Migrants and the Making of America: The Short- and Long-Run Effects of Immigration during the Age of Mass Migration*

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Abstract: We study European immigration into the United States during the Age of Mass Migration (1850–1920), and estimate its long-term effects on economic prosperity. We exploit variation in the extent of immigration across counties arising from the interaction of fluctuations in aggregate immigrant inflows and the gradual expansion of the railway. We find that locations with more historical immigration today have higher incomes, less poverty, less unemployment, higher rates of urbanization, and greater educational attainment. The long-run effects appear to arise from the persistence of sizeable short-run benefits, including earlier and more intensive industrialization, increased agricultural productivity, and more innovation.

Keywords: Immigration, historical persistence, economic development.

JEL Classification: B52; F22; N72; O10; O40.

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1. Introduction

An important issue within current American political discourse is the impact that immigrants have on the communities into which they settle. While this topic has received significant attention to date, the focus has tended to be on the short-term effects of immigrants.[1] However, also important is the question of what long-run impacts immigrants have in the locations into which they settle, particularly since the short- and long-term impacts may be very different.

We contribute to the understanding of the impact of immigration by taking a historical perspective. In particular, we examine migration into the United States between 1850 and 1920 – during America's Age of Mass Migration – and estimate the causal impact of immigrants on economic and social outcomes today, approximately 100 years later. This period of immigration is notable for a number of reasons. First, it was the largest in United States history. Second, the wave of "new" immigrants that arrived during this period was not a simple extension of the previous waves of immigrants. While earlier immigrants were primarily from French, Irish and English origin, the new wave also included, for the first time and in large numbers, immigrants from southern, northern, and eastern Europe who spoke different languages and had different religious practices (Hatton and Williamson, 2005, p. 51, Daniels, 2002, pp. 121–137, Abramitzky and Boustan, 2015).

Empirically studying the long-run impacts of immigration is challenging. A natural strategy is to examine the relationship between historical immigration and current economic outcomes across counties in the United States. However, there are important shortcomings of such an exercise. There may be omitted factors, such as geographic or climatic characteristics, that may have affected whether immigrants settled in a particular location. These may independently impact the outcomes of interest. It is also possible that migrants were attracted to locations with more growth potential. Alternatively, they may have only been able to settle in more marginal locations, with poorer future economic growth, where land and rents were cheaper. All of these concerns would cause OLS estimates to be biased.

An important contribution of our analysis is the development of an identification strategy that overcomes this problem. We propose an instrumental variables (IV) strategy that exploits two

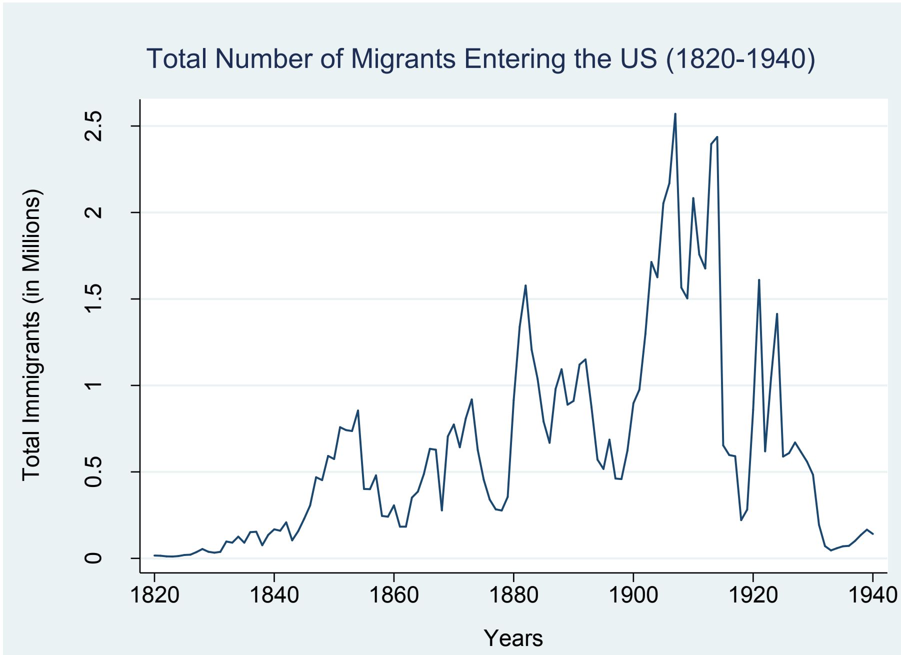
[1] See Kerr and Kerr (2016) for evidence of the impact of immigrants on entrepreneurial activity; Peri (2012) for evidence of the impacts of immigrants on productivity; Peri and Sparber (2009) for evidence of impacts on occupational specialization; Hunt and Gauthier-Loiselle (2010) for evidence of impacts on innovation; Card (2012) for evidence of impacts on average wages; and Card (2009) for evidence on wage inequality.

facts about immigration during this period. The first is that after arriving into the United States, immigrants tended to use the newly constructed railway to travel inland to their eventual place of residence (Faulkner, 1960, Foerster, 1969). Therefore, at any point in time, a county's connection to the railway network affected the number of immigrants that settled in the county. The second fact is that the total inflow of immigrants fluctuated greatly during this period. Figure 1a reports historical annual total immigration into the United States between 1820 and 1940 (Migration Policy Institute, 2016). As shown, the flow of immigrants varied significantly from year-to-year. Even after normalizing the flows by the current United States population and aggregating to the decade level, which is the unit of observation in our analysis, one still observes significant variation over time. These data are shown in Figure 1b.[2] It is clear that there are decades in which immigration was significantly higher than average (e.g., 1850s, 1880s, and 1900s) and other decades in which immigration was significantly lower than average (e.g., 1860s, 1870s, and 1890s).

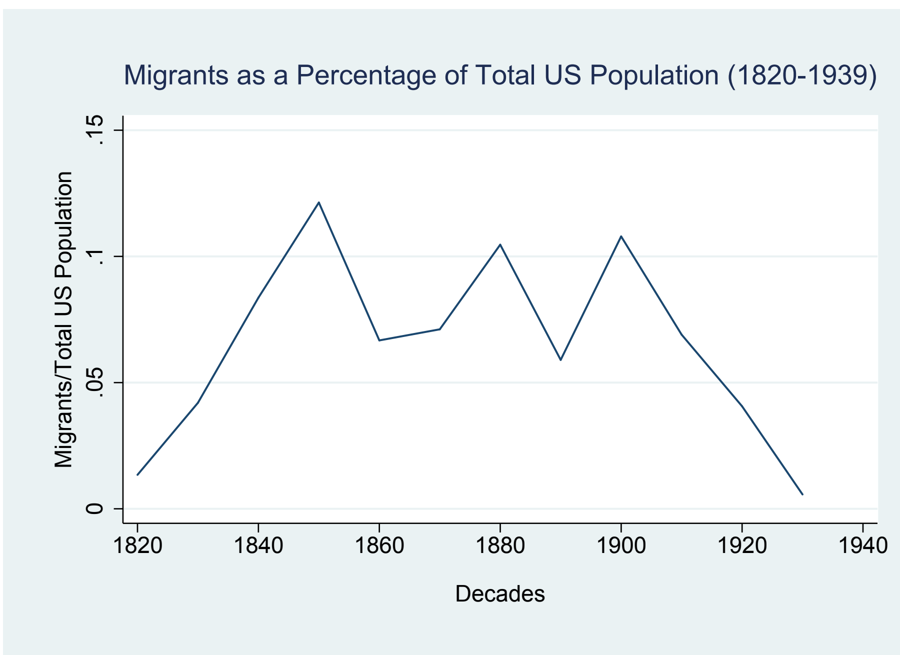
Holding constant the total length of time a county was connected to the railway network (in our analysis we always condition on this), if a county is connected during periods of high immigration, then it will tend to have more immigrant settlement. During this time, once a county became connected to the railway network it almost always stayed connected. Therefore, asking whether a county was connected during periods with relatively higher or lower aggregate immigrant inflows is equivalent to asking whether a county became connected to the railway network just prior to a decade with particularly high immigration or just prior to a decade with particularly low immigration. All else equal, the average inflow of immigrants during the time in which the county was connected to the railway will be greater in the former case than in the latter case. Thus, intuitively, our estimates exploit comparisons of counties that became connect at approximately the same point in time (i.e., contiguous decades), but some counties were connection just prior to an immigration boom and others just prior to an immigration lull. Examples of such comparisons include: counties first connected just prior to the 1850s (boom decade) with those first connected just prior to the 1860s (lull decade); counties first connected in the 1870s (lull) to the 1880s (boom); the 1890s (lull) to the 1900s (boom); the 1900 (boom) to the 1910 (lull); etc.

Whether a county is first connected prior to a lull or a boom period is mechanically related

[2]The figure reports immigrant flows by decade and normalized by the total United States population. Flows reported in decade t refer to flows during that year and the 9 years that follow. For example, 1820 in the figure refers to flows from 1820–1829. Throughout the paper we maintain this convention unless stated otherwise.



(a) Annual inflow of Migrants into the United States, 1820–1940. Source: Migration Policy Institute.



(b) Decadal averages of annual inflow of migrants into the US normalized by total United States population, 1820–1939. Source: Willcox (1929-1931).

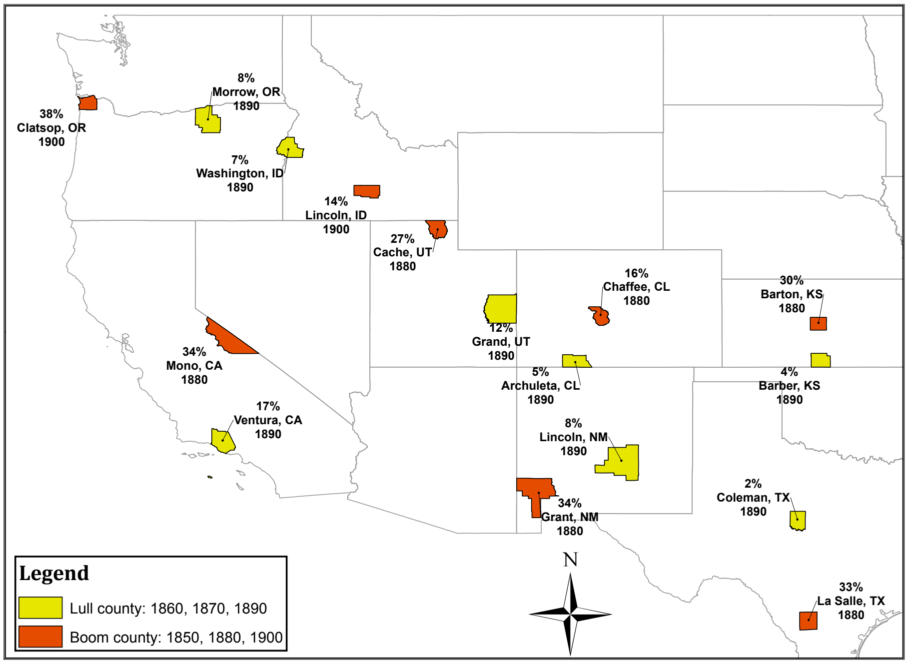
Figure 1: Immigration into the United States during the Age of Mass Migration.

to the length of time that the county is connected to the railway in total. However, as we explain below, our analysis directly controls for this. Also, because of the oscillating pattern of immigration during this time, neither lull decades nor boom decades occur earlier or later on average. In the comparisons above, lull decades sometimes come before boom decades, while boom decades sometimes come before lull decades. As we will show, lull and boom decades appear balanced on a host of observable characteristics. Thus, whether a county first became connected to the railway in 1870 vs. 1880, for example, was likely determined by idiosyncratic factors that, from an econometric point of view, can be taken as random.

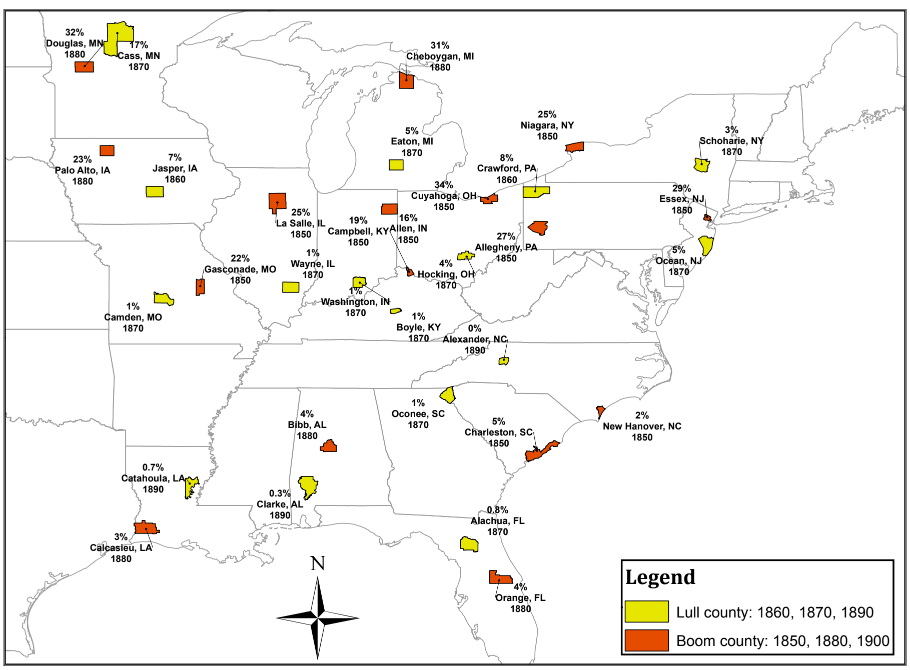
To provide a better sense of these comparisons, Figure 2 presents examples of pairs of counties that are within the same state (our analysis includes state fixed effects), but became connected to the railway at different times due to its gradual construction. In addition, one county of each pair became connected just prior to a high-immigration (i.e., boom) decade and the other became connected just prior to a low-immigration (i.e., lull) decade. Whether the connection occurred just prior to a boom or lull decade is indicated by the color (shade) of the county, with red (dark shade) indicating counties that were connected just prior to a boom decade and yellow (light shade) indicating counties that were connected just prior to a lull decade. Also reported in the figure is the subsequent average migrant share measured from the census data for the period 1860–1920. These examples illustrate how the exact timing of a county's connection to the railway network can have significant impacts on the extent of subsequent immigration into a county.

