111***
	(0.0102)	(0.0010)	(0.0180)	(0.0178)	(0.0015)
Birth Year (Females)	-0.0328***	-0.0288***	-0.0264	-0.0270	-0.0082***
	(0.0093)	(0.0011)	(0.0167)	(0.0165)	(0.0013)
N	5,745	5,745	5,745	5,745	5,745
Data from All Other States					
Birth Year (Males)	-0.0116	-0.0126***	-0.0148	-0.0158	0.0019
	(0.0082)	(0.0012)	(0.0151)	(0.0152)	(0.0017)
Birth Year (Females)	-0.0149*	-0.0145***	-0.0019	-0.0026	0.0136***
	(0.0068)	(0.0016)	(0.0128)	(0.0129)	(0.0015)
N	5,735	5,735	5,735	5,735	5,735
Age	None	None	Quartic	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Robust standard errors in parenthesis. *** represents significance at the 1% level, ** at the 5% level, and * at the 10% level.

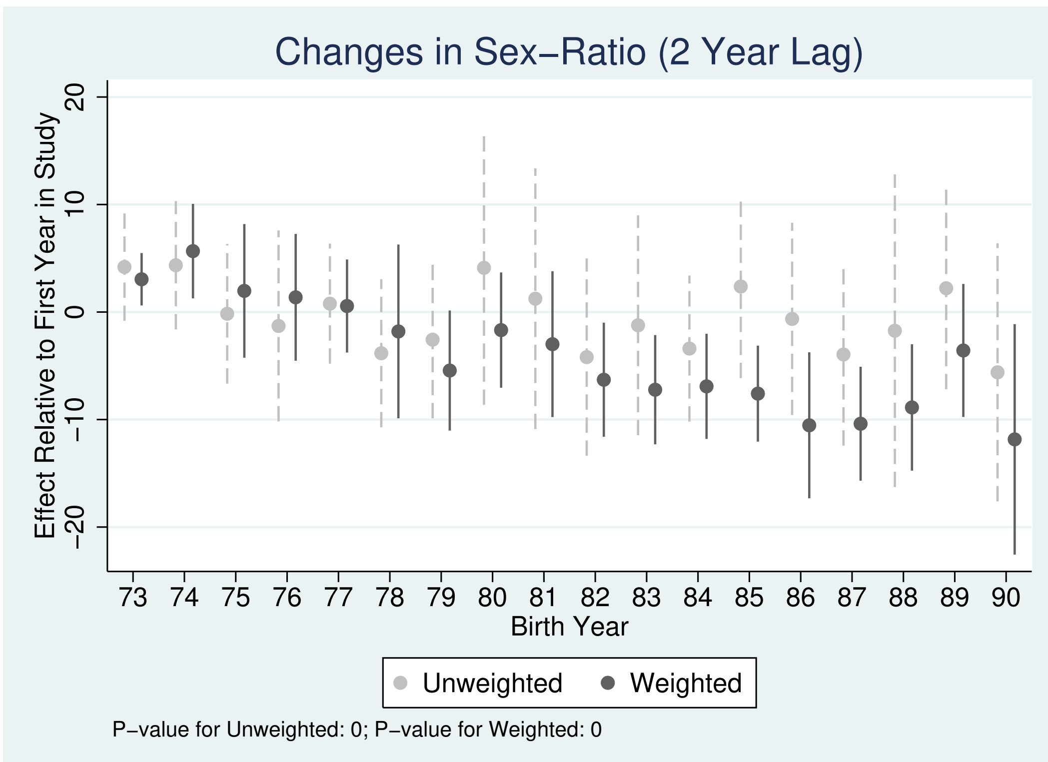
Table 2 Sex Ratios Among Immigrants By Gender-Year Lag

	Unweighted Estimations			**Weighted Estimations**		
	(All States)	**(Traditional)**	**(New)**	**(All States)**	**(Traditional)**	**(New)**
Birth Year (0 Lags)	-0.1495	0.3617***	0.1509	-1.1480***	-0.6628***	-1.9189***
	(0.1171)	(0.1614)	(0.3784)	(0.0976)	(0.1065)	(0.1720)
N	5,782	5,771	5,760	5,782	5,771	5,760
Birth Year (1 Lags)	-0.0972	0.4933***	0.3344	-0.9545***	-0.4538***	-1.7140***
	(0.1436)	(0.1819)	(0.5345)	(0.1174)	(0.1302)	(0.1982)
N	5,470	5,456	5,445	5,470	5,456	5,445
Birth Year (2 Lags)	-0.2089	0.5810***	0.0530	-0.8186***	-0.3346***	-1.5176***
	(0.1474)	(0.2134)	(0.4286)	(0.1333)	(0.1478)	(0.1993)
N	5,158	5,146	5,134	5,158	5,146	5,134
Birth Year (3 Lags)	-0.0834	0.6268***	0.2936	-0.5922***	-0.1218	-1.1318***
	(0.1795)	(0.2421)	(0.5726)	(0.1523)	(0.1728)	(0.2291)
N	4,846	4,835	4,823	4,846	4,835	4,823
Birth Year (4 Lags)	-0.0451	0.7718***	0.0471	-0.3856***	0.0423	-0.9828**
	(0.2082)	(0.3052)	(0.6117)	(0.1856)	(0.2060)	(0.2842)
N	4,534	4,523	4,511	4,534	4,523	4,511
Birth Year (5 Lags)	0.0253	1.2424***	0.4608	-0.0930	0.4333*	-0.5295
	(0.2994)	(0.3810)	(0.9192)	(0.2315)	(0.2485)	(0.3643)
N	4,222	4,211	4,200	4,222	4,211	4,200
Birth Year (6 Lags)	-0.0342	1.0674***	0.2981	0.0078	0.4089	-0.3368
	(0.3772)	(0.4250)	(0.7777)	(0.2694)	(0.2922)	(0.4040)
N	3,910	3,899	3,888	3,910	3,899	3,888
Birth Year (7 Lags)	-0.0063	0.8841*	0.7282	0.1671	0.5945*	0.1422
	(0.4894)	(0.5121)	(1.5129)	(0.3231)	(0.3563)	(0.6023)
N	3,598	3,587	3,577	3,598	3,587	3,577
Age	Indicators	Indicators	Indicators	Indicators	Indicators	Indicators
Birth Place	Indicators	Indicators	Indicators	Indicators	Indicators	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Robust standard errors in parenthesis. *** represents significance at the 1% level, ** at the 5% level, and * at the 10% level.

