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MIGRATORY FLOWS IN THE AGE OF
MASS MIGRATION**

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ABSTRACT

The Making of Modern America: Migratory Flows in the Age of Mass Migration*

We provide new estimates of migrant flows into and out of America during the Age of Mass Migration at the turn of the twentieth century. Our analysis is based on a novel data set of administrative records covering the universe of 24 million migrants who entered Ellis Island, New York between 1892 and 1924. We use these records to measure inflows into New York, and then scale-up these figures to estimate migrant inflows into America as a whole.

Combining these flow estimates with census data on the stock of foreign-born in America in 1900, 1910 and 1920, we conduct a demographic accounting exercise to estimate out-migration rates in aggregate and for each nationality-age-gender cohort. This exercise overturns common wisdom on two fronts. First, we estimate flows into the US to be 20% and 170% higher than stated in official statistics for the 1900-10 and 1910-20 decades, respectively. Second, once mortality is accounted for, we estimate out-migration rates from the US to be around .6 for the 1900-10 decade and around .75 for the 1910-20. These figures are over twice as high as official estimates for each decade. That migration was effectively a two-way flow between the US and the sending countries has major implications for understanding the potential selection of immigrants that chose to permanently reside in the US, their impact on Americans in labor markets, and institutional change in America and sending countries

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1 Introduction

The US is regarded by many social scientists as the ultimate multicultural society: 31 million individuals were recorded as foreign-born in the 2000 Census, corresponding to 12% of the population, and the US remains the primary destination for immigrants from developing countries [Hanson 2009]. The sheer magnitude of migratory flows into the US, the diversity of immigrants in terms of countries of origin, and the long period over which substantial migratory flows have taken place, marks out the US as an almost unique host country to study in terms of the economic impacts of migration on migrants themselves, natives in the host country, and sending country economies.¹

This paper provides new evidence on the extent and nature of mass migration into *and out of* the US at the turn of the twentieth century, a period often referred to as the ‘Age of Mass Migration’, reflecting the fact that tens of millions of individuals migrated to the US from Europe and further afield at this time. Indeed, there are few if any comparable episodes of history in which such large-scale voluntary migration has occurred.² A key innovation in our analysis is to use novel data based on administrative records from passenger ship manifests on the universe of individuals that entered the US during this period through its main port of entry, Ellis Island, New York. These records provide details on over 24 million migrants that entered between 1892 and 1924. These individuals are those who laid the foundations for modern America – there are an estimated 100 million living descendants of these Ellis Island immigrants today.^{3,4}

Despite the economic and historical importance of migration at the turn of the twentieth century, the official statistics commonly used in academic research are known to be measured with considerable error [Jerome 1926, Kuznets and Rubin 1954, Hutchinson 1958, Thomas 1973, McClelland and Zeckhauser 1983, Schaefer 1994, Carter *et al.* 2006]. The detailed administrative records we exploit allow us to present alternative estimates of migrant inflows and outflows. In doing so, we draw a very different picture of transatlantic migratory flows than has previously been recognized by scholars.⁵

¹There are some smaller countries in which the percentage of foreign-born individuals is higher. Among the EU15 countries, none had a foreign-born population larger than 9% in 2006 with the exception of Luxembourg.

²In terms of contemporary mass migrations, it is estimated that 8 million Latinos entered the US during the 1980s, and .6 million individuals entered the UK from the A8 countries between 2004-6. Historically, similar quantitative migratory flows have been observed during episodes of either forced migration or when binding constraints are relaxed. For example, in the four years after the India-Pakistan-Bangladesh partition 18 million individuals are estimated to have migrated out of India [Bharadwaj *et al.* 2008]; Russian migrants into Israel corresponded to around a 12% population increase between 1990-4 [Friedberg 2001]. Finally, there were an estimated .6 million migrants from East to West Germany over the period 1989-90 [Heiland 2004].

³The immigration station at Ellis Island opened in 1892, and grew dramatically over the subsequent three decades. It lost the principal function for which it was established in 1924, when the second Quota Law was introduced. This legislative act provided for the examination of prospective migrants at American Consulates overseas. The Ellis Island station closed in 1954 [Pitkin 1975].

⁴There are few economics studies that have made use of passenger ship manifests from other ports: (i) Barde and Bobonis [2006] present evidence on detention by nationality at Angel Island, San Francisco, the main port of entry for Asians, for the period 1913-19; (ii) Puerta [2005] presents evidence on chain migration of one million Italians to Buenos Aires from 1882 to 1920; (iii) Ganguli [2010] presents evidence from Ellis Island ship manifests on the effect of literacy tests on inflows.

⁵Earlier studies have of course explicitly recognized that return migration was an important phenomenon during at the turn of the century, and that this remains an under researched area. For example, Gould [1980] writes, “If

Our analysis proceeds in three stages. First, we present descriptive evidence on patterns of entry into Ellis Island by year of arrival. We do so in aggregate and for cohorts defined along three dimensions: nationality, age and gender. This stage of the analysis provides a like-for-like comparison between official statistics on inflows into this main port of entry into the US, and what we derive from newly available administrative records relating to inflows into the same port over the same time period.

Second, we combine inflow measures into Ellis Island based on administrative records with other data sources to provide a scaled-up estimate of the total inflow of immigrants into America as a whole, that accounts for: (i) inflows from other sea ports of entry into America; (ii) inflows over land via Canada and Mexico; (iii) missing data in administrative records and other corrections for potentially mis-coded nationalities; (iv) expulsion or death at Ellis Island. Each adjustment is described in detail in the Appendix. Given this methodology, a comparison between the official statistics and the derived aggregate inflows will reflect *both* the accuracies of the two series and the accuracies of the assumptions we make in order to scale-up the administrative series of inflows to New York to those for America as a whole.

Third, to estimate the number of individuals that have out-migrated from the US during this period we use demographic accounting techniques that relate changes in population stocks and migratory flows [Warren and Peck 1980, Jasso and Rosenzweig 1982]. This involved combining the *flow* estimates of immigrant entry into the US between 1900 and 1920 with the *stock* of foreign-born resident in the US at census date 1900-1910-1920, again by nationality-gender-age cohort. Taking the ratio of out-migrants to in-migrants from the same cohort and over the same decade, we then provide novel estimates for out-migration rates for each decade, 1900-10 and 1910-20. These can be directly compared to official statistics compiled at the time [Ferenczi-Willcox 1929], that have been the foundation for earlier academic work.⁶

Our main results are as follows. First, using only the administrative records on entry in Ellis Island, we find the number of immigrant arrivals into New York to be 18% higher than official statistics record between 1900-10, and around 50% higher than is officially recorded during 1910-20. After scaling-up these figures to estimate migrant inflows into America as a whole, we find that our preferred estimate implies the number of immigrant arrivals is 20% higher than official statistics between 1900-10, and more than 170% higher than is officially recorded during 1910-20.

the immigrants came, as so many models assert, because of higher wages and better job opportunities in the USA than in Europe, why did so many go back? As obvious a question as this has been totally ignored by the majority of econometric studies on Pre world War One migration.” (p.50) ; “there is a lot of truth in the alternative possibility, that is, an increasing fraction of those who migrated to the USA never intended to remain permanently” (p.51); “there is ample evidence that the growth of return migration reflects fundamentally an increase in intentionally temporary movements made more feasible and profitable by the greater speed, comfort, and declining real cost of long-distance passenger shipping” (p.52). Taylor and Williamson [1994] write that, “Migration rates in table 1 [*note: which cover the period 1870-1910*] are derived from data in the appendix, and reflect adjustments for unobserved return migration. It is well known that historical data from the period systematically undernumerate return migration. We cannot know how serious the errors are, but we can apply sensitivity analysis to establish what impact such errors may have.” (p.2, italics added).

⁶We refer to out-migration rather than return migration because we cannot infer whether individuals return to their original country of origin, or whether they use America as a stepping stone to a third country.

Second, our demographic accounting exercise implies that the number of *out*-migrants from America is mis-measured with even more severe error than are the migrant inflow estimates: we document the number of out-migrants to be three times higher than is officially recorded for the 1900-10 decade, and more than seven times higher for 1910-20. Combining our estimated inflows and outflows by decade, we then find that the rate of out-migration from America, namely the ratio of the number of out-migrants to the number in-migrants from the same cohort and over the same decade to be 76% for the 1900-10 decade, and close to 100% over the 1910-20 decade. Although these results do *not* imply that it is the *same* individuals who enter and exit America within each decade, the results do suggest there is a considerable degree of turnover in the foreign-born population in America at the turn of the twentieth century, and potentially large migrant flows back to European sending countries.

Our estimated rates of out-migration differ substantially from the conventional wisdom among scholars, that have previously thought out-migration rates to be closer to 35% in each decade [Hatton and Williamson 2005]. Given the discrepancy between what we document based on administrative records and what has been officially recorded, it is important to validate our findings using another approach. One way to do so is to examine how the stock of foreign-born varies between census dates. More precisely, US census data suggests the absolute increase in the foreign-born population was from 13.5 in 1910 to 13.9 million in 1920, corresponding to only a 3% increase. In short, *regardless* of the actual migrant inflow estimate – be it from official statistics or administrative records – census data alone suggests that for this decade the undisputed inflow of millions of migrants *must* have been matched by a similarly sized out-flow of foreign-born individuals. Indeed, for this decade our accounting exercise suggests an out-migration rate of just under 100%.

Finally, the comparison of out-migration rates derived from the administrative records from Ellis Island and the official statistics based on Ferenczi-Willcox [1929] is conducted by ignoring mortality and purely derived counts of migrant inflows and outflows. Moving away from such pure counts and taking mortality rates into account, our data suggest that among those still expected to be alive at the end of the decade, out-migration rates were between .584 and .632 for the 1900-10 decade, and between .746 and .812 for the 1910-20 decade, depending on precisely which mortality rate is assumed. This is the more useful figure for future economic analysis, although the former figure based on counts establishes how far off official statistics might be.

At the core of this paper is an attempt to accurately *measure* migratory inflows and outflows from America during the age of Mass Migration. While it is certainly the case that for the time period we study, the sheer magnitude of migratory flows into the US is sufficiently large to likely have quantitatively large and permanent effects on both the US economy and sending country economies, related research questions cannot be addressed without first establishing rates of out-migration. There are indeed three classes of research question that naturally follow from this type of exercise on building accurate measures of migrant outflows. All are relevant to contemporary academic work on migration.

For example, the first strand of literature to which our results are relevant relates to the analysis

of immigrant behavior in the US. In any plausible framework the likelihood to out-migrate affects investment into own human capital, children’s human capital, savings, and social networks [Galor and Stark 1990, Dustmann 1997, 1999, 2007, Cortes 2004]. In turn, many of these investments determine the substitutability of immigrant and native labor and this has first order implications for establishing any causal impact immigrants on natives in host country labor markets, that has been the most studied and controversial areas of the economics of migration [Angrist and Kugler 2003, Ottaviano and Peri 2011, Borjas *et al.* 2008].⁷

Second, establishing rates of out-migration sheds light on the likely benefits of migration that eventually accrue to sending countries through remittances [Acosta *et al.* 2008], brain gain [Dustmann and Weiss 2007, Docquier and Rapoport 2008, Mayr and Peri 2009], the establishment of information networks between sending and host nations [Agrawal *et al.* 2008, Kerr 2008], and the quality of sending country institutions [Docquier *et al.* 2011].

Third, having accurate rates of out-migration helps shed light on the nature of selection into out-migration, and self-selection into permanent residence abroad. Theory suggests that such selection can be positive or negative [Borjas and Bratsberg 1996], and hence our setting in which out-migration rates vary across cohorts and within a cohort over time, might be useful in identifying the historic nature of selection across cohorts.⁸ Moreover, those migrants that choose to remain in the receiving country over time might be selected so as to demand a particular set of public goods in the receiving country. Conditional on them having voting rights, these individuals might indeed be able to influence the equilibrium public goods provision in the receiving country, especially in jurisdictions in which they are residentially segregated. The development of such public goods or ‘institutions’ more broadly defined, can well have long runs impacts on the economy and economic growth [Acemoglu *et al.* 2005].

The final reason why measuring historic out-migration accurately is relevant for contemporary work in migration is that despite the importance of accurately measuring out-migration for policy and research questions and the fact that there are an estimated 110 million individuals resident outside their home country [UN 2005], such statistics remain notoriously inaccurate, incomplete, or non-existent today [Thomas 1973, Warren and Peck 1980, Keeling 2006]. The US abandoned conducting a systematic review of migrants at the point of their exit from the US in 1957, and the US is certainly not alone in maintaining poor quality data on out-migration.⁹

⁷This remains a hotly debated topic with mixed evidence on wage outcomes on natives of immigrants: negative effects are found in Borjas *et al.* [1996], Borjas [1999, 2003], and little impact is found in Card [1990, 2001, 2005], Dustmann *et al.* [2005]. Our analysis suggests that differing propensities to out-migrate across cohorts might be important for explaining such impacts and reconciling different research findings.

⁸Indeed, the current evidence on the historic nature of self-selection of migrants to America is mixed. Comparing migration rates across occupation groups in Germany, Wegge [2002] finds that members of the richest and poorest occupations were least likely to migrate, while workers in the mid-skill range, such as machinists, metal workers and brewers, were most likely to do so. Abramitzky *et al.* [2011] find evidence that poorer individuals were more likely to migrate from Norway between 1865 and 1900, and Williamson [2006] reports that immigrants from five European countries between 1899 and 1909 are likely to have been positively selected in terms of literacy rates and entrepreneurial traits.

⁹For example the UK has no official mechanism to record out-migration, relying instead on estimates based on limited surveys such as the *International Passenger Survey* or the *Quarterly National Household Survey*. It has also long been recognized that sending country records are of lower quality than receiving country data [Willcox 1979].

Having accurate measures of migrant inflows and outflows will be of first order importance to understand migrant behavior, their impacts on natives and the receiving economy more widely, as well as on sending countries. To this extent we view this analysis as the foundation upon which to build a broader future research agenda.

The paper is organized as follows. Section 2 describes our data sources and presents descriptive evidence. Section 3 presents estimates of inflows both to New York and to the US as a whole, comparing them with official statistics. Section 4 describes the migration accounting exercise and presents the results on out-migration in aggregate, and by nationality-gender-age cohorts. Section 5 concludes. The Appendix places the time period under study into a wider historical context, discusses the established evidence on whether travel times and travel costs relative to wages, are likely to have been sufficiently high to deter out-migration during the period we study, and provides further details the assumptions and additional data underlying the accounting exercise.

2 Data Sources

2.1 Ellis Island Administrative Records

Core to our analysis are the administrative records of passenger ship manifests from Ellis Island, obtained from the American Family Immigration History Centre. The database contains the universe of 24 million individuals whose names appear on the original ship passenger manifests for the Port of New York between 1892 and 1924. The Manifest of Immigrants Act 1819 required that from 1820, the master of every vessel entering a US port list *each* passenger taken on at any foreign port by name, gender, age, occupation, whether or not they *intend* to become a US citizen, and country of origin [Carter and Sutch 1998]. Passenger lists are complete in that *all* ships and *all* passengers are recorded including foreign nationals, US nationals, foreign born nationals that have acquired US citizenship, and those intending to stay temporarily.¹⁰ Passenger lists were prepared by the ship’s captain before the ship departed. The list was created from passenger documents that were required for entry into America. In many cases, these documents would have been created at the time the passenger purchased their ticket. Passengers with incomplete documentation were sent back at the shipping companies expense, thus incentivizing shipping companies to ensure passenger documentation and ship manifests were accurate and complete.

Shipping companies were also liable for fines of \$200 per alien if they were deemed to have been excludable based on the literacy test introduced in 1917. Indeed, as Goldin [1994] reports, in 1917 fines were levied for only 192 excludable illiterate alien arrivals out of the hundreds of thousands that arrived.

For example Ferenzi-Wilcox [1929] show that prior to 1900 each sending country with the exception of England, reports far fewer migrants to the US than those recorded by US port officials.

¹⁰The data was entered by 12,000 volunteers of the Church of Jesus Christ of Latter-day Saints. We have checked for duplicate records, defined to be those in which an individual is recorded to have the same first and second name, age, gender, marital status, place of residence, and to have arrived on the same ship on the same date. Far fewer than one tenth of one percent of records are duplicates so defined. Members of the ship’s crew were included on the manifests from 1918 onwards.

The electronic version of the administrative records from ship manifests include information on the passenger’s first name, surname, age in years, gender, place (town and country) of last residence outside the US, date of arrival, whether the individual is a new arrival to the US or a returnee, marital status, ethnicity, the name of vessel, the original port of departure and other ports at which the ship stopped. Over time passenger lists expanded to systematically encompass information on beliefs about politics, marriage, health, literacy, and final destination in the US, although this information is not electronically recorded in the manifests we exploit. Figure 1 shows an example of a ship manifest. The information available in electronic format is in solid boxes; the information we do not have is in dashed boxes. Most relevant for this study is that the available information allows us to measure aggregate inflows of individuals in cohorts defined along four dimensions: nationality, gender, age and year of arrival. Throughout we define nationalities using pre-1918 country borders.

2.2 Census Data

We use US census data from 1880 to 1920 in our analysis. To estimate the stock of foreign-born in America prior to the great wave of migration captured in the Ellis Island administrative records, we use the 100% sample 1880 IPUMS census [Ruggles *et al.* 2009]. This shows there to be 50 million individuals resident in the US on census day 1880, 6.7 million (13%) of which are foreign-born. There are 90 nationalities among the foreign-born population resident in the US in 1880. Recall that the size of the immigrant inflow into the US through Ellis Island alone was over 24 million between 1892-1924, corresponding to almost half the total US population in 1880.

The other IPUMS census samples we use are 1900 (5%), 1910 (1.4%), and 1920 (1%) [Ruggles *et al.* 2009]. In each of these years, around 14% of the total population is foreign-born. Nationality of birth and year of arrival into the US are recorded in these censuses. The nationality of birth is recorded even if individual has obtained US citizenship by census day, which applies to 31% of individuals, with a further 5% recorded to be in the process of acquiring citizenship. As the accounting exercise we conduct applies to those individuals that might have left America after having entered, we do not use information on children of immigrants born in the US and so we make no assumptions on immigrant fertility in the US. Over census years 1900-20, this gives a total of 916,773 foreign-born individuals.¹¹

2.3 Descriptive Evidence

To begin with, we present some broad descriptive evidence on the migration patterns from the Ellis Island administrative records. Figure 2Ai shows the total number of arrivals into Ellis Island over the span of data: 1892 to 1924, for the ten countries from which the greatest number of immigrants originate over this time period. As a point of comparison, Figure 2Ai also shows for

¹¹A final point to note is that the 1920 census was conducted in January (as opposed to April and June for the other two censuses). Hence there is a concern that there will be greater error in measured stocks of foreign-born populations in 1920 than for the other census years.

each nationality, the size of the foreign-born population from that country recorded in the 100% sample of the 1880 US census.

Figure 2Ai highlights the sheer scale of migration during the study period. In 1880 the *total* foreign-born population in the US was 6.7 million; between 1892 and 1924 almost that many individuals arrived from Italy into Ellis Island alone, and 24 million arrived into Ellis Island overall. Moreover, inflows into Ellis Island by nationality for the three decades after 1892 do not closely mirror the initial stocks of these nationalities in the US in 1880. The largest group of immigrants into Ellis Island are Italians, over five million of whom entered over this period. Yet there were approximately zero Italians resident in the US in 1880. This point is further emphasized by comparing Figure 2Ai to Figure 2Aii that shows the ten largest nationalities in the US 1880 census. Some nationalities that were highly prominent in the US in 1880, such as those from France, Bohemia and Switzerland went into relative decline in the decades after 1890. As well recognized by historians, these nationalities were gradually replaced by migrants from Southern and Eastern Europe such as Italy, Russia, Greece and Spain.¹²

Although Figure 2A focuses on the inflow of foreign-born individuals, there is also a large inflow of US citizens into Ellis Island, actually comprising the fourth largest national group in our data. The vast majority of these individuals are return migrants that have previously acquired US citizenship. For reasons explained below and in the Appendix, the accounting exercise we conduct is based on individuals that arrive to America for the *first* time, rather than returnees. This distinction is recorded in the administrative records.¹³

Figure 2Bi shows migrants' age distribution by gender. To see how the age distribution of new arrivals differs from those already settled in the US, Figure 2Bii shows the age distribution by gender, for the foreign-born population in the US in 1880. As expected male migrants are slightly older than females. Both are younger than the foreign-born population of the same gender already resident in the US in 1880, and the age distribution among new migrants is more compressed than among the foreign-born in 1880. We also note that around two thirds of arrivals are men, and the majority of migrants are single. However, around 20% of migrants are single women with females being more likely to be single than married.¹⁴

Figure 2Ci provides time series evidence on the total number of immigrants into Ellis Island each year, as indicated on the left hand axis. There are large year-to-year fluctuations in migrant

¹²The Figure shows that some highly prominent nationalities in the US in 1880 such as Canadians and Chinese, do not show up as having significant migrant inflows through Ellis Island, New York. When we later attempt to scale-up immigrant inflows from Ellis Island to those for the US as a whole, we will need to account for the differential patterns, by nationality, of migrant inflows into the US by land and sea.

