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ABSTRACT

The Effects of Immigration in a Developing Country: Brazil in the Age of Mass Migration*

The effects of immigration are reasonably well understood in developed countries, but they are far more poorly understood in developing ones despite the importance of these countries as immigrant destinations. We address this shortcoming by studying the effects of immigration to Brazil during the Age of Mass Migration on its agricultural sector in 1920. This context benefits from the widely recognized value of historical perspective in studies of the effects of immigration. But unlike studies that focus on the United States to understand the effects of migration from poor to rich countries, our context is informative of developing countries' experience because Brazil in this period was unique among major migrant destinations as a low-income country with a large agricultural sector and weak institutions. Instrumenting for a municipality's immigrant share using the interaction of aggregate immigrant inflows and the expansion of Brazil's railway network, we find that a greater immigrant share in a municipality led to an increase in farm values. We show that the bulk of the effect of immigration can be explained by more intense cultivation of land, which we attribute to temporary immigrants exerting greater labor effort than natives. Finally, we find that it is unlikely that immigration's effect on agriculture slowed Brazil's structural transformation.

JEL Classification: F22, J61, N36, N56, O13, O15, Q15

Keywords: immigration, developing countries, effects of immigration, age of mass migration, Brazil, agriculture

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1 Introduction

What are the effects of immigration in a developing country? Despite the importance of developing countries as migrant destinations (Ratha and Shaw 2007),[1] hosting over 40 percent of world migrants (World Bank 2016, p. 11), the effects of immigration in these economies remain unclear. The literature on the economics of migration focuses almost entirely on immigration to rich countries and on developing countries as immigrant sources (Biavaschi et al. 2018; Böhme and Kups 2017; Hanson 2009; Hatton and Williamson 2002, 2005), providing little guidance. Indeed, developing countries may attract different types of migrants or migrants from different places of origin than more developed countries, which, together with substantial differences in economic structure and institutions, may ultimately cause the effects of immigration to differ from those in more developed countries.

In this paper, we study the effects of European immigration to Brazil in the period 1855–1920. Our main focus is on Brazil's agricultural sector in 1920, motivated by the structure of Brazil's economy and the role of immigrants within this economy. Brazil at this time was an overwhelmingly agrarian economy with an emerging industrial sector. Brazilian policy makers, motivated by labor demand in the expanding coffee sector and the decline and eventual abolition of slavery in 1888, initially encouraged immigration from Europe to provide labor for the agricultural sector,[2] and even outside of official migration subsidy programs, immigrants largely entered the agricultural sector. Given the prominence of the agricultural sector and its importance in the immigrant experience in Brazil, we investigate whether migration did, in fact, support the development of this sector, which we operationalize by focusing on the value of farms across Brazilian municipalities. We also investigate the contribution of Brazil's agriculture-focused immigration phenomenon to the country's ongoing structural transformation, which enables us to address the long-standing debate in development economics regarding the role of agricultural development in overall economic development (e.g., Asher et al. 2022).

Our historical context is situated within the *Age of Mass Migration*—a period roughly 1840–1920 in which over 50 million people migrated from Europe to the Americas (Hatton and Ward 2019; Hatton and Williamson 1998). The value to the economics of immigration from studying this period is broadly recognized,[3] including in studies of the effects of immigration (e.g., Abramitzky et al. 2023; Price, vom Lehn, and Wilson 2023;

[1]It is estimated that the stock of migrants from developing countries in developing countries exceeds the stock of migrants from developing countries in developed countries (World Bank 2016).

[2]The desire to attract specifically European migrants was at least partially founded on racist beliefs of white superiority and the widespread desire amongst Brazilian policymakers to "whiten" Brazil's population through immigration and miscegenation (da Costa 2000; Machado 2006; Slenes 2010).

[3]See, for instance, Abramitzky and Boustan (2017), Abramitzky, Boustan, and Eriksson (2012), Collins and Zimran (2023), Hatton and Williamson (1998), and Spitzer and Zimran (2018).

Tabellini 2020).[4] This literature, however, focuses almost exclusively on the United States, generating insights for migration from poor to rich countries. Brazil, however, stands apart from the United States and the other main immigrant receiving country—Argentina.[5] Its wages and per-capita GDP were substantially lower (Bolt and van Zanden 2020; Williamson 1995), its agricultural sector was relatively larger, and its institutions were uniquely extractive.[6] These features of the Brazilian economy make Brazilian immigration a closer historical analog of modern immigration to developing countries than is any other immigration flow during this period. The unique and important position of the Age of Mass Migration as a source of insights for the economics of immigration, combined with Brazil's unique status in this context as a relatively poor, agricultural, and undeveloped destination country, thus enables us to better understand the effects of immigration in developing countries.

The main empirical challenge that we face is the endogeneity of immigrants' location choice within Brazil. To address this challenge, we adapt to the Brazilian case an identification strategy previously used by Sequeira, Nunn, and Qian (2020) to study the effects of immigration in the United States during the Age of Mass Migration. This strategy creates an instrumental variable for a municipality's immigrant share of population based on the interaction of aggregate immigrant arrivals and the development of the rail network, which the historical evidence shows was an important method for immigrants to reach their destinations (Holloway 1980; Lanza, Manier, and Musacchio 2023).[7] Intuitively, we compare two municipalities, one of which was linked to the railroad in the year of a large immigration inflow, and the other of which was not linked in that year. The former, by virtue of having access to the rail network in the year of a large inflow, is predicted to have a greater share of immigrants relative to population.[8] This method enables us to control for rail linkage directly, addressing concerns that rail was built targeting specific areas or had direct effects on the local economy. We also show that municipalities linked during immigration booms were similar to those linked during lulls, obviating concerns that the timing of the construction of the rail network and the timing of immigrant inflows were directly linked (Sequeira, Nunn, and Qian 2020).

[4]The value of historical perspective has also been exploited in studies of the effects of immigration in the context of the Bracero program (e.g., Clemens, Lewis, and Postel 2018; Lee, Peri, and Yasenov 2022).

[5]Brazil was the third most important of these destinations in terms of number of immigrants. Canada was a close fourth (Ferenczi and Willcox 1929, p. 172).

[6]Although both the United States and Argentina were also agricultural, Brazil's sector was substantially larger as a share of the labor force, and especially of the immigrant labor force—about 40 percent in 1920, as compared to about 15 percent in the United States and 17 percent in Argentina in 1895. Moreover, in the case of the United States, the bulk of immigration provided labor to the manufacturing sector (Lafortune, Lewis, and Tessada 2019). In Brazil, immigration was targeted to agriculture.

[7]Indeed, the *Hospedaria dos Imigrantes* in Santos, where immigrants were lodged at arrival in São Paulo, was linked directly to the railway network, and immigrants were often provided with tickets to reach their destinations. The same was true of the immigrant hostels in the other major ports of arrival.

[8]We advance this strategy by exploiting annual variation in the extent of the rail network rather than decadal variation of the form used by Sequeira, Nunn, and Qian (2020).

Our main finding, based primarily on data that we digitized from the 1920 Brazilian census, is that municipalities with a higher share of European immigrants in 1920 had greater farm values per hectare, which we interpret as indicating greater development of the agricultural sector. This is true not just for the total farm value, but also for each of its three constituent components—land, infrastructure, and tools and machines. The finding that immigration affected not just land prices, but also the other two components is crucial for two reasons. First it alleviates the concern that our outcome variable captures local characteristics other than agricultural development, which would be capitalized in land values. Second, the value of infrastructure, tools, and machines is linked to the development and productivity of the agricultural sector, which is our ultimate object of interest. Our preferred specification indicates that a one-standard deviation increase in a municipality's share of European immigrants generated a 0.7-standard deviation increase in its farm values per hectare. We show that these results are robust to using different variations of our instrument and to excluding a variety of sets of municipalities that may have been systematically different from the average municipality—those hosting immigrant colonies, large coffee producers, the earliest places linked to the railway, and large population centers.

We also investigate the mechanism for the effect of immigration on farm values. What we find to be the most substantial mechanism is changes in land use patterns. In particular, we find that a greater share of European immigrants led to an increase in the share of farmland cultivated (as opposed to being left fallow or as forest), and that this increase in the intensity of cultivation was responsible for about one quarter of the effect of immigration. We argue that this mechanism reflects temporary immigrants exerting greater labor effort than natives or permanent immigrants. Such a mechanism is in line with a large body of literature showing both theoretically and empirically that temporary immigrants increase their work effort (or labor supply) while in the destination,[9] with the fact that a substantial portion of Brazilian immigration from Europe was temporary (Hatton and Williamson 1998; Lesser 2013), with historical accounts of substantial effort exerted by Brazilian immigrants (Cinel 1991; Florea 2023; Sánchez-Alonso 2007). Consistent with this notion, we show that the effect of immigration on farm values was the product of immigrant labor, not immigrant ownership. Moreover, using farm-level data from São Paulo state and exploiting within-municipality variation, we confirm that immigrant labor and not immigrant ownership affected farm values. These results imply that when immigrants transitioned to ownership, indicating permanent residence, the benefits of their presence for farm values dissipated. We also investigate, and either rule out or show to be unimportant

[9] See Dustmann (1994, 2000), Dustmann, Bentolila, and Faini (1996), Dustmann and Görlach (2016), Epstein and Venturini (2011), Galor and Stark (1991), Hill (1987), Klinthäll (2006), Kyarko and Chartouni (2017), Vijverberg and Zeager (1994), and Wahba (2022).

relative to the land-use mechanism, several other mechanisms—immigrant arrivals increasing the demand for land or providing labor that would otherwise be absent to aid in the exploitation of land; increased coffee cultivation; and increases in the capital intensiveness of agriculture in response to immigration in the form of an increase in the adoption of agricultural tools.

To assess the overall impact of immigration on economic development, we test whether immigration, by facilitating agricultural development, slowed Brazil's structural transformation. Such a test addresses a long-standing debate about the role of agricultural development in promoting or delaying structural transformation (Asher et al. 2022), which is also present in the Brazilian historiography (Suzigan 2000, pp. 23–47). We find that immigration did not slow, and in fact may have accelerated Brazil's structural transformation. In addition to a decline in the agricultural share of the labor force, we find a positive effect of immigration on the literacy of both native- and foreign-born individuals, suggestive evidence that immigration was associated with increased industrial employment, and no evidence that immigration reduced female labor force participation, which would have been detrimental for industrialization. We also find no evidence of an adverse impact on institutions in the form of an increased presence of rentiers, whose presence may have held back development, or of an inflated public sector.

This paper advances a fundamental literature within the economics of immigration—that studying the effects of immigration on the receiving country (Bansak, Simpson, and Zavodny 2020; Borjas 2014). The near exclusive focus of this literature on the effects of immigration in developed countries creates an important blind spot given the importance of developing countries as destinations for immigrants. The combination of the recognized benefit that historical perspective brings to advancing the economics of immigration and Brazil's unique position in the Age of Mass Migration as a major migrant destination that bears a stronger resemblance to modern developing countries than any other destination in that period, enables us to enrich this literature by shedding new light on the effects of immigration in developing rather than developed countries.