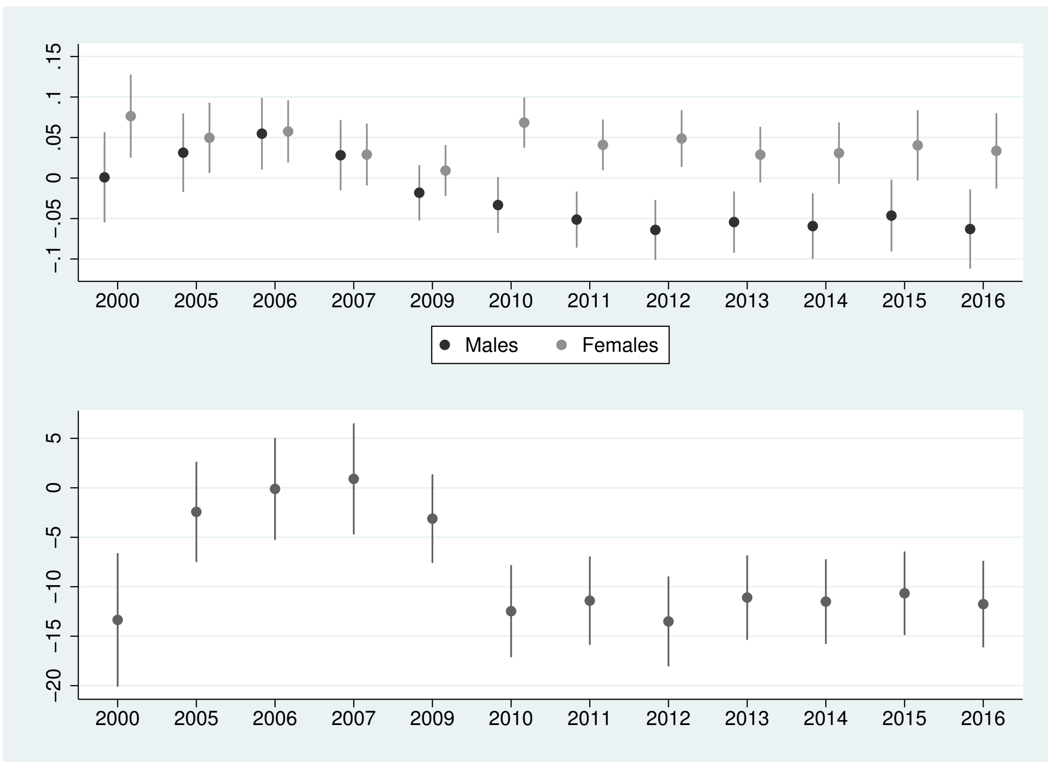
Figures

Figure 1 Sex-Ratio Changes by Birth-Cohort



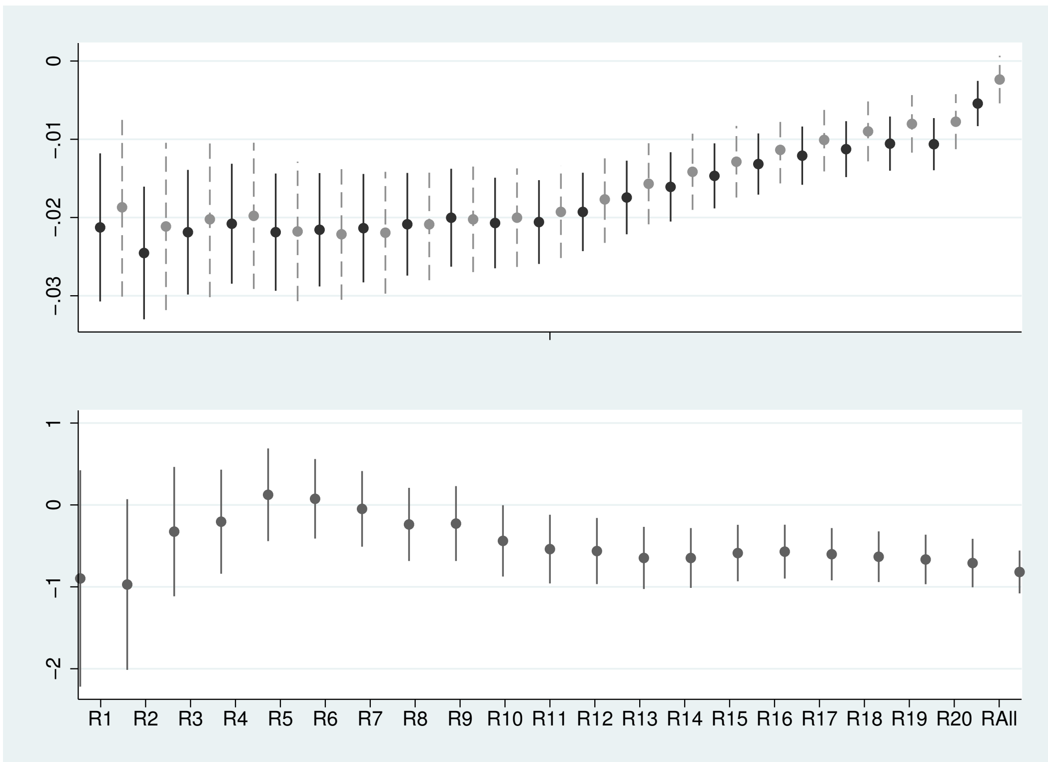
Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Weights used. Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS

Figure 2 Year Indicator Variable Coefficient Estimates



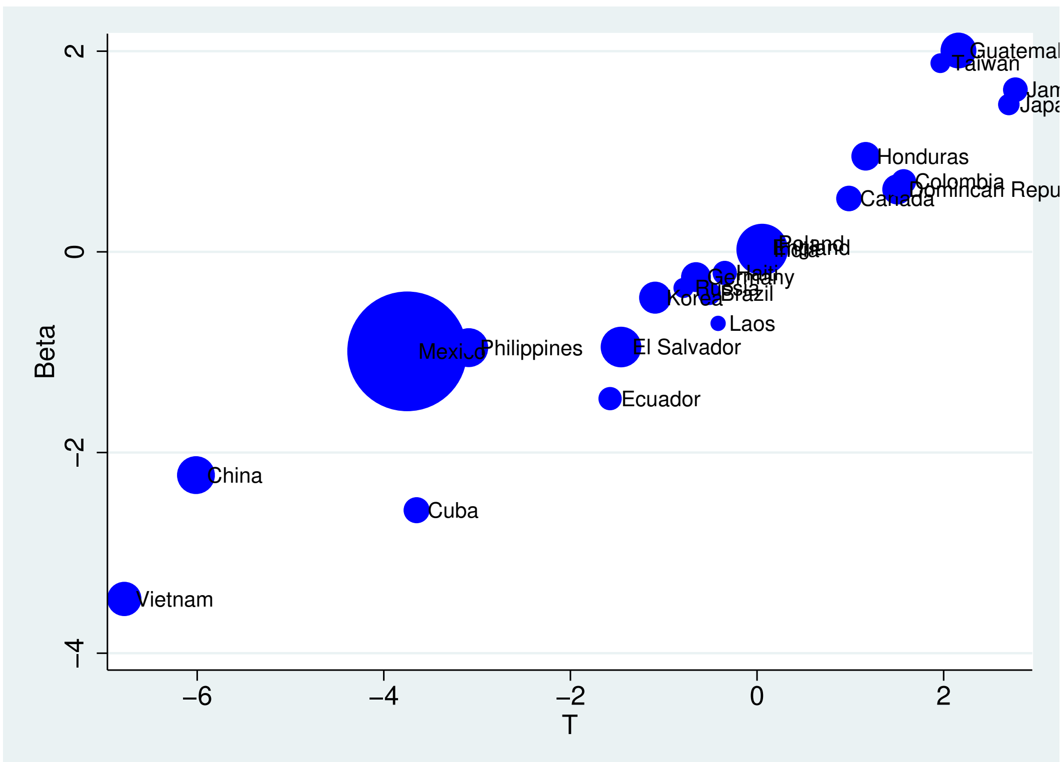
Top panel displays gender specific results; bottom panel displays sex-ratios results. Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Weights used. Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS.