¹³Dupont *et al.* [2009] use a variety of data sources to show the number of Americans going abroad rose dramatically after the first world war, but that for most of our sample period, the number of American-born travellers was negligible relative to the total flow.

¹⁴In 1882 the US enacted legislation denying entrance to people who might become public charges, say because they were unable to support themselves. While in theory this policy was gender-neutral, in practice any unaccompanied woman of any age, marital status, or background might be questioned as a potential public charge because she appeared to lack a male provider. Indeed, Ellis Island officials regularly detained women travelling on pre-paid tickets to join husbands in New York if the man failed to show up in person to claim their 'dependents'. Unaccompanied women could only leave Ellis Island with a male accompanying them. This does not imply single women had to get married at Ellis Island however, as is widely perceived [Gabaccia 1984].

numbers, including a collapse in migrant numbers in 1908. This is also evident in official statistics from the time and has been attributed to the spike in US unemployment that year caused by the 1907 financial crisis [Deltas *et al.* 2008]. These large year-to-year fluctuations are hard to reconcile with migration decisions being motivated by *lifetime* differences in utility between sending and receiving country. Such volatility might however be more in line with models of return migration in which individuals only intend to stay in the US temporarily and so the short run economic conditions can impact upon the choice of when to migrate. We return to discuss models of out-migration in the conclusion.¹⁵

The right hand axis in Figure 2Ci shows the ratio of male to female migrants by arrival year. Until World War One this is relatively constant with around twice as many male migrants arriving annually. This ratio spikes during the later years of data and then appears to revert to a permanently higher level in the 1920s. This long run change might of course in part be related to the 1917 Immigration Act that excluded illiterates and raised the head tax for migrants, leading to relatively higher barriers to entry for women in the short run, and potentially, a change in the composition of female migrants in the longer term.¹⁶

Figure 2Cii shows how immigrant ages evolved over the study period. In 1892 the average male migrant was just over 26 years old, and the average female migrant was just under 24. Over time, migrants of both genders became older. Remarkably, the mean age of female migrants converges to that of men by the end of the study period. This is correlated with two compositional changes over time, namely the increasing share of married women, who were presumably joining their husbands in America, and migrants originating from Southern and Eastern Europe.

Taken together, these descriptives provide a flavour of the general migration patterns into Ellis Island at the turn of the twentieth century. We now move to the core of our analysis: to account for how out-migration rates change over time. To do so we first describe official statistics related to historic migration inflows and outflows, and highlight some of the known concerns with these official series.

2.4 Official Migration Statistics

Official statistics on migration exist as a result of the Passenger Act 1819, that required the captain of each vessel arriving from abroad to deliver a manifest of all passengers taken on board in a foreign port, as described previously. Copies of these manifests were to be transmitted to the Secretary of State by the shipping companies. These steamship companies were relied upon to provide unofficial data about numbers of arriving and departing passengers from ship manifests. From 1892 onwards, these reports were collected and abstracted by the Office or Bureau of Immigration,

¹⁵As described in Reinhart and Rogoff [2008], the financial crisis of 1907 relates to a six-week stretch of runs on banks predominantly in New York in October and early November of 1907. It was triggered by a failed speculation that caused the bankruptcy of two brokerage firms. As a result, real US GNP declined 12% between the second quarter of 1907 and the first quarter of 1908. Between 1907 and 1909 the value of migrant remittances also plummeted and this might have restricted migrant inflows over this period [Esteves and Khoudour-Casteras 2011].

¹⁶If marriages are endogamous, such large changes in sex ratios might alter marriage market competition and subsequently affect out-migration [Angrist 2002].

which is today part of the Immigration and Naturalization Services (INS). Academics rely on the collation of these statistics by Imre Ferenczi, whose work was conducted under the auspices of the International Labor Office in the early 1920s and published in 1929 by the NBER [Willcox 1929]. These official statistics, referred to as Ferenczi-Willcox [1929], bring together all official data series on post-1820 international migration then available in published form or supplied by governments.

While these official statistics have been used by policy makers and academics for nearly eighty years now, potential defects in these series have also long been recognized [Jerome 1926, Kuznets and Rubin 1954, Hutchinson 1958, Thomas 1973, Gould 1979, McClelland and Zeckhauser 1983, Schaefer 1994, Carter and Sutch 1999]. Following these discussions, we describe the main sources of measurement error in migrant flows over the period we study, and how the Ellis Island administrative records allow us to deal with each concern.

First, Hutchinson [1958], Thomas [1973], Gould [1979] and others have argued there was careless collection of ship manifests by port officials. Such errors were compounded by a failure of customs collectors to forward Passenger Abstracts quarterly to the Department of State, and further compounded by a failure of State Department clerks to include all Passenger Abstracts in their annual statistical reports. These errors were further magnified by changes in definition of immigrants over time [Jerome 1926, Kuznets and Rubin 1954, Gould 1979]. Together, these errors could aggregate up to cause severe *underestimates* of migrant arrivals. The Ellis Island administrative records contain manifests for all ships that arrived between 1892 and 1924. As discussed above, ship captains faced strong incentives to collect documents from their passengers and compile accurate ship manifests, as failure to do so implied that the shipping companies would have to take passengers with incomplete records back at their own expense.¹⁷

Second, the official statistics supplied by shipping firms often excluded first-class passengers for the early decades, a point first made by Willcox [1931] and discussed later by Hutchinson [1958] and in Carter and Sutch [1999] for example.¹⁸ Moreover cabin-class (second-class) passengers were

¹⁷Gould [1979] emphasizes how the collection of ship manifests was organized has undergone numerous changes over time, he states (pages 597-8) that “at different times within this period [1820-1924] the original data were collected by three different departments of the US government: the Department of State (1820 to 1870); the Bureau of Statistics in the Treasury Department (1867 to 1895), and the Bureau of Immigration (from 1912, Naturalization and Immigration) from 1892 onwards. Within that period the arriving aliens were counted, in successive periods, according to at least five differing conceptual schemes: (i) foreign-born passengers taken on board ship (Dept. of State series), (ii) the same but excluding transient visitors (Bureau of Statistics series); (iii) all aliens, excluding those travelling cabin class, admitted to USA (Bureau of Immigration series, 1892 to 1901); (iv) the same, but including those travelling cabin class (1902 to 1907); (v) alien immigrants to the USA (1908 onwards). The change from one basis to the next involved differences in measurement which were far from inconsequential”. On the same issue not being unique to the US, Thomas [1973, p35] wrote that “here was a field where Governments had much to gain and hardly anything to lose by forgetting national sovereignty and agreeing on a uniform set of definitions; but instead each State adopted a method of counting which was most likely to help it achieve the aims of its own policy. The result was a jungle of conflicting classifications. The International Labour Office has done a great deal to produce order out of this chaos [...] But as long as the methods of collecting and presenting the information remain so different the task of drawing up an accurate balance sheet of international migration will continue to be full of difficulty.”

¹⁸Willcox [1931, p646] wrote that “The United States Bureau of Immigration has not adhered to one definition [of cabin-class passengers]”, and that “no point in the interpretation of the statistics is more baffling than the question whether these “cabin aliens” were included in the totals” (p.650). Hutchinson [1958, p983] writes that “cabin-class passengers were not included as immigrants for a number of years after the beginning to the Bureau of

only first included from 1904 onwards. Such higher class passengers were often processed on board the ship and not through the Ellis Island Port station. Furthermore, prior to 1904, not only were statistics from restricted to passengers in steerage class, but they were further restricted to *aliens* traveling as steerage passengers, rather than also including US citizens, or returning foreign-born nationals who had earlier acquired US citizenship. As a result, this leads to further under-counting of migrant flows by nationality and in aggregate. In contrast, ship manifests contain a complete list of *all* passengers, regardless of class of travel and nationality.¹⁹

To get a sense of the potential bias induced, we note that Hyde [1975] reports that by 1880 the largest transatlantic liner could carry 300 cabin and 1200 steerage passengers. Keeling [2008] reports a similar division of passengers by class based on records of the Cunard Steamship Company, one of the largest carriers, and Coyne and Murphy [2007] present evidence from steamship arrivals into New York in 1913 from eight leading steamship firms showing that 11% of passengers travelled first class and 17% were in second class. As carriers faced intense competition, to cover fixed costs, large numbers of passengers had to be carried. This led to a steady increase in ship size that averaged 3000 gross tons in each succeeding decade. As cabin rates were approximately double those for steerage, shipping firms might have had incentives to provide relatively more cabin-class places over time. Indeed, Keeling [1999] argues that after 1900 the fastest growing segment of travel was for second-class routes from both Southern and Northern Europe.^{20,21}

This source of measurement error in migrant inflows would also bias official estimates of out-flows if those in steerage and other classes had different propensities to out-migrate, as is plausible under many models of out-migration.²² Our estimates address such concerns because they are based on comprehensive ship manifests that cover passengers in *all* travelling classes, and they contain precise information on place of last residence, US citizenship, and whether the migrant is

Immigration series, even if coming for permanent residence”, and that, “the publications of the Bureau of Statistics and the Bureau of Immigration do not explain fully how passengers of this group were treated statistically, and this remains one of the more obscure points in the interpretation of the immigration statistics”. Carter and Sutch [1999, p6] write that “the figures apparently exclude first-class passengers for the early decades.”

¹⁹Precisely the same points are made in Barde and Bobonis [2006] who compare the coverage of passengers recorded on ship manifests into Angel Island to those recorded in official statistics. They conclude that the former included passengers in first and cabin class, as well as US citizens.

²⁰To shed light on the percentage of passengers in first class arriving into other ports, we note that Keeling [2011] provides details of ocean liner characteristics for the period 1890 to 1913, covering ships entering/leaving the ports of New York, Boston, Philadelphia, Baltimore to/from Europe, where his main comparison is between Cunard ships and those of its four main rivals. He notes that across all five shipping companies and ports, the percentage of first class passengers to vary between 10 and 15% across years, and all these ports. Finally, we have also obtained the passenger records used by Barde and Bobonis [2006] in their study of arrivals into Angel Island, San Francisco. This data relates to 29,344 passengers included in the records of 303 ship arrivals between May 13, 1913, and August 16, 1919. Their data give some indication of the class each passenger was travelling in and suggests that around 11% of all passengers entering Angel Island were not in steerage class over this period.

²¹To get a further sense of the scale of measurement error induced we note that Hutchinson [1958, p.984] reports the number of alien cabin passengers recorded in some annual reports from 1899 to 1903, none of whom would have been recorded as immigrants. The ratio of such aliens to formally recognized immigrants varies from 7% in 1903, to between 12 and 15% in all years from 1899 to 1902.

²²Such models include those that emphasize: (i) return migration being planned as part of an optimal life cycle residential location sequence [Borjas and Bratsberg 1996, Dustmann and Weiss 2007]; (ii) target income earner models [Yang 2006]; (iii) erroneous beliefs of migrants, or negative shocks in the US [Pessino 1991, Borjas and Bratsberg 1996]; (iv) differential returns to multi-dimensional skills [Gould and Moav 2009, Dustmann *et al.* 2011].

newly arriving to the US or is a returnee. We therefore shed light on the cumulative degree of mis-measurement arising from these two concerns, by comparing official statistics on entry specifically into New York vis-à-vis the implied inflows from the administrative records from Ellis Island. This comparison is obviously not sensitive to any assumptions on our part on how to scale-up migrant numbers from Ellis Island to the US as whole.

Other concerns also exist with official migration records from this period. Foremost among these are concerns relating to the accurate recording of immigrants via all sea and land ports of entry [Jerome 1926, Kuznets and Rubin 1954, Hutchinson 1958, Carter and Sutch 1999].²³ When scaling-up the migrant inflows based on administrative records into Ellis Island to those for the US as a whole, we use a variety of data sources to take account of inflows from other sea ports and land crossings from Canada and Mexico, as described in the Appendix.

The two primary sources of measurement error described above arise for measuring both migrant inflow and outflows. On inflows, Thomas [1973] has previously provided evidence on the extent of the shortfall in US immigration statistics caused by these combined sources of error for the mid nineteenth century. He shows that during that period, major port cities such as New York made their own yearly tally of immigrant arrivals, and remarkably, these figures often exceeded federal totals for *all* east coast ports. This is precisely what we will later document to be the case for the 1910-20 decade. Over both decades, our results suggest even more severe errors in officially recorded number of *out*-migrants. This is not altogether surprising given that governments have even weaker incentives to accurately record migrant outflows, a situation that continues today [Warren and Peck 1980, Keeling 2006].

Indeed, this is reflected in the methodology used by Willcox to calculate net immigration in the early period when shipping companies volunteered information, that simply *assumed* a constant fraction of gross inflows departed. More precisely, Willcox [1940, pp390-1] states, “In estimating net immigration during early years it is probably safe to assume that between 1900 and 1907 likewise it was about 61% of gross immigration”, so that implied an out-migration rate of .39 before any other adjustments. This assumption was heavily criticized by Kuznets and Rubin [1954], who suggested the number of departures was probably under-reported by the steamship companies. For years after 1907 when steamship companies were compelled to provide records of departures, there remains the concern that cabin-class passengers were not all recorded [Jerome 1926].²⁴

In addition, the classification of departees into emigrants and non-emigrants was problematic and not consistently coded [Kuznets and Rubin 1954, Gould 1980]. As Gould [1980, p55] states, “the division of departing aliens into emigrants and non-emigrants was defective, being based only

²³To provide more evidence of the suggested scale of measurement error, we note that Hutchinson [1958, p987] finds that between 1904 and 1907, the number of immigrants entering via Canada was around 4.4% of those arriving through US sea ports.

²⁴Indeed, Jerome [1926, p103] provides an indication of the extent of such under-counting in departures, stating that, “in the years (fiscal) 1908 and 1909 the number of departing male steerage passengers was 578,097 and the number of officially recorded male emigrant aliens was 501,892”. If so, this suggest male migrant outflows were under-counted by 13% in this year despite shipping companies being required to provide such records.

on an *ex ante* statement of intentions which may not have been honestly stated”, and Kuznets and Rubin [1954] suggest these concerns with the official series remained up until the 1920s, as the distinction between an immigrant and non-immigrant had no legal meaning in the US prior to the 1920s.

Given these concerns, there have of course been previous attempts to amend the series in Ferenczi-Willcox [1929], although none of these have been able to use the detailed administrative records we exploit. One of the most important attempts to do so was conducted by Kuznets and Rubin [1954], who re-estimated inflows and outflows.²⁵ As we discuss later in more detail, they find rates of out-migration to be around 50%, rather than the 35% rate implied by Ferenczi-Willcox [1929] over our study period. Our estimates suggest out-migration rates are even higher than Kuznets and Rubin [1954] concluded, being closer to 76% and 100% in the two decades studied.

3 Estimated Inflows

3.1 Inflows into Ellis Island, New York

We first focus on arrivals into Ellis Island New York so that we can make a direct like-for-like comparison between our estimated immigrant inflows based on administrative records and those from official statistics. We provide two estimates of migrant inflows: the first is based on the raw administrative statistics from which *none* of the adjustments described in the Appendix are made. The second estimate, which is our preferred measure, corrects for missing data, other potential errors in recorded nationalities, and exclusions.

Three other points are important for the comparison between our estimates and official records. First, in the official records in Ferenczi-Willcox [1929] no account is taken of survival probabilities. Hence we simply sum the total number of migrant arrivals into New York over a decade, with no regard for whether these individuals are still alive at the end of the decade. Second, the official statistics make no distinction between new and returnee arrivals. For the purposes of comparison we sum across new and returning arrivals from the administrative records. Finally, we note that official statistics on foreign-born arrivals are actually broken down into: (i) immigrant foreign-born

²⁵We later describe in more detail the precise method they use. Here we note that Kuznets and Rubin [1954] implied the measurement errors in the official statistics were non-trivial, stating, “Since migration across our borders is so strategic in the economic development of this country, it is a shock to find that the basic quantitative records of this movement are subject to numerous errors” (p9, part II). The key sources of error they highlighted were changes in the authorities that collect migration statistics starting from a system pre-1908 in which steamship companies voluntarily provided statistics to port authorities; various modifications in the way cabin-passengers were recorded; changes over time in the definition of immigrant, and the gradual coverage of crossings by land. Specifically related to out-migration statistics, they criticize Willcox in his attempt to estimate “net immigration” as a percentage of “gross immigration”: they argue that “he does not indicate the basis for the linear aspect of his assumption and if the nativity composition of immigration to this country in the nineteenth century as well as the conditions of transportation are true as reported, the return flow was definitely smaller in the earlier recorded period of immigration.” They conclude their discussion of the sources of error by writing, “it should be clear from the discussion above that the migration data, for most of the period covered in the analysis, are for a somewhat changing area of coverage and subject to serious biases. The major defect is the exclusion of movements across land borders and incomplete coverage even of arrivals and departures by sea”.

arrivals, or those who intended to settle in the US; (ii) non-immigrant foreign-born arrivals, or admitted aliens who declared an intention not to settle in the US. We can therefore compare our estimates with those for immigrant foreign-born arrivals as well as total foreign-born arrivals.

3.1.1 By Decade

The top half of Table 1 refers to 1900-10, and the bottom half to 1910-20. Column 1 shows the official statistics from Ferenczi-Willcox [1929], Columns 2 and 3 show our preferred and raw estimates respectively. To make the comparisons as detailed as possible, the rows correspond to breakdowns by: (i) immigrant foreign-born arrivals; (ii) non-immigrant foreign-born arrivals; (iii) foreign-born arrivals, summed across immigrant and non-immigrants; (iv) US-citizen arrivals; (v) arrivals summed across foreign-born and US-citizens.

The first row shows that for the 1900-10 decade, official statistics state there were 7,431,670 foreign-born immigrant arrivals into New York. In contrast, our preferred estimate in Column 2 based on administrative records is 8,968,628, that is 21% higher than Ferenczi-Willcox [1929] as shown in Column 4.

The next row shows that in this decade 713,749 foreign-born arrivals are officially recorded as having the intention of temporarily remaining in the US, i.e. they are recorded as non-immigrant arrivals. This inflow corresponds to around 9.6% of the magnitude of immigrant foreign-born arrivals. Summing across immigrants and non-immigrants, the next row shows that official statistics suggest in total there were 8,145,419 foreign-born arrivals into New York. In contrast, our estimate based on administrative records is between 8 and 10% higher, depending on whether the raw or preferred measure is used.