This paper also contributes to the literature focusing on the economics of the Age of Mass Migration (e.g., Abramitzky and Boustan 2017; Hatton and Ward 2019), and more particularly to studies of the effects of immigration in this period (e.g., Abramitzky et al. 2023; Ager et al. 2021; Cohen and Biddle 2022; Price, vom Lehn, and Wilson 2023; Tabellini 2020).[10] Just as the economics of immigration has focused on developed-

[10] In addition to bringing a different perspective with its focus on Brazil, this paper provides an important insight on the effects of immigration to the United States in the Age of Mass Migration, albeit in a counterfactual sense. Specifically, the paper sheds light on the what the effects may have been had immigrants settled in large numbers in the US South. In reality, few immigrants to the United States settled outside the Northeast and Midwest. But contemporaries repeatedly discussed a desire for the labor supply that immigrants would provide in the South (Benton-Cohen 2018; Goldin 1994; US Congress 1911). Indeed, there were a number of unsuccessful efforts to encourage Europeans to settle in the US South, and subsidized immigration—an

country destinations, this literature has focused largely on the United States, where immigrants arrived in pursuit of high wages in an industrializing economy (Hatton and Williamson 1998; Lafortune, Lewis, and Tessada 2019; Williamson 1995). Latin America and particularly Brazil, remain understudied even though Brazil was the third-most popular overall and the second-most popular destination after the United States in the 1890s (Ferenczi and Willcox 1929; Sánchez-Alonso 2019). Within the relatively small literature on the Brazilian experience of the Age of Mass Migration, this paper is most closely related to Lanza, Manier, and Musacchio (2023), who have found evidence of a linkage between the subsidized immigration program and coffee productivity in the state of São Paulo. Beyond this, most research focuses on the long-term effects of immigration on income and human capital accumulation in specific regions of Brazil (e.g., de Carvalho Filho and Monasterio 2012; Klein 1995; Stolz, Baten, and Botelho 2013; Witzel de Souza 2018). This paper provides the first causal study of the effects of immigration on Brazilian agriculture in the Age of Mass Migration that covers the entirety of Brazil, and the whole of the immigration flow, whether subsidized or unsubsidized, contributing to the long-standing debate about the role of immigration to the development of the largest Latin American economy (e.g., Alston et al. 2016; Holloway 1980; Papadia 2019).

2 Background

2.1 The Effects of Immigration in Developing Countries

Understanding the effects of immigration on the economies of receiving countries is a fundamental goal of the economics of immigration. Canonical studies focus on the labor-market effects of immigration, largely in the United States after the transition to its current immigration regime in 1965 (e.g., Abramitzky and Boustan 2017; Borjas 2003, 2014; Card 1990, 2005; Hanson 2009; Kerr and Kerr 2011), with a smaller set focusing on the effects of immigration in other modern developed countries (e.g., Dustmann, Schönberg, and Stuhler 2016; Manacorda, Manning, and Wadsworth 2012). This literature is enriched by studies focusing on the effects of immigration in the United States during the Age of Mass Migration (e.g., Abramitzky et al. 2023; Ager et al. 2021; Cohen and Biddle 2022; Hatton and Williamson 1998; Price, vom Lehn, and Wilson 2023; Tabellini 2020), which exploit a variety of advantages of this historical setting, such as the long time horizon, open borders, the ability to follow individuals over time, and differences in economic structure to

important feature of Brazilian immigration—was considered but was ultimately banned by the Foran Act in 1885. In the later years of the Age of Mass Migration, southern and eastern European immigrants were criticized for their supposed unwillingness to settle in the US South (Benton-Cohen 2018; Zimran 2022). As a result, what may have occurred if these large flows had materialized, either spontaneously or if subsidized immigration had come to fruition, remains unknown. This paper sheds light on what might have been.

shed light on the economics of immigration in general.[11]

Although these studies have enriched our understanding of the effects of immigration on receiving economies, the focus of nearly all of them is on rich countries and largely on flows from poor to rich countries. This is true in the case of studies of the modern United States, which draws the bulk of its migrants from Latin America and Asia (Abramitzky and Boustan 2017). It is also true of studies of the United States in the Age of Mass Migration. Most immigrants to the United States in this period were from countries with substantially lower wages (Williamson 1995). Moreover, although it was more agricultural than it is now, the US economy was far more industrialized than that of any other major origin or receiving country of the Age of Mass Migration (Abramitzky and Boustan 2017; Hatton and Williamson 1994; Hatton and Ward 2019).[12]

The ultimate result of the focus on the United States in both the modern and historical literatures is that migration to developing countries is poorly understood, particularly its effects on the receiving economies. Indeed, with a small number of exceptions (e.g., Biavaschi et al. 2018; Gindling 2009; Lanza, Manier, and Musacchio 2023; Özden and Wagner 2014), previous literature focuses on developing countries as the source rather than the destination of migrants (Hanson 2009). A corollary of this, given the agricultural nature of many developing economies, is that the effects of immigration on the agricultural sector are poorly understood relative to other sectors (c.f., Abramitzky et al. 2023; Clemens, Lewis, and Postel 2018; Lanza, Manier, and Musacchio 2023). Moreover, there are a number of reasons to suspect that the effects of immigration in developing countries are different from those in developed countries. All of the factors that combine to determine these effects—the origins and selection of immigrants, their substitutability with natives, the sectors comprising their economies, and the duration of immigrants' stays in the destination, among other factors—are likely to be different. As a result, studies of the effects of immigration in a developing country can, both in isolation and in comparison to the effects in rich countries, help to advance the empirical and theoretical understanding of the economics of immigration.

[11] Related to this is work by Clemens, Lewis, and Postel (2018) and Lee, Peri, and Yasenov (2022) on the Bracero program (1942-1964), which was a conduit for substantial migration from Mexico to the United States. Though not perfectly comparable to the Age of Mass Migration, this phenomenon also provides a setting of relatively unencumbered migration from which to gain insights on the economics of migration. Also related are studies of the long-run effects of historical migration on modern outcomes (e.g., Burchardi, Chaney, and Hassan 2019; Sequeira, Nunn, and Qian 2020).

[12] Indeed, the bulk of studies examining the effects of immigration in the United States during the Age of Mass Migration focus on the twentieth century, or even on the end of the Age of Mass Migration with the imposition of country-of-origin quotas. Thus, although the United States was strongly agriculturally focused in the early Age of Migration, this is not the period generally studied when focusing on the effects of immigration.

2.2 Brazil in the Age of Mass Migration

Over 3.5 million European immigrants entered Brazil between 1850 and 1920; Figure 1 plots the time series of Brazilian immigration. Nearly 1.5 million of these arrived between 1888—when the government implemented a subsidized immigration program, in large part to provide labor for coffee cultivation after the abolition of slavery—and 1900. This made Brazil the second most popular immigrant destination in the New World in this period, trailing only the United States (Ferenczi and Willcox 1929, p. 550).[13] The largest single group of immigrants in this period were from Italy, where immigrants were recruited for subsidized labor contracts from the north of the country. Over 80 percent of immigrants were subsidized in the pre-1900 period, possibly reflecting the limited attractiveness of Brazil as a destination due to its relatively low wages and living standards, the fresh memory of slavery, and the perceptions of an adverse disease environment (Papadia 2019).

The *colono* contract was at the center of the subsidized immigration program, which was particularly important in São Paulo as the epicenter of coffee production (Lanza, Manier, and Musacchio 2023).[14] Under this scheme, immigrants received free passage and lodging, and were responsible for caring for and harvesting coffee trees for a three-year contract period. In order to reduce the incentive for return migration, the *colono* contract required adult male immigrants to be accompanied by their families (Klein 1995). However, the evidence shows that this requirement was not strictly enforced, as about 35% of all immigrants processed at São Paulo from 1911 to 1920 were returnees (Holloway 1980, p. 56). Lesser (2013) documents that in order to receive the subsidy, single migrants that had met during or just after the voyage reported to be a "family," which may help explain why only 46 percent of immigrants remained permanently in the state of São Paulo (Sánchez-Albornoz 1986).

The immigrant experience in Brazil began at reception centers, known as Immigrant Hostels (*Hospedarias dos Imigrantes*), which were present in each of the three main entry ports of Santos in the state of São Paulo, Rio de Janeiro, and Salvador in the state of Bahia. At these hostels, immigrants could sleep, eat, and, if necessary, receive medical attention or vaccinations after being registered. The hostels also had direct access to railways, which facilitated the transportation of immigrants to their final destination. The São Paulo hostel, which processed most migrants, was the venue for the matching of immigrants arriving under the subsidy program and the coffee plantations. In general, these immigrants had one week after arrival to find a

[13] European immigration to Brazil began with the establishment of agricultural colonies in southern Brazil by German and Italian immigrants in the 1820s (Foerster 1919). There was also a wave of immigration of Americans from the US South in the wake of the Civil War (Dawsey and Dawsey 1995) and efforts made to recruit European sharecroppers to grow coffee after Dom Pedro II's crackdown on the illegal Atlantic slave trade in 1850 (Barman 1999).

[14] Subsidized immigrants were also recruited for mining in Minas Gerais.

farm on which to work, and upon signing a contract would be provided with a train ticket to their destination (Holloway 1980; Lanza, Manier, and Musacchio 2023).

Brazilian immigration changed substantially at the beginning of the twentieth century. Concerns about the conditions of migrants in Brazil, particularly of those residing in colonies and working on coffee plantations, led to bans on subsidized migration by several European governments (Lesser 2013). Most notably, the Italian *Decreto Prinetti* in 1902, which made subsidized emigration illegal, was targeted mainly at limiting migration to Brazil.[15] In part as a result of these bans, subsidized migrants no longer made up the majority of entrants to the country, with their share falling to about 40 percent (Cameron 1931). Although these bans did not halt mass migration to Brazil, as Figure 1 shows, they did lead to a change in the origin of migrants. In particular, Figure 2 shows a decline in the share of immigration coming from Italy with a commensurate increase in the share from Portugal and Spain.[16] The shift in migrant origins was coupled with changes in settlement: whereas immigrants arriving before 1900 were almost entirely directed to agricultural areas, those entering after 1900 settled in large numbers in cities in the states of São Paulo and Rio de Janeiro (Foerster 1919, p. 289).

Although it is well established that immigrants were more numerate and literate than the Brazilian population (Rocha, Ferraz, and Soares 2017; Stolz, Baten, and Botelho 2013), direct evidence on the selection of immigrants is limited. It is possible that subsidized immigrants were negatively selected, as subsidies significantly relaxed liquidity constraints, allowing the relatively poor and unskilled to migrate (Angelucci 2015; Belot and Hatton 2012; Chiquiar and Hanson 2005; McKenzie and Rapoport 2010; Orrenius and Zavodny 2005; Spitzer and Zimran 2018). Beyond this speculation, the few studies addressing the selection of Italian and Portuguese migrants, the two major immigrant groups in Brazil, provide mixed evidence.[17]

Despite policymakers' efforts, return migration was prevalent. Italian data on return migration, which are available from 1905 onwards, indicate that between 50 and 75 percent of immigrants returned to Italy.[18]

[15] Prussia also nominally prohibited emigration to Brazil as early as 1859, and similar measures were implemented for the whole German empire from 1871 (Fausto 1999).