Figure 3 Estimates by Time in U.S.



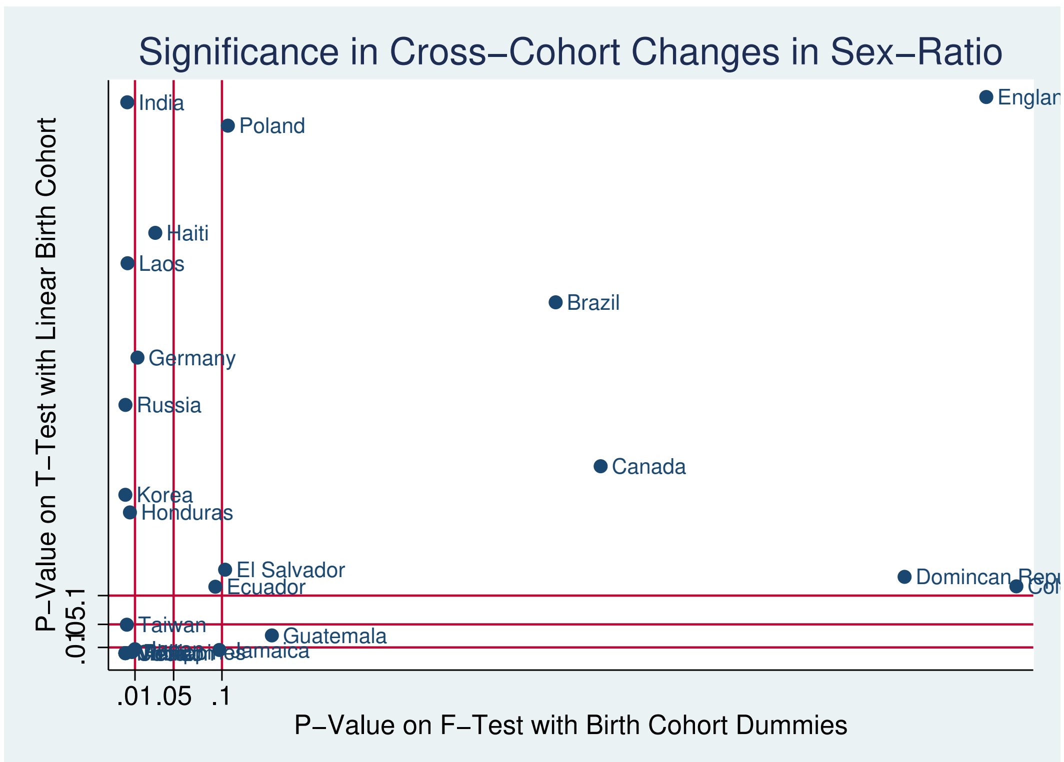
Top panel displays gender specific results; male results are reported to the left of female results. The bottom panel displays sex-ratios results. "R1" denotes immigrants in the U.S. for 1 year or less, "R20" is 20 years or less, and "RAll" is full sample. Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Weights used. Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS.

Figure 4 Significance and Magnitude of Results



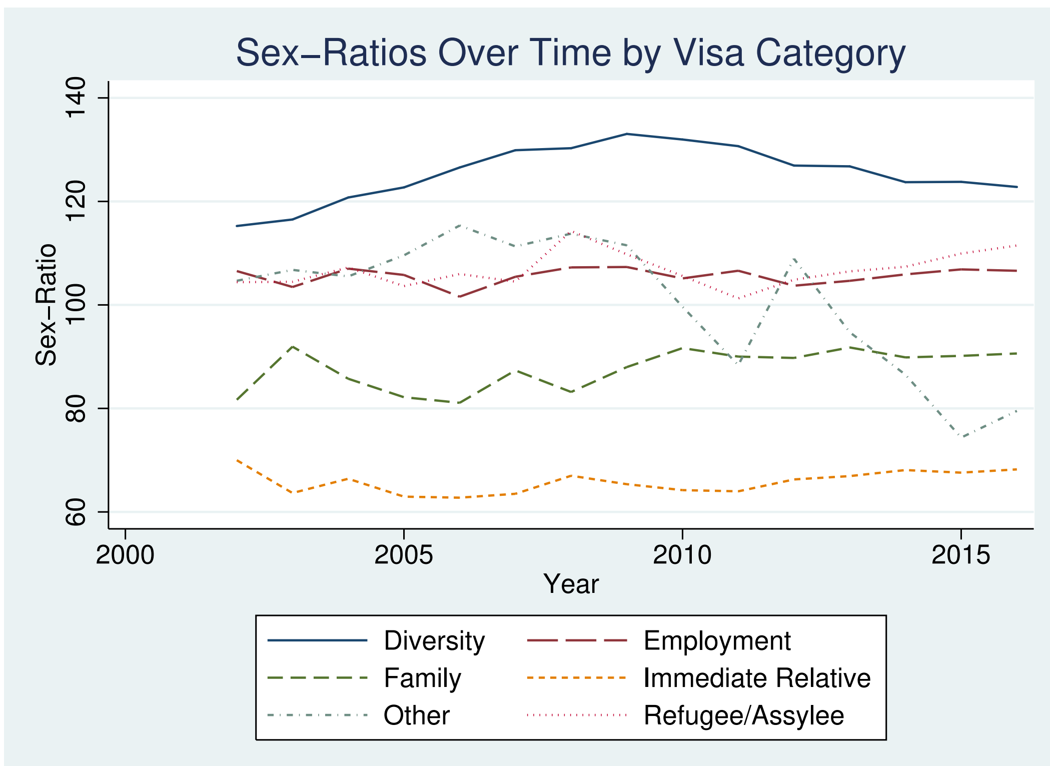
Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Weights used. Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS.