The next row focuses on inflows of US-citizens into New York. Here we see that official statistics actually record significantly *more* US citizen arrivals than do administrative records. Indeed official statistic estimates are around a third higher than those based on administrative records. The discrepancy might arise from the different times at which nationality is recorded in the two data sources. In the ship manifests on which our estimates are based, nationality is recorded *before* entry to the US and is likely to refer to nationality of birth. If it were the case that official statistics confounded nationality of birth with individual's reported *intention* to obtain US citizenship, this can lead to an over-estimate of US-citizen arrivals. As previously noted, US census data suggests that indeed around one third of foreign-born migrants to the US obtain US citizenship by census date, that corresponds quite closely with the extent of undercount of US citizens. Moreover, given out-migration, this figure based on those present on census day actually underestimates the total percentage of migrants that ever attempted to obtain US citizenship.²⁶

The final row in the upper panel then sums across both categories to give an overall indication

²⁶Indeed, the Passenger Act of March 1819 states that captains of each vessel are required to note intentions to become a US citizen. As Carter and Sutch (1999, p6, footnote) state, "these "official statistics" of immigration which are the result of the Passenger Act of March 2, 1819, that required the captain of each vessel arriving from abroad to deliver a manifest of all passengers taken on board in a foreign port, with their sex, age, occupation, country of origin, and whether or not they intended to become inhabitants of the United States".

of mis-measurement of migrant inflows across temporary and permanent arrivals, and across all nationalities. In this decade our preferred estimate is 5% higher than the official statistics as recorded in Ferenczi-Willcox [1929], implying that while some of the differences might be due to different classifications of US citizens, over half a million migrants who are recorded coming into Ellis Island are missing from the official statistics.

The lower panel of Table 1 repeats the analysis for 1910-20. In this decade the discrepancy between officially recorded foreign-born arrivals and those inferred from the administrative records is more severe. Our preferred estimate of all foreign-born arrivals (immigrants and non-immigrants) is 34% higher than the official statistics. In contrast to the previous decade, official statistics and administrative records closely correspond in terms of the numbers of US-citizen arrivals over the decade. Finally, the last row shows that summing over the types of migrant and nationalities, total arrival numbers are underestimated by 20 to 28% depending on the estimate derived from administrative records.

To summarize, we find official statistics to generally underestimate migrant inflows, as has long been suggested among scholars. We provide novel evidence on the extent of this mis-measurement that presumably arises predominantly from incomplete collection of ships manifests, the exclusion of first and cabin-class passengers, and not accounting for deported arrivees. The extent of undercounting we uncover is large especially for the more turbulent decade of 1910-1920. While there might be slightly alternative methods of making the adjustments to derive our preferred estimate, it is unlikely that such alternatives would suggest official estimates are indeed accurate.

3.1.2 By Year of Arrival

To get a better sense of how discrepancies between our preferred estimate and official statistics vary by year of arrival, we provide the time series for both measures over the entire period that can be compared, 1892-1924. Figure 3A shows the time series for total arrivals (foreign-born and US-citizen arrivals) from both sources. Up until 1916 the two aggregate series track each other relatively closely. From 1917 onwards, official statistics far underestimate total arrivals from administrative records. Hence the main sources of bias – incomplete collection of ships manifests, the exclusion of first and cabin-class passengers, and not accounting for exclusions, are likely to have become more severe from the end of the first world war onwards.

A similar turning point is highlighted in Figure 3B that shows the time series for US-born arrivals by year. Prior to 1917 official statistics tend to record more US-citizen arrivals into Ellis Island than suggested by administrative records. However the situation is reversed from nearly every year from 1917 onwards. The administrative records therefore suggest that from 1917 onwards, the recording of US-citizen arrivals into Ellis Island was subject to the same sorts of mis-measurement as for foreign-born immigrant arrivals.²⁷

²⁷ A number of important changes occurred in 1917 that might relate to this divergence in series. The Immigration Act of 1917 increased the entry head tax from \$4 to \$8 and introduced a literacy test, consisting of reading several sentences of the US constitution in any language chosen by the potential immigrant. Only adult men aged over 16 and below 60 had to take the test: close family members were exempt [Harzig 2003, p39]. Overall the test is unlikely

3.2 Inflows into America

Table 2 presents an analogous set of comparisons between our estimates based on the Ellis Island administrative records and official statistic estimates of inflows into the US from Ferenczi-Willcox [1929]. We again provide two estimates: the first is based on the raw administrative statistics from which *none* of the adjustments described above and in the Appendix are made. Hence this essentially assumes that New York is the *only* entry point into the US; the second is our preferred estimate that corrects for the following factors: (i) missing data and other potentially mis-coded nationalities; (ii) expulsion or death; (iii) inflows from other sea ports; (iv) inflows over land via Canada and Mexico.

Inflows from other sea ports and over land are quantitatively the two most important adjustments. To correct for the former we use official statistics on yearly inflows by port, and assume that, while the levels might be underestimated, the ratio between immigrants into Ellis Island and into other ports is correct. Our implicit assumption is that the main sources of errors in official statistics (careless collection of ship manifests, exclusion of first and second class passengers) are proportional to the true number of arrivals in each port. To refine our adjustment we use historical sources to identify the nationalities which were more likely to use other ports, and derive nationality specific adjustment factors as described in the Appendix. To account for inflows over land we use Canadian official statistics by nationality and year and, using estimates from the literature, assume that 40% of migrants arriving in Canada are US bound. On inflows from Mexico, we make the conservative choice of assuming no inflows (either legal or illegal) so as to likely underestimate total immigrant inflows into America.

Table 2 presents the results following a similar formatting as Table 1. For the 1900-10 decade, the first row shows official statistics record 9,719,358 foreign-born immigrant arrivals into America. In contrast, the preferred estimate based on administrative records is 41% higher, at over 13.7 million. To get a sense of how the total inflows into America are affected by each of the adjustments made we note the following. For the 1900-10 decade, the raw Ellis Island records suggest there are 8.8 million arrivals, as shown in Column 3 of Table 2. Correcting for missing values, US citizenship and expulsion and death, raises the estimate to 8.97 million. Adjusting for other ports of entry raises it to 12.3 million, adjusting for inflows from Canada and Mexico raises it to 13.7 million, as shown in the preferred estimate in Column 2 of Table 2.

The next two rows demonstrate that accounting for non-immigrant arrivals, we still find that the number of total foreign-born migrants in official statistics of Ferenczi-Willcox [1929] is 28%

to have had much impact on the entry of married women, but might have restricted the entry of single women. Our data shows that the spike in gender ratios around 1917 varies across countries of origin, being higher for migrants from Southern and Eastern Europe (that happens to coincide with countries less directly involved in the first world war). It is also well recognized that towards the end of the 1910s there was an increase in temporary migration [Gould 1980] and this increase might explain the widening gap between our estimates (that include all temporary migrants) and the official statistics (that make some attempt to distinguish between temporary and permanent migrants). However, it is well known that official attempts to distinguish both forms of migrant are at best, and often inconsistently applied up until the 1920s. Whether and how these phenomena might be related: namely if the Immigration Act of 1917 led to more selective and temporary migration, and whether this was differential across genders, remains open for future research.

lower than implied by our preferred estimate. On US-citizen arrivals, we note a similar pattern as that in Table 1 for this decade: official statistics *over-report* such arrivals relative to administrative records based on nationalities as recorded in ship manifests. Taking into account all arrivals of all nationalities, the fifth row shows that total arrivals are around 20% higher using our data than is officially recorded over this decade.

The lower panel of Table 2 then repeats the analysis for the 1910-20 decade. In this period the discrepancy between officially recorded foreign-born arrivals and those inferred from administrative records is far more severe than for the previous decade. Remarkably, our preferred estimate of all foreign-born immigrant arrivals is 178% higher than the official statistics. The true scale of mis-measurement becomes apparent when we note that in this decade, our derived estimate for immigrant arrivals into New York alone is almost of equal size as is officially recorded for the US as a whole. We are however certainly not the first to note that mis-measurement of historic inflows into America might be of such orders of magnitude. For example, Thomas [1973] shows that major port cities such as New York made their own yearly tally of immigrant arrivals in the mid 19th century and these figures often exceeded federal totals for *all* east coast ports, a result also reported in Swierenga [1981].²⁸

Moreover, minor ports gain importance over this decade, so that the ratio of entries through Ellis Island falls from 76% during the 1900-1910 period to 55% during 1910-1920 (and below 50% after 1916). Taken together, the fact that official statistics grossly underestimate migrant flows into Ellis Island, and that our estimates suggest a smaller percentage of all inflows into America went through Ellis Island than the official statistics imply, helps explain the large discrepancy between the official statistics and our estimates.

As the next two rows demonstrate, accounting for non-immigrant arrivals, we still find that the number of total foreign-born migrants into the US in official statistics to be 126% lower than our preferred estimate. Unlike for the previous decade, US-citizen arrivals are also under recorded by around 15% in official statistics relative to our estimates based on administrative records. Finally, taking into account all arrivals of all nationalities, the fifth row shows that the our preferred measure of the number of total arrivals is slightly more than double what is officially recorded for the 1910-20 decade.

One way to check the plausibility of these under-counts, is to find another margin on which to compare the Ellis Island administrative records official statistics related to migration.²⁹ We attempt to do so by examining the number of officially recorded sailings from European ports to

²⁸Finally, we note that other historical studies have found large undercounts for other US ports. In particular, Grubb [1990] assesses the accuracy of the official US immigration statistics for the port of Philadelphia over 1819-1830 by comparing these statistics with alternative immigration records for that port: 12% of all passengers from foreign ports landed there in the 1820s, second only to New York, and before 1820 it was probably the single largest US port of entry. Grubb [1990] reports that, "If the Federal record undercounted passengers at other ports by the same percentage as it did at Philadelphia—and there is reason to suspect that the under count may have been greater elsewhere—then the total number of passengers arriving to the US between 1821 and 1831 would be 136,565 higher than reported by the Federal statistics, or a 77.4% increase (Table 1, Col. 8)". Moreover, the primary reason Grubb [1990] cites for this under counting is that "the State Department failed comprehensively to collect and compile the local records [...]" (pp.53-54).

²⁹We thank a referee for providing this suggestion.

the all US ports: such statistics can be derived from the Ellis Island administrative data given that precise information is given on each ship and its date of arrival into New York.

Comparable official statistics are provided for the period 1899-1911 in Deltas *et al.* [2008]. Their figures are derived from court documents relating to a legal case brought against shipping company cartels. They report that 4565 ships brought steerage class passengers to the US over this period from Great Britain. The Ellis Island administrative records indicate there were 5300 crossings into New York from Great Britain over this period. We scale-up this figure using the same scaling factor as for the total number of arrivals (immigrants and non-immigrants alike) for the 1900-10 decade. From Column 2 in Tables 1 and 2 we have this scaling factor to be $(15282254/10168964) = 1.50$. This implies that around 7950 ships might have arrived from Great Britain, suggested the number cited in official records to be only 57% of the projected total. The under-count is not as severe for ships originating from other regions. For example, Deltas *et al.* [2008] report 4085 crossings from the Mediterranean (which we take to be Italy, Spain, Greece, Portugal, Turkey and ports in southern France). Our administrative records show 2555 entries into Ellis Island over the same period from this region. If this is scaled-up we project there to have been 3833 crossings, some 94% of the crossings reported in Deltas *et al.* [2008]. These under-counts remain consistent with careless collection and processing of ship manifests as being an important source of measurement error in official statistics on migrant inflows in this period.

4 Estimated Outflows

4.1 Migration Accounting

The results so far show that many more individuals migrated to America at the turn of the century than previously recognized. We now turn to understand how many of them chose to remain there. To estimate migrant outflows we conduct a demographic accounting exercise that relates changes in population stocks and migratory flows [Warren and Peck 1980, Jasso and Rosenzweig 1982].³⁰ This procedure allows us to infer the number of individuals that must have out-migrated from America between any two census dates, when the stock of foreign-borns is measured. Taking the ratio of out-migrants to in-migrants allows us to provide novel estimates of out-migration rates by decade. The aggregate rates of out-migration rates can be directly compared to official statistics compiled at the time [Ferenczi-Willcox 1929], as well as other amendments of the official series such as Kuznets and Rubin [1954].

To begin with we define a cohort along three dimensions: gender, age and nationality. Such information is contained both within the Ellis Island administrative records and US Censuses in 1900, 1910 and 1920. In the administrative records we observe 118 different nationalities, namely there is at least one entrant from nationality n between 1900 and 1920. To match with detailed

³⁰Studies based on more recent data have to distinguish between temporary visitors, such as students or extended business travellers, and permanent migrants. To do so, researchers have typically used INS data for a single entry cohort and then followed these individuals over time. No such issues arise for the time period we study when immigrants always had the possibility to permanently reside in the US.

mortality rate data for the study period, we split ages into eleven age groups: (0, 1-4, 5-14, 25-34,...,85+). Hence in total we have 2596 *potential* nationality-gender-age (*nga*) cohorts of entry (118 nationalities $\times$ 11 age groups $\times$ 2 genders).

Consider first the stock of foreign-born individuals in cohort *nga* resident in the US in year t , denoted P_t^{nga} . The accounting exercise is based on the fact that the foreign-born population in the US among this *nga* cohort in the next year $t + 1$ is given by,

$$P_{t+1}^{ng,a+1} = (1 - D_t^{ga})P_t^{nga} + I_{t+1}^{ng,a+1} - E_{t+1}^{ng,a+1}, \quad (1)$$

where D_t^{ga} is the mortality rate of foreign-born individuals of gender g and age a in year t , $I_{t+1}^{ng,a+1}$ is the migrant inflow of cohort *nga* between years t and $t + 1$, and $E_{t+1}^{ng,a+1}$ is the outflow of migrants from the US of those in cohort *nga* between years t and $t + 1$. By repeated substitution between two census years t and $t + 10$ we derive that the stock of foreign-born individuals in entry cohort *nga* that reside in the US in census year $t + 10$ is,

$$\begin{aligned} P_{t+10}^{ng,a+10} &= \prod_{j=0}^{j=9} (1 - D_{t+j}^{g,a+j}) P_t^{nga} \\ &+ \sum_{k=1}^{k=9} \prod_{j=k}^{j=9} (1 - D_{t+j}^{g,a+j}) (I_{t+k}^{ng,a+k} - E_{t+k}^{ng,a+k}) + (I_{t+10}^{ng,a+10} - E_{t+10}^{ng,a+10}). \end{aligned} \quad (2)$$

Hence the cohort population stock in census year $t + 10$ is a function of survivors in this cohort from the previous census in year t , and survivors on census date in year $t + 10$ of the net inflows of migrants for each and every year since the previous census. Rearranging (2) then gives the total number of out-migrants from cohort *nga* between two census dates,

$$\begin{aligned} E_{t+10}^{ng,a+10} + \sum_{k=1}^{k=9} \prod_{j=k}^{j=9} (1 - D_{t+j}^{g,a+j}) (E_{t+k}^{ng,a+k}) &= \prod_{j=0}^{j=9} (1 - D_{t+j}^{g,a+j}) P_t^{nga} - P_{t+10}^{ng,a+10} \\ &+ I_{t+10}^{ng,a+10} + \sum_{k=1}^{k=9} \prod_{j=k}^{j=9} (1 - D_{t+j}^{g,a+j}) (I_{t+k}^{ng,a+k}). \end{aligned} \quad (3)$$

To be clear, the left hand side is the number of out-migrants in cohort *nga* in census year $t + 10$ that: (i) have out-migrated since the previous census in year t ; (ii) are still alive *somewhere*. On this second point we note that we cannot identify whether individuals have returned to their home country, or use the US as a stepping stone before moving to some third country.

The administrative records distinguish between new and returnee migrants. In the Appendix we discuss in more detail why it is preferable to use data only on *new* immigrant arrivals to measure $I_{t+1}^{ng,a+1}$. We do so by considering various scenarios that differ in the year of arrival, departure and return relative to census dates t and $t + 10$. In all cases, the out-migration measure based on new immigrant arrivals is shown to be preferred as it avoids double counting migrants engaged in repeat migrations. In consequence, we mostly do not need to consider whether and when foreign-borns obtain US citizenship, as only information on new migrants, who should all be non-US citizens, is used for the accounting exercise.³¹

³¹We note that between 1900-20, 12.7% of migrants into Ellis Island are returnees. 87% of returnees are US citizens. Given the vast majority of returnees are likely to be foreign-born rather than American-born travellers

4.2 Census Cohorts

To implement (3) we need to measure the stock of foreign-born in a given cohort on two consecutive census dates: P_t^{nga} and $P_{t+10}^{ng,a+10}$. Census data from 1900, 1910 and 1920 allows us to also define cohorts by nationality-gender-age. To calculate the stock of foreign-borns in a cohort we have to take account of the clustered design of the census samples. Denote clusters as $c = 1, \dots, L$, household (c, h) is the h th household in cluster c , n_c is number of sampled households in cluster c , and m_{ch} is the number of individuals in household (c, h) . Hence the estimated population in cohort nga in census year t is,

$$\hat{P}_t^{nga} = \sum_{c=1}^L \sum_{h=1}^{n_c} \sum_{i=1}^{m_{ch}} w_{ihct}^{nga} \quad (4)$$

where w_{ihct}^{nga} is individual sampling weight of person i in cohort nga census year t . Out of the 2596 potential cohorts described above, 1287 have at least one individual in them resident in the US between 1900 and 1920.³²

4.3 Mortality Rates

The final component in (3) is the mortality rate, D_t^a . For years 1900 to 1939, mortality rates specific to race-gender-age-year are available for the US from US Vital Statistics Special Reports [1956], where races are white and other, and age groups are 0, 1-4, 5-14, 15-24, ..., 75-84, and 85+.³³ These age groups are those we use to define cohort dimension a . The accounting exercise assumes mortality rates among migrants are the same in America and the sending country. This is unlikely to be true so it is useful to check the sensitivity of our results to alternative choices of mortality rate. Two obvious choices are that migrants have the same mortality rate as whites in America,

[Dupont *et al.* 2009], this suggests those engaged in repeat migration obtained US citizenship at some point and is indicative of planned repeat migration.

³²Three further points are of note. First, there are no missing values for age or gender. Only 418 out of 916,773 observations having missing nationality of birth data in these IPUMS census samples. The individual sampling weight is the variable `perwt` in the IPUMS census samples. Second, given the data is a sample from the census, we can also construct $var(\hat{P}_t^{nga})$ accounting for the census sampling frame as follows [Cochran 1977],

$$var(\hat{P}_t^{nga}) = \sum_{c=1}^L \left(1 - \frac{n_c}{N_c}\right) \frac{n_c}{n_c - 1} \sum_{h=1}^{n_c} (w_{ihct}^{nga} - \bar{w}_{ct}^{nga})^2,$$

where N_c is the total number of households in the cluster population. $(1 - \frac{n_c}{N_c})$ is referred to as the finite population correction, and is equal to .95, .986, and .99 for the 1900, 1910 and 1920 censuses respectively. When constructing these variances we implicitly assume that within a census year t , for cohorts k and k' , $cov(\hat{P}_t^k, \hat{P}_t^{k'}) \neq 0$ and that across census years t and t' , $cov(\hat{P}_t^k, \hat{P}_{t'}^k) = 0$. Treating the census population as the only random variable in (3) we can then construct a confidence interval for the number of out-migrants in cohort k between t and $t+10$. Third, we assume the census takes place on July 1st each census year and so use mid-year inflows of immigrant numbers, I_t^{nga} and $I_{t+10}^{ng,a+10}$, for census years 1900, 1910 and 1920. We make the corresponding adjustment to official statistics to compare these series with our estimates.