The benefit of combining the two sources of variation – the timing of the construction of the railway and the timing of migration booms – is that the interaction between the two generates variation that most likely does not affect our contemporary outcomes of interest through other channels. Whether a county became connected to the railway just prior to an immigration boom rather than immigration lull is unlikely to have a direct impact on our current outcomes of interest other than through historical immigration to the county.

To implement our IV strategy, we begin with a "zero-stage" regression where we examine a panel of counties every census decade from 1860 to 1920, and estimate the determinants of the share of the population that was foreign-born. The specification includes county fixed effects, time-period fixed effects, and a host of covariates, including: the share of immigrants in the previous decade, a measure of population density, urbanization, and an indicator variable that equals one if a county is connected to the railway network at that time, as well as its interaction



(a) Map of the Western United States.



(b) Map of the Eastern United States

Figure 2: Maps illustrating of the basic logic of the identification strategy. The maps show pairs of counties within the same state, one was connected just prior to an immigration boom and the other just prior to an immigration lull. Reported next to each county is the average immigration share from 1860–1920, the county name, and the first full decade in which it was connected to the railway.

with a measure of aggregate industrial development.

The instrument, and our identification strategy, exploits the *differential* effect that access to the railway has depending on the aggregate inflow of immigrants into the country at the time. The variable that forms the basis of our instrument is an interaction between the aggregate inflow of European immigrants into the United States (normalized by total population) during the 10 years prior, and an indicator variable that equals one if the county was connected to the railway network at the beginning of the 10-year period. This interaction captures the additional impact on immigrant settlement that counties with a railway in high immigration decades had relative to counties with a railway in low immigration decades.

In the zero-stage panel regression, we control for both components of the interaction term (the railway connectivity indicator and the aggregate inflow of immigrants), but neither is included as part of the constructed instrument.[3] Thus, the zero-stage equation accounts for the (average) direct effect that being connected to the railway has on immigration into a county, and this effect does not enter as part of our instrument. Since the railway likely has a wide range of impacts other than its effect on immigration, the most notable being increasing industrialization, we do not want our instrument to be driven by any direct impact of the railway. It is only the differential impact of the railway relative to the aggregate inflow of immigrants into the United States that we take as exogenous.

In our zero-stage panel regression, we find that the interaction term, which comprises the instrument, is a strong predictor of the inflow of immigrants into a county. It is robustly positive and highly significant, which indicates that counties received a larger share of immigrants when they were connected to the railway network *and* the aggregate flow of immigrants into the country was high.

Using these estimates, we construct estimated measures of the share of the population that was foreign born (for each county and decade) that is predicted by the interaction term only. For each county, we then create an average across all time periods to construct a measure of the average of the predicted migrant share in each decade from 1860-1920. We use this as an instrument for the actual average migrant share in each decade from 1860-1920, and using 2SLS we estimate the impact of average migrant share on medium and long-run economic and social outcomes.

There are a number of potential concerns with our identification strategy. First, despite the

[3]The aggregate inflow of immigrants is absorbed by decade fixed effects.

fact that the direct effect of railway connectivity is controlled for in our zero-stage equation, it is possible that our instrument is still correlated with how early a county was connected to the railway. Given this concern, in all of our IV specifications, we control for a measure of when the county became connected to the railway network.

A second potential concern is that decades with high immigration inflows may have been different for other reasons. For example, if immigration inflows happen to coincide with high levels of industrial development, then the differential impact of connection to the railway depending on aggregate immigration may be correlated with the differential impact of connection to the railway depending on industrial development. Given this concern, in our zero-stage specification, we allow railway connection to have a differential effect along these lines. In our zero stage regression, we include an interaction of the railway connectivity and an index of aggregate industrialization in the United States. In addition, using the same procedure as with our instrument, we create a measure of predicted immigration using this interaction term and we control for this generated variable in all of our IV specifications. Thus, any effects that are due to the timing of connection to the railway relative to the level of industrialization should be accounted for by this covariate.

A third potential concern with our estimates is the possibility that the aggregate flow of immigrants could have been endogenous to the railway expansion. In particular, if immigrant inflows tended to increase once the railway became connected to counties with a greater future growth potential, then our instrument would suffer from reverse causality and be invalid. Thus, as a robustness check, we construct a measure of the predicted flow of European migrants to the United States that is determined solely by temperature and precipitation shocks in the origin countries. By using the flow of immigrants determined by origin-country weather shocks, we are able to correct for the potential endogeneity of immigrant flows to factors from within the United States, including the railway expansion. We find that predicted immigrant flows are highly correlated with actual flows, and that using the predicted values yields estimates that are nearly identical to our baseline estimates.

Relying on this identification strategy and looking across counties in the year 2000, we estimate the long-term economic impacts of immigration during the Age of Mass Migration. The 2SLS estimates suggest that immigration, measured as the average share of migrants in the population between 1860 and 1920, generated significant economic benefits today. It resulted in significantly higher incomes, less poverty, less unemployment, more urbanization, and higher educational attainment. The estimates, in addition to being highly significant, are also economically meaningful. For example, according to the estimates for per capita income, moving a county with no historical immigration to the 50th percentile of the sample results in a 20% increase in average per capita income today.

Our analysis also attempts to gain some understanding about the potential mechanisms that underlie our estimates. It is possible that the benefits that we estimate arise because immigrants created long-run economic benefits. It is also possible that the benefits we estimate arise due to the relocation, as opposed to creation, of economic prosperity.[4] To better understand exactly why locations with more historical immigration are more prosperous today, we undertake a number of strategies to estimate the presence of spillover effects. We estimate how immigration into a county affects economic outcomes in neighboring counties, in other counties within the same state, and in other counties within the same state that are not neighbors. For all estimates, we fail to find evidence of negative spillovers. That is, we find no evidence of immigration into a county resulting in a decline in long-run economic prosperity in nearby counties. In fact, if anything, spillovers appear to be positive although the precision of the spillover effects varies.[5]

As a second step in better understanding mechanisms, we ask when the economic benefits of immigrants began to emerge. It is possible that in the short-run immigrants acted as a burden on the economy and their benefit was only felt in the medium- or long-run. The immigration backlash and the rise of social and political nativist movements at the time suggest that there may have been immediate costs to immigration, at least as felt by some groups. However, when we use our IV strategy to estimate the short-run effects of immigration, we find evidence for significant benefits of immigrants that are felt immediately. Immigration resulted in more and larger manufacturing establishments, greater agricultural productivity, and higher rates of innovation.

These findings are consistent with arguments, commonly made in the historical literature, that suggests that immigrants benefitted the economy by providing an ample supply of unskilled labor, which was crucial for early industrialization. Immigrants also resulted in a small but potentially important supply of skilled individuals, who provided knowledge, know-how, skills,

[4]As in Kline and Moretti's (2014) analysis of the Tennessee Valley Authority, greater early industrialization may be directly offset by a decrease in industrialization elsewhere in the economy.

[5]The finding of positive spillovers is consistent with the findings from Greenstone, Hornbeck and Moretti (2010).

and innovations, which were economically beneficial and particularly important for industrial development.[6]

Having estimated the short-run effects of immigrants, we then turn to an examination of the full dynamic impacts of immigrants, examining their effects in the short-, medium-, and long-runs. Examining urbanization rates each decade from 1920 to 2000, we find that the vast majority of the benefits of immigration from 1850–1920 were felt by 1920, and that these benefits persisted, increasingly slightly, until 2000. We also examine income and education, but for the more limited time period for which data are available (post WWII). We find a similar pattern for these outcomes as well.

We also examine two additional explanations for the long-run impact of immigration. The first is that historical immigration resulted in social benefits, along the lines of social capital or social cohesion, which persist until today and have economic benefits. The second is that places with more historical immigration have more immigration today, which is economically beneficial. We test for both explanations and find no evidence for either. We find no relationship between historical immigration and measures of social capital, voter turnout, or crime rates. We also find no relationship between historical immigration and rates of immigration today or anytime after WWII.

Our findings provide evidence that helps us better understand the impacts of immigration in United States history. The first is that in the long-run, immigration has had extremely large economic benefits. The second is that there is no evidence that these long-run benefits come at short-run costs. In fact, immigration immediately led to economic benefits that took the form of higher incomes, higher productivity, more innovation, and more industrialization. These findings complement recent scholarship examining the selection of immigrants to the United States (e.g., Abramitzky, Boustan and Eriksson, 2012, 2013, Spitzer and Zimran, 2013) and their experiences after arrival (e.g., Abramitzky, Boustan and Eriksson, 2014), as well as the existing literature on the importance of the cultural legacies of immigration (e.g., Fischer, 1989, Ottaviano and Peri, 2006, Ager and Bruckner, 2013, Grosjean, 2014, Bandiera, Mohnen, Rasul and Viarengo, 2016). Our findings of the long-term benefits of immigrants within the United States complement existing

[6]On average, immigrants appear to have been less educated than native-born populations. We find that, consistent with this, immigration is associated with lower levels of education in the short-run (prior to 1920). However, in the medium- and long-run (1950 and later), we find immigration switches to having a positive effect on education levels, which increases monotonically over time.

studies that also find long-term benefits of historical immigration in Brazil (Rocha, Ferraz and Soares, 2015) and Argentina (Droller, 2013).

Our long-run estimates also complement a large empirical literature that examines the shorter-run consequences of immigration in the United States (e.g., Borjas, 1994, 1995, 1999, Card, 1990, 2009, 2012, Hunt and Gauthier-Loiselle, 2010, Peri, 2012, Rodriguez-Pose and von Berlepsch, 2014).[7] The results also complement Atack, Bateman, Haines and Margo's (2010) findings that show that in the United States Midwest between 1850 and 1860, railways accounted for more than half of the increase in urbanization rates. Our findings provide evidence for a potential channel underlying the Atack et al. (2010) result. The railways brought immigrants to the connected locations which, in turn, increased income and urbanization in those areas.

Our paper examines the effect of immigrants in general and not the different impacts of immigrants from different countries, which has been the focus of some lines of research (e.g., Fischer, 1989, Fulford, Petkov and Schiantarelli, 2015, Burchardi and Hassan, 2015). In theory, our identification strategy could be used to instrument separately for immigrants from different countries. Following the same logic as for all immigrants, one could estimate a zero stage equation and use variation from the interaction of the total flow of immigrants from a sending-country during a decade and the location of the railway network at the beginning of the decade to construct an instrument for the presence of immigrants from that sending country living in a county. However, in practice, one would have over 30 endogenous immigrant share variables, one for each sending country for which we have data, and the same number of instruments. Doing this, one finds that the first stages are all very weak. In addition, in the first-stage equations, immigrant flows often load on the "wrong" instruments e.g., other countries' instruments are better predictors than the own-country instrument. These issues are most likely due to the collinearity that is present in the endogenous variables and the instruments.

Our paper is structured as follows. We next turn to a description of the historical setting of our analysis. This is followed, in Section 3, by an overview of our identification strategy, which aims to provide causal estimates of the long-term effects of immigration. In Sections 4 and 5, we report our baseline estimates, as well as a variety of robustness checks. In Section 6, we turn to mechanisms, first examining dynamics by estimating the short- and medium-run impacts of

[7]While much of the literature focuses on short-run effects, an exception is Rodriguez-Pose and von Berlepsch (2014) who also examine the relationship between historical immigration and long-term economic development today.

immigrants, and then checking for the effects of immigration on proximate factors. We end with concluding thoughts in Section 7.

2. Historical Background

A. *Immigration and the Railway*

Throughout our period of interest, migration was facilitated by the railways. The best land was often granted to the railway companies by the Federal government in an attempt to promote the development of uninhabited territories. The railway companies, including the Union Pacific, Santa Fe, Burlington, Northern Pacific, among others, through a variety of mechanisms, intentionally promoted the settlement of these tracks of land contiguous to their railway lines, in part, to stimulate demand for the railway (Luebke, 1977, p. 410). They did this by selling the land cheaply and by encouraging immigrants from Europe to settle there. Common methods used to accomplish this were the establishment of advertising offices in Europe and subsidizing migrants' trans-Atlantic travel. Historian James Hedges (1926, p. 312) describes these efforts, writing that: "The stream of population which followed the wake of the railroads of the West was in part the natural consequences of the mere fact of the construction of the roads, but more largely the result of the strenuous efforts put forth by the railroad companies themselves."