[16] There was also a change in the main immigrant sources within Italy, with migrants before 1902 coming primarily from the north and those after coming primarily from the south. See Online Appendix Figure A.1 for the division of immigrants by origin in the 1920 census.

[17] Fernández-Sánchez and Tortorici (2023) show that Portuguese migrants, who mostly moved to Brazil, were on average positively selected on the basis of literacy. Determining the selection of Italians is more difficult given the highly segmented destination choice patterns of this group (Hatton and Williamson 1998; Spitzer and Zimran 2023). But given the early dominance of northern Italy in the migratory flow to Brazil, due in part to the fact that migration subsidies were offered exclusively to migrants from the north of Italy (Hatton and Williamson 1998, p. 102), and that migrants from this region to the United States were negatively selected (Spitzer and Zimran 2018), it is likely that the early migrants were negatively selected. Hatton and Williamson (1998, p. 121) also find that farmers from Italy, who tended to be relatively poor, were more likely to travel to Brazil than they were to the United States, possibly in search of land. However, the shift of Italian emigration to a largely southern-Italian phenomenon at the turn of the twentieth century may have been associated with a more positive selection, as migrants from this region who emigrated to the United States were positively selected (Spitzer and Zimran 2018, 2023).

[18] We have not been able to locate similar data for the other main immigrant source country, Portugal.

Foreign observers widely believed that those who remained were exploited under the *colono* contract (Lesser 2013), fueling the bans on subsidized immigration. Recent scholarship has debated whether this was true, providing a more nuanced story: immigrants were able to transition to land ownership after a few years on the *fazenda* (Klein 1995; Lanza 2021). More specifically, Holloway (1980, p. xvi) documents that many first-generation immigrants were likely to become owners of small and medium-sized farms. However, the specific mechanisms through which immigrants achieved this transition have not been identified.

Altogether, Brazil's immigration and economy bear some important similarities to those of the other major migrant destinations—the prevalence, at least from the later nineteenth century, of migrants from the poorer European periphery, the high rate of return migration, and, in Argentina's case, the size of the agricultural sector (Droller and Fiszbein 2021; Lesser 2013). But many features set it apart. Most dramatically, there were substantial differences in development between Brazil and the other two major migrant-receiving countries in the Americas, as shown in Figure 3: Brazil was, by a substantial margin, the poorest of the three countries (Bolt and van Zanden 2020); indeed, Argentina was one of the 10 richest countries in the world at the eve of World War I and had living standards similar to those of the United States (Spruk 2019). In addition, the concentration of Brazilian immigrants in agriculture was unique in comparison to Argentina and the United States, where most immigrants provided labor outside the agricultural sector (Pérez 2017): in Brazil, approximately 40 percent of immigrant men worked in agriculture in 1920 (Online Appendix Figure A.2) as opposed to about 15 percent in the United States and 17 percent in Argentina in 1895. Subsidized migration was also uniquely important in Brazil. The United States explicitly banned subsidized migration beginning in 1885, and although there is evidence of subsidized immigration in Argentina, it did not have the relevance it did in Brazil (Lesser 2013). Brazil also had weaker institutions and worse governance, reflected in low access to justice and an inefficient public sector, as well as a high concentration of economic power and a highly unequal land distribution (Naritomi, Soares, and Assunção 2012).[19] Understanding the impacts of immigration in this context can thus provide new insights beyond those coming from studying the effects of immigration in the United States and even the more comparable Argentina.

2.3 Existing Research on the Effects of Brazilian Immigration

Research addressing the effects of immigration in Brazil dates at least to Dean's (1969) classic account of the industrialization of the state of São Paulo, which had become the industrial engine of Brazil by 1920

[19] While substantial inequality was present in Argentina in the early twentieth century, it was not nearly as extreme as in other Latin American societies (Sokoloff and Engerman 2000).

(Palma et al. 2021). He assigns a direct role to migrants, but the crucial group of immigrants in this account is the bourgeois immigrant—relatively wealthy and skilled, and mostly active in industry and commerce—rather than the modal immigrant workers in agriculture. Conversely Dean (1969) argues that the bourgeois immigrants in the agricultural sector—both those who started off as landowners and those who became landowners at a later stage—had no detectable generalized positive effect on Brazilian local development because of an insurmountable advantage of domestic planters, potentially arising from superior knowledge, better access to capital, and the occupation of better land.

Among the more recent literature on the Brazilian experience of the Age of Mass Migration, Lanza, Manier, and Musacchio (2023), the work most closely related to ours, provide the clearest evidence on the effects of immigration. They use the same farm-level data for the state of São Paulo that we use (though aggregated to the municipality level in their case) to study the effect of immigration as part of the subsidized immigration program on agricultural output and capital adoption. Arguing that the assignment of immigrants to municipalities within this program was random and comparing municipalities with a greater immigrant share to those with a smaller share, they find that a greater share of immigrants was associated with greater coffee output per farm and the adoption of more agricultural tools in 1920.

Other studies of the effects of Brazilian immigration focus in large part on the long-run effects of immigrant human capital or of immigrant colonies and schools established by or at the behest of immigrants (de Carvalho Filho and Colistete 2010; de Carvalho Filho and Monasterio 2012; Rocha, Ferraz, and Soares 2017; Stolz, Baten, and Botelho 2013; Witzel de Souza 2018).[20] These studies also tend to focus on only a portion of the Brazilian immigration experience, limiting themselves to either a single source country (e.g., Witzel de Souza 2018) or region of Brazil (e.g., de Carvalho Filho and Monasterio 2012). More broadly, the understanding of the effects of immigration in Brazil tend to focus on immigration's connection to coffee production in São Paulo (Holloway 1980), leaving the role of immigration in the development of other regions and sectors less clearly understood. In particular, what remains lacking is an understanding of the effects of both subsidized and unsubsidized immigration on contemporary outcomes covering all of Brazil and addressing directly the potential for endogenous location choice by immigrants. This paper contributes such a study.

[20] Feler, Musacchio, and Reis (2016) study the effects of immigration on banking in the 1940s and 1950s. Tang and Monteiro (2023) also study Japanese immigration as an instrument for education.

3 Conceptual Framework

The expected effect of immigration on Brazil's agricultural sector is theoretically ambiguous. The simplest way in which immigration could impact this sector is by simply adding to the agricultural labor force. In an environment in which the agricultural frontier was rapidly expanding, a shortage of labor could prevent land from being cultivated; in such a situation, additional labor provided by immigration can increase the value of land that previously could not be cultivated. Such a force would have been particularly strong in this environment in which the valuable coffee sector was growing and demanding increasing amounts of labor. Such an effect need not prevail, however, if, for instance, native and immigrant labor were perfectly substitutable and natives relocated within Brazil in response to the arrival of immigrant labor.[21] Similar arguments could be made for immigrants increasing the demand for land and investing in farm capital in the form of tools and machines where land would otherwise be uncultivated or in lower demand.

The predicted effect of immigration is complicated by the likelihood that immigrants and natives were fundamentally different from one another, and thus not perfectly substitutable. For instance, immigrants may have possessed certain characteristics that made them particularly productive agricultural workers, such as specialized agricultural knowledge or greater human capital. If this were the case, a greater concentration of immigrants would spur local agricultural development, which would ultimately be reflected in higher farm values. Similarly, immigrant labor's complementarity with capital may have differed from that of natives. Importantly in the Brazilian context, immigrants may have uniquely enabled the opening of land to coffee production.

Immigrants may also have faced different incentives than natives. For instance, temporary migrants, who made up a substantial share of migrants to Brazil in this period, may have been incentivized to exert greater labor effort than natives or permanent immigrants while in Brazil, which would in turn contribute to greater land values where they settled. Such a mechanism is consistent with evidence that temporary immigrants substitute inter-temporally, exerting greater labor effort in the destination and enjoying greater leisure at home (Dustmann 1994, 2000; Dustmann, Bentolila, and Faini 1996; Dustmann and Görlach 2016; Epstein and Venturini 2011; Galor and Stark 1991; Hill 1987; Holloway 1980; Klinthäll 2006; Kyarko and Chartouni 2017; Vijverberg and Zeager 1994; Wahba 2022).

The effects of immigration on sectors outside of agriculture in a largely agricultural economy are also

[21] In such a situation, immigrant arrivals could lead to the increase of land values elsewhere in Brazil, if, for instance, immigrant arrivals led natives to relocate to the frontier where labor was previously scarce. Unfortunately, no identification strategy based on the comparison of different municipalities within Brazil can identify such an effect absent detailed data on internal migration, which do not exist.

theoretically ambiguous. It has been posited that greater agricultural productivity could encourage structural transformation (Johnston and Mellor 1961; Montero and Yang 2022; Timmer 1988), but it has also been suggested that it can lead to specialization in primary production, discourage human and physical capital accumulation, hinder the development of other sectors of the economy, and ultimately delay structural change (Matsuyama 1982). The existing empirical literature is equally ambiguous (Asher et al. 2022; Bustos, Caprettini, and Ponticelli 2016; Bustos, Garber, and Ponticelli 2020; Foster and Rosenzweig 1996; Hornbeck and Keskin 2015), suggesting that the effect of agricultural development may be strongly context-dependent. In the Brazilian case, one body of literature argues that industry only started to develop rapidly once the agricultural export sector, led by coffee, was disrupted by events such as the First World War and the Great Depression. Another, however, has argued that the development of the agricultural export sector was a crucial precursor for the development of other sectors of the economy, particularly industry (Suzigan 2000).

The ambiguity of theory and existing empirical evidence regarding the effects of immigration on an agricultural developing economy, and in turn on that economy's structural transformation, implies that these effects are ultimately empirical questions. Our analysis seeks to answer these questions, guided in our search for potential mechanisms and effects by the theory outlined above.

4 Data

Our analysis is based on data we digitized for this project from the 1920 Population and Agricultural Census of Brazil (Directoria Geral de Estatística 1922). The 1920 census was the first complete population census successfully carried out in Brazil since 1872, and the first ever agricultural census covering the whole country. While this means we do not have access to repeated data over time, the census provides a very rich set of variables at the municipality level that capture economic, population, human capital, and labor force characteristics.[22] We also use complementary data from a variety of other sources, mainly as control variables throughout the analysis, as well as farm-level data from the state of São Paulo to bolster some of our main empirical results.