Figure 5 Non-Linear and Linear Significance and Magnitude of Results



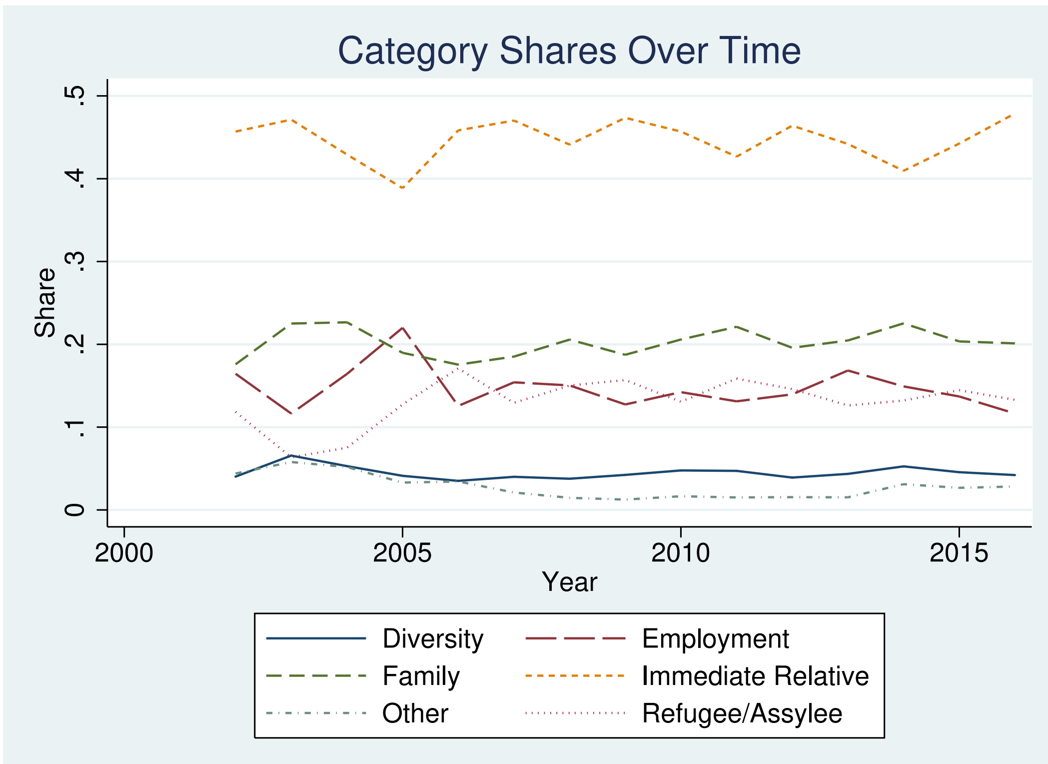
Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Weights used. Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS.

Figure 6 Programs Sex-Ratio over Time



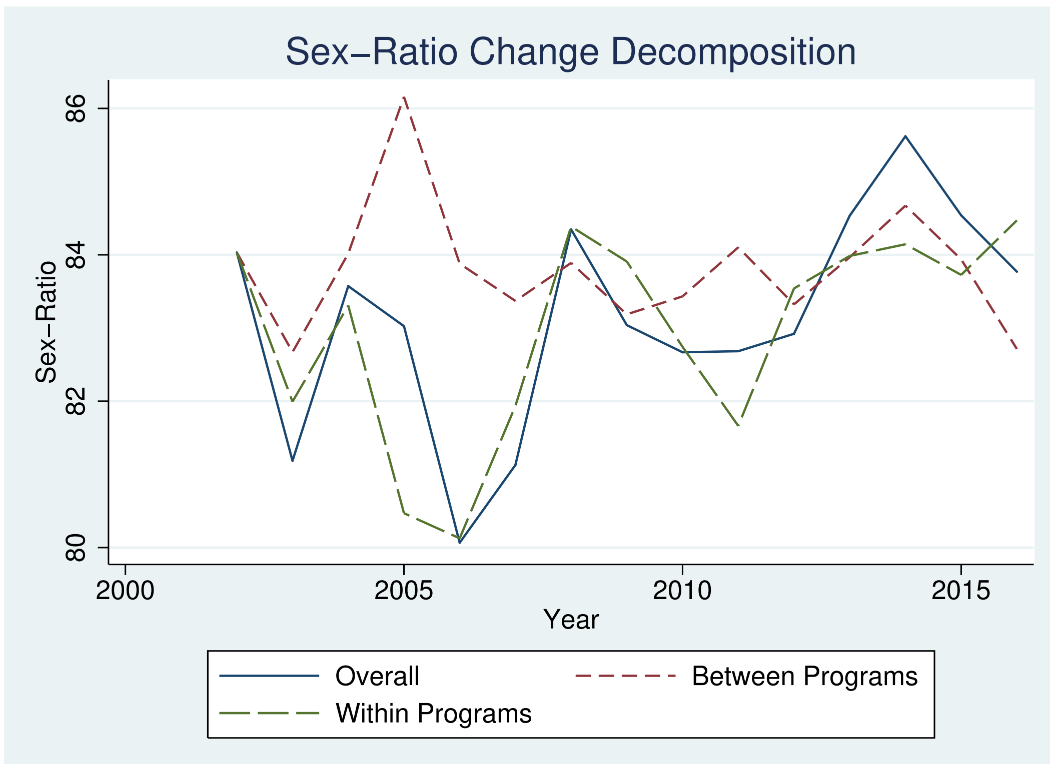
Source: U.S. Department of Homeland Security Immigration Yearbooks, 2002-2016. Tables 7, 7D, 7, 9, 9, 9D, 9, 9, 9, 9D, 9, 9D, 9D, 9, 9 and 9, by year, respectively.