³³For this time period, these mortality data are derived for the Death Registration Area (DRA) consisting of ten states and the District of Columbia that was only successfully established in 1900 [Haines 2001]. These states are Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island and Vermont: in 1900 43% of the foreign-born population resided in these states. The rates are likely to be upward biased for any group that predominantly migrated to rural locations. The Census Bureau defines White individuals as those 'having origins in any of the original peoples of Europe, the Middle East, or North Africa.'

as assumed by Warren and Peck [1980] and Jasso and Rosenzweig [1982], or that migrants have mortality rates similar to those of other races.³⁴

A third alternative is based on nationality specific mortality rates, that we have collected from a variety of sources [Tizzano 1965, Nugent 1992, Mitchell 2007]. They cover all the major European sending countries in our study period for census years 1900, 1910 and 1920. The obvious drawback to using these mortality rates is that they are not broken down by gender-age-inter-censal years. This would not matter for the fact that for a number of Eastern and Southern European countries, such as Russia and Spain, average mortality rates at the turn of the twentieth century lie *outside* the bounds given by white and other race mortality rates in the US. Hence we later also present estimates of out-migration based on these nationality specific mortality rates.³⁵

4.4 Out-migration Rates in Aggregate

We first present estimate of out-migration rates for the US as a whole, aggregating out-migrants across all *nga* cohorts. As our initial aim is to compare the derived rates of out-migration and compare these to official statistics, we continue to take no account of survival probabilities ($D_t^{ga} = 0$), assume half-years within census year, and include both new and returnee arrivals. We therefore re-arrange (3) to estimate the following out-migration rate,

$$\frac{\sum_{k=1}^{k=10} E_{t+k}}{\sum_{k=1}^{k=10} I_{t+k}} = 1 + \frac{P_t - P_{t+10}}{\sum_{k=1}^{k=10} I_{t+k}}, \quad (5)$$

where the number of immigrant arrivals (I), population stock (P) and number of out-migrants (E) are all aggregated across all *nga* cohorts. The results are shown in Table 3A, again split by decade, and following a similar formatting to the earlier Tables.³⁶

The first row in the upper panel of Table 3A reiterates that for the 1900-10 decade, our preferred estimate of immigrant inflows is 41% higher than is officially recorded. Combining with information on the foreign-born population stock, the implied number of out-migrants is 10,429,231, that is more than three times the officially recorded number of out-migrants of 3,377,618 as Column 4 shows. Using our most preferred estimate then implies an out-migration rate during 1900-10 of

³⁴In historic data, foreign-borns had higher mortality rates than whites [Ward 1971, Haines 1977]. The foreign-born population was twice as likely as native population to reside in urban areas in 1900 [Klein 2004], and urban mortality rates were higher [Higgs 1973, Haines 1977]. There is no evidence that the foreign-born had greater mortality from the Spanish Flu outbreak in 1918 conditional on age and urban-rural residence [Taubenberger and Morens 2006]. It is estimated that 500,000 to 675,000 individuals died during the outbreak. By the 1930s, mortality differentials by nativity were converging and had largely disappeared [Haines and Steckel 2000].

³⁵There are pros and cons of each choice of mortality rate. For example, there evidence in favor of Barker’s fetal origin hypothesis of there being long lasting health effects of conditions experienced in utero [Almond 2006]. If so then country of birth mortality rates might be the most relevant. On the other hand, predominant causes of death in the US relate to contagious diseases, and extrapolating average mortality rates to age specific mortality rates might lead to sever biases at tails of the age distribution [Anderson and Ray 2010].

³⁶To be clear, this exercise *cannot* be conducted using census data alone. Although in the census we observe year of arrival, we can only construct I_{t+k} for those migrants that choose to reside in the US on census date $t + 10$. The administrative records we exploit are crucial in being able to estimate I_{t+k} for all years and among migrants that no longer reside in the US on census date $t + 10$.

.761. Remarkably, this is more than double the official estimate for the decade based on Ferenczi-Willcox [1929], that is .348. This official rate is widely cited among economic historians and demographers although as emphasized throughout, it has long been recognized that the official statistics might severely mis-measure migratory flows to and from America.

Even taking an extreme position and using the lower bound estimate of immigrant arrivals that effectively assumes New York is the *only* entry point into America, the result in Column 5 shows an implied out-migration rate that is 2.35 times the official statistic. To summarize, although the previous results in Tables 1 and 2 have shown inflows to be recorded with error in official records, Table 3A emphasizes that the measurement error in *out-migration* statistics is orders of magnitudes larger than for the inflow measures. This is unsurprising given the historic lack of incentives for governments to accurately record outflows, a situation that persists today [Thomas 1973, Warren and Peck 1980, Keeling 2006].³⁷

The lower panel of Table 3A repeats the analysis for the more turbulent 1910-20 decade. The first row reiterates that our preferred estimate of immigrant inflows is more than double what is officially recorded. Combining with information on the foreign-born population stock, we find the implied number of out-migrants to be 7.61 times larger than is officially recorded: official estimates suggest that around 2.4 million individuals out-migrated from America over this decade. Our accounting exercise reveals this number to be closer to 18 million. Again, even taking an extreme position and taking the lower bound estimate of immigrant arrivals and out-migrant flows, we find an implied out-migration rate that is 3.72 times the official statistic.

As with the earlier decade, mis-measured migrant inflows are considerably magnified by the errors in number of migrant outflows that lead to vastly different implied rates of out-migration than previously documented. More precisely, using our most preferred estimates, our method implies an out-migration rate of .975, almost three times the official estimate for the decade based on Ferenczi-Willcox [1929], that is .356. Moreover, this out-migration rate of almost one implies the magnitude of flows to and from America during the 1910-20 decade were of comparable size.³⁸

Given the vast discrepancy between the out-migration rates we derive and the established wisdom based on official statistics, we present a simple way to validate our estimates. To do so, we compare estimates of the total *stock* of the foreign-born population in the US on each census date. These figures are aggregated from the IPUMS census samples and there is little reason to expect them to be widely mis-measured in aggregate across all *nga* cohorts.³⁹

³⁷The US abandoned conducting a systematic review of migrants at the point of their exit from the US in 1957. The US is not alone in keeping poor data on out-migration. For example the UK has no official mechanism to record out-migration, relying instead on estimates based on limited surveys such as the *International Passenger Survey* or the *Quarterly National Household Survey*. It has also long been recognized that sending country records are of lower quality than receiving country data [Willcox 1979]. For example Ferenczi-Wilcox [1929] show that prior to 1900 each sending country with the exception of England, reports far fewer migrants to the US than those recorded by US port officials.

³⁸The official estimates of out-migration rates are based only on foreign-born immigrant arrivals into the US, excluding non-immigrant arrivals that are reported to have declared an intention not to settle in the US. Including both immigrant and non-immigrant arrivals obviously increases the denominator on the left hand side of (5), reducing the official out-migration rate further to .315 for the 1900-10 decade, and to .289 for the 1910-20 decade.

³⁹As is intuitive, another way to conduct a reality check on these outflow rates would be to use independent

A special case in which to calculate the out-migration rate from (5) is when the stock of foreign-born is not much changing, so $P_t - P_{t+10}$ is close to zero and the out-migration rate must be close to one. This is precisely the case for the 1910-20 decade. We then note that US census data suggests that during this decade, the increase in the *number* of foreign-born individuals was only marginal between 1910 and 1920, from 13.5 million to 13.9 million, an increase of only 3%. This corresponds closely to our implied out-migration rate of .975, as shown in the lower half of Table 3. In short, the simple fact that the *number* of foreign-borns in the US changed so little between 1910 and 1920 is highly indicative of there being an almost equal number of out-migrants as migrant inflows, so the out-migration rates ought to be close to one. This fact remains true *irrespective* of whichever estimate one wishes to take of migrant inflows over this decade – be it the 6,659,210 recorded immigrant arrivals in Ferenczi-Willcox [1929] or the 18,511,266 based on our preferred estimates and accounting exercise.

Our analysis is based on the assumption that the census accurately reports the number of foreign-born in aggregate (P_t, P_{t+10}). This might not be the case if the census were poorly targeted in rural areas where many migrants chose to reside. In addition, as noted earlier, the 1920 census was conducted in January (as opposed to April and June for the other two censuses). Hence there is a concern that there will be greater error in measured stocks of foreign-born populations in 1920 than for the other census years.

Hence an alternative thought experiment that sheds light on the plausibility of our estimates is to ask what would the error have to be in these census estimates if the official Ferenczi-Wilcox series were to be correct. From Table 3A we see that for 1900-10, we document there to be just over seven million more out-migrants than officially recorded. If the official record is correct, this implies census data must mis-measure the change in the foreign-born population by a similar magnitude. Given that in 1900 the US census reports there to 10.6 million foreign-borns in the US, this magnitude of measurement error in census data appears unlikely to drive our findings.

As emphasized throughout, it has long been argued that the official series in Ferenczi-Willcox [1929] are likely measured with error. In Table 3B we compare our estimates with one of the most detailed earlier attempts to correct these official statistics, conducted by Kuznets and Rubin [1954]. A few points are of note. First, Kuznets-Rubin [1954] generally estimate higher rates of out-migration, at .448 for the 1900-10 decade, rising to .536 for the 1910-20 decade. This difference with Ferenczi-Willcox [1929] is mostly driven by higher estimated numbers of out-migrants for each decade. However, the estimates provided by Kuznets-Rubin [1954] still remain far below those we

data sources, say from European countries, that document the number of returnee migrants from the US. We have conducted a search of European censuses available in electronic format for this period for Italy, Austria-Hungary, Russia, Germany, Ireland, Greece, Spain, Norway, Sweden, Iceland, and England and Wales. Unfortunately none of these appear to contain information that would allow return migrants (from any destination) to be identified.

derive using our detailed administrative records.^{40,41}

To properly interpret the high rates of out-migration we document, it is important to stress first that no account yet has been taken of mortality rates. The next set of results present evidence on mortality adjusted out-migration rates that are at the core of future economic analysis. The results so far have focused exclusively on pure count data in order to compare estimates from official statistics to those derived from the Ellis Island administrative records and the various assumptions we make to scale-up these inflows to those for America as a whole.

It is equally important to stress that the accounting exercise we conduct does not imply that it is the *same* individuals that arrive and depart America within each decade. Rather, the evidence highlights that the magnitude of flows to and from America are far more similar in each decade than has been previously recognized. Ignoring mortality and simply comparing counts, we find that for every four migrants that entered between 1900-10, three left over the period; over the 1910-20 decade there was an almost equal flow of individuals to and from America. In short, the notion that the American economy simply absorbed such large numbers of migrant inflows is incorrect. That migration was effectively a two-way flow between the US and the sending countries has major implications for understanding the potential selection of immigrants that chose to permanently reside in the US at the turn of the twentieth century, their impact on Americans in labor markets, and institutional change both in America and sending country economies.

4.5 Out-migration Rates By Cohort

Table 4 presents, for each decade, a disaggregated analysis of out-migration rates by cohort. The first row shows our previous most preferred estimate of out-migration defined in (5). Given that we are no longer focussed on comparisons with official statistics, the next few rows move to a more meaningful out-migration rate defined from (3),

$$\frac{E_{t+10}^{ng,a+10} + \sum_{k=1}^{k=9} \prod_{j=k}^{j=9} (1 - D_{t+j}^{a+j})(E_{t+k}^{ng,a+k})}{I_{t+10}^{ng,a+10} + \sum_{k=1}^{k=9} \prod_{j=k}^{j=9} (1 - D_{t+j}^{a+j})(I_{t+k}^{ng,a+k})} = 1 + \frac{\prod_{j=0}^{j=9} (1 - D_{t+j}^{a+j}) P_t^{nga} - P_{t+10}^{ng,a+10}}{I_{t+10}^{ng,a+10} + \sum_{k=1}^{k=9} \prod_{j=k}^{j=9} (1 - D_{t+j}^{a+j})(I_{t+k}^{ng,a+k})}. \quad (6)$$

⁴⁰Kuznets and Rubin [1954] developed “an approximation to net immigration,” (series AD22), by calculating the difference between arrivals and departures of alien passengers. They use the official data on arrivals and departures for the period beginning in 1908 and make estimates for the period before this year. For the period 1870 to 1890, they use the official data on arrivals (series AD23). They estimate departures by starting with the official number of Americans returning from abroad (assuming that these Americans stay abroad for one year), and assuming that their median age was 35 so that a mortality rate could be applied, and a guess that permanently departing citizens constituted 0.5 percent of all citizen departures. For 1901 to 1907, they estimated emigration by extrapolating the 1908-1914 ratio of departures to arrivals using the official data on arrivals for 1900-1907. They also recognized that the official missed many crossings by land but it remains unclear whether they were able to take account of such land crossings in their adjustments for all decades. This could be one source of divergence between our results from theirs. On departures by gender, they applied a constant factor assuming 82.8% of all male arrivals departed, a ratio estimated on the basis of the official data for 1908-14 and the sex distribution of the immigrant flows for 1900-7. Again this is a potential source of why our numbers might differ from theirs given that we use census data to calculate departures by nationality-age-gender cohorts.

⁴¹Another notable attempt to re-estimate out-migration rates is Keeling [2006] who uses shipping records (not passenger ship manifests) to estimate that between 1908-1914, 5.1 out of 10.4 million crossings out-migrated, again suggesting an out-migration rate close to .5.

The second row in Table 4 then bases the out-migration rate estimate only on *new* migrant arrivals. As described in the Appendix this is the more preferred economic measure of out-migration as it avoids double-counting migration spells. We see that the out-migration falls slightly in each decade with this adjustment.

The next batch of adjustments additionally account for survival probabilities of migrants between dates of arrival and census date. Hence the out-migration rate is the ratio of out-migrants to in-migrants in cohort *nga* in census year $t + 10$ that in-migrated since t , and out-migrated before census $t + 10$ and are *still alive somewhere* at $t + 10$. This reflects potentially different age distributions of migrant inflows and outflows. As previously discussed, various mortality rates can be used. Table 4 shows how the inferred out-migration rate varies as we adopt mortality rates of whites in the US, other races in the US, and nationality specific mortality rates. Aggregating across cohorts, we find that out-migration rates are highest assuming white mortality rates and lowest assuming other race mortality rates as expected.

Hence moving away from pure counts of inflows and outflows and so taking mortality rates into account, our data suggest that among those still expected to be alive at the end of each decade, out-migration rates were between .584 and .632 for the 1900-10 decade, and between .746 and .812 for the 1910-20 decade, depending on precisely which mortality rate is assumed. This is the more useful figure for future economic analysis, although the earlier figure based on counts establishes how far off official statistics might be.

The remaining rows break down out-migration rates by the three dimensions along which cohorts are defined, assuming white mortality rates. In the decade 1900-10 we find that men are far more likely to out migrate than women, with out-migration rates of .865 and .558 respectively. However in the later decade 1910-20 there are no differences by gender. This might be because of the changing composition of migrants by gender suggested by Figure 2 that shows that the ages of women migrants converged to those of men, and that a greater share of female migrants are married over time. Breaking out-migration rates into those of children (defined as being aged 14 or less at entry) and adults (those aged at least 15 at entry) we see that adults have lower out-migration rates than those that arrive as children.

The lower part of Table 4 then breaks down rates of out-migration by nationality. We do so for the ten countries that send the most migrants over the period, as shown in Figure 2. Taking these countries as a whole, out-migration rates in 1900-10 are .599, slightly lower than the rate among all countries (.632). This changes in the second decade when out-migration from these major sending countries (.978) is far higher than the average across all countries (.812). Examining out-migration rates by country reveals with this is so.

In the 1900-10 decade, there is little correlation between the number of migrant inflows from the sending country and rates of out-migration. Rather we generally find higher out-migration rates among Southern European countries of Italy, Greece and Spain, and the lowest out-migration rate is among Russians. A similar ranking across countries has previously been documented by Hatton and Williamson [2005] based on official statistics. These suggest out-migration rates to be highest (at around .5) for Spanish and Italian migrants, and lowest among Russians, Irish and

Scandinavian migrants.⁴²

In the next decade, out-migration rates rise tremendously across all countries. Importantly, among those countries not allied to the US during first world war, Germany and Austria-Hungary, out-migration rates exceed one. In other words more individuals left the US during this period than entered (and were still alive in 1920). This presumably reflects anti-German discrimination in the US that has been documented during this period [Moser 2012].⁴³

As a check on the underlying accounting methodology, the final row shows estimated out-migration rates among Canadians to the US. Reassuringly, for this group for whom the underlying decision to migrate to the neighboring country might be very different to migrants from Europe, we find out-migration rates that are considerably lower at around .4 in each decade. Hence the demographic accounting exercise that we conduct does not necessarily imply out-migration rates to be far higher than previously thought for this era for all countries. These out-migration rates by nationality also suggest the earlier aggregate results are unlikely to be driven solely by American soldiers returning to the US after World War One.

To appreciate how the nature of international migration might have changed from the Age of Mass Migration we study, we compare our estimates with those based on contemporary data. For example, the official US Bureau of the Census estimates an out-migration rate for 1981-90 as 22%, although this figure does not distinguish between those with permanent or temporary visas. Using Census and INS data that establishes whether migrants are permanent or not, Warren and Peck [1980] estimate out-migration rates for 1960-70 to be 18%, and on average, higher for women and older age groups. Using similar data Borjas and Bratsburg [1996] estimate an out-migration rate of 17.5% within a 10 year period, much of it within the first five years. Finally, Jasso

⁴²Cinell [1991] provides a detailed study of Italian migration. He writes that, "Historical accuracy, however, and a more balanced view of the transatlantic movement as a process of mutual enrichment between Europe and the United States compel us to pay attention also to the millions of Europeans who returned" (p.96) ; "return migration was an unprecedented feature of the so-called return migration" [...] [...] "however, these observers were puzzled when they realized Italians were returning in large numbers" (p.98); in another quote he hints at the causes of return migration most relevant among Italians: "in Italy emigrants were expected to return as a matter of course. Tradition had established the pattern" [...] "Emigration could be tolerated only as a temporary emergency to cope with a serious financial problem" (p.99); he gives some sense of the extent of return migration for Italians: "Italian indicators suggest that migration was a vast phenomenon. From 1902 to 1910 1,058,000 Italians returned from the United States; the departures were 2,200,000 that is 48 returns for every 100 departures. Return migration reached its peak in 1908 when 240,000 returned and only 131,000 departed" [...] 'In each year from 1911 to 1914, from 100,000 to 150,000 Italians returned from the United States. Although emigration and returns declined in absolute numbers, return migration increased in percentages from 1911 to 1920: for every 100 Italians heading for the United States 54 returned. Finally, from 1921 to 1930, returns and departures almost canceled each other out. Almost 385,000 individuals reached the United States and 365,000 returned, that is 95 returns for every 100 departures' (p.105); and suggests the phenomenon of return migration was not limited to flows from Italy to the United States: "Return migration of Italians from the United States was not the exception, it was the rule. It occurred from Brazil and Argentina, as well as from central and northern Europe. For instance, from 1902 to 1910, 670,000 Italians left for Argentina and 270,000 returned, 40 returns for every 100 departures. The peak years of return migration were 1907 and 1908. Departures declined to 310,000 in the following decade, but returns climbed to 291,000, 94 returns for every 100 departures, a higher percentage than the United States" (p.106).

⁴³At the outbreak of the first world war in 1914, the US remained neutral. In 1917, the US joined the Allied powers of the triple entente (the United Kingdom, France and Russia). The opposing Central Powers comprised of Germany, Austria-Hungary, the Ottoman Empire and Bulgaria from 1915 onwards. The other country that both had significant migratory flows to America and was involved in the war is Italy, who from 1915 onwards were among the Allied countries.

and Rosenzweig [1982] combine INS administrative records at entry for the 1971 cohort of legal permanent immigrants with their subsequent naturalization to estimate 10 year out-migration rates of between 30 and 50% by nationality.

This comparison reinforces the notion mentioned earlier, that historic rates of out-migration during the Age of Mass Migration we study are significantly higher than is observed today. As a consequence many of the choices and outcomes economists seek to understand related to migration, such as migrant investments into their human capital, the substitutability of migrants and natives in the labor market, and the gains to sending country economies, might have been historically very different than is the case from international migration today.

5 Conclusions

We use a novel data set of administrative records on 24 million migrants that entered Ellis Island, New York between 1892 and 1924 to estimate migrant flows into and out of America at the turn of the twentieth century. Combining immigrant *flow* estimates from these administrative records with census data on the *stock* of foreign-born in America in 1900, 1910 and 1920, we estimate out-migration rates in aggregate and by nationality-gender-age cohort. The accounting exercise reveals that, among those still expected to be alive at the end of each decade and hence taking mortality into account, out-migration rates were between .584 and .632 for the 1900-10 decade, and between .746 and .812 for the 1910-20 decade, depending on precisely which mortality rate is assumed. In comparison, official statistics from the time, that have long been suspected of being measured with error, have previously led scholars to report out-migration rates around half of this magnitude in each decade.