4.1 Outcome Variables

The 1920 census provides data on the average monetary value of farms (agricultural establishments) by municipality in milréis—the currency of Brazil at the time—in total and broken down into three components—

[22] Note that we exclude Acre from the analysis, as data for this territory are not consistently reported.

land, infrastructure, and tools and machinery.[23] These establishments were often made up of a single plot of land, but could also refer to multiple plots in the same municipality managed by the same person, group of people, or organization (e.g., the government).[24] Combined with information on the size of farms, these data enable us to compute our main outcome variable—the average value of farms per hectare of land. We consider farm values per hectare to be a measure of agricultural development, which includes any factor making the local agricultural sector more productive and valuable. One concern with the use of farm values as a measure of agricultural development is that they include the value of land, which in turn would capitalize local characteristics and amenities potentially unrelated to immigration. Fortunately, the other two components of farm values—improvements and tools and machines—are strictly related to agricultural productivity, and thus ensure we are indeed capturing the effects of migration on agricultural development. Moreover, our control variables are designed to capture a broad range of additional factors affecting farm values, and our identification strategy addresses the potential for endogenous location choice by immigrants.

We also collect data on a series of factors that may have affected the value of farms through their relationship with immigration. The first set of variables covers the state of the labor force: we use population density (inhabitants per km^2) and agricultural employment density (workers employed in agriculture per km^2). As measures of land use, we use data on the share of farm land cultivated and the share of cultivated farmland by planted crop.[25] We also measure the use of tools and machines in agriculture: specifically we use data on the share of farms with tools—plows, harrows, seeders, cultivators, harvesters, and tractors—and machines in the form of devices employed for processing crops.[26]

As previous literature has shown that agricultural development, or its absence, can influence the transformation of the economy (e.g., Abadie, Gu, and Shen 2023; Asher et al. 2022; Bustos, Garber, and Ponticelli 2020; Hornbeck and Keskin 2015; Lewis 1954; Matsuyama 1982; Montero and Yang 2022; Schultz 1964; Timmer 1988), we also examine four sets of outcome variables related to structural change. To measure human capital formation, we use data on literacy—the share of individuals who could read and write—which

[23] Directoria Geral de Estatística (1922, Volume III, 1^a Parte: Agricultura, pp. 298-385)

[24] As defined in the census, agricultural establishments are "the whole extension of land subject to the exclusive administration of an owner, tenant, stakeholder or administrator, who directly manages the cultivation of crops or livestock by themselves or with the help of paid staff" (Directoria Geral de Estatística 1922, Volume III, 1^a Parte: Agricultura, page 7). Land cultivated in urban settings was excluded from the census, as were farms with an annual production worth less than 500 milréis. This essentially means excluding establishments practicing subsistence agriculture, and focusing, instead, on commercially oriented farms. To give some perspective, 500 milréis was approximately 107 times the average daily wage of a plough-man living in a rural area in 1920 (Directoria Geral de Estatística 1922, Volume V, 2^a Parte: Salarios, p. XXV).

[25] These crops include rice, maize, wheat, beans, potatoes, manioc, cotton, sugarcane, tobacco, castor beans, coffee, cocoa, coconut, and rubber.

[26] Directoria Geral de Estatística (1922, Volume III, 3^a Parte: Agricultura, p. 17–105.). A primary examples are machines used for processing and distilling sugar in on-farm, refineries.

the census reports separately for immigrants and natives.[27] As indicators of economic structure, we use data on the share of workers employed in agriculture, in industry, and in the public sector. We also use the population share of individuals living on income from property or investments (rentiers) as a measure of the presence of local landed elites.[28] To measure state capacity, we use data on public finances, including (export) tax revenue per capita and expenditure per capita in both education and public services. Finally, we collect data on the female to male ratio among the employed population by economic sector (agriculture and industry).

4.2 Explanatory Variables

We use data on the total population and number of European immigrants by municipality to construct our main explanatory variable—the population share of European immigrants by municipality.[29] We focus on European immigration for two reasons. First, the historical literature has documented that, during the Age of Mass Migration, nearly 90 percent of the immigrant flows to Brazil came from Europe (Lesser 2013; Sánchez-Alonso 2019). Second, the exogenous variation that our identification strategy relies on is partially the product of shocks to European immigration.

Our identification strategy also relies on variation in railway access at the local level. We obtain these data from Giesbrecht (2023), which allow us to identify the first station built in each municipality as well as the year when its construction was completed—that is, the year when each municipality was linked to the railway network. We then compute two variables with this information—the number of years that a given municipality had been connected to the railway network by 1920 and an indicator variable for municipalities that were not connected by 1920.

4.3 Control Variables

We collect data on a number of municipality characteristics that may have affected farm value and immigrant settlement to include as control variables in our analysis. To capture proximity to international and domestic markets, we create three variables—distance to the nearest port or frontier custom house, distance to the nearest principal city, and distance to the nearest principal town.[30] We also collect data on the location

[27] Directoria Geral de Estatística (1922, Volume IV, 1^a Parte: População, pp. 20–481)

[28] Directoria Geral de Estatística (1922, Volume V, 5^a Parte: População, Tomo I pp. 180–625, Tomo II pp. 6–825.)

[29] Directoria Geral de Estatística (1922, Volume IV, 1^a Parte: População, pp. 550-887). The computation of this variable implies excluding immigrants mainly from Asia (Japan) and South America (Argentina, Paraguay, and Uruguay), who represented about 12 percent of the immigrant population. The exact text of the immigrant data in the original source is "Popoulção estrangeira do estado de XX segundo a nacioladidade e o sexo, inclusivo os estrangeiros que adoptaram a nacionalidade braziliera."

[30] These features are identified using a map of Brazil created by the International Bureau of the American Republics (IBAR) in 1905, shown in Online Appendix Figure A.3.

of immigrant colonies from the same source and from Gagliardi (1958) for the state of São Paulo. We also create a battery of variables to control for differences in geographic conditions across municipalities, including surface area, ruggedness, altitude, latitude, longitude, and the interaction of latitude and longitude. Finally, we use data from the Global Agro-Ecological Zones project (Food and Agriculture Organization 2021) to construct three variables that capture the suitability of land for agriculture and the adaptability of land for the production of different crops. These variables consist of the first two principal components of suitability for all major crops reported in the census except rubber,[31] and the Herfindahl-Hirschman Index (HHI) of suitability, capturing how concentrated land suitability is in each municipality, with lower values indicating a greater adaptability of land for the production of different crops.

4.4 Farm-Level Data

We complement our municipal-level analysis with data from the 1904–1905 Agricultural Census of the state of São Paulo (Secreteria da Agricultura 1906–1910). The data from this source are similar to those coming from the 1920 census, reporting the share of cultivated farm land, the share of cultivated farm land by planted crop, employment density (workers per hectare), and the breakdown of employment by foreign or native birth. But these data are reported at the level of the farm rather than the municipality. In total, we have information for over 40,000 farms across 163 municipalities. This source provides information on land values, as well as farm ownership—that is, whether the farm was owned by a foreign- or native-born person—and on the share of native and foreign workers.[32]

4.5 Summary Statistics

Online Appendix Tables A.1 and A.2 present summary statistics for all of the variables in our dataset. Figure 4 presents maps displaying the geographic distribution of our main outcome variable (panel a) and our main explanatory variable of interest (panel b). The south and southeast are shown at increased magnification, as these regions received the majority of migrants. A number of features of our data are readily apparent. The first is that there is a concentration of high farm values and high immigrant shares in the vicinity of São Paulo, in the main coffee growing area of the southeast. We will present a number of exercises verifying that our results are not driven by this region. The second is that there was considerable variation in both

[31] Specifically, this is the low input, no irrigation land suitability data for beans, cocoa, coconut, coffee, cotton, maize, potato, rice (dry and wet), sugar, tobacco, and wheat.

[32] The digitized data were kindly shared with us by Renato Colistete. See Bassanezi and Francisco (2003) (who first digitized the data), Colistete (2015), and Luna, Klein, and Summerhill (2014) for previous uses of this source.

farm values and immigrant shares throughout the country.

Panel (a) of Figure 5 presents the geographic evolution of the Brazilian railway network over time—part of the variation that contributes to our instrumental variables strategy. The expansion of the network inland from major ports over time is clear.[33] Notably, there appears to have been an important regional component to the rail network. Rail was virtually absent from the North, and evolved into several geographically distinct networks rather than one unified one. For this reason, and because differences across regions in migrant settlement patterns, we posit, verify, and exploit the fact that the impact of rail on immigrant settlement patterns may have varied by region.

5 Empirical Strategy

Our main estimating equation for the effect of immigration on farm value is given by

$$\text{FarmValue}_i = \psi \text{ImmShare}_i + \mathbf{X}_i' \Pi + \lambda_j + \varepsilon_i,$$

where FarmValue_i is the average value per hectare of farms in municipality i, ImmShare_i is the population share of European immigrants in municipality i, λ_j are region or state fixed effects,[34] and $\mathbf{X}_i$ is a vector of municipality-level covariates that we use to control for a number of factors that may influence farm value, such as local geographic conditions—ruggedness, altitude, surface area, latitude, longitude, the interaction between latitude and longitude, and metrics capturing the quality of land for agricultural activities—and the linear and quadratic distance to the nearest port or custom house, principal city, and principal town.[35] We also control for the years a municipality was connected to the rail network and whether it had not yet been linked by 1920. Our main results are reported with robust standard errors, but all results are robust to correcting for spatial correlation (Colella et al. 2019; Conley 1999), as we show in Online Appendix B.

Regardless of the richness of our controls, estimating the causal impact of immigration on farm value is complicated by the likely endogeneity of immigrants' destination choices.[36] For instance, immigrants may have settled in places with better land quality (beyond our ability to control for it), or where other factors,

[33] The first railway station was completed in 1854. While the railway network expanded significantly into the interior starting from the last decade of the 19th century (Figure 5), Brazil's railway mileage in 1914 was equivalent to that of the United States in the 1850s (Herranz-Loncán 2014; Summerhill 2003).

[34] Online Appendix Figure A.4 presents a map of political divisions of Brazil, showing the country's regions and the states that each contains.

[35] These controls address identification concerns such as that immigrants may have settled in places with more fertile land.

[36] Notably, Lanza, Manier, and Musacchio (2023) argue that the placement of immigrants by the official immigrant recruitment system was random, which contributes to the validity of our OLS regressions. But these represented only a portion of the immigrant arrivals—which also included unsubsidized immigrants and immigrants to other states—whose effects we are interested in understanding.

such as better management, were available. Immigrants' settlement patterns may also have been influenced by local elites, whose presence could also have impacted agricultural productivity.