Upon arrival to the United States, railroads were the primary means of transport to the interior. James Hedges (1926, p. 312) goes on to describe the settlement of the Western United States as "a story of Mennonites and sects from South Russia, journeying out to the prairies of Kansas, not with wagon and ox-teams but in the drab passenger coaches of early western railroads. It is the story of Swedes and Norwegians in Minnesota, of Germans in Dakota, Bohemians in Nebraska and of Hollanders in Iowa, who sought new homes where the railroads led them." Thus, the railways were an important means of transport for immigrants moving from the coastal ports of the east to the interior of the United States

B. *Why Migrants Matter in both the Short- and Long-Run*

There are a number of reasons why immigration during America's Age of Mass Migration may have mattered in both the short- and long-runs. The contributions of immigrants is nicely summarized by John F. Kennedy in his book, *A Nation of Immigrants*, where he writes: "Between

1880 and 1920 America became the industrial and agricultural giant of the world... This could not have been done without the hard labor, the technical skills and entrepreneurial ability of the 23.5 million people who came to America in this period." (Kennedy, 1964, p. 34). We discuss each of these potential contributions of immigration below.

Provision of unskilled labor: Immigrants may have spurred industrialization through their provision of an ample supply of unskilled labor. During the Age of Mass Migration, a large proportion of immigrants provided the labor force that was employed in newly established factories. As historian James Bergquist (2007, pp. 264–265) puts it: "New Immigration from England, Ireland, and Germany brought many of the working classes to the growing industrial centers and to the coal-mining regions. Many of the English and Germans had previous experience in the industrial cities of their homelands."

Many have hypothesized that the rapid increase in industrialization in the United States was fueled by an ample supply of immigrant labor. For example, Foerster (1924, p. 331) writes that "the sixfold increase in the capital invested in manufactures between the outbreak of the Civil War and the year 1890, a period in which the population in the country doubled, was largely made possible by the inpouring immigrants."

Evidence that immigration resulted in cheaper labor costs – i.e., low wages – has been put forth by Goldin (1994). Examining variation across American cities between 1890 and 1903, she finds that greater immigration was associated with lower wage growth: a one-percentage-point increase in the foreign-born population is associated with a decrease in wages of about 1.0–1.5 percent. Interestingly, these effects are found both for less-skilled laborers and more-skilled artisans.

Provision of important skills for industry: Although the vast majority of immigrants worked in unskilled occupations, an important fraction engaged in more specialized activities. Malone (1935) reports that among the noteworthy and exceptional individuals summarized in the fifteen volume *Dictionary of American Biography*, 12.5% of those born after 1790 were foreign born, which is actually higher than the national proportion of foreigners (in our sample, this is 10.1%). More recently, Abramitzky et al. (2014) examine the occupational distribution of immigrants and natives in 1900, and find that immigrants were as equally likely as natives to be in unskilled occupations, much less likely to be in farming, and more likely to hold semi-skilled or skilled blue collar occupations such as carpenters or machinists.

Some immigrant groups, were disproportionately represented in skilled occupations. For example, in 1870, 37% of German-born workers were employed in skilled occupations (Daniels, 2002, p. 150). Bergquist (2007, p. 194) describes the early migrants from 1870–1920 as often bringing "skills and knowledge that paved the way to becoming self-sufficient tradesmen". These skilled immigrants included carpenters, cabinetmakers, blacksmiths, brewers, distillers, barbers, tailors, machinists, jewelers, clockmakers, butchers, bakers, sculptors, artists, and musicians. Immigrants commonly used expertise and/or past experience to gain a foothold in particular trades.

Different immigrant groups tended to bring with them different sets of experiences and skills that allowed them to specialize in particular occupations. For example, Bergquist (2007, p. 195) describes the Genoese Italians, writing: "Reflecting their origins in a region with a venerable tradition in the commercial trades, the Genoese opened saloons and restaurants; they also went into confectionary and fresh fruit businesses". And, describing Jewish immigrants, he writes that "their premigration experiences as well as cultural traditions also equipped eastern European Jews and Armenians with abilities suitable to the retail and professional undertakings". (Bergquist, 2007, p. 195).[8]

Provision of agricultural know-how: Immigrants represented a small but important proportion of farm operators (15.3% in 1900 and 10.5% in 1920), with the vast majority of these being owner-operators (80% in 1920) (Cance, 1925, pp. 102–103). Immigrants also contributed to productivity improvements within agriculture, bringing with them knowledge about agricultural techniques. Cance (1925, p. 113), writing just after the end of the Age of Mass Migration, argues that "some of the very best of our farmers are immigrants of the first and second generation," a fact that he attributed to their "better farm practices." (p. 104)

The most notable group of immigrant farmers were the Germans, who were the largest immigrant group within the farming sector, accounting for 25% of all foreign-born farm-operators in 1920 (Cance, 1925, p. 113). Kollmorgen (1942, pp. 53–54), describes the Pennsylvania Germans: "Not only did the Pennsylvania German adopt new kinds of crops and better stock, he also perfected and popularized certain seeds, crops and foods. He was the first to breed the Conestoga horse; he became known for the variety of vegetables he raised; he played an

[8]Formal empirical evidence of skilled immigrants having important impacts on industrial development has been put forth in other contexts. For example, Hornung (2014) finds large positive impacts of 17th century Huguenot immigration into Prussia on the productivity of textile manufacturing.

important part in perfecting several kinds of wheat and apples. Moreover, he pioneered the rotation and diversification of crops and in providing good shelter for stock." A particularly telling example of this is the introduction of the alfalfa seed, which was widely adopted as an excellent foraging crop in the Northwest. In 1857, the seed was taken to Minnesota from a village in Baden by a German immigrant named Wendelin Grimm (Saloutos, 1976, p. 66). In his analysis of German immigrant farmers of Texas in the late 19th century, Jordan (1966, pp. 5–7) documents numerous contemporary reports of the superiority of German farmers, citing their advanced "intelligence, industriousness, and thrift", and describing them as "laborious, persevering, and eager to accumulate".

A concrete example of the impact that immigrants had on agricultural innovation can be found in a study by Gripshover and Bell (2012) that documents innovations in the U.S. onion farming industry between 1883 and 1939. The authors examine the 97 onion-farming inventions during this period, and use the micro-census, as well as biographical and genealogical sources, to obtain as much information as possible on the inventors. They find that of the 81 different inventors, a significant proportion, 19%, were foreign-born, and 49% were either first- or second-generation immigrants. The first ever patent for a mechanical "onion-cultivator" was granted in 1883 to James Peter Turner, an immigrant born in England who moved to the United States in 1850.

Provision of knowledge and innovation: It has been noted that immigrants contributed directly to the productivity of the United States economy through important technological innovations. One example of such an innovation is the suspension bridge. John A. Roebling, a German-born and trained civil engineer, is credited with ushering in the era of the suspension bridge at a time in United States history in which transportation infrastructure was desperately needed. He built numerous suspension bridges, his most noteworthy being the Niagara Fall Suspension Bridge and the Brooklyn Bridge (Faust, 1916, p. 10). Other notable engineers include: Charles Conrad Schneider, born in Saxony, who constructed the famous cantilever bridge across the Niagara River in 1883; Austrian Gustav Lindenthal, who built the Hell Gate Bridge; and John F. O'Rourke, an Irish engineer, who built seven of the tunnels under the East and Hudson Rivers, and six of the tunnels of the New York subway systems (Wittke, 1939, pp. 389–390).

Another example is Alexander Graham Bell, who was born in Scotland in 1847, and moved to Boston in 1871. In 1876, Bell developed an acoustic telegraph that could transmit voices and sounds telegraphically, and within a year, the Bell Telephone company was established. Other notable inventors include: David Thomas (Welsh), who invented the hot blast furnace; John Ericsson (Swedish), who invented the ironclad ship and the screw propeller; Conrad Hubert (Russian), who invented the flashlight; and Ottmar Mergenthaler (German), who invented the linotype machine (Kennedy, 1964, pp. 33–34).

Immigrants also made important contributions to the educational system of the U.S. (Faust, 1916, p. 10). For example, the kindergarten was brought to the United States by German immigrant Friederich Fröbel. Recent research by Paz (2015) finds that the presence of kindergartens during the kindergarten movement (1890–1910) resulted in an average of 0.6 additional years of total schooling by adulthood and six percent higher income. Further, Ager, Cinnirella and Jensen (2016) show that not only did kindergartens increase education and incomes of children, but they also caused parents to have fewer children. As well, the current structure of graduate departments at American Universities is modeled after the German system. It was first introduced by Johns Hopkins University at its foundation in 1876. In addition, the State University system, which began in Michigan, was modeled after the Prussian state school and university system. The Michigan model then became the standard for other state schools in the West (Faust, 1916, p. 11).

In addition to technological and educational innovations, immigrants also contributed to business innovation. For example, Hatton and Williamson (2005, p. 94) report that among individuals born between 1816 and 1850, immigrants are disproportionately represented among the top businessmen in the United States.

3. Identification Strategy

Our identification strategy begins with a panel of counties and census decades from 1860 to 1920.[9] Using a wide variety of historical maps, we digitized and constructed the railway network for each decade between 1830 and 1920. Figures A5–A15 of the online appendix show the digitized and geo-referenced railway network between 1850 and 1920. The backgrounds show the geo-referenced images of the original paper maps from which the data were obtained.

[9] Although 1860 is the first year of our panel, we measure the presence of the railway one-decade prior. Therefore, 1850 is the earliest period of railway data that we use in our analysis. 1850 is the decade in which the census started to consistently record whether an individual was foreign-born. All census data were obtained through the Natural Historical Geographic Information System (NHGIS) available at www.nhgis.org (see Minnesota Population Center, 2011), and the Inter-university Consortium for Political and Social Research (ICPSR) available at www.icpsr.umich.edu (see Haines and Inter-university Consortium for Political and Social Research, 2010).

Construction of the digitized railway network occurred in the following manner. We first obtained an accurate and geo-referenced shape file of the current railway network.[10] We then laid the modern shapefile over a digitized version of a paper map of the most recent historical time period of interest, 1920. We proceeded to remove all railway lines that exist today but did not exist in 1920. We repeated this for each earlier time period in sequence – i.e., 1910, 1900, etc – at each point removing railway lines that did not exist in the previous decade. This procedure ensures the greatest precision in digitizing the exact location of the railway lines. Because of mapping imprecisions from the original historical maps, simply tracing the lines from each paper map would have generated inaccurate maps of historical railway networks. The details of the procedure are further reported in the online data appendix.

As a measure of whether a county was connected to the railway network, we created an indicator variable that equals one if a county's boundary is intersected by at least one railway line. The proportion of connected counties steadily increased overtime from just under 20% in 1850 to over 90% in 1920 (see appendix Figure A1 for the proportion in all decades).

The second important source of information in our analysis is data on aggregate immigration flows. Using Willcox (1929-1931), we have digitized data for the total number of European immigrants entering the United States each year between 1820 and 1920.[11] We use this to construct a measure of the total number of immigrants that arrived in the decade prior to each time period in our sample. As discussed in the introduction, and as we have seen in Figures 1a and 1b, aggregate immigration flows varied significantly from year-to-year and, importantly, from decade-to-decade. This volatility is an important source of variation for our analysis.[12]

Our identification strategy exploits the interaction of these two sources of variation, one that arises from differences in aggregate immigrant inflows over time and the other from changing access to the railway network experienced by counties over time. Our estimation strategy begins

[10]The shapefile used was the 2009 version of the National Transportation Atlas Railroads (NTAR), which is at a 1:100,000 scale. The data are from the the United States Department of Transportation.

[11]We use Willcox (1929-1931) rather than the already-digitized data available from Migration Policy Institute (2016) because Willcox (1929-1931) reports immigrants by sending country and Migration Policy Institute (2016) does not. This information is necessary for a robustness check where we examine immigration flows from a country that are driven by local weather shocks.

[12]In our analysis, we only consider European immigrants, who comprised the vast majority of immigrants during this period. Our analysis does not therefore include immigrants from Latin America, Asia or Africa, since immigrants from these locations account for less than 5% of immigrants into the United States during our period of interest (see e.g., Abramitzky and Boustan, 2015, Figure 2).

with the following zero-stage equation:

$$\begin{aligned} \text{Migrant Share}_{it} &= \alpha_t + \alpha_i + \gamma \, \text{Migrant Share}_{it-1} + \delta I_{it-1}^{\text{RR Access}} + \beta \, \text{Migrant Flow}_{t-1} \times I_{it-1}^{\text{RR Access}} \\ &\quad + \theta \, \text{Industrialization}_{t-1} \times I_{it-1}^{\text{RR Access}} + \mathbf{X}_{it-1}\mathbf{\Gamma} + \varepsilon_{it} \end{aligned} \tag{1}$$

where i indexes counties and t indexes census years (1860, 1870, 1880, 1890, 1900, 1910, 1920);[13] α_t and α_i denote decade and county fixed effects, respectively; and $\text{Migrant Share}_{it-1}$ denotes a lagged dependent variable, which captures the mechanical relationship between the previous decade's population of immigrants and this decade's population of immigrants.[14] $\text{Migrant Share}_{it}$ is the share of the population that are migrants (i.e., foreign born) in county i in census year t; $\text{Migrant Flow}_{t-1}$ is the flow of immigrants arriving in the United States normalized by total United States population in the ten years prior to year t (e.g., if $t = 1860$, then $\text{Migrant Flow}_{t-1}$ measures immigrants arriving from 1850–1859), and $I_{it-1}^{\text{RR Access}}$ is an indicator variable that equals one if county i is connected to the railway network in decade $t-1$ (e.g., if $t = 1860$, then $I_{it-1}^{\text{RR Access}}$ is an indicator variable for 1850). $\mathbf{X}_{it-1}$ is a vector that includes the following covariates: a one-period lag of the urbanization rate, and its interaction with the lagged immigrant flow variable. These controls are intended to capture the potential influence that cities had in attracting immigrants to counties. These controls are particularly important given the potential impact that the railway had on urbanization.