Figure 7 Programs Shares over Time



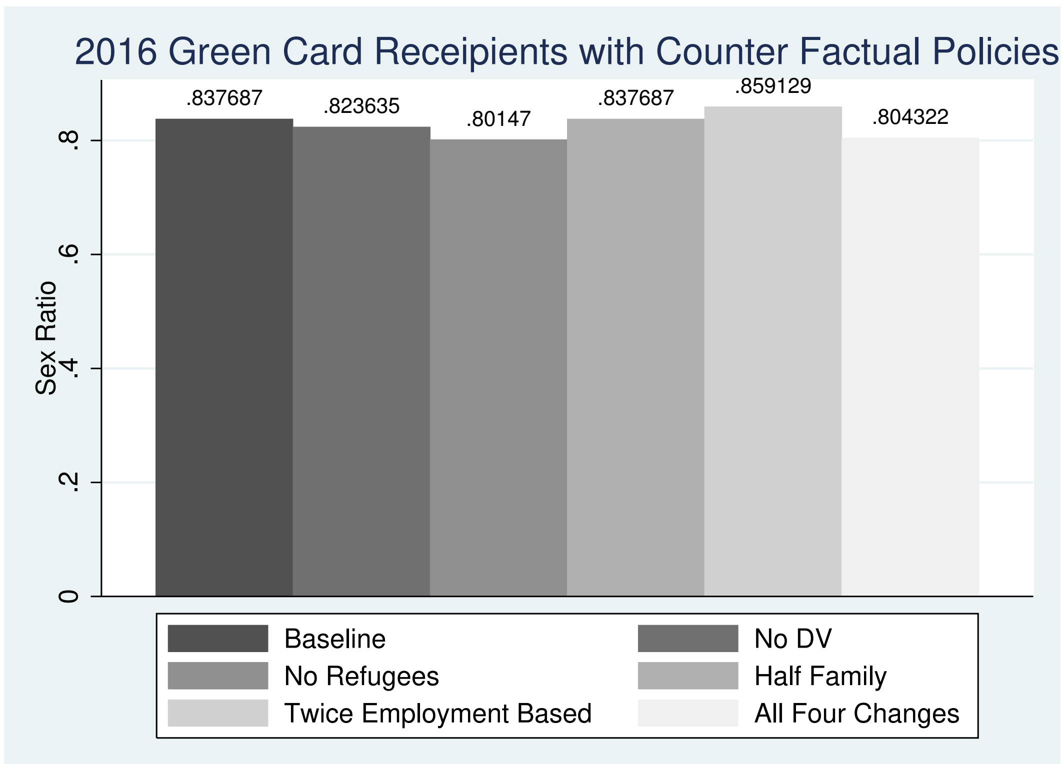
Source: U.S. Department of Homeland Security Immigration Yearbooks, 2002-2016. Tables 7, 7D, 7, 9, 9, 9D, 9, 9, 9, 9D, 9, 9D, 9D, 9, 9 and 9, by year, respectively.

Figure 8 Shift Share Analysis



Source: U.S. Department of Homeland Security Immigration Yearbooks, 2002-2016. Tables 7, 7D, 7, 9, 9, 9D, 9, 9, 9, 9D, 9, 9D, 9D, 9, 9 and 9, by year, respectively.

Figure 9 Counter Factual Policy Changes



Source: U.S. Department of Homeland Security Immigration Yearbooks, 2002-2016. Tables 7, 7D, 7, 9, 9, 9D, 9, 9, 9, 9D, 9, 9D, 9D, 9, 9 and 9, by year, respectively.

Appendix Tables

Table A1 Male and Female Growth Rates ; State Level

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Birth Year (Males)	0.0115***	0.0032***	0.0520***	0.0514***	0.0406***	0.0270***
	(0.0009)	(0.0008)	(0.0013)	(0.0013)	(0.0012)	(0.0010)
N	70,224	70,224	70,224	70,224	70,224	70,224
Birth Year (Females)	0.0056***	-0.0007	0.0542***	0.0537***	0.0450***	0.0310***
	(0.0008)	(0.0008)	(0.0013)	(0.0013)	(0.0012)	(0.0010)
N	70,224	70,224	70,224	70,224	70,224	70,224
Age	None	None	Quartic	Indicators	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators	Indicators
State Indicators	None	None	None	None	None	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Robust standard errors in parenthesis. *** represents significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A2 Male and Female Growth Rates ; State Level (Precision Weighted)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Birth Year (Males)	-0.0215**	-0.0225***	-0.0214	-0.0225	-0.0085	-0.0057***
	(0.0078)	(0.0038)	(0.0140)	(0.0138)	(0.0071)	(0.0017)
N	70,224	70,224	70,224	70,224	70,224	70,224
Birth Year (Females)	-0.0273***	-0.0274***	-0.0155	-0.0161	-0.0030	0.0000
	(0.0076)	(0.0041)	(0.0140)	(0.0137)	(0.0076)	(0.0019)
N	70,224	70,224	70,224	70,224	70,224	70,224
Age	None	None	Quartic	Indicators	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators	Indicators
State Indicators	None	None	None	None	None	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Robust standard errors in parenthesis. *** represents significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A3 Sex Ratios Among Immigrants By Gender-Year Lag (unweighted ; P-value on F on birth cohort indicators)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Birth Year (0 Lags)	0.0000	0.0000	0.6454	0.7320	0.1769
N	5,782	5,782	5,782	5,782	5,782
Birth Year (1 Lags)	0.0000	0.0000	0.3789	0.4966	0.0731
N	5,470	5,470	5,470	5,470	5,470
Birth Year (2 Lags)	0.0000	0.0000	0.5699	0.4360	0.0675
N	5,158	5,158	5,158	5,158	5,158
Birth Year (3 Lags)	0.0000	0.0000	0.7942	0.8027	0.5030
N	4,846	4,846	4,846	4,846	4,846
Birth Year (4 Lags)	0.0000	0.0000	0.9956	0.9707	0.9303
N	4,534	4,534	4,534	4,534	4,534
Birth Year (5 Lags)	0.0000	0.0000	0.6792	0.8110	0.6855
N	4,222	4,222	4,222	4,222	4,222
Birth Year (6 Lags)	0.0000	0.0000	0.7287	0.9029	0.8057
N	3,910	3,910	3,910	3,910	3,910
Birth Year (7 Lags)	0.0000	0.0000	0.6624	0.8332	0.7008
N	3,598	3,598	3,598	3,598	3,598
Age	None	None	Quartic	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Table cells are P-values from an F-test of joint significance of birth cohort dummies.

Table A4 Sex Ratios Among Immigrants By Gender-Year Lag (with population weights ; P-value on F on birth cohort indicators)

	(1)	(2)	(3)	(4)	(5)
Birth Year (0 Lags)	0.0000	0.0000	0.0000	0.0000	0.0000
N	5,782	5,782	5,782	5,782	5,782
Birth Year (1 Lags)	0.0000	0.0000	0.0028	0.0003	0.0000
N	5,470	5,470	5,470	5,470	5,470
Birth Year (2 Lags)	0.0000	0.0000	0.0233	0.0043	0.0000
N	5,158	5,158	5,158	5,158	5,158
Birth Year (3 Lags)	0.0000	0.0000	0.3861	0.2524	0.0028
N	4,846	4,846	4,846	4,846	4,846
Birth Year (4 Lags)	0.0000	0.0000	0.8697	0.7734	0.2942
N	4,534	4,534	4,534	4,534	4,534
Birth Year (5 Lags)	0.0000	0.0000	0.9662	0.9614	0.8405
N	4,222	4,222	4,222	4,222	4,222
Birth Year (6 Lags)	0.0000	0.0000	0.5948	0.6970	0.4673
N	3,910	3,910	3,910	3,910	3,910
Birth Year (7 Lags)	0.0000	0.0000	0.8674	0.7522	0.5846
N	3,598	3,598	3,598	3,598	3,598
Age	None	None	Quartic	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Table cells are P-values from an F-test of joint significance of birth cohort dummies.