In this paper, our primary aim has been to accurately measure migratory flows to and from the US at the turn of the twentieth century. In future research we plan to build on the findings presented to provide an analysis of *why* individuals out-migrate. Clearly, such behavior is hard to explain in simple income-maximizing models in the presence of large wage differentials [Sjastaad 1962, Harris and Todaro 1970, Gibson and McKenzie 2011]. Indeed there is a vast literature estimating substantial gains from migration [Hanson 2009, Abramitzky *et al.* 2012a].⁴⁴

A number of models however do seek to explain return migration using explanations based on: (i) return migration being planned as part of an optimal life cycle residential location sequence to first migrate, accumulate capital, and then return home [Borjas and Bratsberg 1996, Dustmann and Weiss 2007]; (ii) time varying complementarities between consumption and location [Hill 1987, Djajic and Milbourne 1988]; (iii) target income models [Yang 2006]; (iv) erroneous beliefs or negative shocks [Pessino 1991, Borjas and Bratsberg 1996]; (v) differential returns to multi-dimensional skills [Gould and Moav 2009, Dustmann *et al.* 2011].

⁴⁴Abramitzky *et al.* [2012a] show that among Norwegian migrants between 1865 and 1900, comparing within-brother pairs of stayer and leavers, the mean rate of return to migration is 120% (90%) for those originating from urban (rural) areas in Norway. This estimates accounts for self-selection by using birth order as an instrument for the propensity to migrate.

Abramitzky *et al.* [2012b] present historic evidence on the nature of how migrants to the US are differently selected from stayers, exploiting variation in wealth and inheritance laws in Norway that give differential incentives to migrate out of Norway depending on the gender composition of siblings and birth order. Their evidence suggests migrants are negatively selected relative to those that choose to remain in their country of birth.⁴⁵ In a follow-up paper, Abramitzky *et al.* [2012c] then study how immigrants fared in the US labor market from 1850 through to 1913, accounting for self-selection among stayers. They find that the nature of selection varied across countries of origin, with there being negative selection among those who returned to England, Italy, Norway, Russia and Switzerland, while the evidence suggests positive selection among those migrants that chose to return to Finland, and for other countries the evidence is not clear-cut.

Understanding the causes of return migration [Djajic and Milbourne 1988, Massey and Espinosa 1997, Massey *et al.* 2003, Reyes 2004, Thom 2010], and the nature of selection into migration and out-migration remain central topics in the economics of migration [Ambrosini *et al.* 2012, Fernandez-Huertas Moraga 2011, Gibson and McKenzie 2011, Grogger and Hanson 2011].⁴⁶ Building on our current study, we hope to be able to exploit variation in the out-migration rates across nationality-age-gender and by year of arrival cohorts to help distinguish between the different potential underlying causes of out-migration. By combining this variation with historic policy changes related to entry costs, literacy requirements, and quotas for migrants for example, this can potentially shed light on how contemporary policies might alter the nature of migration.

A second broad strand of future research stemming from this data explores the role of social networks in determining behavior and labor market outcomes among migrants. In historic data, Lafortune and Tessada [2010] examine the role played by networks and labor market characteristics in determining location and occupation choices of migrants into the US from 1889 to 1932.⁴⁷ Again,

⁴⁵Historic data is also presented in Armstrong and Lewis [2012] who use information on 2,976 adult male arrivals and their families into Canadian ports from 1925 to 1929, based on passenger lists. They specifically explore whether capital constraints impacted migration from Holland to Canada and find that capital constraints delayed migration and can help explain the large wage gap between the two countries at the time. Hatton and Williamson [2004] also describe how the selection of migrants changed over the nineteenth and twentieth centuries. They describe patterns consistent with migrants being positively selected early in this time period, but becoming more negatively selected later in the period.

⁴⁶Fernandez-Huertas Moraga [2011] examines the extent to which Mexican emigrants to the United States are negatively selected. Grogger and Hanson [2011] examine the income maximization and the selection and sorting of international migrants. Using data on emigrant stocks by schooling level and source country in OECD destinations, they find that a simple model of income maximization can account for both phenomena. Results on selection show that migrants for a source-destination pair are more educated relative to non-migrants the larger is the absolute skill-related difference in earnings between the destination country and the source. Results on sorting indicate that the relative stock of more educated migrants in a destination is increasing in the absolute earnings difference between high and low-skilled workers. Gibson and McKenzie [2011] focus on decisions related to migration and return migration. They field a survey that globally tracks the brightest academic performers from three Pacific countries with the highest rates of brain drain over 1976-2004 to assess the extent of emigration and return migration among the very highly skilled. Within this sample, the emigration decision is found to be strongly associated with risk aversion and patience, and choice of secondary school subjects, and not strongly linked to either liquidity constraints or to the gain in income to be had from migrating. Likewise, the decision to return is strongly linked to family and lifestyle reasons, rather than to the income opportunities in different countries.

⁴⁷Other historic evidence on chain migration through social networks is provided by Hatton and Williamson [1998], who report that up to 90% of migrant arrivals into the US were traveling to meet a friend or relative who had previously migrated; Teteryatnikova [2012] documents how among Italian migrants in the second half of the

there is a wealth of evidence based on contemporary data on the importance of social networks for various aspects of migrant behaviors including the nature of self-selection into migration, providing information to new arrivals, or reducing the costs of not assimilating with the native population [Massey 1988, Borjas 1999, Munshi 2003, Dolfin and Genicot 2010, McKenzie and Rapoport 2010].

The Ellis Island administrative records can also be used to provide rich information on social networks of migrants at the time of arrival. For example, given that the ship manifests record the precise shape and date of arrival for each individual, it is possible to reconstruct information on the set of individuals that arrive on the same ship with any given migrant. Using information on nationality, place of residence and surnames, provides some indicative information on the size of various social networks arrived with.

Figure 4 presents some preliminary statistics from the administrative records database on these measures of social networks, averaged by year across all arrivals into New York from 1892 to 1924. Figure 4A shows the number of individuals that arrived on the same ship by year of arrival (on the left hand axis), and the number of individuals that were of the same nationality and on the same ship by year of arrival (on the right hand axis). Both series follow similar fluctuations over time, with smaller ships arriving to the US with the onset of World War One. Immediately prior to the war, the average ship size appears to have been around 500 passengers, and this plummets to less than 150 passengers on average during the war. In most years, the percentage of passengers on the same of the same nationality is however far more constant: on average, around 20% of all those on the same ship are of the same nationality.

Figure 4B shows the number of individuals that are from the same place of residence on the same ship, by year of arrival (on the left hand axis), and the number of individuals with the same family name (surname) and place of residence, by year of arrival (on the right hand axis). The patterns for these two time series are less volatile than those in Figure 4A: in most years, individuals travel with around three other individuals from the same place of residence; and around two thirds of migrants appear to arrive into New York with one other individual of the same surname from the same place of residence. Both show generally declining trends in the size of social networks so measured over time. Whether this is because some early arrivals from these social networks remain resident in the US in later years, or whether substitutes for the services provided by network members become more developed over time so that the need to travel with others from the network declines, remains open for future research.

The evidence presented in this paper suggests the extent of migratory flows into and out of America at the turn of the twentieth century are far larger than previously recognized by scholars. Building on this insight we hope in future work to understand the process of out-migration, and the consequent impact of migration on migrants, natives, and the economic and institutional development of both America and sending countries. We might therefore help reconcile the views that historic mass migration had large beneficial effects on origin countries [Hatton and Williamson 2005] but that this is no longer true today. Given the period we study is mostly characterized

nineteenth century, small differences in their initial connections in North America could generate very different migratory flows across destinations.

by a complete absence of administrative barriers to migration, studying these historic behaviors might be informative on the effects of easing migration barriers today.⁴⁸

A Appendix

A.1 Historic Context

Figure A1A shows the time series for transatlantic immigrant numbers in five year spans from the mid-1800s to the mid-1900s, based on the official Ferenczi-Willcox [1929] statistics. While our analysis ultimately shows these figures likely significantly underestimate inflows, they still remain the main source from which to describe very long run trends in migration to America. While for most of the nineteenth century annual inflows were around 300,000, they rose dramatically from 1880 onwards. The time period we study from 1892 to 1924 covers the peak years of migration into America, many of which witnessed over a million annual migrant arrivals. Towards the end of our study period migrant numbers dramatically reduced during World War One, recovered somewhat in the early 1920s and dwindled again during the depression era. Finally, the figure highlights the gradual change in national composition of European migrants. In the mid 1800s the vast majority originated from Britain and Germany, but by the end of our study period, the majority originated from Southern and Eastern Europe.⁴⁹

Migration for much of the period we study was characterized by few *administrative* constraints. Pre-1917, migration took place without restrictions such as visas or quotas. Post-1917, significant legislative changes began to restrict entry into the US, through the imposition of quotas and tougher eligibility criteria, and post World War Two, nearly all international migration has taken place subject to some form of binding constraint [Goldin 1994].

Although the Age of Mass Migration was characterized by few administrative constraints, there remain two other constraints of potential first order: (i) non-monetary costs such as travel times; (ii) monetary travel costs relative to wages. On time costs, the move from sail ships to steamships for passenger travel began in the 1860s [Cameron 1989], reducing voyage times from Europe to the US from five weeks to two weeks [Hyde 1975, Cohn 1984]. Moreover, shipping firms began publishing departure schedules which further reduced passenger uncertainty, waiting

⁴⁸As Goldin [1994] and Hatton and Williamson [2005] describe, pre-World War One, migration took place without restrictions such as visas or quotas. From 1917 onwards, significant legislative changes began to restrict entry into the US, through the imposition of quotas and tougher eligibility criteria, and post World War Two, nearly all international migration has taken place subject to some form of binding constraint. This has led to the view that a return to an era of free movement of labor, as with trade, would raise world welfare [Rodrik 2005, Rosenzweig 2005, Kremer and Watt 2006]. Indeed, there are suggestions that a 3% increase in labor migration would result in half the gains associated with complete trade liberalization [Winters *et al.* 2003]. The removal of all barriers to migration between OECD and non-OECD countries would boost world output between 92 and 172% [Klein and Ventura 2009].

⁴⁹Hatton [2003] documents the relative importance of America as a destination for British migrants during the decades either side of 1900. As Figure A1B shows, in nearly all years the US remained the modal destination choice. By 1910 although more migrants left for Canada as their first destination, many did so with the intention of onward travel to the US, as we later account for. For migrants from other countries, the overwhelming majority had the US as their destination [Hatton and Williamson 2005].

times and the opportunity cost of foregone employment [Keeling 1999]. Complementary changes in transportation technology – such as the growth of railroad networks, canals and steamship travel within Europe and the US, also contributed to the overall surge in transatlantic migration flows from the mid to late 1800s [O’Rourke and Williamson 1999].⁵⁰

On ship mortality rates were relatively low. Even during the period of longer sail ship voyages these were estimated to be around 1% between 1820-60 [Cohn 1984]. Many ships stopped *en route* between their original port in Europe and their final port destination in America. In such cases, passenger lodgings were often arranged [Herson 2008]. In summary, time and opportunity costs should not be considered as significant barriers to migration or out-migration during the period we study.

The monetary costs of passage plummeted well before 1880. Between 1816 and 1860 the British-US route index fell by 80% [Hatton and Williamson 2005]. In absolute terms, by 1860 the average voyage cost is estimated to be \$20 by Hatton and Williamson [1998] and Keeling [1999]. Ó Gráda and O’Rourke [1997] suggest it was just a few dollars even by the late 1840s. In relative terms, we note that the second half of the nineteenth century was a period of generally rising real wages throughout Europe, with wages converging to those of the US [Williamson 1995, O’Rourke and Williamson 1997]. Abramitzky *et al.* [2012] document the monetary cost of voyage represented 18% of annual earnings of a Norwegian farm labourer. There is also evidence that many immigrant tickets were pre-paid by previous immigrants, strengthening chain migration. For example, this is estimated to be the case for 30% of Finnish immigrants between 1891 and 1914, 50% of Swedes in the 1880s, and 40% of Norwegians in 1870s [Hvidt 1975, Kero 1991].⁵¹

A.2 New Arrivals and Returnees

The administrative records distinguish between individuals arriving to America for the first time, and returnees. To see which of these is most relevant for the accounting exercise we consider various scenarios in which we vary the years of arrival, departure and return relative to census dates t and $t + 10$. These scenarios are represented in Figure A2. Each row represents a different scenario,

⁵⁰Hurd [1975] provides data on the growth of railroad mileages by country from 1850 to 1910. In the most important sending countries, the UK and Germany, railroad mileage increased 3 and 13 times respectively over this period. The US witnessed an explosion in railroad mileage from 9021 miles in 1850 to 249,902 miles in 1910. Apart from the precipitous decline in transportation costs, other important factors suggested by Hatton and Williamson [2005] driving the Age of Mass Migration include the use of government subsidies, the elimination of any remaining restrictions (such as Britain removing restrictions on migration in 1825 and 1827, Germany in the 1920s and Sweden in the 1840s), and the Irish famine – the Irish accounted for the majority of migrants to the US between 1846 and 1850 [Ó Gráda and O’Rourke 1997].

⁵¹In terms of entry costs into America, a series of legislative changes increased the nominal monetary costs of entry. In particular, the Immigration Act of 1894 doubled the head tax on entry to \$1. The Immigration Act of 1907 increased this to \$4 and gave wider terms of exclusion. The Immigration Act of 1917 raised the head tax to \$8 and also excluded illiterates from entry [Reisler 1976, Scruggs 1988]. Subsequent legislation attempted to favor migrants from the more long established nationalities in the US. The first quantitative immigration law was the Quota Law of 1921 that limited the number of aliens of any nationality entering the US to 3% of the foreign-born persons of that nationality who lived in the US in 1910. The Immigration Act 1924 then established the ‘national origins quota system’, whereby an annual quota of immigrants by nationality was set to 2% of the number of foreign-born persons of such nationality resident in the US in 1890.

and towards the right hand side of the figure, the resulting accounting exercise is conducted in two cases: when immigrant inflows are measured using all arrivals (new and returnee) and when only new arrivals (I_{t+10}^{new}) are counted. Of course these scenarios are not an exhaustive list, but other cases are derivatives of those considered. Throughout we show that whenever $I_{t+10} \neq I_{t+10}^{new}$, using I_{t+10} would lead us to overestimate the number of out-migrants.

In scenario one the individual arrives before census date t and departs before census date $t + 10$. The individual is therefore measured as resident in the US on census date t ($P_t = 1$), the individual is not observed arriving to the US between census dates ($I_{t+10} = I_{t+10}^{new} = 0$), and is not recorded as being in the US on census date $t + 10$ ($P_{t+10} = 0$). Hence as shown in Columns 1 and 2, accounting for out-migration using information on either new or returnee migrants leads to the same conclusion that out-migration between census dates is one ($E_{t+10} = 1$). This is so because the individual is never recorded as an immigrant between census dates and so it is irrelevant whether information based on new or returnee arrivals is used. This is also true in the second scenario considered, in which the individual arrives and departs between census dates t and $t + 10$. Again, as the migrant is only observed entering the US once, $I_{t+10} = I_{t+10}^{new} = 1$ and $E_{t+10} = 1$ using either immigrant measure. The remaining scenarios are more interesting because in each $I_{t+10} \neq I_{t+10}^{new}$ and so E_{t+10} is sensitive to the choice of whether we use information on returnees.

In scenario three the individual arrives before census date t , departs and then returns to the US before $t + 10$. Hence the individual is observed on both census dates ($P_t = P_{t+10} = 1$). The individual is observed arriving into the US between census dates so $I_{t+10} = 1$, but because this arrivee is a returnee, $I_{t+10}^{new} = 0$. Hence the measure of out-migration that uses data on all arrivals $E_{t+10} = 1$, but if only information on new arrivals is used, $E_{t+10} = 0$. The measure based on *new* arrivals is preferred – the individual out-migrated only temporarily from the US between census dates. E_{t+10}^{new} reflects this but E_{t+10} does not.

Scenario four is the same as scenario three except the individual leaves America after having returned once, and this departure occurs before $t + 10$. As before $I_{t+10} = 1$, but because this arrivee is a returnee, $I_{t+10}^{new} = 0$. In contrast to the previous scenario the individual is not recorded as being in the US on census date $t + 10$, so $P_t = 1$ and $P_{t+10} = 0$. As a result, $E_{t+10} = 2$ which is misleading given the spirit of the accounting exercise. In contrast $E_{t+10}^{new} = 1$ as is more intuitive so that out-migrations are only counted once. However this scenario emphasizes that because out-migration rates necessarily have to be defined over some time period (t to $t + 10$) it can be the case that individuals that out-migrate just before census date $t + 10$ and plan to return after $t + 10$, will be counted as out-migrants for the accounting exercise for the period t to $t + 10$.

In the remaining two scenarios the individual arrives after census date t . In scenario five the individual departs and then returns to the US before $t + 10$. As the individual enters twice between census dates, $I_{t+10} = 2$ and $I_{t+10}^{new} = 1$ because the individual is only recorded as a new arrival on first entry. As a result, $E_{t+10} = 1$ and $E_{t+10}^{new} = 0$. Given the temporary nature of the individual's out-migration, E_{t+10}^{new} is again the preferred measure.

Finally, scenario six is the same as scenario five except the individual leaves the US before census date $t + 10$ and so is recorded in neither US census, $P_t = P_{t+10} = 0$. It is still the case that

$I_{t+10} = 2$ and $I_{t+10}^{new} = 1$ and so $E_{t+10} = 2$ and $E_{t+10}^{new} = 1$. As in all other cases, the out-migration measure based on new immigrant arrivals is then preferred.

A.3 Scaling-Up

The administrative records from Ellis Island are the basis from which we measure immigrant inflows into the Port of New York. As discussed above, when conducting the accounting exercise we restrict attention throughout to new immigrant arrivals. Aggregating this across all nationality-gender-age (*nga*) cohorts that arrived into New York in year t gives $I_{t+1}^{ng,a+1}$. However, in the accounting exercise described in (3) the figures for the population stock, migrant inflows, and migrant out-flows refer to the *total* numbers for the US as a whole. Conceptually, it makes little sense to define *out-migration* at the level of a port of entry (unlike for migration inflows). Rather numbers and rates of out-migration need to be defined for the US in aggregate. Hence to conduct the accounting exercise, we first need to scale-up the immigrant inflows measured from Ellis Island records to those for the US. We proceed in five steps. In each, our approach is to base adjustments on conservative assumptions so that our preferred immigrant estimate is likely to underestimate true immigrant inflows, and hence underestimate numbers of out-migrants.

A.3.1 Missing Data

Our first adjustment corrects for missing nationality data in the administrative records. Between 1900-20 there are 14,917,859 individuals arriving into the US for the first time. Nationality is missing for 4.6% of records, age is missing for 1.6%, gender is missing for .7%. Arrival date is available for virtually all records. We replace missing values of nationality assuming nationality takes the modal value among individuals on the same ship and arrival date, place of residence, and surname. Doing so, the percentage of records with missing nationality information falls from 4.6% to 1.2%. To fill in the remaining missing values, we assume values for nationality, gender and age are missing at random, and assign missing values equally across all *nga* cohorts for each arrival year t . Hence we re-scale immigration numbers as follows,

$$\tilde{I}_t^{nga} = \left[\frac{\#total\ obs_t}{\#total\ obs_t - \#missing\ obs_t} \right] \times I_t^{nga}, \quad (7)$$

where $\#total\ obs_t$ is the total number of new arrivals into Ellis Island in year t , and $\#missing\ obs_t$ is the number of new arrivals with missing information in nationality, gender or age.

A.3.2 Other Potential Mis-coding of Nationalities

As explained above the accounting exercise is conducted using information on *new* migrants to the US, not returnees. Although in theory all such new migrants should be recorded as non-US citizens, we find that 2.8% of them have their nationality recorded as US in the administrative records. There are a number of possible explanations. First, they might be US-born citizens

that are actually returning to the US after having travelled abroad. Alternatively, they might be foreign-born citizens genuinely entering the US for the first time but with the intention of obtaining US citizenship. We assume all such individuals are foreign-born nationals and then assign them to a nationality-gender-age cohort. To conduct this assignment we combine the censuses from 1900, 1910 and 1920 and focus on the 284,000 foreign-born individuals that are recorded to be US naturalized citizens on census date. For each individual, the US census also records their year of entry into the US. We use this to calculate the share of naturalized US citizens in each cohort nga by year of arrival t . In the Ellis Island administrative records we then assign these shares to the 2.8% of new immigrant arrivals recorded to have US nationality.