The key component of equation (1) is the interaction between the aggregate inflow of immigrants into the United States during the past 10 years and whether a county was connected to the railway at the beginning of this 10-year period: $\text{Migrant Flow}_{t-1} \times I_{it-1}^{\text{RR Access}}$. This captures the following logic: counties that are connected to the railway network during periods of high aggregate immigrant inflows into the United States should have a larger subsequent share of immigrants in the population. Thus, we expect the estimate of β in equation (1) to be positive and significant.

Given the concern that the timing of connection of the railway may have a direct effect on long-term development by allowing specialization and industrialization, we also allow the impact of railway connection to vary differentially depending on the level of aggregate industrial

[13] We have 49 state fixed effects in total: 48 states (i.e., all states but Hawaii and Alaska) and Washington D.C.

[14] Due to the presence of a Nickel bias, there is concern that the estimate of β_1 may be biased, which could have some effect on the other estimates, and in particular, γ. As we discuss below, and report in appendix Table A1, the estimates of equation (1) are nearly identical without the inclusion of a lagged dependent variable, as is our constructed instrument.

development at the time: $\text{Industrialization}_{t-1} \times I_{it-1}^{\text{RR Access}}$.[15] The variable $\text{Industrialization}_{t-1}$ is the annual average during the 10 years prior to census year t. This interaction term captures any differential impacts that connection to the railway network has depending on the level of aggregate industrial development at the time.

After estimating equation (1), we then construct our instrument by first calculating the immigrant share in each county and period that is predicted by the interaction between the flow of migrants in the previous decade and whether the county had access to the railway in that particular decade: $\widehat{\text{Migrant Share}}_{it} = \widehat{\beta}_1 \text{Migrant Flow}_{t-1} \times I_{it-1}^{\text{RR Access}}$. The coefficient $\widehat{\beta}_1$ is the estimate of β from equation (1).

We thus have predicted measures for each county and time period, and we can construct instruments for migrant shares that are averaged over multiple decades. As our baseline measure, we use the average of the predicted migrant share for the census years from 1860 to 1920, which we denote $\text{Avg}\,\widehat{\text{Migrant}}\,\text{Share}_i$. Since some counties were still in the process of being formed during this period, our panel is unbalanced with counties entering over time.[16] When constructing $\text{Avg}\,\widehat{\text{Migrant}}\,\text{Share}_i$, we use the average immigrant share for all periods between 1860 and 1920 for which the county is in existence.

As discussed above, a concern with our IV strategy is that the timing of connection to the railway relative to aggregate immigration inflows may be related to the timing of the connection of the railway relative to United States-wide industrial development. In turn, this could have important long-run impacts that may violate the exclusion restriction of our instrument, resulting in biased 2SLS estimates. Thus, an important control variable in equation (1) is the interaction between aggregate industrial development and railway access: $\text{Industrialization}_{t-1} \times I_{it-1}^{\text{RR Access}}$. In addition to controlling for this interaction in our zero-stage equation (1), we also treat this interaction term symmetrically to our instrument and create the generated regressor, $\widehat{\theta}\,\text{Industrialization}_{t-1} \times I_{it-1}^{\text{RR Access}}$, which we control for in our 2SLS estimates.

We implement our IV procedure using 2SLS, with $\text{Avg}\,\widehat{\text{Migrant}}\,\text{Share}_i$ as an instrument for the actual average migrant share for this period. This procedure is an example of the use of a "generated-regressor". When estimating 2SLS using generated instruments, under very weak

[15] The level of industrialization is measured using the natural log of the annual industrial production index taken from Davis (2004). The data are shown in appendix Figure A2.

[16] In 1860, there are 1,600 counties in our sample, there are 1,974 counties in 1870; 2,216 in 1880; 2,468 in 1890; 2,728 in 1900; 2,797 in 1910; and 2,946 in 1920.

assumptions, the point estimates are consistent and the 2SLS standard errors and test statistics are asymptotically valid. For more information see Pagan (1984) and Wooldridge (2002, pp. 116–117).

Equation 2 represents our first stage and Equation 3 our second stage:

$$\text{Avg Migrant Share}_{is} = \alpha_s + \alpha \text{Avg}\,\widehat{\text{Migrant}}\,\text{Share}_{is} + \omega \text{RR Duration}_{is} + \mathbf{X}_{is}\mathbf{\Omega} + \varepsilon_{is} \tag{2}$$

$$Y_{is} = \alpha_s + \beta \text{Avg Migrant Share}_{is} + \pi \text{RR Duration}_{is} + \mathbf{X}_{is}\mathbf{\Pi} + \nu_{is} \tag{3}$$

where i indexes counties and s states. Y_{is} is a contemporary outcome of interest; for example, current per capita income, inequality, education, or social capital. These variables are generally measured in 2000. $\text{Avg Migrant share}_i$ is the average migrant share in county i between 1860 and 1920; and $\text{Avg}\,\widehat{\text{Migrant}}\,\text{Share}_{is}$ is the predicted migrant share from the zero-stage equation. The vector $\mathbf{X}_i$ includes the following covariates: the longitude of a county's centroid, the latitude of a county's centroid, and the predicted migrant share due to the interaction of railway connectivity and the level of industrialization, $1/n \sum_t \widehat{\theta}\,\text{Industrialization}_{t-1} \times I_{it-1}^{\text{RR Access}}$, where n is the number of decades for which county i is in the sample.

The specification includes state fixed effects, α_s, which are intended to capture broad differences between counties. These will absorb a host of broad differences due to, for example, geography or history. The specification also includes RR Duration_{is}, which is the number of years, as of 2000, that a county has been connected to the railway network. The variable is included to address the possibility that our instrument may be correlated with early connection to the railway network, which could have an independent long-run effect.

A. *Threats to Identification*

There are several potential concerns with our identification strategy. The first concern arises from the fact that the timing of a county's access to the railway was not randomly assigned. For example, counties that were further west were more likely to become connected to the railway network at a later date. Our zero-stage estimating equation includes county fixed effects, and our 2SLS estimating equations control for the latitude and longitude of a county's centroid, as well as state fixed effects. In addition, in our 2SLS estimates, we also directly control for whether a county was early or late to be connected to the railway network by including a measure of the number of years a county has been connected to the railway network as of 2000.

It is also important to keep in mind that our identification is not driven by whether a county was early or late to be connected to the railway, but exactly when the county was connected to the railway, and in particular when it became connected relative to the timing of aggregate immigration booms or lulls. Thus, the important question to consider is whether counties that were connected just prior to the most significant boom periods (e.g. 1850-59, 1880-89, or 1900-09) are different from counties that were connected during the biggest lull periods (e.g. 1860-69, 1870-79, and 1890-99).

In Table 1, we report this comparison by checking the balance on important county-level economic, demographic, and geographic characteristics that might have been correlated with the placement of the railroads or the settlement of migrants, and ultimately, with our outcomes of interest today. Table 1 confirms that these counties were indeed very similar at baseline (i.e., 1840), prior to the arrival of the railroads or the wave of mass immigration. We first consider a host of economic characteristics, including the share of the population in commerce, share of the population in agriculture, share of the population in mining, per capita investments of capital in manufacturing, value of agricultural output per capita, value of agricultural crops per capita, the number of post offices per 1,000 inhabitants, newspapers per 1,000 inhabitants, or the presence of a connection to a canal or naturally navigable waterway. We find that the economic profiles of the two sets of counties appears to have been similar. Among the eleven economic characteristics considered, we find that for only one measure – population density – is there a significant difference between the two groups.

We also examine the share of foreign-born in each county at baseline. Since this measure is unavailable for 1840, we report measures in the two preceding decades, 1820 and 1830. We find that overall, this aspect of the two sets of counties appears to have been fairly similar. While there is a statistically significant difference for the share of foreign born in 1830, it is only at a 10% significance level. Motivated by the importance of past immigrant and pre-existing stocks of immigrants, our baseline zero-stage equation includes a one-decade lag of the share of the population that is foreign born. This helps to net out any potential dynamic effects of past immigration that may be correlated with the source of variation we are using, namely the interaction between being connected to the railway and aggregate migration flows.

Next, we examine geographic characteristics, including the latitude and longitude of a county's centroid, and whether a county is located in the Midwest/West, or in in the South. We do find

Table 1: Balance statistics between the lull-connection and boom-connection counties.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Boom-Connection Counties			Lull-Connection Counties			Equality of Means	Chi Square
	Obs	Mean	Std Dev	Obs	Mean	Std Dev	*p*-value	*p*-value
Economic Characteristics:								
Urban Share, 1840	795	0.934	(0.372)	408	0.786	(0.210)	0.728	
Population Density, 1840	781	0.180	(1.107)	386	0.071	(0.107)	0.010	
Share of the Population in Commerce, 1840	763	0.005	(0.006)	316	0.004	(0.007)	0.452	
Share of the Population in Agriculture, 1840	781	0.247	(0.123)	386	0.256	(0.127)	0.252	
Share of the Population in Mining, 1840	781	0.0009	(0.0048)	386	0.0009	(0.0053)	0.990	
Capital Invested in Manufacturing per capita, 1840	776	10.26	(18.70)	385	9.29	(36.38)	0.625	
Value of Agricultural Output per capita, 1840	774	45.95	(28.57)	384	44.18	(32.07)	0.361	
Value of Agricultural Crops per capita, 1840	774	41.82	(28.11)	384	40.56	(31.96)	0.511	
Post Offices per 1,000 Inhabitants, 1840	846	0.665	(0.019)	448	0.636	(0.060)	0.644	
Newspapers per 1,000 inhabitants 1840	252	0.175	(0.020)	138	0.125	(0.026)	0.130	
Water Connection Indicator, 1840	782	0.515	(0.500)	386	0.469	(0.500)	0.136	
Demographic Characteristics:								
Foreign Share of the Population, 1820	490	0.005	(0.011)	204	0.004	(0.010)	0.160	
Foreign Share of the Population, 1830	629	0.004	(0.001)	286	0.003	(0.001)	0.070	
Geographic Characteristics:								
Latitude	1,080	598,244	(26,549)	1,410	341,201	(26,549)	0.000	
Longitude	1,080	154,816	(13,992)	1,410	209,222	(16,184)	0.011	
Share of Counties in the Midwest and West	1,421	42%		1,090	51%			0.000
Share of Counties in the South	1,375	44%		1,009	41%			0.277

Notes : "Boom-Connection Counties" are counties that we observe as connected to the railway for the first time in either 1850, 1880 or 1900. "Lull-Connection Counties" are counties that we observe as being connected for the first time in 1860, 1870 and 1890. Column 7 reports the *p* -value from a test of equality of means with unequal variances, while column 8 reports the *p* -value for a Chi-square test of equality of proportions.

statistically significant differences for latitude, longitude and being located in the Midwest/West. Thus, in our analysis, we are careful to account for potential geographic differences. In the zero-stage panel regressions, they are accounted for by the inclusion of county fixed effects. In our 2SLS regressions, we control for state fixed effects, as well as for a county's centroid.

A second concern is that the railway was important in many ways other than providing transportation to recent immigrants. Again, it is important to keep in mind that our instrument is not identified from how early a county became connected to the railway network, but whether the county became connected prior to a period of high nationwide immigration. In our 2SLS equations, we include a measure of the number of years, as of 2000, that a county has been connected to the railway. However, a related concern still remains: there may have been other changes over time that differentially affected counties that were connected to the railway relative to those that were not, and this historical experience may have affected the long-run evolution of the county, impacting our outcomes of interest today. A potential candidate is the process of industrialization that was occurring at the time. As the United States industrialized, counties that became connected to the railway network during certain key periods may have disproportionately benefited, which may have had long-term impacts (Haines and Margo, 2008, Atack and Margo, 2010, Atack et al., 2010, Atack, Haines and Margo, 2011, Donaldson and Hornbeck, 2016).

As discussed above, to address this concern, we construct a control variable that accounts for these differential historical effects using the exact same logic and procedure that we use for our migration instrument. Specifically, we include in our zero-stage equation an interaction of the railway-connection indicator with a measure of aggregate industrial development: $\text{Industrialization}_{t-1} \times I_{t-1}^{\text{RR\_Access}}$. As we do for our instrument, we then use the zero-stage estimates to construct a predicted measure using the coefficient estimates, i.e., $1/n \sum_t \hat{\theta}\, \text{Industrialization}_{t-1} \times I_{t-1}^{\text{RR\_Access}}$, and we include this as a control variable in our 2SLS equations. This intends to capture the possibility that gaining access to the railway prior to significant industrial development may have been particularly beneficial for long-term economic development.