Table A5 Sex Ratios Among Immigrants By Gender-Year Lag (unweighted, state level data)

	(1)	(2)	(3)	(4)	(5)	(6)
Birth Year (0 Lags)	2.0243***	1.7304***	0.9986***	0.9673***	0.7138***	1.0514***
	(0.2480)	(0.2429)	(0.2675)	(0.2672)	(0.2644)	(0.2739)
N	70,224	70,224	70,224	70,224	70,224	70,224
Birth Year (1 Lags)	2.5706***	2.2816***	1.2518***	1.1646***	0.9261**	1.2528***
	(0.5770)	(0.5493)	(0.4504)	(0.4385)	(0.4106)	(0.4537)
N	66,199	66,199	66,199	66,199	66,199	66,199
Birth Year (2 Lags)	3.0723***	2.7941***	1.2069***	1.1275***	0.8733***	1.1520***
	(0.3260)	(0.3146)	(0.3202)	(0.3166)	(0.3082)	(0.3242)
N	62,577	62,577	62,577	62,577	62,577	62,577
Birth Year (3 Lags)	4.1832***	3.9350***	1.6665***	1.5828***	1.3461***	1.6386***
	(0.6322)	(0.6042)	(0.5295)	(0.5036)	(0.4777)	(0.5222)
N	58,372	58,372	58,372	58,372	58,372	58,372
Birth Year (4 Lags)	5.0647***	4.8192***	1.9164***	1.7742***	1.5558***	1.7772***
	(0.7209)	(0.6895)	(0.6240)	(0.5821)	(0.5539)	(0.5982)
N	54,178	54,178	54,178	54,178	54,178	54,178
Birth Year (5 Lags)	5.7495***	5.4883***	1.6723**	1.5616**	1.3254**	1.5312**
	(0.8054)	(0.7709)	(0.7211)	(0.6634)	(0.6343)	(0.6906)
N	50,118	50,118	50,118	50,118	50,118	50,118
Birth Year (6 Lags)	6.5836***	6.4241***	2.2103***	1.9287**	1.8166**	1.9495**
	(0.8819)	(0.8486)	(0.8308)	(0.7494)	(0.7216)	(0.7666)
N	45,970	45,970	45,970	45,970	45,970	45,970
Birth Year (7 Lags)	7.6911***	7.5550***	2.4789*	2.0513	1.9804	2.1408*
	(1.4630)	(1.4015)	(1.4241)	(1.2477)	(1.2022)	(1.2881)
N	42,071	42,071	42,071	42,071	42,071	42,071
Age	None	None	Quartic	Indicators	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators	Indicators
State	None	Indicators	None	None	Indicators	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Robust standard errors in parenthesis. *** represents significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A6 Sex Ratios Among Immigrants By Gender-Year Lag (with population weights, state level data)

	(1)	(2)	(3)	(4)	(5)	(6)
Birth Year (0 Lags)	1.8277***	1.6486***	-0.6019***	-0.6484***	-0.7313***	-0.9633***
	(0.1521)	(0.1519)	(0.1983)	(0.2022)	(0.1973)	(0.1714)
N	70,224	70,224	70,224	70,224	70,224	70,224
Birth Year (1 Lags)	2.6984***	2.5202***	-0.0533	-0.1085	-0.1825	-0.3946
	(0.3602)	(0.3608)	(0.2917)	(0.2723)	(0.2800)	(0.2537)
N	66,199	66,199	66,199	66,199	66,199	66,199
Birth Year (2 Lags)	3.4570***	3.2997***	0.1335	0.1013	0.0384	-0.1787
	(0.1902)	(0.1856)	(0.2397)	(0.2381)	(0.2327)	(0.2040)
N	62,577	62,577	62,577	62,577	62,577	62,577
Birth Year (3 Lags)	4.6220***	4.4905***	0.6418**	0.6194**	0.5739*	0.3530
	(0.3626)	(0.3609)	(0.3311)	(0.3163)	(0.3195)	(0.2945)
N	58,372	58,372	58,372	58,372	58,372	58,372
Birth Year (4 Lags)	5.6326***	5.5460***	1.0162***	0.9707***	0.9607***	0.7415***
	(0.4195)	(0.4179)	(0.3762)	(0.3544)	(0.3571)	(0.3327)
N	54,178	54,178	54,178	54,178	54,178	54,178
Birth Year (5 Lags)	6.8739***	6.8058***	1.3706***	1.2617***	1.2484***	1.0192***
	(0.4733)	(0.4705)	(0.4350)	(0.4133)	(0.4133)	(0.3873)
N	50,118	50,118	50,118	50,118	50,118	50,118
Birth Year (6 Lags)	7.7053***	7.7189***	1.8810***	1.8185***	1.8476***	1.6061***
	(0.5187)	(0.5153)	(0.4997)	(0.4735)	(0.4733)	(0.4402)
N	45,970	45,970	45,970	45,970	45,970	45,970
Birth Year (7 Lags)	9.2100***	9.2547***	2.5746***	2.3725***	2.4255***	2.1975***
	(1.1381)	(1.1358)	(0.9135)	(0.8216)	(0.8470)	(0.8100)
N	42,071	42,071	42,071	42,071	42,071	42,071
Age	None	None	Quartic	Indicators	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators	Indicators
State	None	Indicators	None	None	Indicators	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Robust standard errors in parenthesis. *** represents significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A7 Sex Ratios Among Immigrants By Gender-Year Lag (unweighted ; P-value on F on birth cohort indicators)

	(1)	(2)	(3)	(4)	(5)	(6)
Birth Year (0 Lags)	0.0000	0.0000	0.0643	0.0970	0.1547	0.0432
N	70,224	70,224	70,224	70,224	70,224	70,224
Birth Year (1 Lags)	0.0000	0.0000	0.0120	0.0597	0.1904	0.0541
N	66,199	66,199	66,199	66,199	66,199	66,199
Birth Year (2 Lags)	0.0000	0.0000	0.0417	0.0367	0.1041	0.0343
N	62,577	62,577	62,577	62,577	62,577	62,577
Birth Year (3 Lags)	0.0000	0.0000	0.0194	0.0261	0.0227	0.0120
N	58,372	58,372	58,372	58,372	58,372	58,372
Birth Year (4 Lags)	0.0000	0.0000	0.1798	0.1002	0.1145	0.0815
N	54,178	54,178	54,178	54,178	54,178	54,178
Birth Year (5 Lags)	0.0000	0.0000	0.0531	0.0523	0.0578	0.0551
N	50,118	50,118	50,118	50,118	50,118	50,118
Birth Year (6 Lags)	0.0000	0.0000	0.0265	0.0709	0.0494	0.0542
N	45,970	45,970	45,970	45,970	45,970	45,970
Birth Year (7 Lags)	0.0000	0.0000	0.5898	0.6886	0.5841	0.6192
N	42,071	42,071	42,071	42,071	42,071	42,071
Age	None	None	Quartic	Indicators	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators	Indicators
State	None	Indicators	None	None	Indicators	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Table cells are P-values from an F-test of joint significance of birth cohort dummies.