The direction of the resulting bias, however, is unclear. A natural concern is that our estimates would overstate the effect of immigration if immigrants were to disproportionately settle in areas where local characteristics were responsible for greater land values. But the available historical evidence suggests instead that immigrant settlement patterns were such that our estimates might instead be biased downwards.[37] In particular, there is substantial historical evidence indicating that migrants often did not settle in the most economically favorable locations. One reason is that migrants had very little information about the final destination of their migration. Even more strikingly, they sometime had little say in where they eventually settled within a state or broader region, needing to choose a destination based on labor demand during their one-week stay at the immigrant hostel (Lanza, Manier, and Musacchio 2023). This lack of choice and the limitations to free movement within Brazil for some time after arrival in the country, as well as frequent maltreatment by landowners, manifested themselves in widespread discontent on the part of the migrants, especially in the earlier phases of mass immigration (da Costa 2000; Fausto 1999). Immigrant colonies—a Brazilian peculiarity, which saw the state cooperate with private planters to create rural settlements for migrants—also highlight difficulties in the migrant experience in Brazil. Although research has shown that municipalities featuring such colonies experienced faster development later on (de Carvalho Filho and Monasterio 2012; Rocha, Soares, and Ferraz 2017), this type of migration was not generally seen as particularly fruitful by contemporaries. One reason was the perception that the migrant colonies were not located in economically favorable locations (Cameron 1931).

Migrants may also have been incentivized to settle in areas predisposed to have lower land values. For instance, some migrants may have chosen to settle in less economically dynamic areas with lower land values (to the extent they had a choice) in exchange for the prospect of an easier access to land ownership. Historians have argued that the prospect of land ownership was indeed a strong pull factor for migrants, especially for the largest immigrant group, Italians (Holloway 1980). Seeking out lower land prices was likely also salient for secondary migration following initial settlement.

Nonetheless, the potential for endogenous location choice must be addressed. To overcome the identification challenge, we implement an instrumental variable strategy based on the interaction of immigrant inflows and the expansion of the Brazilian rail network, following Sequeira, Nunn, and Qian's (2020) study of the effects of immigration during the Age of Mass Migration in the United States. The intuition of this

[37] Of course, measurement error in our regressor of interest could also be responsible for attenuating our estimates and would be addressed by instrumentation.

instrument is to compare two otherwise identical municipalities, one of which was linked just before a year of large immigrant inflows and the other of which was linked just after. Because of the importance of rail in linking migrants to their destinations, they would be more likely to settle in a municipality that was linked to rail at the time of their arrival. The municipality linked to rail just before the large immigrant inflow would thus receive immigrants from that wave, while that linked in the following year would not. These initial settlement patterns would then affect subsequent settlement patterns by creating migrant networks that subsequent immigrants might follow into these destinations (Spitzer and Zimran 2023). For this reason, even temporary migration—important in light of the high rate of return migration—would be affected by this variation.

In particular, we construct an instrument for ImmShare_i, which we refer to as AvgImmShare_i, of the form

$$\text{AvgImmShare}_i = \frac{1}{\theta_i} \sum_{t=1855}^{1920} \text{ImmFlow}_t \times \text{Railway}_{it-1}, \tag{1}$$

where ImmFlow_t is the immigration flow to Brazil year t, normalized by Brazil's population size, Railway_{it-1} is an indicator variable for the presence of a train station in municipality i in year $t-1$, and θ_i is the number of years that municipality i had been connected to the railway network by 1920.[38] This equation captures a number of refinements that we make to Sequeira, Nunn, and Qian's (2020) identification strategy. The first is that we use annual data on the state of the rail network rather than data by decade.[39] We also make a slight departure by dividing by the number of years that a municipality was linked to the rail network (θ_i) rather than the number of years in the study period, though our results are robust to using Sequeira, Nunn, and Qian's (2020) normalization.[40] Dividing by the number of years linked gives a sense of the number of immigrants that we might expect to observe at a given point in time, which is what we will see in the 1920 census.

Given the potential for heterogeneity in the predictive power of the instrument in its first stage, we interact the instrument with region indicators to exploit variation in the strength of first-stage identification

[38] In Online Appendix C, we show that our results are robust to an alternative definition of rail connectedness in which a municipality is considered connected to the rail network if another municipality whose centroid is within 100km of its own has a rail station.

[39] We focus on railway linkage in year $t-1$ rather than in year t to ensure that municipality is linked for the entire year rather than only some, potentially small, fraction.

[40] These results are available upon request.

across regions.[41] The first-stage regression equation for our IV strategy is thus

$$\text{ImmShare}_i = \gamma_j \text{AvgImmShare}_i + X_i' \Omega + \lambda_j + u_i,$$

where γ_j is a region-specific coefficient. We also show that our results are robust to exploiting variation at the state level in Online Appendix D.[42] The value of the instrument for each municipality is presented in Figure 5(b). While the geographic extent of the non-zero instrument value matches that of the railroad (by construction), as shown in panel (a), this map also makes clear that the variation across space is not precisely the same as that in panel (a)—a fact arising from the incorporation of immigrant inflows in a particular year into the creation of the instrument.

The controls most crucial to our identification are, following Sequeira, Nunn, and Qian (2020), the number of years that a municipality was connected to the railway network by 1920 and an indicator variable for municipalities that were not connected by 1920.[43] These controls address the obvious concern that rail linkage may have had direct effects on economic activity (Summerhill 2005), and that the location of rail construction was not random, likely targeting areas where economic activity was or would be greater (e.g., Atack et al. 2010; Donaldson and Hornbeck 2016; Zimran 2020).

As in the case of Sequeira, Nunn, and Qian's (2020) application of this instrumentation approach, perhaps the main identification concern facing our instrument is that municipalities connected to the railway network during an immigration boom may have been systematically different from those connected during an immigration lull. Such differences could arise if, for example, aggregate immigrant flows increased when locations with greater economic potential were connected to the railway network. This concern is mitigated by the fact that the historical literature has documented that these fluctuations were influenced by a number of global and national macroeconomic factors, including changes in the price of coffee, the increase in labor demand due to the abolition of slavery, the implementation of the Decreto Prinetti in 1902, the First World

[41] Abadie, Gu, and Shen (2023) show that limiting attention to subsamples in which the instrument does have a strong first stage can result in bias. They also show, however, that the method that we implement, also used by Deryugina et al. (2019), Dix-Carneiro and Kovak (2017), Jackson, Johnson, and Persico (2016), and Pascali (2017), provides more reliable estimates. Abadie, Gu, and Shen (2023) caution that this method may be problematic where there are many different subsamples, but our case, with five regions in Brazil, is unlikely to face such issues.

[42] Our main results include a demonstration that our results are robust to controlling for state fixed effects.

[43] As in Sequeira, Nunn, and Qian's (2020) application of this identification strategy, including these controls implies that the identification technically arises from the functional form restriction in which the control for years of rail linkage is linear whereas the instrument is a non-linear function of a municipality's years of rail linkage (since the year of linkage is the sole determinant of years of linkage). But, again as in Sequeira, Nunn, and Qian's (2020) application, the non-linearity of the instrument is not arbitrary, but is instead the product of actual variations in Brazilian immigration rates. In addition, our normalization by years linked to the network provides further non-linearity. The combination of the linear control for years of linkage, the control for whether a place was ever linked, and an instrument in which the variation is determined by immigrant arrivals is simply to ensure that the identification derives not from how long a place was linked to the rail network but only from when in the immigration cycle it was linked. We illustrate this nonlinearity graphically in Online Appendix Figure A.6.

War, and global macroeconomic shocks such as the Panic of 1907 (Hatton and Williamson 1998; Sequeira, Nunn, and Qian 2020; Spitzer 2015; Spitzer, Tortorici, and Zimran 2022). To address these concerns more formally, we follow Sequeira, Nunn, and Qian (2020) by comparing the observable characteristics of locations that became linked during immigration lulls to those linked during immigration booms.[44] We operationalize this test by defining booms as years with an immigrant inflow above the previous five years' moving average and defining lulls conversely. The booms and lulls are identified in Figure 1. Columns (1)–(3) of Table 1 present the means of the observable characteristics for the full sample and for each group of locations. Column (4) tests for the statistical significance of differences between the groups, finding that the two sets of municipalities were, in fact, systematically different, though these differences were, for the most part, with respect to geographic variables, capturing the gradual rollout of the railway from the coast. But columns (5) and (6), which repeat the analysis controlling for region and state fixed effects respectively, show that the differences are largely explained by the linkage of different parts of the country at different times, and that within region and states the differences are statistically significant in only a small number of cases. Thus, the evidence does not support concerns that railway expansion may have responded to immigrant inflows or vice versa.

6 Main Results and Robustness

Table 2 presents our main results, estimated both by OLS (panel A) and using the instrumental-variables strategy introduced above (panel B). All variables discussed in this table are standardized, meaning that the coefficients can be interpreted as standard deviation changes in the outcome variable induced by a one-standard deviation increase in the share of European immigrants. Columns (1)–(4) use total farm values per hectare as the outcome, while columns (5)–(7) divide the farm value outcome into its constituent components—land, infrastructure, and tools and machines. Our OLS results reveal a statistically significant positive relationship between the share of European immigrants and farm value per hectare: a one-standard deviation increase in the immigrant share was associated with a 0.6-standard deviation increase in farm value. Adding controls for land quality (column 2), distance to domestic and international markets (column 3), and state fixed effects (column 4) has only a negligible effect on the magnitude of the estimates and has little impact on their precision. Dividing farm value into its constituent components shows that the effect of immigration was realized for all three—roughly equally for land and infrastructure, and with a somewhat

[44] In order to use the 1872 census for this test, we aggregate our 1920 municipalities into larger minimum comparable areas. See the notes to Table 1 and Online Appendix Figure A.7.

smaller effect for tools and machines. The results for the individual components of value help to shed light on the mechanisms for immigration's effect. Notably, that the effect goes beyond the value of land alone suggests that the results are not purely the product of greater demand for land or of local amenities capitalized into the value of immobile factors (Bleakley and Rhode 2022). The effect on tools and machines also indicates an interesting complementarity between immigration and capital. We investigate these potential mechanisms in more detail below.

Panel B of Table 2 presents our instrumental variables estimates. This panel shows, in support of the relevance of our instrument, that our first-stage F-statistics are nearly 5 times larger than the weak instrument critical value of the LIML estimator with one endogenous regressor and 5 instruments, 4.84 (Bound, Jaeger, and Baker 1995; Stock and Yogo 2005).[45] Our IV estimates corroborate the OLS estimates of panel A, revealing a statistically significant positive effect of a greater share of European immigrants on farm values in general and on each component. In our preferred specification in column (4), which controls for state fixed effects, we find that a one-standard deviation increase in the share of immigrants yielded approximately a 0.7-standard deviation increase in farm value.