A comparison of Figures 1b and appendix Figure A2 provides some intuition for the variation that our 2SLS estimates are identified from. In our analysis, we account for the effects of the timing of access to the railways relative to industrial production at the time. As shown in appendix Figure A2, industrial production is steadily increasing in the United States during this period. In contrast, variation in our instrument is due to variation that arises from the timing of access to the railways relative to the fluctuations in the aggregate flows of immigrants into the United States. As shown in Figure 1b, unlike the industrialization index, the time variation in aggregate immigration is not monotonically increasing, but instead increases, then decreases, then increases, and then decreases. It is this difference, in part, that is providing identification for our estimates.[17]

A final concern arises due to the potential endogeneity of aggregate immigrant inflows (and the time variation we are using for identification). In particular, the inflow of immigrants could have been influenced by which parts of the country the railway was connected to at the time. When the railway became connected to counties with greater future growth potential, then the flow of immigrants may have increased in response. We address this concern by constructing a measure of immigrant flows that is purely supply driven. We rely on annual (and seasonal) historical temperature and rainfall data from Luterbacher, Dietrich, Xoplaki, Grosjean and Wanner (2004) and Pauling, Luterbacher, Casty and Wanner (2006) respectively, to generate variation in annual

[17]The logged industrialization index closely approximates a linear time trend. Our estimates are very similar if one uses an instrument based on the interaction between a linear time trend and the indicator of railroad access, rather than the industrialization index.

immigrant flows that is solely due to sending-country weather shocks in the previous year. We then aggregate these predicted annual flows to the decade level, and perform our analysis using this measure rather than actual immigrant inflows. Details of the analysis are reported in section 5.A. We find similar results to our baseline estimates using this alternative measure of immigrant flows to the United States

4. Estimates

A. *Zero-Stage Estimates: Construction of the Instrument*

Estimates of equation (1) are reported in column 1 of Table 2. All standard errors are adjusted for spatial autocorrelation, and we report Conley standard errors using a five-degree window.[18] We see that the estimated coefficient for our interaction of interest, lagged railroad access multiplied by lagged immigrant inflow, is positive and highly significant.

As a method of assessing the validity of our interaction instrument, we also estimate a more flexible variant of equation (1), where we interact the indicator for whether a county had access to the railway network in the previous decade with decade fixed effects, rather than with the previous decade's (normalized) aggregate inflow of immigrants. This allows the importance of being connected to the railway to vary flexibly over time. We then examine the relationship between the coefficients of the interaction terms and the aggregate (normalized) inflow of immigrants during the previous decade. As shown in Figure 3, we observed a strong positive relationship between the two variables (corr = 0.73, p = 0.06). Thus, the decades in which connection to the railway network had the largest effects on county-level immigrant settlement are also the decades for which we observe the largest aggregate immigrant inflows. It is this relationship that forms the core of our instrument and identification strategy.

Our baseline sample includes all counties that exist in each time period. We recognize that one could argue that the logic of our identification strategy applies less well (or does not apply) to the Northeast of the United States, where there are many urban centers located on the coast, where travel distances are relatively short, and where the railway network was already being developed prior to the start of the first period in our analysis. Thus, we re-estimate equation (1), but omitting

[18] The reported Conley standard errors are very similar to standard errors clustered by county, suggesting that there is very little positive spatial autocorrelation in the data.

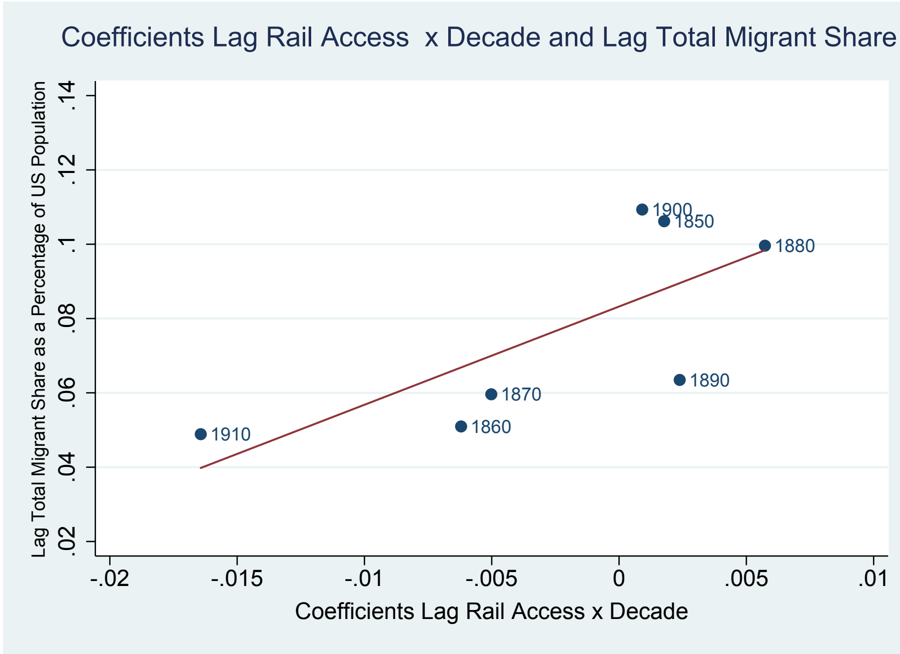


Figure 3: Estimated impact of a county's connection to the railway on immigrant settlement in a decade and total immigration (as a share of total population) in that same decade.

counties from the Northeast from our analysis.[19] The estimates, which are reported in column 2 of Table 2, show that omitting the counties in the Northeast results in estimates that are nearly identical to our baseline estimates.[20]

A related concern is the applicability of the model to the United States South, which featured comparatively little immigration from Europe. In column 3, we report estimates, after omitting counties in the South. Again, we find that our estimates are similar. The point estimate increases slightly in magnitude and remains highly significant. Lastly, column 4 reports estimates when we omit both the Northeast and South together, leaving out counties in the Midwest and Western United States. The results remain robust.

In general, the zero-stage estimates are not sensitive to the particular functional form of our estimating equation. For example, we obtain qualitatively identical estimates, and very similar predicted migrant shares measures, if we estimate a specification without a lagged dependent variable. These estimates are reported in appendix Table A2.

[19]We follow the regional definitions from the Census. The Northeast includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont.

[20]These characteristics of the Northeast also provide an opportunity for a placebo test to check whether other omitted factors are driving our estimates. In particular, looking at the Northeast only, we should not observe the same effects as we do for the rest of the country. As we show in appendix Table A1, this is exactly what we find.

Table 2: Zero-stage OLS panel estimates.

	(1)	(2)	(3)	(4)
Dependent Variable	**Migrant Share of Total County Population**			
	All Counties	**Excluding Northeast**	**Excluding South**	**Midwest and West**
Lag Rail Access	0.149***	0.153***	0.177***	0.197***
x Lag Migrant Inflow/Total US Population	[0.032]	[0.034]	[0.055]	[0.061]
Control Variables:				
Lag Rail Access	-0.003	-0.006**	0.003	-0.003
x Lag Log Industrialization Index	[0.003]	[0.003]	[0.006]	[0.006]
Lag Migrant Share	Yes	Yes	Yes	Yes
Lag Rail Access	Yes	Yes	Yes	Yes
Lag Urban Indicator	Yes	Yes	Yes	Yes
x Lag Migrant Inflow/Total US Population	Yes	Yes	Yes	Yes
Lag Urban Indicator	Yes	Yes	Yes	Yes
Log County Population Density	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes	Yes
Observations	16,729	15,706	11,591	10,568
R-squared	0.927	0.927	0.917	0.919
Mean of Dependent Variable	0.087	0.084	0.115	0.113

Notes : OLS estimates are reported. An observation is a county in a time period (1860, 1870, 1880, 1890, 1900, 1910 or 1920). The dependent variable "Migrant Share of Total County Population" is the proportion of a county's population that is foreign born in period t. "Lag Rail Access" is an indicator variable that equals one if a county has a railway in period *t-1* . Conley standard errors are reported in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

B. *The Long-Term Economic Impacts of Immigration*

Using the zero-stage estimates of Table 2, we use the method described in section 3 to construct our predicted migrant share instrument. Estimates examining measures of the economic health of a county today are reported in Table 3. Panel A reports OLS estimates of equation (3), panel B reports the second-stage 2SLS estimates of equation (3), and panel C reports the first-stage estimates – i.e., equation (2).[21] The reported standard errors are Conley standard errors adjusted for spatial correlation using a window of five degrees.[22]

As reported in panel C, our predicted-migrant-share instrument is strongly correlated with actual migrant share, resulting in a strong first stage. The Kleibergen-Paap F-statistics are approximately 10.4. According to the 2SLS estimates (panel B), counties with a greater share of immigrants between 1860 and 1920 have significantly higher average per capita income in 2000 (column 1).[23] The magnitude of the coefficient suggests that moving a county's average historical migrant share from zero to the 50th percentile of the sample – a change of 0.049 or 4.9% – results

[21]The results reported are for the full sample. They are also very similar for each of our regional subsamples.
[22]The results are quantitatively very similar when we use smaller or larger windows e.g. one degree or ten degrees.
[23]All outcomes are reported in Table 3.

Table 3: OLS and 2SLS estimates of the impacts of historical immigration on the health of the economy today.

Dependent Variable	(1) Log Average per Capita Income, 2000	(2) Prop of Population Below Poverty Line, 2000	(3) Unemployment Rate, 2000	(4) Urbanization Share, 2000	(5) Average Years of Schooling, 2000
			A. OLS Estimates		
Average Migrant Share, 1860-1920	0.183**	0.015	0.036***	0.930***	-0.210
	[0.080]	[0.016]	[0.013]	[0.081]	[0.206]
			B. 2SLS Estimates		
Average Migrant Share, 1860-1920	4.080***	-0.599**	-0.606**	6.234***	12.302***
	[1.463]	[0.288]	[0.239]	[2.222]	[4.345]
			C. First Stage Estimates Dependent Variable: Average Migrant Share, 1860-1920		
Predicted Avg. Migrant Share, 1860-1920	4.423***	4.423***	4.423***	4.423***	4.423***
	[1.357]	[1.357]	[1.357]	[1.357]	[1.357]
Kleibergen Paap *F* -statistic	10.43	10.43	10.43	10.43	10.43
Controls (in all Panels):					
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	2,935	2,935	2,935	2,935	2,935
Mean of Dep. Var. (2nd-Stage and OLS)	10.02	0.136	0.047	0.401	11.45

Notes : An observation is a county. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from the 2SLS. Coefficient estimates are reported, with Conley standard errors reported in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

in an increase in average income of $4.08 \times 0.049 = 0.20$ or 20%.[24] This is a large and plausible effect.

A comparison of the OLS and 2SLS estimates for per capita income (panels A and B) reveals evidence of negative selection by immigrants. The OLS correlation between historical migrant share and current per capita income is much smaller than the 2SLS estimates. The natural explanation for this is that migrants tended to move to "worse" places that counterfactually would have had lower long-run economic growth. This selection results in OLS estimates that are biased towards zero and understate the positive effect of immigrants on long-term growth.

It is also the case that relative to the OLS estimates, the 2SLS local average treatment (LATE) estimates place more weight on regions that experienced new railroad development during our period of analysis, such as the West and Midwest. The different between the OLS average treatment effect (ATE) estimates and the 2SLS LATE estimates is another potential explanation for the difference in magnitudes. To get some sense of the importance of this, we re-estimate the regressions of Table 3 separately for the the Midwest and West, and for all other counties (i.e., the Northeast and South). We expect the ATE and LATE estimates to be more similar for counties

[24]The distribution of average migrant share is shown in appendix Figure A3. The distribution is noticeably right skewed, with a large number of counties with very low levels of average migrant share, and a small number of counties with high levels. The mean of average migrant share is 0.098 and the standard deviation is 0.111. The median is 0.049, the 25th percentile is 0.007, and the 75th percentile is 0.163.

from Midwest and West. However, as reported in appendix Tables A3 and A4, we find that the OLS and IV estimates are very similar in the two samples, as are their relative magnitudes.

We next consider alternative measures of the strength of a county's economy: the proportion of the population living below the poverty line (column 2) and the unemployment rate (column 3). We estimate a negative impact of historical migrant share on both poverty and unemployment. According to the estimates, moving a county with no historical immigration to the 50th percentile of the distribution (0.049) is associated with a decrease in the proportion of people living under the poverty line by 3 percentage points and a decrease in the unemployment rate by 3 percentage points. These findings are consistent with the long-run increase in income found in column 1. In addition, comparing the OLS to the 2SLS estimates, again, provides evidence that migrants tended to select into locations with worse long-run growth potential.

In columns 4 and 5, we consider two last measures of economic development: the urbanization rate and average years of schooling. We estimate a large positive effect on both urbanization and education. An increase in average migrant share from zero to the 50th percentile (0.049) is associated with a 31 percentage point increase in the urbanization rate and 0.6 additional years of schooling.

Overall, the estimates show that within the United States historical context, immigration had large positive impacts on economic growth and development.

5. Robustness Checks

A. *Endogeneity of Immigrant Supply*

A primary concern with our estimates is that the timing of the inflow of immigrants to the US could have been endogenous to the connection of the railway to economically attractive counties. Once the railway expanded to these counties, the flow of European immigrants might have increased in response. To address this concern we check the robustness of our results to the use of a measure of immigrant flows that is driven only by supply factors (from Europe) and not demand factors (from the United States).

Our strategy relies on exploiting variation in immigration arising from origin-country weather shocks. This strategy is motivated by the existing evidence of a strong link between climate and agricultural output in Europe during the Age of Mass Migration. For example, Solomou and

Wu (1999) study Britain, France, and Germany from 1850–1913 and find that between one third and two thirds of the total variation in agricultural production is explained by weather shocks. It is also motivated by existing findings of a strong relationship between weather shocks and international migration in the contemporary time period within developing countries (e.g., Feng, Krueger and Oppenheimer, 2010).