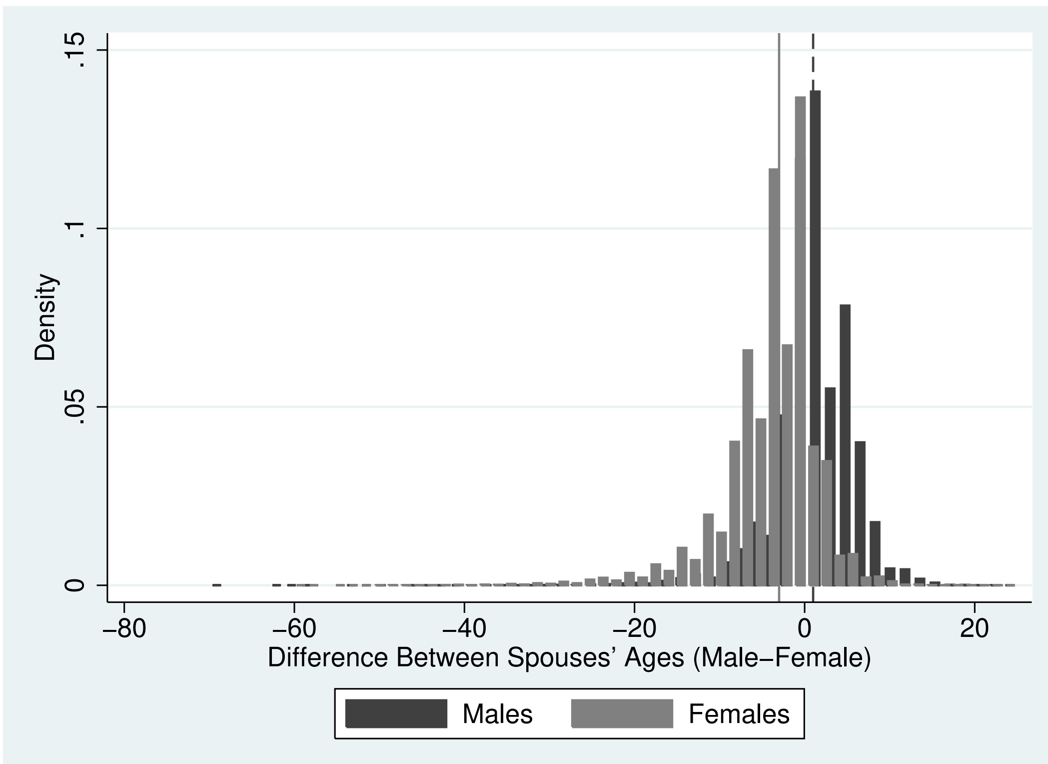
Table A8 Sex Ratios Among Immigrants By Gender-Year Lag (with population weights ; P-value on F on birth cohort indicators)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Birth Year (0 Lags)	0.0000	0.0000	0.1062	0.1389	0.0316	0.0000
N	70,224	70,224	70,224	70,224	70,224	70,224
Birth Year (1 Lags)	0.0000	0.0000	0.0333	0.2322	0.1498	0.0014
N	66,199	66,199	66,199	66,199	66,199	66,199
Birth Year (2 Lags)	0.0000	0.0000	0.0290	0.1100	0.0504	0.0027
N	62,577	62,577	62,577	62,577	62,577	62,577
Birth Year (3 Lags)	0.0000	0.0000	0.4373	0.5911	0.4113	0.2071
N	58,372	58,372	58,372	58,372	58,372	58,372
Birth Year (4 Lags)	0.0000	0.0000	0.5364	0.5822	0.4315	0.3501
N	54,178	54,178	54,178	54,178	54,178	54,178
Birth Year (5 Lags)	0.0000	0.0000	0.1604	0.2180	0.1875	0.1914
N	50,118	50,118	50,118	50,118	50,118	50,118
Birth Year (6 Lags)	0.0000	0.0000	0.0011	0.0176	0.0121	0.0140
N	45,970	45,970	45,970	45,970	45,970	45,970
Birth Year (7 Lags)	0.0000	0.0000	0.0265	0.0955	0.0553	0.0557
N	42,071	42,071	42,071	42,071	42,071	42,071
Age	None	None	Quartic	Indicators	Indicators	Indicators
Birth Place	None	Indicators	None	None	Indicators	Indicators
State	None	Indicators	None	None	Indicators	Indicators

Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS Ruggles et al. (2017). Table cells are P-values from an F-test of joint significance of birth cohort dummies.