In Table 3, we verify the robustness of our results to a number of sample restrictions.[46] These sample restrictions address concerns that should, in principle, be addressed by our instrumental variables strategy, but which are nevertheless useful in ensuring that specific subsets of our sample are not driving our results.[47] In Panel A, we exclude municipalities that contained immigrant colonies. These settlements were the product of partnerships between private planters and national or state governments, which led to the creation of new rural communities. This form of immigration has been associated with faster economic development as a result of greater human capital accumulation (Rocha, Ferraz, and Soares 2017), but may also have been built in economically unfavorable locations (Cameron 1931). Given the peculiar developmental history of these places, their farm value could have been the product of forces other than immigration. In Panel B, we exclude areas that were large producers of coffee in order to account for the crucial role that this commodity played in shaping local development and attracting immigrant labor force. We define large coffee producers as those municipalities in the top decile of agricultural land share dedicated to coffee production. Concretely, this translates into excluding municipalities with a share of land dedicated to coffee production above 60

[45]We use LIML given that the critical values for this estimator decrease as the number of excluded instruments increases, a property that fits our setting well, but the results are very similar if we employ two stage least squares, as shown in Online Appendix E. This is important as some of our robustness checks are based on 2SLS estimation. Our F-statistics are also greater than thresholds for smaller numbers of instruments, which may be important given that not all of the 5 instruments may enter into the first stage significantly.

[46]We do the same for the individual components of farm value in Online Appendix F.

[47]Online Appendix Figure A.5 shows which municipalities are dropped in each case.

percent.[48] In Panel C, we exclude municipalities obtaining a railway station in the first three decades of the rail network expansion. It is possible that municipalities connected earlier may have been systematically different from those connected later on in a way that our controls are not be able to capture. Finally, in Panel D we exclude large population centers—defined as municipalities in the top quartile of the population distribution in 1920—in order to address the concern that economic centers may be significantly influencing our results or that agriculture may not have been particularly important in these places. In all cases, we find no reason to believe that our results were driven by any of the concerns that we address, and, in general, we find little evidence that these concerns even influenced the magnitude of our estimates.

7 Mechanisms

Having established a large, robust causal effect of European immigration on farm value, we now examine potential mechanisms that may explain this effect. We approach this exercise in three steps. First, in Table 4, we use our instrumental variables strategy to test whether the variables that operationalize our proposed mechanisms were, in fact, affected by immigration. Next, in Table 5, we evaluate the impact of controlling for this mechanism on the coefficient on the European share in our instrumental variables analysis, as in Panel B of Table 2, with column (7) of this table showing the impact of controlling for all mechanisms. Finally, in Table 6 we implement a Gelbach (2016) decomposition to determine the degree to which the coefficient on the European share is changed by including the proposed mechanism as a control when all mechanisms are included.[49]

7.1 Labor Force

The first mechanism that we test attributes the effects of immigration directly to its role in increasing the size of the labor force in a particular place. That is, immigration may have increased the number of available workers, enabling the exploitation of land, just as the official immigration program intended. A greater population may also have increased local demand for land (though our results above for the components of farm value suggest that the latter mechanism is unlikely to explain our results). We operationalize demand

[48] We obtain similar results if we drop the top decile of municipalities by agricultural land area dedicated to coffee, or the top decile of municipalities by volume of coffee production. The former approach, as shown in Online Appendix Figure A.5, involves excluding the bulk of São Paulo's coffee-producing region, which stands out in Figure 4. These results are available upon request.

[49] Note that because of technical difficulties arising from our use of multiple instruments the decomposition is performed for the OLS analog of the regressions, not for the IV estimates, so the decomposition is not precise. But given the similarity of the OLS and IV results, this is not a major concern.

for land using population density and the agricultural labor supply using agricultural employment density (i.e., the number of agricultural workers per hectare).

These mechanisms, however, are not supported by the data. In columns (1) and (2) of Table 4, we find no statistically significant relationship between immigration and either population density or agricultural employment density. Indeed, the point estimates are negative, contrary to the effect of immigration on density that would be required under such a mechanism. Consistent with this finding, although column (2) of Table 5 shows that both measures of the availability of labor were positively related to the value of farms, the European share coefficient is only minimally changed by the introduction of the labor force variables. This result is confirmed by the Gelbach (2016) decomposition in Table 6, which shows, both for farm values in total and for each individual component, that the inclusion of labor force variables has a relatively small (in comparison to the other mechanisms that we explore below) impact on the coefficient on the European share of population with virtually all of the effect operating through the value of land. These results rule out what is perhaps the most obvious mechanism for the effect of migration on farm prices, showing instead that the effect of immigration is connected to some peculiar characteristic of the immigrant labor force rather than merely its presence.

7.2 Land Use

The next set of mechanisms that we investigate concerns the use of land—specifically cultivation intensity and the crop mix. We capture cultivation intensity with the share of farmland cultivated (as opposed to being left fallow or forest). We measure the crop mix using two variables—the share of cultivated land dedicated to coffee and the share of cultivated land dedicated to other cash crops (cotton, cocoa, sugarcane, tobacco, castor beans, and rubber).[50] The hypothesis is that some characteristic of the immigrants enabled a more intensive production of coffee, and more generally may have either incentivized or enabled a change in the crop mix. Immigrants may have also enabled greater utilization of the available resources, leading, for example, to more intense cultivation of land. There is historical evidence pointing in this direction, as immigrants under the subsidy program were able to, and derived a substantial share of their incomes, from using the land between rows of coffee trees to cultivate other crops (Holloway 1980, p. 30).

Column (3) of Table 4 shows that a greater share of Europeans increased the share of farm land cultivated. Columns (4) and (5) show that a greater immigrant share led to a greater share of land devoted to coffee production, but had no impact on the share of land devoted to other cash crops. Columns (3) and (4) of

[50]The residual category is "staple" crops (rice, maize, wheat, beans, potatoes, manioc, and coconut).

Table 5 control for the cultivated share of farms and for the crop mix, respectively. These factors were both associated with greater farm values, and their inclusion leads to a substantial decline in the magnitude of the European share coefficient, which constitutes evidence that these are mechanisms through which the effect of the immigration share passed. This is confirmed by the Gelbach (2016) decomposition in Table 6, which shows that it was the cultivated share of farms that was responsible for the bulk of the reduction in the effect of the share of Europeans on farm values. The production of coffee, while responsible for a non-negligible change in the immigrant share coefficient, particularly with respect to the value of tools and machines, appears to have been a less important mechanism despite the links between immigration and coffee production.

Based on these results, we conclude that European immigrants enabled a greater share of farm land to be cultivated, raising the value of the farm. As shown above, however, this was not the product of immigrants providing labor where it was absent. Instead, it appears that immigrants provided some peculiar benefit that was unique to them. We argue that this peculiar characteristic of immigrants was that they exerted greater labor effort than native workers, and in particular that temporary immigrants exerted greater labor effort than natives or permanent immigrants. A substantial literature has shown, both theoretically and empirically, that when immigration is temporary, immigrants substitute inter-temporally, exerting greater labor effort in the destination while enjoying greater leisure when returning home.[51] Given the high rates of return migration to Europe from Brazil, it is plausible that this inter-temporal substitution operated in our case. The historical literature has also highlighted that migrants were reputed for their labor effort (Cinel 1991; Florea 2023; Holloway 1980; Sánchez-Alonso 2007). The historical literature also provides evidence of a potentially related mechanism in which permanent immigrants who did not yet own land but who sought to transition into landownership would have been incentivized to increase their labor effort until they had saved sufficiently to acquire land. Indeed, the historical literature has highlighted that one of the incentives driving immigrants in exerting labor effort was the possibility of eventually owning land (Holloway 1980; Lesser 2013).

Table 7 presents evidence substantiating this view based on the logic that, if the effect of immigrants on farm values came from temporary migrants, then permanent immigrants in the form of foreign-born land owners should not exhibit the same effect. Columns (1) and (2) use the same municipality-level data from the 1920 Census as in our analysis above. Column (1) shows that a greater share of European immigrants

[51]In particular, see Dustmann (1994, 2000), Dustmann, Bentolila, and Faini (1996), Dustmann and Görlach (2016), Epstein and Venturini (2011), Galor and Stark (1991), Hill (1987), Klinthäll (2006), Kyarko and Chartouni (2017), Vijverberg and Zeager (1994), and Wahba (2022).

led to a greater share of farms that were foreign owned. But in column (2), we find no evidence that foreign ownership was associated with greater farm values; indeed, the point estimate for the coefficient on the share of farms owned by the foreign born is negative.[52]

The 1920 census, however, does not enable us to explicitly separate native- and foreign-born agricultural workers (it permits only the observation of the share of Europeans in the whole population). The 1904–1905 Agricultural Census of the State of São Paulo, however, makes such a distinction, and also provides information on land values, the nationality of farm owners, and number of foreign and domestic workers for over 40,000 farms across 163 municipalities (Secreteria da Agricultura 1906–1910). Moreover, because the data are reported at the level of the farm rather than the municipality, we can include municipality fixed effects in order to exploit only within-municipality variation. Column (3) of Table 7 substantiates our main result using the farm-level data, showing that a greater share of foreign-born workers was associated with greater land values. Column (4) shows that foreign ownership had no such association. Column (5) includes both variables in the regression. While we continue to find that a greater share of foreign-born workers was associated with greater land values, the effect is completely dissipated for farms owned by a foreign-born individual—the coefficient on foreign ownership is statistically significant and *negative*. Moreover, the magnitude of the estimate is such that foreign ownership almost entirely eliminates the benefit of a one-standard deviation increase in the share of foreign workers.

Altogether, the results of Table 7 are consistent with immigrants exerting greater labor effort as long as they were temporary immigrants, but reverting away from this exertion upon purchasing land and becoming a permanent immigrant.

7.3 Tools and Machines

We also consider the adoption of agricultural tools and machines as a potential mechanism for the effect of immigration. We build on our finding that immigration increased all components of farm value, including that of tools and machinery and on Lanza, Manier, and Musacchio's (2023) findings that immigration under the subsidized immigration program in São Paulo state led to greater adoption of agricultural tools and machines. We operationalize this mechanism using the share of farms in the municipality that had agricultural tools or machines. Column (6) of Table 4 shows, consistent with our results in column (7) of Table 2, that immigration led to a greater share of farms using tools while column (7) shows that that immigration had no effect on the share of farms using machines. Such a relationship can be rationalized by

[52] We perform this exercise while recognizing the potential endogeneity of the share of farms owed by the foreign born in addition to the European share of population.

considering tools as complementary to labor and machines as substitutes (Lanza, Manier, and Musacchio 2023). In Table 5, we find that farms that adopted agricultural tools were indeed more valuable, though the effect is less than 0.2 standard deviations, and that the size of the European migrants share coefficient is reduced by around 0.12 standard deviations when it is included. Notably, columns (2) and (3) of Table 6 show that the tool mechanism goes beyond the mechanical channel of increasing the tools and machines component of farm values—tools are also responsible for reducing the coefficient on the immigrant share for the land and infrastructure components of value as well. The magnitude of the impact is about one-third that of the share of farms cultivated, and so we view the tools mechanism as second order in comparison to it.

8 Implications for Development and Structural Change

Our analysis has established a robust and quantitatively large positive effect of European immigration on the agricultural sector in Brazil. As outlined in section 3 above, there are a variety of possible implication of this effect for the rest of the Brazilian economy and its transition to industrialization and sustained economic growth beyond the primary sector.