A.3.3 Deaths and Expulsions

The third adjustment corrects for death in voyage and expulsion at the port of entry. As ship manifests recorded passengers close to the point of departure, those that died *en route* to the US need to be removed and should not be included in immigrant inflows. Reassuringly, on ship mortality rates were relatively low. Even during the earlier period of sail ship voyages that were two to three times longer than steam ship voyages, on ship mortality rates were estimated to be around 1% between 1820-60 [Cohn 1984]. We note that during its entire years of operation from 1892 to 1954, there were only 3500 deaths at Ellis Island, 350 births, and three suicides.⁵²

On expulsion, nine out of every 100,000 immigrants were detained for mental examination and further questioning, and 2% were denied access to the US because of them suffering from a chronic contagious disease, having a criminal background, or being declared insane. From 1903 passenger ship companies were fined \$100 for every excluded passenger, discouraging them taking on board ill, disabled or impoverished passengers.⁵³ In short, death and expulsion is likely to lead to there being a small difference between those recorded on ship manifests as travelling to the US and the actual number of immigrant arrivals. We take a conservative approach and assume 2% of all immigrants recorded on ship manifests either died or were expelled, and we assume US-citizens are not expelled.

A.3.4 Other Sea Ports

Prior to 1892 arrivals were recorded only for sea ports of entry of the continental US and Alaska. In 1894 immigrants to the US who arrived via Canadian sea ports began to be included. On land ports, counting arrivals at the land borders was not required by the early immigration acts. Complete reporting was attempted in 1855 with partial success, was interrupted by the Civil War, and was discontinued in 1885. Beginning in 1894, European immigrants who arrived at Canadian

⁵²As Cohn [1984] notes, given the length of the trip and taking into account the ages of the immigrants, this mortality rate is approximately four times higher than that experienced by non-migrants. Mortality was especially high among children and the elderly. There appears to have been little trend over time in mortality or differences in the loss rate by nationality.

⁵³Office of Immigration statistics on arrivals mention 2419 aliens being debarred in 1893, 2799 being debarred in 1896, and 1880 being debarred in 1897.

ports declaring an intention to proceed to the US were included in immigration statistics. In 1904 land border entry posts were finally established on the Mexican and Canadian borders. More stations were opened over time, but reporting of land border arrivals was not fully established until 1908 [Ramirez 2001]. However, not all migrants entering via the Canadian and Mexican borders were counted for inclusion in the immigration statistics. Before 1930, no count was made of residents of Canada, Newfoundland, or Mexico who had been living there for a year or longer and who self-reported planning to remain in the US for less than six months. Hence if individuals out-migrated due to, for example, negative shocks [Pessino 1991, Borjas and Bratsberg 1996], they would not be captured in official statistics.⁵⁴

To account for other sea ports of entry we note first that for the period we study, the other major ports of entry are Baltimore, Boston, Philadelphia, and San Francisco. Official statistics record inflows by year into each port. Between 1900 and 1920, according to these official statistics Ellis Island accounted for 75% of all inflows into the US in the median year. Between 1900 and 1910, the median share is 76% and this falls to 55% for the 1910-20 decade. This fall is entirely due to the years during and just after the first world war – Ellis Island drops below 50% of all immigrant arrivals from 1916 to 1919.

We assume that the *ratio* of immigrants into Ellis Island relative to all sea ports as recorded in official statistics is correct, even though the number of immigrant inflows at each port is likely measured with error. This is equivalent to assuming the ratio of true arrivals into Ellis Island and the US as a whole is the same as the ratio of the errors with which each is measured in official statistics. The main sources of error in official statistics for sea ports are: (i) careless collection of ship manifests; (ii) the exclusion of first and cabin-class passengers; (iii) the exclusion of US citizens, or returning foreign-born nationals who had earlier acquired US citizenship. Hence our underlying assumption is justified as long as these combined sources of error are proportionate to the true number of arrivals into each port. Taking this to be the case we therefore re-scale immigration inflows for each year of arrival as follows,

$$\tilde{I}_t^{nga} = \left[\frac{\# \text{arrivals into USA}_t}{\# \text{arrivals into NY}_t} \right] \times \tilde{I}_t^{nga}, \quad (8)$$

where the ratio $\frac{\# \text{arrivals into USA}_t}{\# \text{arrivals into NY}_t}$ for each year of arrival t is taken from official statistics.

It might however be reasonable to assume some nationalities specialized in arriving into some sea ports especially given the importance of chain migration [Stark 1988, Stolarik 1988]. Hence we also derive an alternative adjustment that allows this weight to be nationality-year specific.

We have combined details from a variety of sources, including Stolarik [1988], Filby and Meyer

⁵⁴A more minor concern is that migrant arrivals from US territories were not always accurately recorded either. Arrivals in Alaska were first reported in 1871, but only irregularly thereafter until 1904, after which Alaska was regularly included among the places of entry. Arrivals in Hawaii were first included in 1901, Puerto Rico in 1902, Guam in 1929, Samoa in 1932 and the Virgin Islands in 1942. Arrivals in and departures from the Philippines were recorded in the port tables for 1910-24, but were not included in the total immigration data. For 1925-31, such arrivals and departures were obtained annually from the Bureau of Insular Affairs, War Department, and published in separate tables. Since 1932, the Immigration Service has kept no records of arrivals in the Philippines or departures from the Philippines to foreign countries.

[1981], Tepper [1993] and Cohn [2009] to understand which nationalities might have gone to other ports during the time period we study.⁵⁵ Based on this literature, we assume the following nationalities are likely to have relatively more entrants via other sea ports of entry than the average nationality as assumed in (8): Britain, Ireland, Germany, Austria-Hungary, Italy, Greece, Portugal, Poland, Russia, Armenia, Ukraine, Belgium, as well as migrants from the following Pacific rim countries that would of course have predominantly entered through San Francisco: China, Australia, Japan, Korea and the Philippines. For these countries, the scaling-up factor is set to be the 90th percentile value of $\left[\frac{\# \text{arrivals into USA}_t}{\# \text{arrivals into NY}_t} \right]$ for each decade (1900-1910, 1910-1920). For all other countries, the adjustment in (8) is still used.

A.3.5 Land Borders

Our fifth adjustment aims to conservatively account for inflows into the US from its land borders. To deal first with inflows from Canada, we note that from 1894 onwards, US-bound overseas immigrants disembarking in Canadian ports had to undergo inspection by US officers stationed there before being allowed to proceed to a US destination. According to Smith [2000], the steamship lines agreed to treat all passengers destined to the United States as if they would be landing at a US port of entry. This meant completing a US ship passenger manifest form and selling tickets only to those who appeared admissible under US law. Canadian railroads agreed to carry only those immigrants who were legally admitted to the United States to US destinations.

By the time the first immigration stations opened on the US-Canada border, around 40% of migrants arriving in Canada were thought to be heading for the US, and might have accounted for up to 22% of immigrants into US [Hatton and Williamson 2005]. To measure these inflows, we use official statistics on immigrant inflows into Canada by nationality and year from 1900 to 1920, as reported by the Division of Immigration, Department of Manpower and Immigration of Canada [Anderson and Frideres 1981]. We assume the share of individuals in any gender-age cohort within a nationality is the same as for inflows into Ellis Island for the same nationality and year of arrival, and throughout we assume 40% of arrivals into Canada are *en route* to the US.⁵⁶

On inflows from Mexico, we focus on measuring inflows of Mexicans. In contrast to the land border with Canada, there is little evidence that non-Mexicans, especially Europeans, entered the US via Mexico in large numbers. Focusing then on Mexican migrants, we note that large-scale

⁵⁵Boston was the terminus for Britain's Cunard steamship line and rates were subsidized by the British government. This port was predominantly used by Irish, Italian, Greek, Portuguese, Polish and Russian Jews, and Armenians. A key advantage of Baltimore was its railroad links to the American West, strengthened by the 1867 agreement between the Baltimore and Ohio Railroad and the North German Lloyd Steamship Line. Immigrant groups were predominantly German, Irish and English. Philadelphia was the port for The American Line and Red Star Line shipping companies. They had weekly sailings from Liverpool, Antwerp and Hamburg. These brought large numbers of migrants from Poland, Russia and Austria-Hungary. San Francisco became a major port for immigration from southern and eastern Europe, and it remained the major entry point for the Chinese.

⁵⁶The statistics reported in Anderson and Frideres [1981] have been extracted from the Division of Immigration, Department of Manpower and Immigration of Canada. The data includes information on 46 immigrant nationalities arriving to Canada over 1900-1920. It is based on the administrative records collected by the Canadian port officials and transferred to the government that had the responsibility to fill immigration reports. The data includes arrivals to all Canadian ports.

migration began in 1900 when US financed railroads penetrated the Mexican interior [Cardoso 1980, Hart 1987]. A generally accepted figure is that around 50,000 Mexican immigrants from Mexico were arriving into the US annually by 1908-10, but there are reasons to suspect this is an underestimate [Briggs 1984, Gonzales and Fernandez 2003]. US industrialists intensified recruitment of Mexicans when World War One broke out [Driscoll 1999]. To get a sense of the scale of Mexicans officially recorded in the US, there are 68,000 Mexicans recorded in the 1880 census, and this rises to 500,000 in 1920 census. However, Mexico never features as a top ten source country in terms of population stocks in the US. Hence given the paucity of evidence on Mexican inflows, we choose to follow the most conservative route and assume these are zero rather than potentially over estimate their number at least in some years.

On illegals, at the start of our sample period given the lack of legislation related to immigration it is unclear how to even define an illegal migrant. Of course this changes over time and there is a view that flows of illegals increased in response to tougher immigration controls embodied in the 1921 Quota Act [Briggs 1984, Gemery 1994, Hatton and Williamson 2005]. Indeed, Briggs [1984] estimates hundreds of thousands, and perhaps millions, of illegal immigrants entered the US in the 1920s via Canada and Mexico after the 1921 Quota Act was passed. As a result, the US border patrol was established in 1924, the same year as the Immigration Act passed to tighten borders and significantly improve migration statistics [Massey *et al.* 2002]. Hence given the paucity of evidence on illegal inflows, we again follow the most conservative route and assume these are zero.

A.3.6 Remaining Error in Out-migrant Numbers

Having made the five adjustments above we obtain estimates for immigration inflows into the US as whole by nationality-gender-age-year of entry cohorts. We then combine this information with census data and set mortality rates to zero to calculate (3) for each cohort and decade. We then aggregate across all cohorts of the same nationality by decade to examine nationalities for which the accounting exercise produces negative estimates of out-migration. Such estimates are obviously incorrect and can help provide insight into likely further adjustments that are required.

The results are shown in Table A1 and Figure A2. Columns A in Table A1 shows that of the 118 nationalities represented in the Ellis Island administrative records, 66 (56%) have at least one individual recorded to be resident in the US in the 1900 census, with the remaining 52 nationalities recorded to have a zero population in 1900 ($P_{1900}^n = 0$). Calculating (3) for the 1900-10 decade, Column B then shows the number of nationalities that are implied to have positive, zero, or negative numbers of out-migrants. The rows in Table A1 correspond to estimates of out-migrant numbers based on alternative scaling-up adjustments in immigrant numbers.

For example, the first row shows that if we take the raw data from Ellis Island and make none of the adjustments described above, then for the 1900-10 decade: (i) 85 out of 118 nationalities are found to have a strictly positive number of out-migrants; (ii) 17 nationalities are found to have zero out-migrants; (iii) 16 nationalities are inferred to have negative numbers of out-migrants. The remaining rows in Column B show that these numbers are relatively stable as we make

sequentially more of the adjustments to scale-up immigrant numbers described above. Even with all our preferred adjustments, the bottom row shows there remain 14 nationalities for which a negative number of out-migrants is implied.⁵⁷

Figure A2a then shows for these 14 nations for whom total out-migration over 1900-10, $\sum_{k=1}^{k=10} E_{1900+k}^n < 0$, the actual stock of foreign-borns of each nationality observed in the US census in 1880, 1900, 1910 and 1920. Two points are of note.

First, the country for which negative out-migration is estimated but that has the largest population resident in the US is Mexico. This is not surprising given the difficulties described above in obtaining reliable information on inflows across US-Mexico land borders. Indeed we have followed a conservative approach and set these inflows to zero.⁵⁸

Second, many of the countries listed are in the Pacific rim. Hence we expect the vast majority of such migrants to enter the US through Angel Island, San Francisco or other West Coast ports. This suggests the adjustment embodied in (8) is likely too conservative for such nationalities. For the remaining countries, the foreign born population in the US is very small in all census dates. Hence any small sampling variation could lead us to find a negative number of out-migrants.

We now repeat the analysis for the more turbulent decade of 1910-20. Returning to Table A1 we see that at the start of this decade on census date in 1910, individuals from 76 of the 118 nationalities represented in the Ellis Island demonstrative records are identified to be resident in the US. Using the raw unadjusted data from Ellis Island we find that for 1910-20 decade: (i) 57 out of 118 nationalities are found to have a strictly positive number of out-migrants; (ii) 18 nationalities are found to have zero out-migrants; (iii) 43 nationalities are inferred to have negative numbers of out-migrants. The remaining rows in Column B show that as we make each adjustment described previously, our preferred estimate then has 31 nationalities with implied negative numbers of out-migrants.

Figure A2b shows for these 31 nations the actual stock of foreign-borns of each nationality observed in the US census in 1880, 1900, 1910 and 1920.⁵⁹ Two points are of note. First, Mexico again ranks as a problematic case. The other problematic cases of Poland and Bohemia relate to countries that experienced border conflicts post-1917, and Galicia that experienced jurisdictional changes over the study period. These changes might have led to discrepancies between reported nationalities in administrative records at time of entry, and reported nationalities on later census dates. Second, the actual population stocks resident in the US from most of these countries are very small, and this is true across the four census dates.

⁵⁷The number of nationalities with implied negative numbers of out-migrants declines if we exploit information on $var(\hat{P}_t^{nga})$ as described in Section 4.2 and check the number of nationalities for which the number of out-migrants is significantly below zero.

⁵⁸Indeed, the problem might be even more severe as the 1910 and 1920 censuses are known to have been conducted at times of the year when the Mexican migratory population was at its lowest point during the year [Cardosa 1980].

⁵⁹We can use the 1880 census, in which 100% and 1% samples are available to given an indication of the potential mis-measurement of population stocks. From the 1880 census, we find the median ratio of $\hat{P}_t$ based on a 100% sample to that based on a 1% sample to be 1.15. Hence as the 1920 census is the smallest sample we use (1%) we might well under-count $P_{t+10}^{ng,a+10}$ in 1920, making it more likely that we find a negative number of out-migrants for 1910-20. This might in part explain the larger number of problematic countries for this decade.

Hence our final adjustment is to set negative out-migrant numbers to zero for any nga cohort for which $\sum_{k=1}^{k=10} E_{t+k}^{ng,a+k} < 0$, as is done in Borjas and Bratsberg [1996].

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Table 1: Official Statistics and Administrative Record Measures of Migrant Inflows into New York, by Decade

	(1) Official Statistic Ferenzi-Willcox [1929]	(2) Preferred Estimate	(3) Raw Data	(4) Ratio: Preferred Estimate to Official Statistic (Col 2/Col 1)	(5) Ratio: Raw Data Estimate to Official Statistic (Col 3/Col 1)
<u>1900-1910</u>					
Total immigrant foreign-born arrivals	7431670	8968628	8792771	1.21	1.18
Total non-immigrant foreign-born arrivals	713749	-	-	-	-
Total foreign-born arrivals	8145419	8968628	8792771	1.10	1.08
Total US citizen arrivals	1546237	1200336	1150045	0.78	0.74
Total arrivals	9691656	10168964	9942816	1.05	1.03
<u>1910-1920</u>					
Total immigrant foreign-born arrivals	4416448	7054163	6624076	1.60	1.50
Total non-immigrant foreign-born arrivals	856931	-	-	-	-
Total foreign-born arrivals	5273379	7054163	6624076	1.34	1.26
Total US citizen arrivals	1214658	1249759	1147865	1.03	0.95
Total arrivals	6488037	8303922	7771941	1.28	1.20

Notes: The official statistics in Column 1 are from Ferenzi-Willcox [1929]. For all other statistics derived from Ellis Island Administrative records, these are based on the total number of immigrant arrivals (new and returnee). For statistics related to arrivals into New York City, the preferred estimate figure in Column 2 is based on corrections for missing data, other potential errors in recorded nationalities, and exclusions. The estimate in Column 3 is based on the raw administrative statistics from which no adjustments are made. We assume the census takes place on July 1st each census year and so use mid-year inflows of immigrant numbers, for census years 1900, 1910 and 1920. We make the corresponding adjustment to official statistics to compare these series with our estimates.

Table 2: Official Statistics and Administrative Record Measures of Migrant Inflows for the US, by Decade

	(1) Official Statistic Ferenzi-Willcox [1929]	(2) Preferred Estimate	(3) Raw Data	(4) Ratio: Preferred Estimate to Official Statistic (Col 2/Col 1)	(5) Ratio: Raw Data Estimate to Official Statistic (Col 3/Col 1)
<u>1900-1910</u>					
Total immigrant foreign-born arrivals	9719358	13712006	8792771	1.41	0.90
Total non-immigrant foreign-born arrivals	994168				
Total foreign-born arrivals	10713526	13712006	8792771	1.28	0.82
Total US citizen arrivals	2040674	1570248	1150045	0.77	0.56
Total arrivals	12754200	15282254	9942816	1.20	0.78
<u>1910-1920</u>					
Total immigrant foreign-born arrivals	6659210	18511266	6624076	2.78	0.99
Total non-immigrant foreign-born arrivals	1540972				
Total foreign-born arrivals	8200182	18511266	6624076	2.26	0.81
Total US citizen arrivals	2111460	2426712	1147865	1.15	0.54
Total arrivals	10311642	20937978	7771941	2.03	0.75

Notes: The official statistics in Column 1 are from Ferenzi-Willcox [1929]. For all other statistics derived from Ellis Island Administrative records, these are based on the total number of immigrant arrivals (new and returnee). For statistics related to arrivals and departures into the US, the preferred estimate in Column 2 is based on corrections for missing data and other potentially mis-coded nationalities, expulsion or death, inflows from other sea ports, and inflows over land via Canada and Mexico. The estimate in Column 3 is based on the raw administrative statistics from which no adjustments are made. We assume the census takes place on July 1st each census year and so use mid-year inflows of immigrant numbers, for census years 1900, 1910 and 1920. We make the corresponding adjustment to official statistics to compare these series with our estimates.

Table 3A: Official Statistics and Administrative Record Measures of Migrant Flows for the US, by Decade

	(1) Official Statistic Ferenzi-Willcox [1929]	(2) Preferred Estimate	(3) Raw Data	(4) Ratio: Preferred Estimate to Official Statistic (Col 2/Col 1)	(5) Ratio: Raw Data Estimate to Official Statistic (Col 3/Col 1)
<u>1900-1910</u>					
Total immigrant foreign-born arrivals	9719358	13712006	8792771	1.41	0.90
Total migrant departures from US	3377618	10429231	7191956	3.09	2.13
Implied out-migration rate for US	0.348	0.761	0.818	2.19	2.35
<u>1910-1920</u>					
Total immigrant foreign-born arrivals	6659210	18511266	6624076	2.78	0.99
Total migrant departures from US	2372071	18048715	8828942	7.61	3.72
Implied out-migration rate for US	0.356	0.975	1.333	2.74	3.74

Table 3B: Kuznets-Rubin [1954] and Administrative Record Measures of Migrant Flows for the US, by Decade

	(1) Kuznets-Rubin [1954]	(2) Preferred Estimate	(3) Raw Data	(4) Ratio: Preferred Estimate to Official Statistic (Col 2/Col 1)	(5) Ratio: Raw Data Estimate to Official Statistic (Col 3/Col 1)
<u>1900-1910</u>					
Total immigrant foreign-born arrivals	9447500	13712006	8792771	1.45	0.93
Total migrant departures from US	4230000	10429231	7191956	2.47	1.70
Implied out-migration rate for US	0.448	0.761	0.818	1.70	1.83
<u>1910-1920</u>					
Total immigrant foreign-born arrivals	7400000	18511266	6624076	2.50	0.90
Total migrant departures from US	3963000	18048715	8828942	4.55	2.23
Implied out-migration rate for US	0.536	0.975	1.333	1.82	2.49

Notes: The official statistics in Column 1 of Table 3A are from Ferenzi-Willcox [1929]. In Table 3B the comparison is made to the Kuznets-Rubin [1954] correction of these official statistics. For all other statistics derived from Ellis Island Administrative records, these are based on the total number of immigrant arrivals (new and returnee). The preferred estimate in Column 2 is based on corrections for missing data and other potentially mis-coded nationalities, expulsion or death, inflows from other sea ports, and inflows over land via Canada and Mexico. The lower bound estimate in Column 3 is based on the raw administrative statistics from which no adjustments are made. The implied out-migration rate is the total number of migrant departures divided by the total number of immigrant arrivals into the US in the same decade. We assume the census takes place on July 1st each census year and so use mid-year inflows of immigrant numbers, for census years 1900, 1910 and 1920. We make the corresponding adjustment to official statistics to compare these series with our estimates.