Appendix Figures

Figure A1 Age Gaps in Marriage in Our Sample

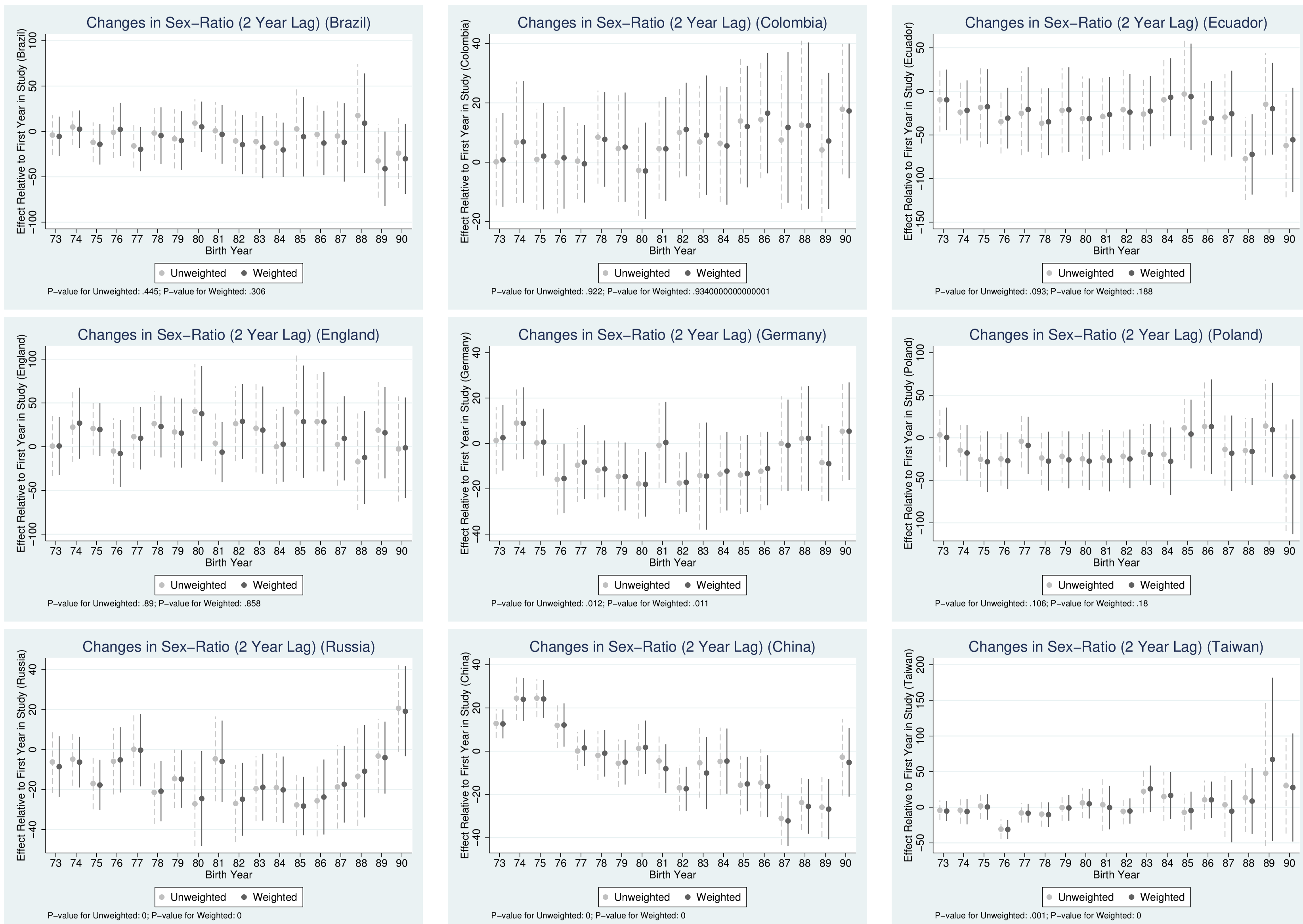


Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS.

Figure A2 Sex-Ratio Changes by Birthplace (1)

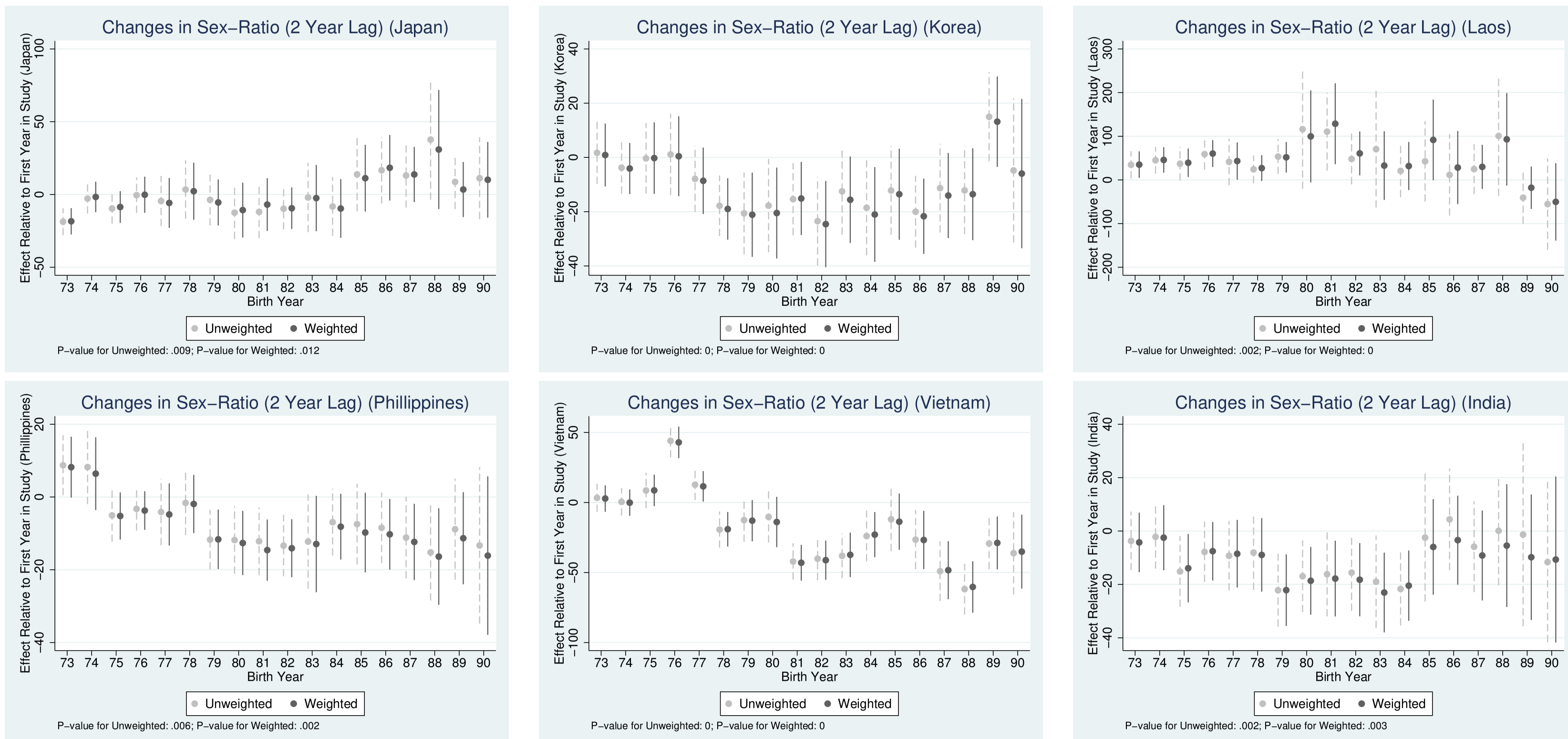
Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Source: 2000 U.S. Census and 2005-2016

Figure A3 Sex-Ratio Changes by Birthplace (2)



Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Source: 2000 U.S. Census and 2005-2016

Figure A4 Sex-Ratio Changes by Birthplace (3)



Data taken from two year lagged sex-ratio, controls include age and birth place fixed effects. Source: 2000 U.S. Census and 2005-2016 American Community Survey, data made available from IPUMS.