To construct measures of origin-country weather shocks, we use historical temperature data from Luterbacher et al. (2004) and historical precipitation data from Pauling et al. (2006). Both sets of data are measured annually (for each of the four seasons within a year) and at a 0.5 degree spatial resolution. Because the emigration data are at the country-level we create country-averages of our weather variables by taking an average over all grid-cells in a country that were under cultivation at the time.[25] Our sample includes the sixteen European countries for which we have immigration, temperature, and crop data.[26] These sixteen countries account for 75% percent of European immigration into the United States from 1860–1920 as captured in Willcox (1929-1931)

We estimate outflows of emigrants for our period of interest using the following equation:

$$\ln \text{Migrant Flow}_{c,t+1} = \sum_{s\in S}\sum_{k\in K}\beta_{c,s,k} I^{Temp,s,k}_{c,t} + \sum_{s\in S}\sum_{k\in K}\gamma_{c,s,k} I^{Precip,s,k}_{c,t} + \varepsilon_{c,t} \qquad (4)$$

where $\ln \text{Migrant Flow}_{c,t+1}$ is the natural log of the flow of immigrants from country c in year $t+1$. $I^{Temp,s,k}_{ct}$ is an indicator variable that equals one if the average temperature in season $s \in \{\text{Spring, Summer, Winter, Autumn}\}$ falls within temperature range k, where k indexes a set K of six temperature categories: 3 or more standard deviations below the mean, 2–3 standard deviations below the mean, 1–2 standard deviations below the mean, 1–2 standard deviations above the mean, 2–3 standard deviations above the mean, and 3+ standard deviations above the mean. Thus, the omitted category is for temperatures that are within one standard deviation of the mean (i.e., the absence of a shock). Since there are six temperature categories and four seasons there are $6 \times 4 = 24$ temperature indicator variables in total. The precipitation indicator variables are structured in exactly the same manner. Thus, there are 24 precipitation indicators as well.

An important characteristic of equation (4) is that the coefficients for the shock variables are allowed to differ for each country in the estimation. In practice, we estimate equation (4) separately for each of the sixteen European countries in our sample. After estimating the

[25] The information on land under cultivation historically is taken from estimates constructed by Ramankutty and Foley (1999), who provide annual estimates at a 5 arc minute (approx. 10 kilometer) resolution.

[26] Our sample includes the following countries: Belgium, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, and Switzerland.

Table 4: Zero-stage OLS panel estimates using predicted migrant flows based on home-country weather shocks.

Dependent Variable	(1)	(2)	(3)	(4)
	Migrant Share of Total County Population			
	All Counties	Excluding Northeast	Excluding South	Midwest and West
Lag Rail Access	0.263***	0.284***	0.318***	0.362***
x Lag Predicted Migrant Inflow/Total US Population	[0.046]	[0.047]	[0.080]	[0.086]
Control Variables:				
Lag Rail Access	-0.005*	-0.008***	0.000	-0.005
x Lag Log Industrialization Index	[0.003]	[0.004]	[0.006]	[0.006]
Lag Migrant Share	Yes	Yes	Yes	Yes
Lag Rail Access	Yes	Yes	Yes	Yes
Lag Urban Indicator	Yes	Yes	Yes	Yes
x Lag Predicted Migrant Inflow/Total US Population	Yes	Yes	Yes	Yes
Lag Urban Indicator	Yes	Yes	Yes	Yes
Log County Population Density	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes	Yes
Observations	16,729	15,706	11,591	10,568
R-squared	0.927	0.927	0.917	0.919
Mean of Dependent Variable	0.087	0.084	0.115	0.113

Notes : OLS estimates are reported. An observation is a county in a time period (1860, 1870, 1880, 1890, 1900, 1910 or 1920). The dependent variable "Migrant Share of Total County Population" is the proportion of a county's population that is forein born in period *t*. "Lag Rail Access" is an indicator variable that equals one if a county has a railway in period *t*-1. Conley standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5 and 10% levels.

$\beta_{c,s,k}$'s and the $\gamma_{c,s,k}$'s, we can calculate predicted log migrant flows for each country and year, $\ln \widehat{\text{Migrant}}\,\text{Flow}_{c,t}$. We find that the predicted migrant flows are highly correlated with actual migrant flows. The relationship between the two measures for each of our 16 countries is shown in appendix Figure A4. We then aggregate the predicted migrant flows across countries to obtain an estimate of the total flow of emigrants from all 16 countries in a given decade: $\text{Agg}\,\widehat{\text{Migrant}}\,\text{Flow}_t = \sum_c \exp(\ln \widehat{\text{Migrant}}\,\text{Flow}_{c,t})$.

Table 5 presents the estimates of equation (1), but using predicted migrant flows rather than actual migrant flows in the equation. The zero-stage estimates are qualitatively and quantitatively similar to the estimates reported in Table 2, although slightly larger in magnitude. We then generate our main instrument, but using predicted aggregate inflows of European immigrants during the period between 1850 and 1920 rather than actual inflows.

The 2SLS estimates of the impact of immigrants on our outcomes of interest using the weather shocks as predictors of immigrant inflows are reported in Table 5. The second stage point estimates of interest are similar to the results obtained when using actual immigrant flows (see Table 3). This suggests that our results are not sensitive to correcting for the potential endogeneity of immigrant supply to the location of railroad expansion in that period.

Table 5: OLS and 2SLS estimates of the impacts of historical immigration, using immigrant inflows predicted by sending-country weather shocks rather than actual flows.

Dependent Variable	(1) Log Average per Capita Income, 2000	(2) Prop of Population Below Poverty Line, 2000	(3) Unemployment Rate, 2000	(4) Urbanization Share, 2000
		A. OLS Estimates		
Average Migrant Share, 1860-1920	0.183**	0.015	0.036***	0.933***
	[0.080]	[0.016]	[0.013]	[0.080]
		B. 2SLS Estimates		
Average Migrant Share, 1860-1920	5.424***	-0.986**	-0.804**	8.826***
	[2.067]	[0.429]	[0.326]	[3.308]
		C. First Stage Estimates Dependent Variable: Average Migrant Share, 1860-1920		
Predicted Avg. Migrant Share, 1860-1920	5.835***	5.835***	5.835***	5.835***
	[2.024]	[2.024]	[2.024]	[2.024]
Kleibergen Paap F-statistic	8.306	8.306	8.306	8.306
Controls (in all Panels):				
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,935	2,935	2,935	2,935
Mean of Dep. Var. (2nd-Stage and OLS)	10.02	0.136	0.047	0.401

Notes : An observation is a county. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from Coefficient estimates are reported, with Conley standard errors reported in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% level

B. *Reverse Causality*

An important concern is the possibility that railroads tended to be built in locations and during times when migration was already occurring (and was expected to continue). If this were the case, then our use of the timing of the building of the railway relative to the timing of immigration booms and lulls is potentially problematic.[27] To directly test for this possibility, we estimate a variant of equation (1), where the outcome variable is an indicator for the presence of a railroad in a county in decade t, and the independent variable of interest is the share of immigrants in the total population in the previous decade $t-1$. The estimates, which are reported in appendix Table A5, show that the coefficient on the lagged immigrant share is close to zero and statistically insignificant. Thus, railroad placement does not appear to have been endogenous to the presence of prior immigrant populations.

[27] This is also one motivation for including a lagged dependent variable in our zero-stage equations. If the presence of a pre-existing immigrant population had such impacts, this should be captured by a measure of the pre-existing immigrant population.

C. *Changing County Boundaries*

An additional challenge when analyzing the impact of immigrants using county-level data is that for a number of counties, current county boundaries were established after the first period of our sample, 1860. Thus, our zero-stage panel is unbalanced, with counties entering over time as they are established.[28] In addition, once counties are established, there can be changes to their boundaries. For our baseline analysis, we match counties across time using the nominally integrated series available in the NHGIS datasets (Minnesota Population Center, 2011).[29] We also check that our results are robust to only using counties that existed in 1860, and effectively had the same boundaries in 1860 as in 2000. This is the case for 1,596 counties or approximately 55% of our sample. As shown in appendix Table A6, the results using this more restrictive sample are qualitatively similar to our baseline estimates. The magnitude of the estimates actually increases, and the point estimates remain statistically significant.

6. Understanding Causal Mechanisms

To this point we have shown that counties that received more immigrants from 1860–1920 are richer, have less poverty, have less unemployment, are more urban, and are more educated today. We now turn to an investigation of the exact mechanisms underlying the reduced-form long-run relationships.

A. *Evidence for the Reallocation of Economic Activity*

A first-order question in terms of mechanisms is whether the gains to counties that received more immigrants came at the cost of counties that received less immigrants. That is, to what extent do the effects we find reflect growth promoting benefits of immigrants versus the reallocation of economic activity across counties. To assess the importance of such reallocation effects, we test whether being close to a county with more historical immigration resulted in *less* long-term economic development today. We would expect such a relationship if immigration caused economic activity to relocate from nearby counties to counties with more immigrants.

[28] In 1860, there are 1,600 counties in our sample, there are 1,974 counties in 1870; 2,216 in 1880; 2,468 in 1890; 2,728 in 1900; 2,797 in 1910; and 2,946 in 1920.

[29] For a detailed explanation of NHGIS' matching strategy see `https://nhgis.org/documentation/time-series#geographic-integration`.

We do this by estimating the impact that historical immigration in all neighboring counties has on the county. We first construct a measure of average immigration shares in all neighboring counties, where we weight each neighboring county in proportion to the length of the shared border. We then re-estimate a version of equation (2) that also includes our measure of the weighted average share of immigrants in contiguous counties. Complementing the added spillover variable is a second instrument, which is the weighted average of predicted migrant shares in contiguous counties. Thus, with this estimation we have two instruments – predicted migrant share (our baseline instrument) and the predicted average migrant share of neighboring counties – and two first stage equations, one with the migrant share of the county as the dependent variable and the other with the average migrant share of neighboring counties as the dependent variable.

The estimates are reported in appendix Table A7. Each column reports estimates for each of our primary outcomes of interest: income, poverty, unemployment, urbanization and schooling. The estimates from the two first stage equation are reported in panel C. Reassuringly, we find that the instruments provide explanatory power in the "right" first-stage equations. Predicted migrant share provides the primary explanatory power in the first-stage equation with the migrant share as the dependent variable, while the predicted migrant share of neighboring counties provides the primary explanatory power in the first-stage equation with migrant share of neighboring countries as the dependent variable. The second stage estimates, which are reported in panel B, if anything suggest *positive*, not *negative*, spillovers across counties. For example, according to the estimates of column 1, being next to counties with more historical immigration causes a county to have higher levels of income today. Although the estimates are not always statistically significant due to collinearity between the instruments, we observe the same pattern for each of our other outcomes of interest.

One concern is that although one observes positive spillovers in adjacent counties, this may not be the nature of the spillovers more generally. In particular, contiguous counties today are often part of the same city, commuting zone, or economic region, so it may not be surprising that we find positive spillovers at this level. Motivated by this concern, we examine the effects of immigration into a county on all other counties in the state. Thus, we construct an average measure of historical immigrant share elsewhere in the state and include this in the estimating equation. We undertake two versions of this exercise; one where we exclude contiguous counties and another where we include them. The estimates are reported in appendix Tables A8 and

A9. We continue to find evidence of positive spillovers. That is, immigration within the same state tends to be associated with higher incomes, less poverty, less unemployment, greater urbanization, and more education. In addition, our baseline within-county effects remain robust to allowing for the presence of within state spillovers.

Overall, the evidence suggests that it is unlikely that the estimates we find are due to a reallocation of economic prosperity across space. This said, an important caveat is that we have tested for this by necessarily making assumptions about the particular form of the spillovers. Our estimates are valid to the extent that the spillovers take the forms assumed.

B. ***Evidence from Short-Run Estimates***

Industrialization: From historical descriptions of the consequences of immigration during this time, a likely explanation for the long-run economic benefits of immigration is that, during the infancy of industrialization, immigration provided an ample supply of labor that was necessary for the take-off of industry and modern economic growth (Goldin, 1994, Hatton and Williamson, 1998, Hirschman and Mogford, 2009). Several historians have documented that immigrants were disproportionately represented in the industrial workforce (Engerman and Sokoloff, 2000, Alexander, 2007). In 1880, despite only accounting for approximately 10% of the total population, immigrants accounted for 57% of the manufacturing workforce (Hirschman and Mogford, 2009).[30]

Given this, we test whether the data are consistent with immigrants helping to spur early industrialization by using 2SLS to estimate versions of equation (3) with measures of manufacturing output during the Age of Mass Migration and immediately afterwards as the dependent variable of interest. The estimates are reported in Table 6. In column 1, we examine the natural log of real manufacturing output per capita, measured as an average of 1860-1920 and in 1930. We find that the presence of immigrants was associated with a large and significant increase in manufacturing output in both time periods. According to the magnitude of the estimated effects, moving a county with no historical immigration to the 50th percentile (an increase of 0.049) led

Table 6: OLS and 2SLS estimates of the impacts of historical immigration on manufacturing output.

Dependent Variable	(1) Log Manufacturing Output per Capita	(2)	(3) Log Manufacturing Output per Establishment	(4)	(5) Log Number of Establishments per 10,000 Inhabitants	(6)
	1860-1920	1930	1860-1920	1930	1860-1920	1930
			A. OLS Estimates			
Average Migrant Share, 1860-1920	3.079***	3.524***	2.788***	2.704***	0.346**	0.730***
	[0.403]	[0.464]	[0.288]	[0.383]	[0.143]	[0.145]
			B. 2SLS Estimates			
Average Migrant Share, 1860-1920	10.093*	11.597*	1.935	8.727*	10.580***	1.630
	[5.769]	[6.182]	[4.573]	[4.971]	[3.620]	[2.462]
			C. First Stage Estimates			
			Dependent Variable: Average Migrant Share, 1860-1920			
Predicted Avg. Migrant Share, 1860-1920	4.528***	5.064***	4.528***	5.064***	4.528***	5.064***
	[1.354]	[1.530]	[1.354]	[1.530]	[1.354]	[1.530]
Kleibergen Paap F-statistic	11.19	10.95	11.19	10.95	11.19	10.95
Controls (in all Panels):						
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,805	2,463	2,805	2,463	2,805	2,462
Mean of Dep. Var. (2nd-Stage and OLS)	6.56	7.21	12.58	14.03	3.35	2.49

Notes : An observation is a county. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from the 2SLS. Coefficient estimates are reported, with Conley standard errors in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

to a 50% increase in average manufacturing output per capita from 1860–1920.