Table 4: Out-migration Rate Estimates by Cohort and Decade

1900-1910				1910-1920		
Cohort	(1) Total immigrant arrivals	(2) Total immigrant departures	(3) Implied out-migration rate	(4) Total immigrant arrivals	(5) Total immigrant departures	(6) Implied out-migration rate
Aggregate based on total immigrant arrivals	13712006	10429231	0.761	18511266	18048715	0.975
Aggregate based on first time immigrant arrivals	13317559	10034791	0.754	13863483	13400968	0.967
White mortality rate	14154747	8951276	0.632	14582711	11836158	0.812
Other mortality rate	14107050	8239115	0.584	14621274	10900747	0.746
Nationality specific mortality rate	14211636	8750683	0.616	14631129	11595469	0.793
Men	8472316	7332065	0.865	10857499	10419854	0.960
Women	4846656	2704150	0.558	3018955	2994091	0.992
Aged 0-14 at time of arrival	1561221	1305334	0.836	1421342	1615365	1.137
Aged 15+ at time of arrival	12651111	7726132	0.611	13211091	10302094	0.780

1900-1910				1910-1920		
Nationality	(1) Total immigrant arrivals	(2) Total immigrant departures	(3) Implied out-migration rate	(4) Total immigrant arrivals	(5) Total immigrant departures	(6) Implied out-migration rate
Top Ten Nationalities Based on Immigrant Arrivals into NYC Between 1892-1924	11996584	7181314	0.599	11002964	10765310	0.978
Rank 1: Italy	3372036	2438093	0.723	2721625	2281362	0.838
Rank 2: Austria-Hungary	2869037	1584087	0.552	878582	1338729	1.524
Rank 3: Russia	2024757	825060	0.407	1116179	1085628	0.973
Rank 4: Great Britain	964993	645387	0.669	2914890	2772513	0.951
Rank 5: Germany	1164191	608361	0.523	646595	787111	1.217
Rank 6: Ireland	644574	477324	0.741	556334	522350	0.939
Rank 7: Sweden	397799	236088	0.593	442348	398894	0.902
Rank 8: Greece	352056	263177	0.748	462087	393909	0.852
Rank 9: Norway	277015	159524	0.576	479516	453094	0.945
Rank 10: Spain	144674	121729	0.841	628530	562680	0.895
Other: Canada	307064	120745	0.393	363390	157123	0.432

Notes: All statistics derived from Ellis Island Administrative records are based on the number of new immigrant arrivals, except in the first row that is based on the total number of immigrant arrivals (new and returnee). These preferred estimates are based on corrections for missing data and other potentially mis-coded nationalities, expulsion or death, inflows from other sea ports, and inflows over land via Canada and Mexico. In the first two rows, a survival rate of one is assumed. In the third and fourth rows, survival rates of whites and "other" race are used. In the fifth row, nationality specific mortality rates are used for Italy, Austria-Hungary, Great Britain, Russia, Germany, Ireland, Sweden, Spain, France, Norway, Denmark, Finland, Belgium, Romania and Switzerland. For all other nationalities, white mortality rates are assumed. For gender and age specific cohorts, white mortality rates are assumed. In the lower panel, for the country specific cohorts, country specific mortality rates are used. The ten countries chosen (plus Canada) are those from which the most immigrant arrivals originate from into Ellis Island over the period 1892-1924.

Table A1: Sign of Estimates of Emigrant Numbers, by Decade

	Decade: 1900-10					Decade: 1910-20				
	A. Number (%) of 1900 Census Values That Are:		B. Number (%) of Emigration Estimates That Are:			C. Number (%) of 1910 Census Values That Are:		C. Number (%) of Emigration Estimates That Are:		
	Zero	Positive	Negative	Zero	Positive	Zero	Positive	Negative	Zero	Positive
Nationalities (118)										
Census population	52 (44.1)	66 (55.9)				42 (35.6)	76 (64.4)			
Raw data from Ellis Island (lower bound)			16 (13.6)	17 (14.4)	85 (72.0)			43 (36.4)	18 (15.3)	57 (48.3)
Adjusting for missing values and exclusions			17 (14.4)	20 (17.0)	81 (68.6)			43 (36.4)	19 (16.1)	56 (47.5)
Adjusting for other ports of entry			16 (13.6)	21 (17.8)	81 (68.6)			37 (31.4)	19 (16.1)	62 (52.5)
Adjusting for other ports of entry and US citizens			15 (12.7)	21 (17.8)	82 (69.5)			32 (27.1)	19 (16.1)	67 (56.8)
Adjusting for other ports of entry including Canada and US citizens			14 (11.9)	21 (17.8)	83 (70.3)			31 (26.3)	19 (16.1)	68 (57.6)

Notes: The unit of observation is nationality. There are 118 nationalities in the sample, from which at least one migrant entered the US via Ellis Island from 1900-20. The adjustment for other ports of entry scales up estimates of immigrant and out-migrant numbers using the ratio of arrivals into the US to those into New York each year. The correction for inflows from Canada assumes 40% of immigrant arrivals into Canada arrive in the US and that their age distribution is the same as into Ellis Island in the same nationality-year of arrival cohort. The correction including US citizens corrects for some foreign born immigrants entering the US after having obtained US citizenship and therefore having US nationality.

Figure 1: Passenger Ship Manifest from March 3rd, 1903

IMMIGRATION SERVICE, Form 156a-18.

SALOON, CABIN, AND STEERAGE ALIENS MUST BE COMPLETELY MANIFESTED. THIS SHEET IS FOR STEERAGE PASSENGERS.

LIST OR MANIFEST OF ALIEN PASSENGERS FOR THE U. S. IMMIGRATION OFFICER AT PORT OF ARRIVAL.

Required by the regulations of the Secretary of the Treasury of the United States, under Act of Congress approved March 3, 1903, to be delivered to the U. S. Immigration Officer by the Commanding Officer of any vessel having such passengers on board upon arrival at a port in the United States.

103 S. Roma sailing from Naples, Italy, Arriving at Port of New York, N.Y. 1905.

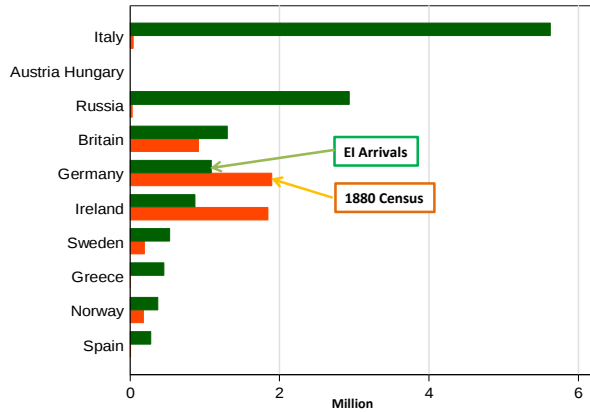
No. or List.	NAME IN FULL.	Age.	Sex.	Married or Single.	Calling or Occupation.	Able to Read. Write.	Nationality. (Country of last permanent residence).	Race or People.	Last Residence. (Province, City, or Town).	Final Destination. (State, City, or Town).	Whether or having a ticket to such final destination.	By whom was passage paid?	Whether in possession of \$50, and if less, how much?	Whether ever before in the United States, and if so, when and where?	Whether going to join a relative or friend, and if so, what relative or friend, and his name and complete address.	Can he speak or understand English? If not, for how long? If not, for how long? If not, for how long?	Whether a Politician, an Architect, or a Minister of Religion.	Condition of Health. Mental and Physical.	Deformed or Cripple. Nature, length of time, and cause.
1	Tadecelli, Onimile	22	M	Single	Seaman		Italy		Genoa	New York		Self	100					Good	
2	German, Karine	15	F	Single	Seaman		Italy		Genoa	New York		Self	100					Good	
3	Long, Ruben	15	M	Single	Seaman		Italy		Genoa	New York		Self	100					Good	
4	Castro, Epistiro	27	M	Single	Seaman		Italy		Genoa	New York		Self	100					Good	
5	Oropell, Ruben	25	M	Single	Seaman		Italy		Genoa	New York		Self	100					Good	

Notes: The passenger ship manifest shown was accessed from <http://www.ellisland.org/search> on April 24th 2010. Fields indicated in solid (dashed) boxes are available (are not available) in the electronic format of the administrative records.

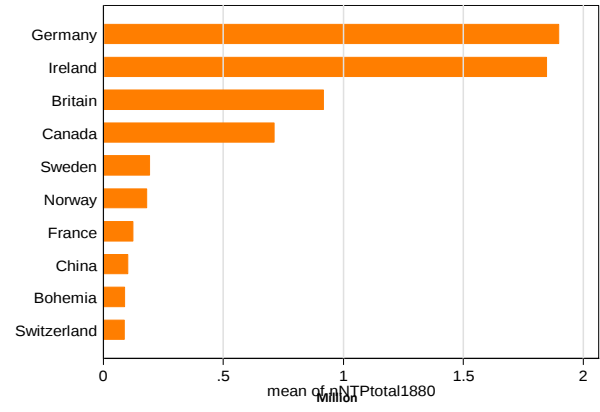
Figure 2: Descriptive Evidence from Administrative Records

A. Total Immigrants, by Nation of Birth

(i) Ellis Island Arrivals 1892-1924, and Population in 1880 US Census

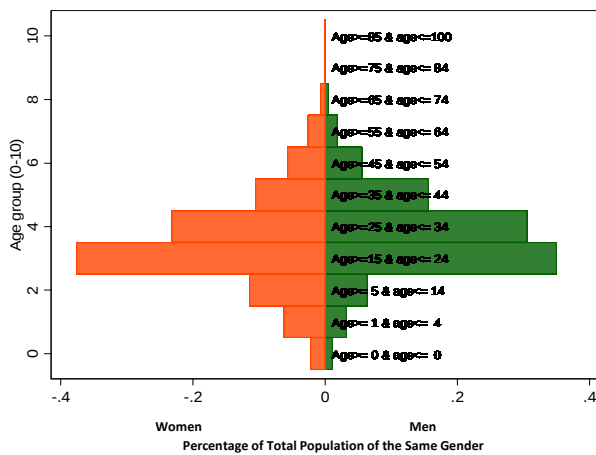


(ii) Foreign Born Population in 1880 US Census

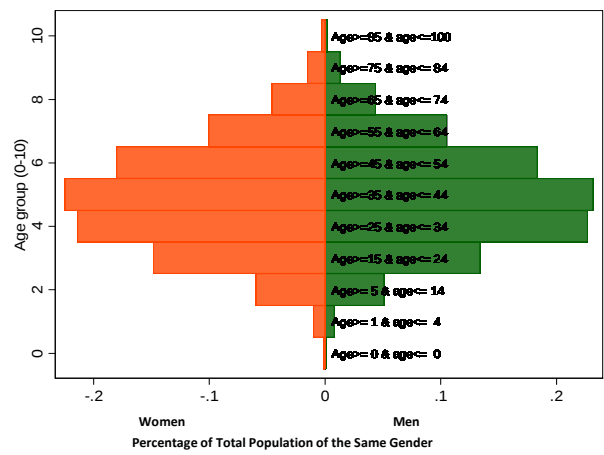


B. Age Distribution, by Gender

(i) Ellis Island Arrivals 1892-1924

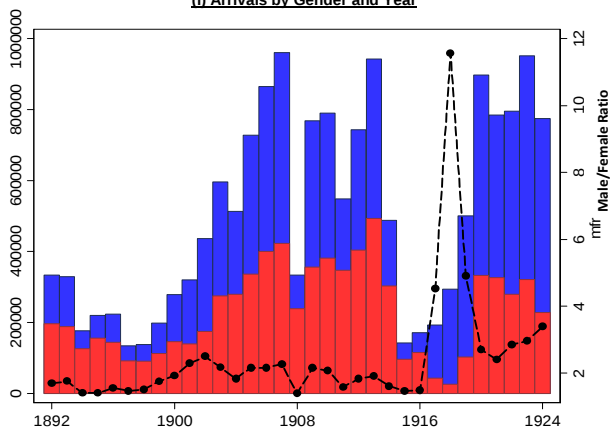


(ii) Foreign Born Population in 1880 US Census

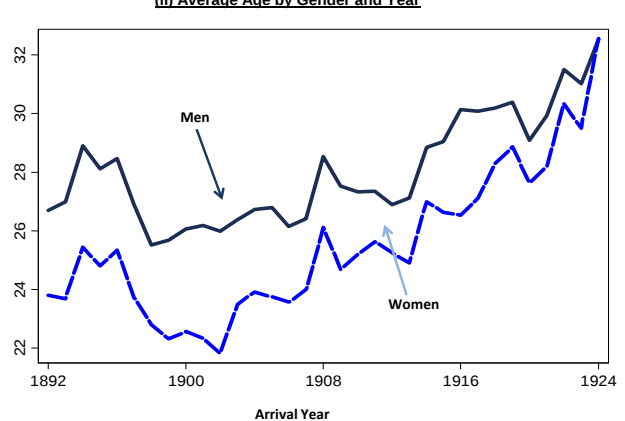


C. Time Series

(i) Arrivals by Gender and Year



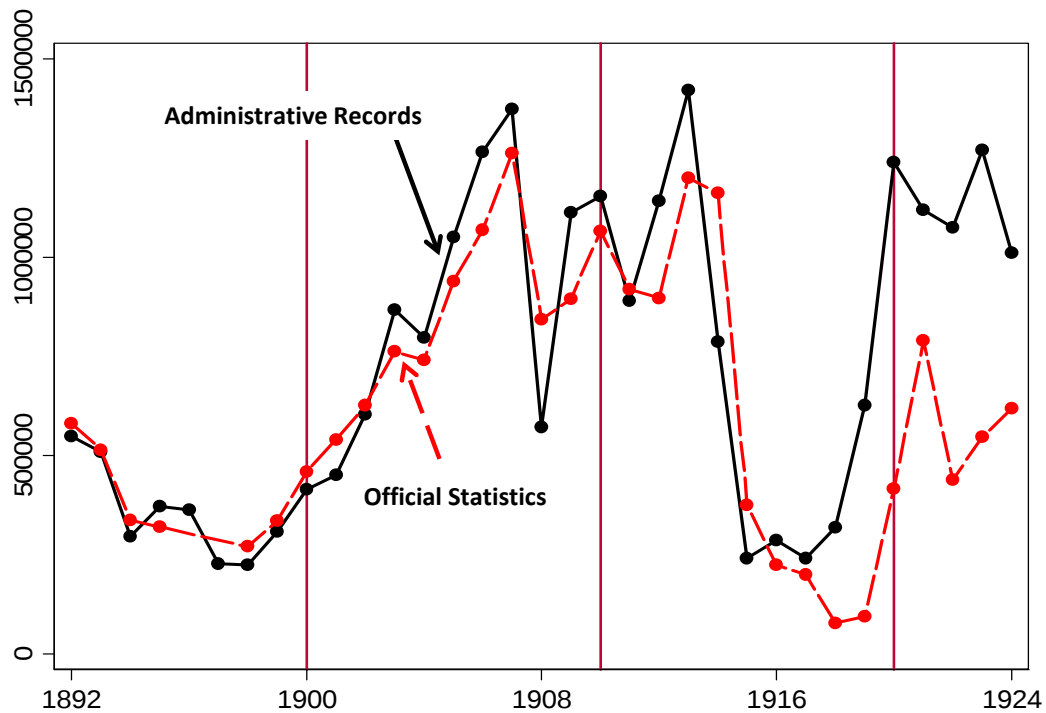
(ii) Average Age by Gender and Year



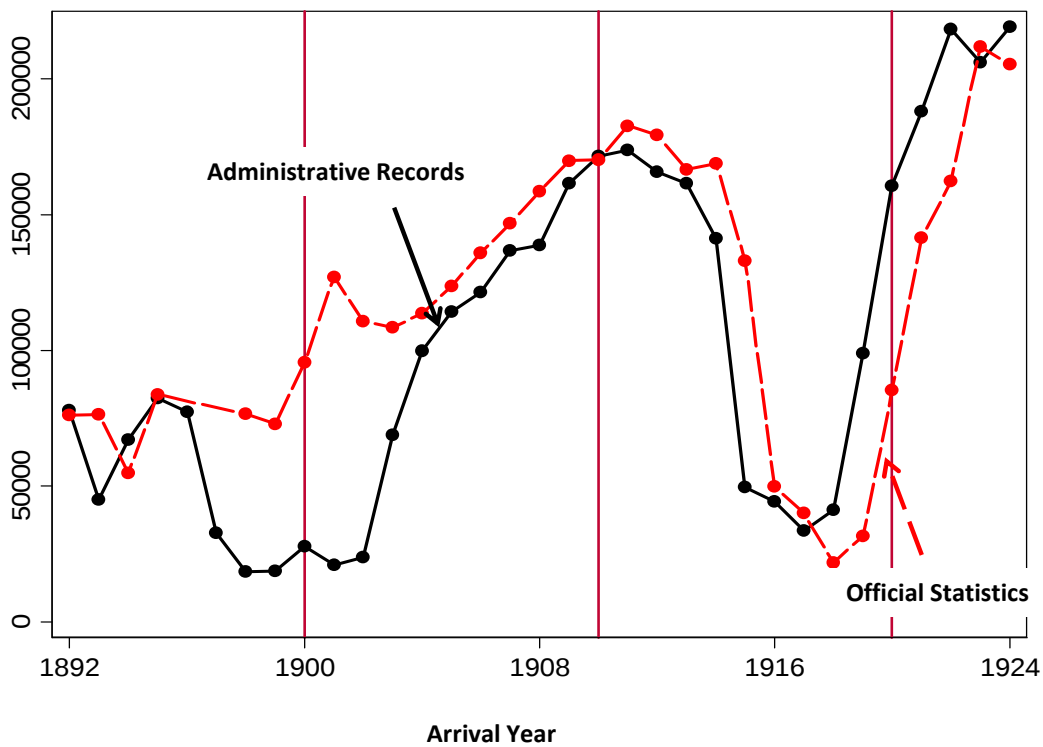
Notes: All graphs are based on the administrative data from Ellis Island records, without any adjustments. The figures for the 1880 Census are based on the 100% IPUMS sample. Figure 2Ai shows the total number of arrivals into Ellis Island from 1892 to 1924, for the ten countries from which the greatest number of immigrants originate over this time period. Figure 2Aii also shows for each nationality, the size of the foreign-born population from that country recorded in the 1880 US census. Figure 2Bi shows migrants' age distribution by gender. Figure 2Bii shows the age distribution by gender, for the foreign-born population in the US in 1880. These age pyramids show the proportion of the population of the same gender that is within a given age group. Figure 2Ci provides time series evidence on the total number of immigrants into Ellis Island each year, as indicated on the left hand axis. The right hand axis in Figure 2Ci shows the ratio of male to female migrants by arrival year. Figure 2Cii shows the average age of immigrants by year of arrival.