An important caveat is that we can only answer this question in the short run, since we observe our outcomes shortly after the end of mass migration. In principle, development and structural transformation may have continued along the same lines or changed direction in unpredictable ways in the decades after our outcomes are observed, for instance due to a lag in the manifestation of the effects of migration through channels like human capital accumulation. At the same time, our short-term analysis has the advantage of not being influenced by subsequent events, such as the introduction of import substitution policies and the many regime changes experienced by Brazil from the 1930s until the 1980s, which had their own, sometimes substantial, economic consequences (Ferraz, Finan, and Martinez-Bravo 2022).

In Table 8, we implement our IV strategy as above, but focus on a variety of outcomes that capture differences in human capital formation (panel A), economic structure (panel B), state capacity (panel C), and female labor force participation (panel D). For each set of variables, we present two specifications—one including the whole sample and another in which we exclude large population centers (as above, these are municipalities in the top quartile of population) in order to ensure that places that may not have been particularly reliant on agriculture to begin with do not drive our results. On the whole, we find no evidence that migration negatively affected other parts of the economy, or that it slowed down structural transformation. In fact there are indications that the reverse may have been true.

Human capital formation has previously been positively linked to immigration in Brazil (de Carvalho Filho and Monasterio 2012; Rocha, Ferraz, and Soares 2017; Witzel de Souza 2018), although not in a causal framework such as ours. We capture human capital by analyzing the literacy rates of the whole population, of natives, of females, and of children between the ages of 7 and 14. These variables are intended to capture spillovers from migrants to the rest of the population. We find that European immigration had a strong positive effect on all of our literacy measures: a one-standard deviation increase in the share of migrants in the population led to a 0.7–0.8-standard deviation increase in each of the measures of literacy. The positive link between immigration and human capital found in previous work is thus confirmed. This is not surprising: immigrants had greater human capital to begin with and they were often successful in lobbying for the creation of schools (de Carvalho Filho and Colistete 2010). These schools were presumably one of the channels through which the provision of education improved at the local level, leading to higher literacy for the overall population.

Next, we focus on employment shares by sector, and specifically on the share of the labor force employed in agriculture and in industry. These measures give an indication of the degree to which immigration aided or slowed down structural change. We also study the effect of immigration on two variables capturing the presence and influence of local landed elites. The first is the share of population made up of rentiers—people relying on returns to wealth as their main source of income. The second is the share of the population employed in public administration, capturing the tendency for local oligarchs to exert their influence by placing loyalists in public administration (Graham 1990). Indeed, many parts of Brazil were characterized by a plantation-based agricultural sector and connected oligarchic system known as *coronelismo*, in which local landed elites offered votes in exchange for aid, employment, and protection, in a classic example of clientelism and patronage (Nunes Leal 1977; Woodard 2005).[53] The influence of landed elites is connected with underdevelopment in the Brazilian context, as the rapid growth following the military coup of 1964, which weakened these elites' grip on power, demonstrates (Ferraz, Finan, and Martinez-Bravo 2022).[54]

We find that municipalities with more migrants had a lower share of workers employed in agriculture, even when excluding large urban centers.[55] We also find suggestive evidence that a greater immigrant

[53]This phenomenon was particularly severe in rural areas, but the situation was only marginally different in coastal cities and other urban centers, where other power groups, such as merchants and professionals, exerted influence alongside traditional elites

[54]It is important to note for our discussion of state capacity below that neither the oligarchs nor their clients in public administration were keen to increase public revenues, given that they were mainly interested in power and authority, not direct embezzlement or corruption involving public funds (Abreu and Lago 2001; Graham 1990). This ensures that oligarchic entrenchment and fiscal capacity remain distinct in our analysis.

[55]Note that the outcome in this case is the share of agricultural workers out of the labor force. The analysis in Tables 4, 5,

share led to a higher share of workers employed in industry, as indicated by the positive coefficient for industrial employment, though the result is not statistically significant. In any case, we find no evidence that immigration *reduced* industrial employment, which would indicate a slowing of structural change. In fact, our results on the whole point to a valuable agricultural sector that demanded less, not more, labor. This supports the view of agricultural development as a driver of overall economic development. We also find no relationship between immigration and rentiers or public administration employees. Thus, immigration, despite its positive effect on the agricultural sector, did not create a larger class of people living off their landed property or an inflated public sector.

We focus next on state capacity, which is a firmly established contributor to economic development.[56] We concentrate specifically on the ability of local governments to collect taxes (i.e., fiscal capacity) and on their provision of public goods. We measure fiscal capacity using total tax revenues per capita, and tax revenues per capita excluding export taxes. We exclude export taxes because trade taxes are generally considered an indicator of low fiscal development, as opposed to direct taxes, and they are also strongly related to the importance of the agricultural sector in the Brazilian setting, making them a poor measure of development beyond primary production. We measure public good provision using per capita expenditure on education and on public services.[57]

We find that European immigration was strongly positively associated with greater fiscal capacity, particularly when export taxes are excluded, and when major urban centers are left out of the sample. We also find suggestive evidence of higher per capita expenditure on public services in response to immigration, although these estimates are not uniformly statistically significant. Altogether, these results indicate greater state capacity in places with greater immigration.

Finally, we analyze the effect of immigration on the sex ratio, measured as women per man. We examine this ratio in the population as a whole, in total employment, and in two key economic sectors—agriculture and industry. Migration during the Age of Mass Migration was male dominated (Hatton and Williamson 1998), leading to potentially severely skewed sex ratios in locations where more migrants settled. Skewed sex ratios, in turn, can have adverse consequences for attitudes towards women in the workplace and female labor market participation (Grosjean and Khattar 2019). The economic changes arising from immigration may have also reduced employment opportunities for women, who, in the Brazilian context, found gainful

and 6 above focused on the ratio of agricultural employment to area.

[56] See Acemoglu (2005), Bardhan (2016), Becker et al. (2022), Besley and Persson (2010), Dincecco and Katz (2016), Dincecco and Prado (2012), Dittmar and Meisenzahl (2020), Epstein (2000), Hoffman (2015), and Johnson and Koyama (2017).

[57] Public services comprise public hygiene, assistance and aid, police, justice and electoral services, infrastructure and sewers, and public lights. The residual categories are the costs of running the local public administration and expenses related to public debt. For more information on local finances in Brazil in this period see Papadia (2019).

employment in the industrial and service sectors more often than in the primary sector (Pena 1981). In turn, reduced opportunities for women and a generally lower labor market participation may have negatively effected economic development.

As expected, we find a more male-skewed sex ratio in municipalities with more immigrants. The effect is large both for the overall sample and when we exclude major population centers. But this male-skewed sex ratio in the population does not translate into a statistically significantly male-skewed sex ratio in either overall employment or employment in agriculture and industry. The lack of such an effect suggests the presence of countervailing forces, which led to women compensating for the lower presence in the population with greater labor force participation.

9 Conclusion

In this paper, we aim to better understand the effects of immigration on the receiving economy in the context of a developing-country destination. As a fundamental component of the economics of immigration (Bansak, Simpson, and Zavodny 2020; Borjas 2014), the effects of immigration have been widely studied, but almost exclusively in developed-country contexts, where the effects may be differ from those in developing countries. Our study is situated in the context of Brazil in the Age of Mass Migration, enabling us to benefit from the broad utility of studying this period for the economics of immigration and specifically from Brazil's unique position in this context as a destination that more closely parallels migration to modern developing countries than to developed ones. Focusing on Brazil's agricultural sector, we find that immigration led to an increase in farm values per hectare, coming primarily from an increase in the share of land cultivated—a mechanism that we, in turn, attribute to the exertion of greater labor effort by temporary immigrants relative to natives and permanent immigrants. We find no evidence that this agricultural development slowed Brazil's structural transformation; indeed we find suggestive evidence that it may have accelerated it by fostering human capital accumulation, reducing agricultural employment, and increasing female labor market participation. Thus, immigrants enabled this developing country to exploit its natural resource endowments, and may have eventually set it on the course of broad-based economic development.

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Figures

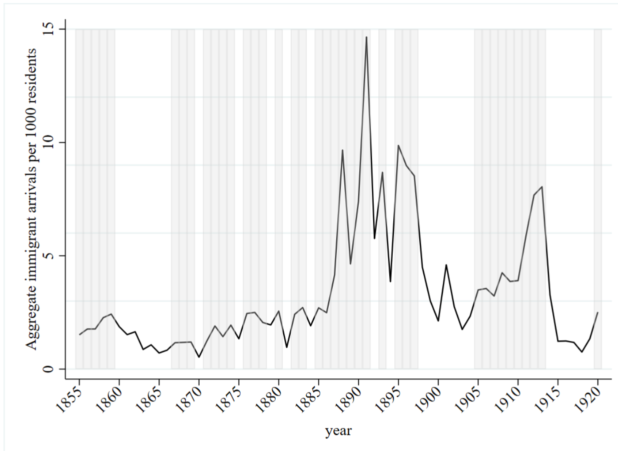


Figure 1: Immigrant arrivals to Brazil by year, and immigration lulls and booms

Note: Shaded areas are immigration booms, defined as years with an immigrant flow above the previous five years' moving average. The remaining periods are lulls. Gaps in the population data are linearly interpolated.

Source: Directoria Geral de Estatística (1908) and Instituto Brasileiro de Geografia e Estatística (1954) for aggregate immigration numbers. Bolt and van Zanden (2020) and Instituto Brasileiro de Geografia e Estatística (1954) for population numbers.

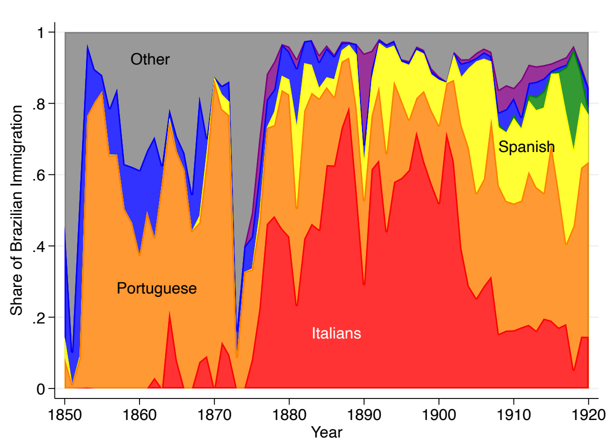


Figure 2: Distribution of origin countries for Brazilian immigration

Note: This graph shows the share of immigration to Brazil coming from each source country. The color key is as follows: Italians (red), Portuguese (orange), Spanish (yellow), Japanese (green), Germans (blue), Russians (purple), and other (gray).

Source: Directoria Geral de Estatística (1908) and Instituto Brasileiro de Geografia e Estatística (1954).