In columns 3–6, we probe specific channels further by examining the extensive and intensive margins of industrialization. To examine the intensive margin, we estimate the impacts of immigrants on establishment size (columns 3 and 4).[31] To examine the extensive margin, we estimate impacts on the number of establishments per 10,000 inhabitants (columns 5 and 6). We find that both margins appear to have been affected by immigration. Interestingly, earlier in the period (1960-1920), the primary effect of immigrants was to increase the number of manufacturing establishments and not their size (i.e., the extensive margin). Later in the period (1930), the primary effect is on output per establishment (i.e., the intensive margin).

[30] A related argument is that immigrants were not only a supply of labor, but that they provided labor at lower costs than native-born workers. Recent evidence in the literature appears to weigh against such a cheap-labor hypothesis. Abramitzky et al. (2013) analyze panel data on immigrant assimilation during the Age of Mass Migration in the United States and argue that the average immigrant did not face a substantial occupation-based earnings penalty upon first arrival. They also find that immigrants experienced occupational advancement at the same rate as natives during this period. However, their findings are consistent with immigration lowering wages in an industry and/or location for all workers, both native- and foreign-born Goldin (1994).

[31] We measure establishment size using output per establishment. We use output rather than value added because value added data are only available for one year of our sample period, 1920. Using this alternative measure, we obtain estimates that are very similar to the estimates of columns 3 and 4.

Overall, the estimates show that immigration had an immediate effect through greater industrialization. These findings are consistent with historical accounts of immigrants bringing both raw labor and manufacturing know-how, both of which were crucial for the growth of manufacturing during this time (Hirschman and Mogford, 2009).

Agriculture: We next turn to estimates of the short-run impact of immigrants on the agricultural sector. Our outcome of interest is total farm values, normalized using either the number of farms or the total acres of farmland.[32] Estimates are reported in Table 7, where columns 1 and 2 use farm value per farm (in 1860–1920 and 1930), while columns 3 and 4 use farm value per acre (in 1860–1920 and 1930) as the dependent variable. For both sets of estimates, we see positive effects of immigration on farm values, with these effects becoming large and significant by 1930. According to the estimates, moving a county with no historical immigration to the 50th percentile (0.049) is associated with a 39–58% increase in 1930 farm value depending on the method of normalization. Thus, immigration appears to have had large positive effects in the agricultural sector, but with the benefits arising towards the end of the Age of Mass Migration.

Human Capital: We next turn to the possibility that immigrants may have resulted in a greater stock of technology and human capital. We examine this potential channel by first estimating the short-run impacts of immigration on educational outcomes. Specifically, we consider the average share of children enrolled in school in the decades between 1870–1920. Column 1 of Table 8 reports these estimates. We find that counties with a higher share of immigrants actually had *lower* enrollment rates. We obtain a similar finding if we instead look at the average share of the total population that is illiterate from 1870–1920. As reported in column 2, immigration is associated with lower rates of literacy.[33]

The finding that immigration resulted in less education in the short-run is consistent with the fact that immigrants were less educated, on average, than native-born populations, particularly towards the end of the Age of Mass Migration. Examining the average rate of illiteracy of native-born and foreign-born populations in the Censuses, we find that in 1850, 9% of immigrants

[32] All data are from the Agricultural Census. Acres of land is only reported in bins: less than 3 acres, 3–9 acres, . . . , 1000+ acres. We calculate an estimate of actual total acreage by using the midpoint of each category, and 1000 for the 1000-or-more-acre category.

[33] These impacts are particularly interesting given the existing evidence that the overall effect of access to the railroads was to increase educational attainment (see Atack, Margo and Perlman, 2012). The authors analyze schooling attainment in United States counties from 1850–1880. According to their estimates, access to the railroads accounted for 40% of the observed increase in schooling during this period.

Table 7: OLS and 2SLS estimates of the impact of historical immigration on farming.

	(1)	(2)	(3)	(4)
Dependent Variable	**Log Total Farm Value (per Farm)**		**Log Total Farm Value (per Acre)**	
	1860-1920	**1930**	**1860-1920**	**1930**
	A. OLS Estimates			
Average Migrant Share,	1.168***	1.927***	2.127***	2.422***
1860-1920	[0.207]	[0.197]	[0.223]	[0.271]
	B. 2SLS Estimates			
Average Migrant Share,	0.168	7.977**	4.470	11.758**
1860-1920	[3.476]	[3.261]	[3.297]	[4.640]
	C. First Stage Estimates			
	Dependent Variable: Average Migrant Share, 1860-1920			
Predicted Avg. Migrant Share,	4.279***	4.279***	4.279***	4.279***
1860-1920	[1.350]	[1.350]	[1.350]	[1.350]
Kleibergen Paap F-statistic	10.05	10.05	10.05	10.05
Controls (in all Panels):				
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,804	2,800	2,804	2,800
Mean of Dep. Var. (2nd-Stage and OLS)	10.42	11.51	5.91	6.56

Notes : An observation is a county. Log Total Farm Value corresponds to the following decades: 1860 and 1900-1930. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from the 2SLS. Coefficient estimates are reported, with Conley standard errors in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

were illiterate versus 4% of natives. In 1870, these figures are close to equal at 15% and 14%, respectively. However, from this point forward, the rates begin to diverge noticeably. In 1900, 13% of immigrants were illiterate compared to 3% of natives.; in 1910, these figures were 12% and 2%; and in 1920 they were 12% and 1%.[34] The negative relationship between migration and educational attainment could also arise, in part, due to the positive economic impacts of immigration, which increased the opportunity cost of schooling. Such an effect has also been found in modern developing economies (e.g., Atkin, 2016).

Comparing the short-run effects of immigration on education in columns 1–2 of Table 8 to the modern education effects reported in column 5 of Table 3, it is clear that there has been a reversal of the impacts of immigration on education in the long-run. While in the short-run, immigrants reduced average education, in the long-run they increased it. While the exact reason for the long-run positive effect on education remain unclear, there are a number of possibilities.

[34]The fact that immigrants had less education than native populations is in contrast to other countries. Immigrants that went to Brazil in the late 19th and early 20th centuries, on average, were more educated than the native populations. In this setting, the evidence suggests that immigration resulted in higher levels of education, which had a persistent impact, resulting in higher living standards today (Rocha et al., 2015).

Table 8: OLS and 2SLS estimates of the impacts of historical immigration on historical human capital and innovation.

	(1)	(2)	(3)	(4)
	Educational Attainment		Innovation	
Dependent Variable	**Share Enrolled In School, 1870-1920**	**Share Illiterate, 1870-1920**	**Log Total Patents per Capita 1860-1920**	**Log European Patents per Capita 1860-1910**
	A. OLS Estimates			
Average Migrant Share,	-0.139***	0.139***	0.018***	0.001***
1860-1920	[0.008]	[0.021]	[0.003]	[0.000]
	B. 2SLS Estimates			
Average Migrant Share,	-0.568***	1.447***	0.147***	0.002**
1860-1920	[0.191]	[0.533]	[0.046]	[0.001]
	C. First Stage Estimates Dependent Variable: Average Migrant Share, 1860-1920			
Predicted Avg. Migrant Share,	4.423***	4.423***	4.369***	4.369***
1860-1920	[1.369]	[1.369]	[1.367]	[1.367]
Kleibergen Paap *F*-statistic	10.43	10.43	10.18	10.18
Controls (in all Panels):				
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,935	2,935	2,929	2,929
Mean of Dep. Var. (2nd-Stage and OLS)	0.190	0.104	0.006	0.0001

Notes : An observation is a county. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from the 2SLS. Coefficient estimates are reported, with Conley standard errors in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

First, it may be that the effects arise due to the long-term impacts of immigrants on income, and the fact that today higher incomes are associated with more education. A second explanation is the mechanism found in the recent study by Foged and Peri (2015). The presence of immigrants, and their supply of unskilled labor, in the long-run, could have led native workers to pursue less manual-intensive occupations and to obtain more schooling. Third, they could also be due, in part, to the mechanism present in the study by Bandiera et al. (2016), where it is shown that states with more immigration from European countries that were less exposed to compulsory education were more likely to adopt compulsory education under the belief that exposure to American public schools would instill the desired civic values that were missing among the immigrants. A final potential explanation is that although immigrants, on average, were less skilled than the native population, they may have had values and aspirational beliefs that facilitated the rapid accumulation of education among their children and potentially future generations of children in their communities. There is also evidence that although immigrants were less educated than native populations, their children were more educated.[35]

Innovative Activity: Another mechanism through which immigrants could have affected early economic development is through innovative activities and knowledge creation (Fairlie and Lofstrom, 2015). As we have discussed, immigrants tended to be strongly represented in unskilled occupations. Some evidence suggests that immigrants from many European countries, namely Ireland, Norway and Italy, were less skilled than the average population in the sending country (Abramitzky et al., 2012, Spitzer and Zimran, 2013, Abramitzky and Boustan, 2015). However, evidence also shows that for immigrants coming from Western European countries, immigrants were, if anything, more skilled than the average of the home-country's population (Wegge, 2002, Long and Ferrie, 2013, Abramitzky and Boustan, 2015).

Consistent with a subset of the immigrants being positively selected from their home populations, one is able to find many examples of immigrants, who were involved in early industrialization in Europe, bringing over more advanced European technologies to the United States (Rosenberg, 1972). Indirectly, it has also been argued that the significant availability of unskilled labor facilitated the introduction of technological and managerial innovations, such as assembly lines (Hirschman and Mogford, 2009) and the rise of the managerial firm (Abramovitz and David, 2000, Chandler, 1977, Denison, 1974, Hounshell, 1984, Wright, 1990). Others have argued that the significant increase in the labor force enabled economies of scale in production, leading to increased profits that spurred innovation (Carter and Sutch, 1999).

As a test for whether innovation was affected by European immigration in the short-run, we examine patenting rates from 1850–1920, using utility patent data that were obtained from the United States Patent and Trademark Office. Estimates are reported in column 3 of Table 8. We find a positive and significant impact of immigration on innovation during this time. An increase in historical immigration from zero to the 50th percentile (0.049) results in a 0.7% increase in patenting.

To assess the extent to which this increase in innovation is due to foreign-born immigrants innovating themselves, we attempt to identify the country of birth of the innovators in the patent applications. The main challenge when conducting this exercise is that the citizenship of patent

[35]For example, the 1910 *Report of the Immigration Commission* undertook a study of 12,011 male iron and steel workers from the Midwest. It reports that although the proportion of foreign-born men that could read and write was lower than for native-born men (81.6% versus 98.9%), native-born men with a foreign father had a higher literacy rate than native-born men with a native (and white) father (99.8% versus 98.2%) (Dillingham, 1911, p. 27).

applicants was not consistently reported prior to 1880. As a result, we were only able to identify the citizenship of the patent applicant in 50% of our sample of 1,297,086 applications. Moreover, according to the Naturalization Act of 1798, immigrants could become naturalized United States citizens after only 14 years of residence in the country. It is therefore possible that several patent applicants are registered as United States citizens, despite being foreign-born immigrants. Another concern is that there were significant challenges and costs associated with obtaining a patent, which might have placed recently arrived foreigners with a limited understanding of English at a disadvantage.[36]

With these caveats in mind, we estimate the impact of immigration on the rate of patenting by inventors that report themselves as being foreign-born. The estimates are reported in column 4 of Table 8. We find a positive and statistically significant effect of immigration on foreign patents. However, the magnitude is much smaller than for total patents. According to the estimates in column 4, an increase in historical immigration from zero to the 50th percentile (0.049) results in an increase in foreign patenting by 0.01%. This suggests that the direct impact of immigrants on foreign patents was lower than the indirect impact of immigrants on innovation by native-born inventors. Such an indirect impact of immigrants on native inventiveness is consistent with the findings of Moser, Voena and Waldinger (2014). Although they examine a slightly later period than our analysis (post-1920), the authors show that innovations by German-Jewish immigrants had a significant effect on the rate of innovation of US-born inventors.

A closer analysis of the types of patents that tended to be registered by European-born inventors suggests that while they were fewer in number, it is possible that several of these patents may have represented contributions that were particularly important for industrialization. The importance of their contribution is suggested by relative citation rates. Of the patents in our sample, 16% are cited by patents in the *NBER Patent Citation Database*, which contains patents from 1975–1999. Among the cited patents, 12% are patents held by individuals that are European-born, which is a figure that is significantly higher than the share of all patents that are registered by European-born inventors, which is 3%. Thus, while European patents may have been small in number, they may have been disproportionately influential.

[36]While the Patent Act of 1793 might have benefited foreigners by removing the requirement of a thorough oral examination as part of the process of granting patents, the cost of a patent was $35 in 1861, which corresponds to about $891 in 2010 USD. Note, however, that the 1869 Report of the Commissioner of Patents compared the $35 fee for a US patent to the significantly higher charges in European countries such as Britain, France and Russia ($450); Belgium ($420), and Austria ($350).