Figure 3: Official Statistics and Administrative Records on Arrivals into Ellis Island New York

A. Total Passenger Arrivals (Foreign and US Born) by Year



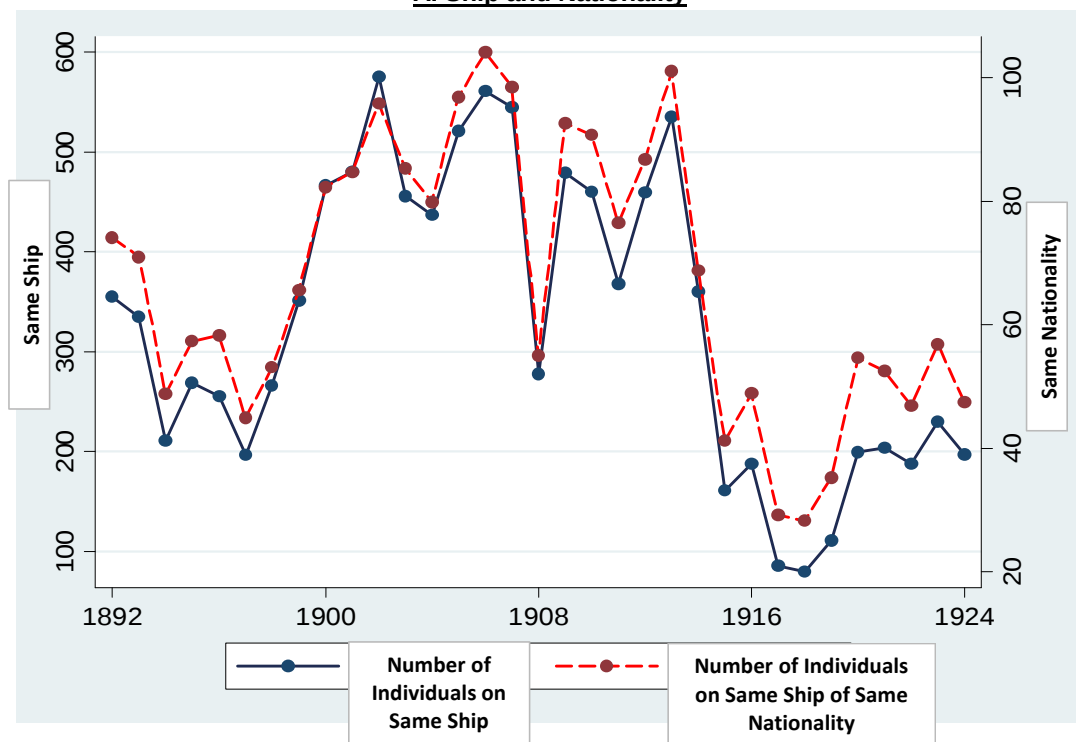
B. American Arrivals by Year



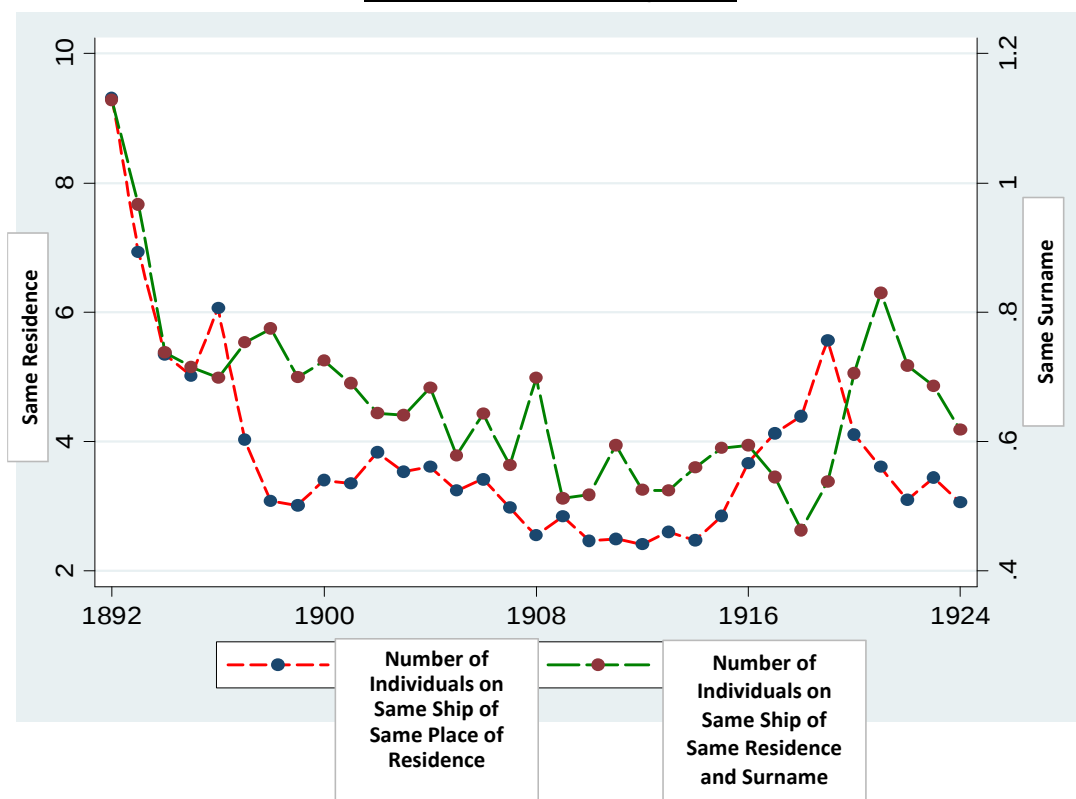
Notes: All figures refer to arrivals into New York City. Official statistics figures are from Ferenzi-Willcox [1929]. All graphs are based on the administrative data from Ellis Island records with corrections for missing data, other potential errors in recorded nationalities, and exclusions. The vertical lines in each Figure correspond to 1900, 1910 and 1920. Figure 3A shows the time series for total arrivals (foreign-born and US-citizen arrivals) from both sources. Figure 3B shows the time series for US-born arrivals by year, from each source.

**Figure 4: Descriptive Evidence on Social Networks on
Arrival into Ellis Island**

A. Ship and Nationality

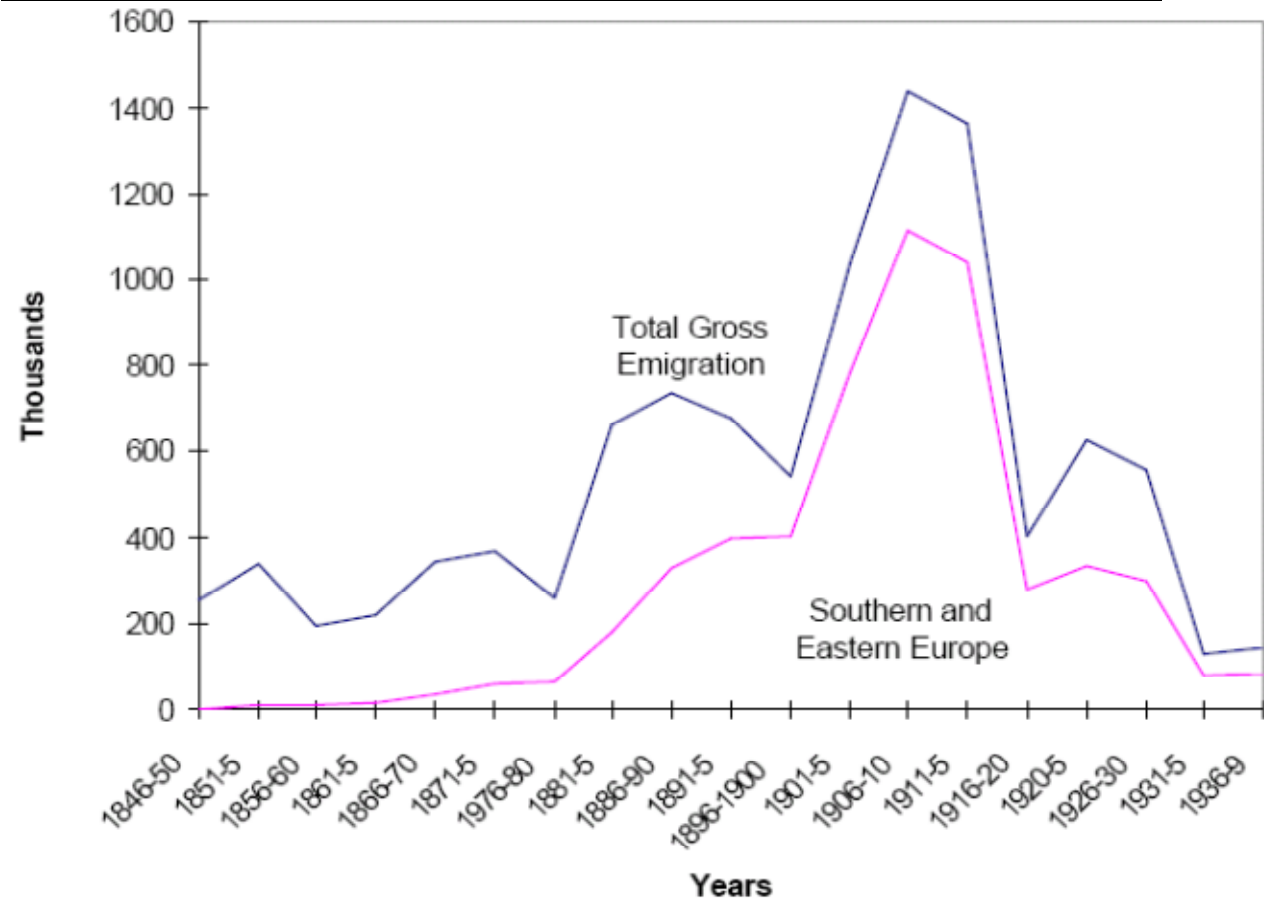


B. Residence and Family Name

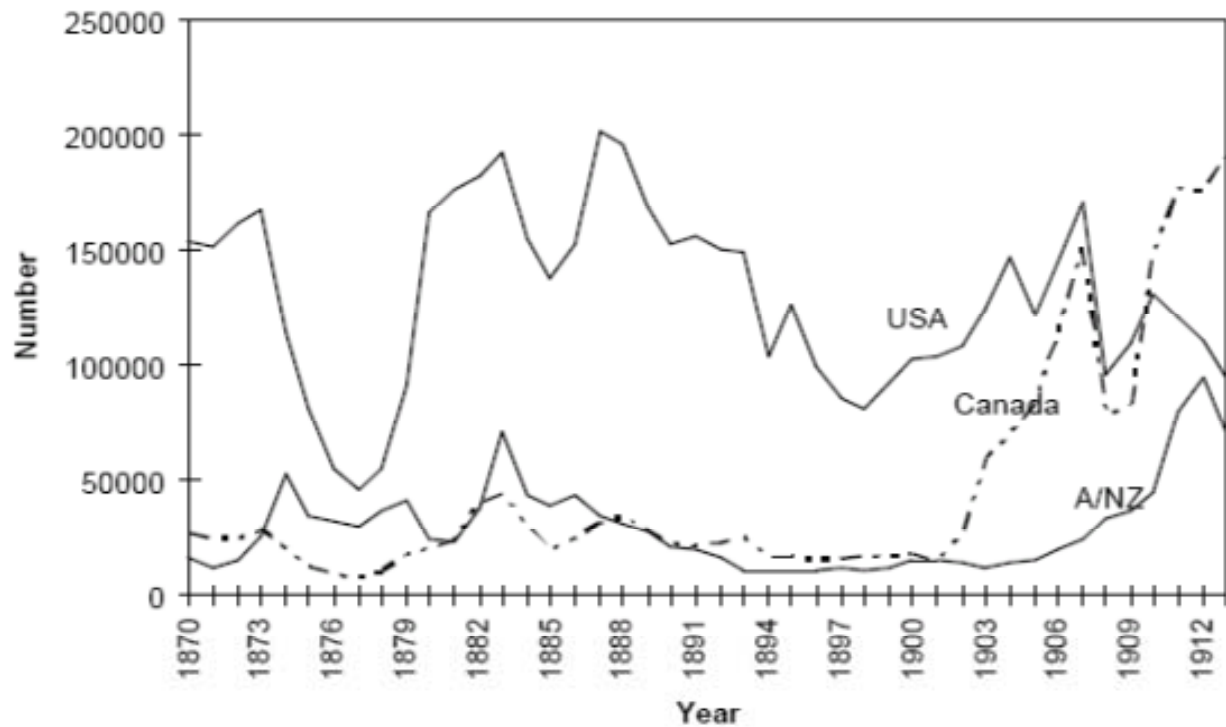


Notes: All figures refer to arrivals into Ellis Island, New York City.

Figure A1A: Gross Intercontinental Migration From Europe: 1846-1939 (annual averages)



**Figure A1B: Gross UK Migration to United States, Canada, Australia
Figure 1B: and New Zealand, 1870-1913**



Notes: Source for Figure A1A: Ferenci and Wilcox (1929). Source for Figure A1B: Hatton (2003), A/NZ refers to Australia and New Zealand as destination.

Figure A2: Accounting for Returnees and New Arrivals

									Column 1		Column 2			
Census Date: P_t					Census Date: P_{t+10}				P_t	I_{t+1}	$Inew_{t+10}$	P_{t+10}	$E_{t+10}=P_t+I_{t+10}-P_{t+10}$	$E_{t+10}=P_t+Inew_{t+10}-P_{t+10}$
Scenario	Time													
1	New Arrival		Departed		1	0	0	0		1		1		
2		New Arrival	Departed		0	1	1	0		1		1		
3	New Arrival	Departed	Return Arrival		1	1	0	1		1		0		
4	New Arrival	Departed	Return Arrival	Departed	1	1	0	0		2		1		
5		New Arrival	Departed	Return Arrival	0	2	1	1		1		0		
6		New Arrival	Departed	Return Arrival	Departed	0	2	1	0		2	1		

Figure A3a: Census Populations in 1880, 1900, 1910 and 1920, for Countries With Implied Negative Emigrant Numbers 1900-1910

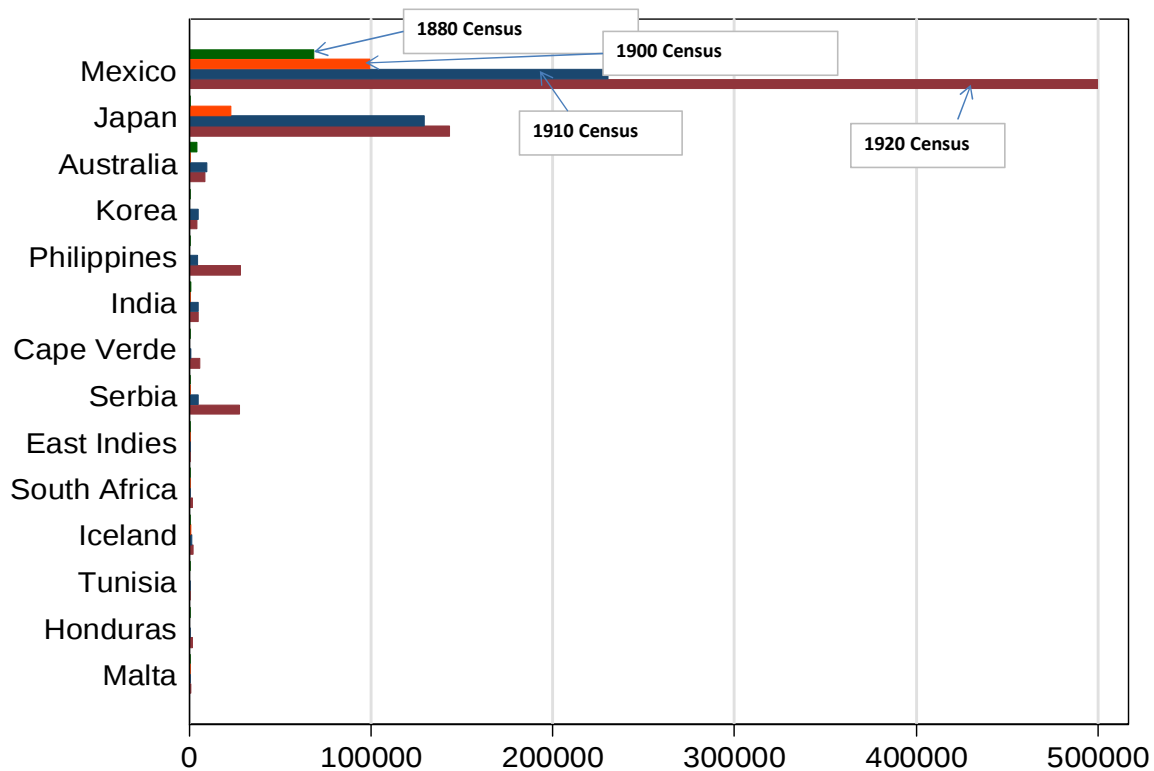
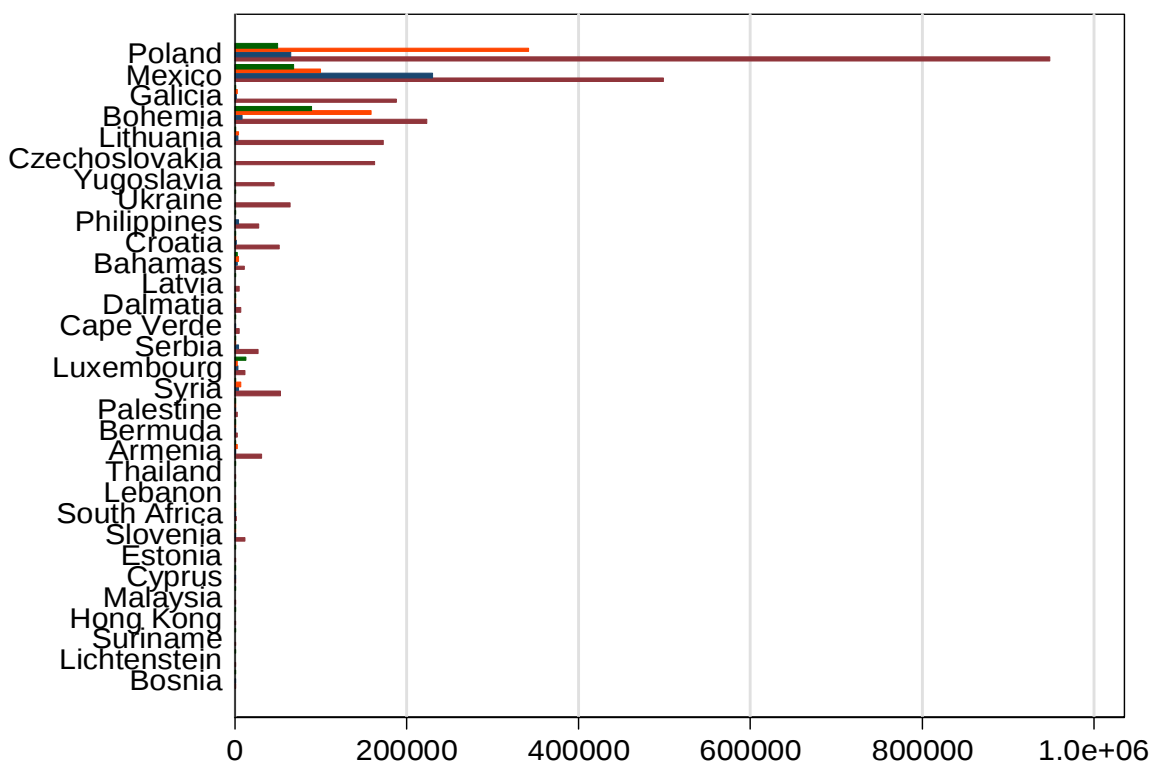


Figure A3b: Census Populations in 1880, 1900, 1910 and 1920, for Countries With Implied Negative Emigrant Numbers 1910-1920



Notes: The sample of countries for the Figure in each decade is those countries for whom the total estimated number of emigrant departures is found to be negative after making corrections for missing values, excluded immigrants, weighting for the ratio of official arrivals into the US to those into New York each year, inflows from Canada, and foreign born individuals with US citizenship. for these countries, the figure then shows the population in the US based on Census data from 1880, 1900, 1910 and 1920.