Table 9: OLS and 2SLS estimates of the impact of historical immigration on urbanization.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable	**Urban Population Share in:**								
	1920	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**
	A. OLS Estimates								
Average Migrant Share,	0.929***	0.940***	0.940***	0.890***	0.883***	0.887***	0.894***	0.941***	0.930***
1860-1920	[0.085]	[0.085]	[0.083]	[0.086]	[0.088]	[0.091]	[0.088]	[0.084]	[0.081]
	B. 2SLS Estimates								
Average Migrant Share,	5.173***	4.615***	5.050***	4.174**	4.995***	4.764**	5.088***	5.424***	6.234***
1860-1920	[1.714]	[1.663]	[1.783]	[1.690]	[1.939]	[1.917]	[1.960]	[2.017]	[2.222]
	C. First Stage Estimates								
	Dependent Variable: Average Migrant Share, 1860-1920								
Predicted Avg. Migrant Share,	4.423***	4.423***	4.423***	4.423***	4.423***	4.461***	4.423***	4.423***	4.423***
1860-1920	[1.369]	[1.369]	[1.369]	[1.369]	[1.369]	[1.370]	[1.369]	[1.369]	[1.369]
Kleibergen Paap *F*-statistic	10.43	10.43	10.43	10.43	10.43	10.60	10.43	10.43	10.43
Controls (in all Panels):									
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,935	2,935	2,935	2,935	2,935	2,933	2,935	2,935	2,935
Mean of Dep. Var. (2nd-Stage and OLS)	0.195	0.219	0.236	0.286	0.324	0.345	0.362	0.365	0.401

Notes : An observation is a county. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from the 2SLS. Coefficient estimates are reported, with Conley standard errors reported in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

C. *Connecting the Short- and Long-Run Effects*

Our analysis to this point has provided evidence for long-run economic benefits to immigration, as well as short-run impacts on industrialization, agricultural productivity, and innovation. We now attempt to connect the short- and long-run effects by examining the full range of effects from immediately after the Age of Mass Migration until today. To do this, we examine urbanization, which has the benefit of being a correlate of income that is available at regular time intervals during our full period of interest. Our analysis estimates versions of equation (3) using 2SLS and with urbanization measured in each decade from 1920 to 2000 as the outcome of interest.

The estimates are reported in Table 9. We find that there is a clear and sizable impact of historical immigration on urbanization over time. This effect was observed almost immediately (in 1920), and it persisted over time.[37] Thus, the estimates indicate that the economic benefit of immigrants were felt early and persisted over time.

Ideally, we would also examine the full dynamic of our other measures of economic development. Unfortunately, unlike urbanization, the other measures are not available during the same time span. For education and per capita income, we can examine how the effects evolve over

[37] We also continue to find evidence of the negative selection of immigrants. The 2SLS estimates are consistently larger in magnitude than the OLS estimates.

time, but only in the post-WWII era. These estimates, which we report in appendix Tables A10 and A11, show that we observe the same basic trend for education and income as we do for urbanization. In the medium- and long-runs, we see that the effects of immigrants persists over time. For income, we find that the benefits persist but do not grow overtime, and for education we find persistence and even growth in the effects over time.

Combining these findings with our short-run estimates suggests that immigrants brought important factors such as unskilled labor, knowledge, and specific skills that resulted in more industrial development, greater productivity in agriculture and manufacturing and more innovation. These resulted in immediate gains to income. The higher levels of incomes have persisted throughout time until today. Thus, the initial benefits of immigration during the Age of Mass Migration appears to have resulted in early benefits that resulted in permanently higher levels of wealth and prosperity.

D. *Evidence from Intervening Channels*

Having examined the short-run effects of immigration, and their long-run persistence, we now turn to an alternative strategy, which is to estimate the long-run impact of immigration on proximate outcomes that could serve as intervening channels. In particular, we examine various measures of the social cohesion of counties, which may result in higher incomes today, as well as current immigration, which may be linked to past immigration, and have economic benefits today.

An important caveat about the estimates that we report is that we are only able to provide reduced-form estimates of the impact of immigration on the outcome being examined.

Social Cohesion

The first factor that we consider is a composite index of social capital that is taken from Rupasingha and Goetz (2008). The measure was created using principal component analysis applied to a range of variables such as the total number of associations and not-for-profit organizations per 10,000 people, as well as census mail response rates and voter turnout. The final variable ranges from -3.9 to $+17.5$ in our sample. The 2SLS estimates are reported in column 1 of Table 10. We find a statistically insignificant effect of historical immigration on social capital today. The estimated effect, in addition to being imprecise, is also small in magnitude. An increase in

Table 10: OLS and 2SLS estimates of the impacts of historical immigration on measures of social cohesion and current immigration.

Dependent Variable	(1) Social Capital, 2000	(2) Voting Turnout, 2000	(3) Total Crime Rate, 2000	(4) Share of Foreign Born, 2000
	A. OLS Estimates			
Average Migrant Share,	-1.293***	-0.076***	0.006***	0.179***
1860-1920	[0.344]	[0.026]	[0.001]	[0.022]
	B. 2SLS Estimates			
Average Migrant Share,	0.880	0.424	0.023	0.045
1860-1920	[4.716]	[0.395]	[0.018]	[0.190]
	C. First Stage Estimates Dependent Variable: Average Migrant Share, 1860-1920			
Predicted Avg. Migrant Share,	4.423***	4.423***	4.423***	4.423***
1860-1920	[1.369]	[1.369]	[1.369]	[1.369]
Kleibergen Paap F-statistic	10.43	10.43	10.43	10.43
Controls (in all Panels):				
Industrialization-Based Predicted Migrant Share	Yes	Yes	Yes	Yes
Date of RR Connection (Years as of 2000)	Yes	Yes	Yes	Yes
Latitude	Yes	Yes	Yes	Yes
Longitude	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,934	2,925	2,935	2,935
Mean of Dep. Var. (2nd-Stage and OLS)	-0.004	0.540	0.006	0.033

Notes : An observation is a county. Panels A and B reports OLS estimates and 2SLS estimates, respectively. Panel C reports the first-stage estimates from the 2SLS. Coefficient estimates are reported, with Conley standard errors reported in square brackets. ***, **, and * indicate significance at the 1, 5 and 10% levels.

historical immigration from zero to the 50th percentile (0.049) is associated with an increase in the social capital index of 0.04, a small effect given the range of the index.

We next turn to alternative measures of social cohesion: voting behavior and crime. Column 2 of Table 10 reports 2SLS estimates of the long-term impacts of immigration on political participation, measured by voter turnout in the 2000 presidential election. We find a positive, but small and insignificant effect of historical migration on voter turnout.[38] Column 3 reports estimates of the impacts of immigration on crime, measured by the total crime rate in 2000.[39] We estimate a positive, but small and statistically insignificant effect of historical immigration on crime.[40] Overall, we find no evidence of immigration having an effect on social capital, crime, or voting. Thus, it is unlikely that the impact of historical immigration on higher levels of economic

[38]According to the estimated magnitude, an increase in historical immigration from zero to the 50th percentile (0.049) is associated with an increase in voter turnout of 2 percentage points, which is small when compared to the mean turnout rate of 54 percent.

[39]The data are taken from the *County and City Data Book*, which is associated with the Census.

[40]According to the point estimate, an increase in historical immigration from zero to the 50th percentile (0.049) is associated with an increase of 0.0011 crimes per year per 10,000 inhabitants, which is equal to 18% of the mean.

prosperity today is due to any of these factors.[41]

Current Immigration

The last intervening channel that we examine is contemporary immigration. It is possible that immigration during the Age of Mass Migration affects long-run economic prosperity through its effect on immigration today. Despite the fact that the magnitude of historical migration is far greater than current migration, this channel may still be responsible for some of the effects that we find. To test for this channel, we estimate the causal impact of historical immigration on the share of foreign born in a county in 2000. The estimates are reported in column 4 of Table 10. We find no relationship between historical immigration and the extent of immigration today.

For completeness, we also examine the impacts of historical immigration on migration in all decades since 1920. The estimates, which are reported in appendix Table A12, show that immediately following the Age of Mass Migration, historical immigration between 1860 and 1920 is (mechanically) associated with a greater share of foreign-born within the population. However, this relationship fades over time, and by 1950 it becomes statistically insignificant and close to zero. As a final check for whether part of our estimated effects of historical immigration is due to its relationship with current immigration, we control for the share of the population that is foreign-born in 2000 when estimating equation (3) with our measures of economic prosperity as the dependent variable. As we report in appendix Table A13, our estimates are nearly identical when we condition on current immigration. Thus, taken as a whole, the estimates suggest that it is unlikely that subsequent immigration is an important channel that explains our findings.

7. Conclusions

We have examined the long-term impact of immigration into the United States during the Age of Mass Migration (1850–1920) on economic prosperity today. To help identify causal effects, we exploit the significant decade-by-decade fluctuations in immigrant inflows that were present during this era, the fact that immigrants commonly used railway lines to arrive at their eventual destinations, and the gradual expansion of the railway network over time. Conceptually, our IV strategy compares counties that received more or less immigrants due to differences in when

[41] Interestingly, like our previous estimates, the estimates from Table 10 also show evidence of strong selection effects. The OLS estimates show that historical immigration is associated with a range of bad outcomes: less social capital, less voting, and more crime. However, according to the IV estimates, the true effects are close to zero and in two cases change signs.

they became connected to the railway network and fluctuations in aggregate immigrant inflows. Counties that became connected just prior to immigration booms, rather than immigration lulls, tended to receive more immigrants.

We have found that immigration generated significant long-term economic benefits. Places that received more migrants today have higher incomes, less poverty, less unemployment, more urbanization, and more education. The magnitudes of our estimates, in addition to being statistically significant, are also economically meaningful.

Throughout our analysis, comparisons of the OLS and 2SLS estimates revealed evidence of negative selection by immigrants. For all outcomes associated with more economic development, the OLS correlation between historical migrant share and the outcome of interest is much smaller than the 2SLS estimates. The most likely explanation for this is that migrants tended to move to "worse" places that counterfactually would have had lower long-run economic growth. Therefore, the OLS estimates tend to understate the positive effect of immigrants on long-term growth.

We then turned to an exploration of the potential mechanisms that generated these long-term benefits. It is possible that the long-run benefits to locations that received more immigrants came at the cost of other locations. Thus, although immigrants did benefit the counties to which they located, this could have been due to a relocation of economic benefits rather than the creation of economic benefits. We estimated a large number of equations to test for the presence of such spatial spillovers. We estimated the impacts of immigration on neighboring (i.e., contiguous) counties, on counties within the same state, and on counties within the same state that are not contiguous. In all specifications examined, we failed to find evidence of immigration reducing economic prosperity in nearby counties (i.e., negative spillovers). If anything, the evidence seems to point to the presence of positive spillovers. Historical immigration to a county appears to also help other counties nearby. Although, we are unable to test for all forms of spillovers possible (e.g., spillovers that are geographically distant), the evidence suggests that the long-run benefits of immigrants are plausibly due to the creation of greater economic activity rather than to the reallocation of economic activity.

To further examine mechanisms, we then used our same identification strategy to examine the short-run effects of historical immigration. We found that immigrants resulted in an immediate increase in industrialization. Immigrants first contributed to the establishment of more manufacturing facilities (i.e., the extensive margin) and then to the development of larger facilities (i.e. the intensive margin). We also tested for the impacts of immigrants on agricultural productivity and found large positive effects in this sector as well. We also found that immigration is associated with greater innovation, as measured by patents. However, immigrants were not associated with increased educational attainment in the short-run, a fact that is not surprising given that immigrants were less educated than the average among the full population.

Having examined the short-run impacts of immigration, we then turned to an examination of the dynamic impacts of immigrants over the short-, medium- and long-runs. Examining urbanization rates from 1920 to 2000, we found that large effects on urbanization were felt immediately, and that they persisted (increasingly in magnitude slightly) over time. We also examined income and education, but for the more limited time period for which data are available (post WWII). We found a similar pattern for these outcomes as well.

Taken as a whole, our estimates provide evidence consistent with a historical narrative that is commonly told of how immigration facilitated economic growth. Immigrants provided an ample supply of less-skilled workers that provided the labor force necessary for industrial development. A smaller number of immigrants brought with them knowledge, skills, and know-how that were beneficial for industry and increased productivity in agriculture. Thus, by providing a sizeable workforce and a (smaller) number of skilled workers, immigration led to early industrial development and long-run prosperity, which continues to persist until today.

We also examined two alternative explanations for the long-run impact of immigration. The first is that historical immigration resulted in social benefits, along the lines of social capital or social cohesion, which persisted, resulting in higher incomes today. The second is that historical immigration may be associated with greater immigration today, which is economically beneficial. We tested for both explanations and found no evidence for either.

The setting of our study – the Age of Mass Migration – was a period of unprecedented rapid industrialization in the United States, when the supply of skilled labor brought by the vast majority of immigrants and industrial knowledge brought by a smaller few may have been particularly valuable. Despite the unique conditions under which the largest episode of immigration in United States history took place, our estimates of the long-run impacts of immigration may still be informative for current immigration debates, particularly when assessing whether immigrants can have long-run impacts on economic growth. According to our estimates, the long-run benefits of immigration have been significant, and are potentially as important, if not more, than their benefits in the short-run. This suggests the importance of taking a long-run view when considering the immigration issue today. Thus, as Abramitzky and Boustan (2015) have argued, we believe that looking backwards and learning from our past experience with immigration is important when moving forward and thinking about immigration policy today.

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