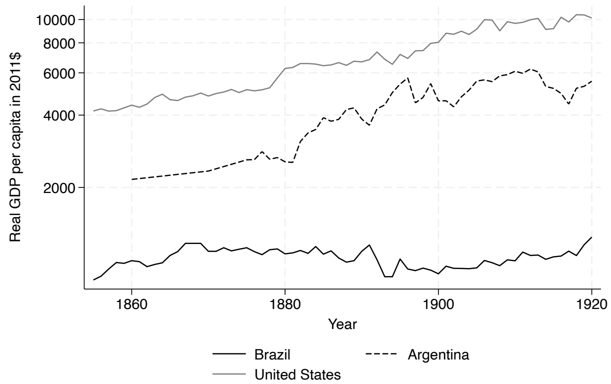
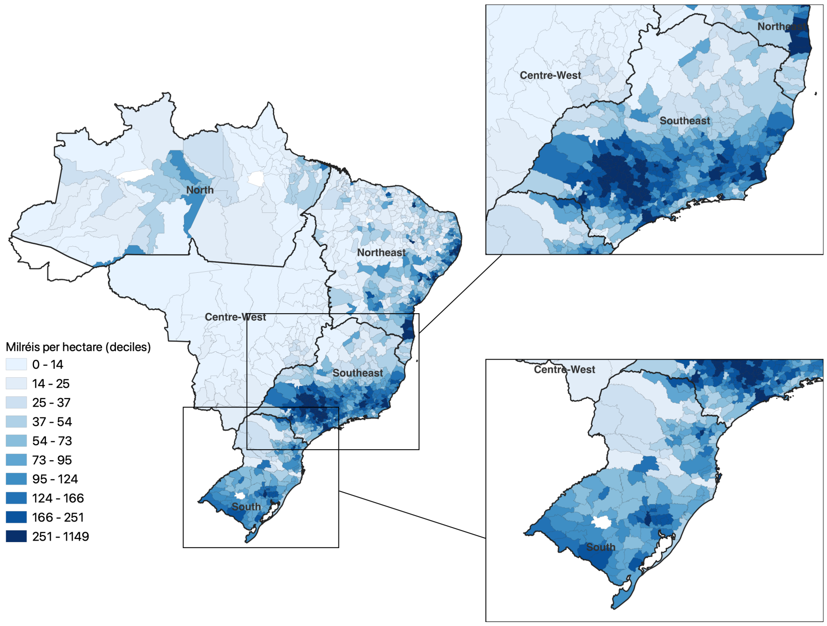


Figure 3: Real GDP per capita in major immigrant destinations

Source: Brazil: Barro and Ursúa (2008), Bolt and van Zanden (2020), and Prados de la Escosura (2009); US: Bolt and van Zanden (2020), Prados de la Escosura (2009), and Sutch (2006); Argentina: Bértola and Ocampo (2012), Bolt and van Zanden (2020), and Prados de la Escosura (2009).

(a) Farm value per hectare



(b) Population share of European immigrants

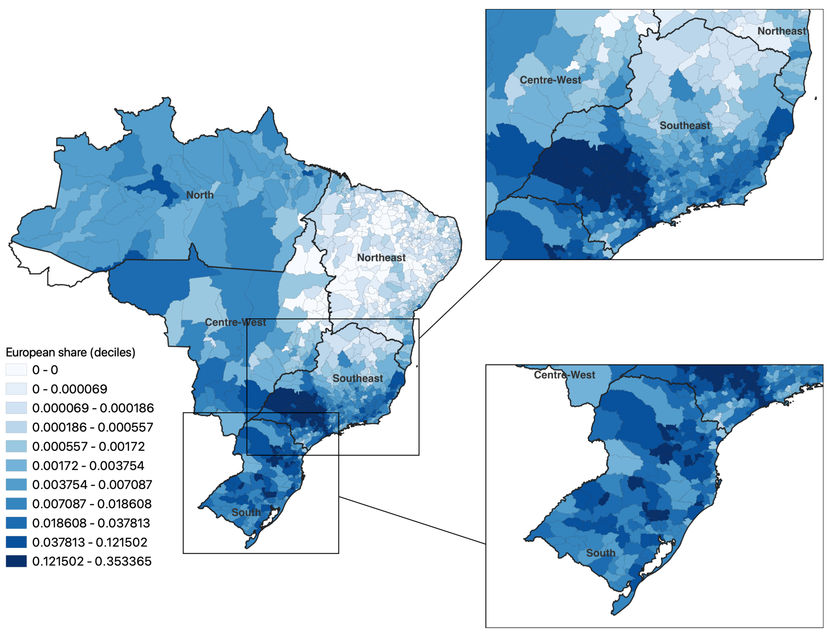
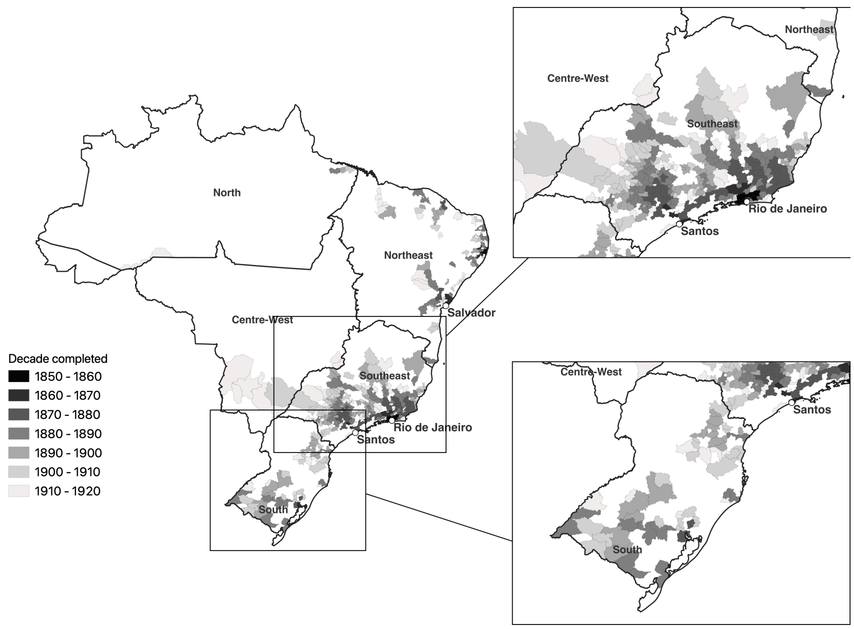


Figure 4: Farm values and immigration

Source: Directoria Geral de Estatística (1922) and Instituto Brasileiro de Geografia e Estatística (2011)

(a) Expansion of Brazil's railway network (1850–1920)



(b) Predicted share of European immigrants

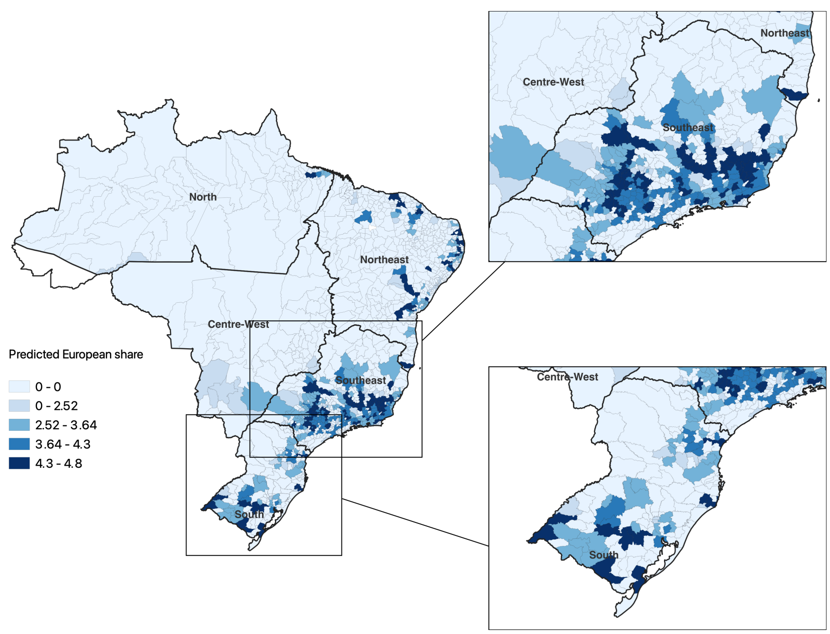


Figure 5: Geographic distribution of the railway and the instrument

Source: Directoria Geral de Estatística (1922), Giesbrecht (2023), and Instituto Brasileiro de Geografia e Estatística (2011).

Tables

Table 1: Balance test for observables: rail connection during immigration booms and lulls

	Full sample	**Boom**	**Lull**	**Difference**	**Cond. Diff. Regions**	**Cond. Diff. States**
	(1)	(2)	(3)	(4)	(5)	(6)
Euro share 1872	0.01	0.02	0.01	-0.01	-0.01	-0.00
Population 1872 (1,000s)	16.41	20.79	17.66	-3.12	-3.41	-1.27
Agricultural employment 1872	0.31	0.32	0.29	-0.03*	-0.03*	-0.03**
Justice work. 1872	0.24	0.23	0.29	0.06	0.05	0.04
Slave share 1872	0.14	0.17	0.15	-0.02	-0.00	0.00
White share 1872	0.38	0.43	0.41	-0.02	0.00	0.01
Literacy 1872	0.15	0.15	0.16	0.01	0.01	0.01
School attendance 1872	0.13	0.12	0.14	0.01	0.01	0.01
Distance (port/custom house)	249.70	221.06	186.05	-35.01	-3.86	1.35
Distance (city)	50.15	43.97	33.18	-10.80**	-8.22*	-6.59
Ruggedness	100.95	120.53	100.40	-20.13**	-11.35	-6.37
Altitude	401.77	495.58	404.27	-91.30**	-23.27	-7.50
Latitude	-14.25	-18.42	-16.44	1.98*	0.02	-0.16
Longitude	-43.58	-44.37	-43.02	1.35*	0.00	-0.05
Land quality	-0.01	-0.31	-0.30	0.01	-0.16	-0.11
Observations	605	168	77	245	245	245

Notes: *** p<0.01, ** p<0.05, * p<0.1. Column (1) shows the average value of each variable for the whole sample (including municipalities never linked to the railroad). Columns (2) and (3) show the averages for the two groups of municipalities—those connected during a boom in aggregate immigration and those connected during a lull. Booms and lulls are defined and illustrated in Figure 1. Column (4) illustrates the results of a equality of means test; columns (5) and (6) do the same conditioning on regional and state fixed effects respectively. For this exercise we use minimum comparable areas rather than municipalities. This is necessary to link data across census years, given the creation and suppression of municipalities over time. Online Appendix Figure A.7 provides an illustration of minimum comparable areas and municipalities across the Brazilian territory created to link the 1872 and 1920 census data.

Table 2: European immigration and farm value

	Farm Value per hectare				Land	Infrastructure	Tools & Machines
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A: OLS			
Share Europeans	0.586***	0.598***	0.595***	0.605***	0.568***	0.599***	0.428***
	(0.0571)	(0.0579)	(0.0570)	(0.0663)	(0.0659)	(0.0658)	(0.0548)
Observations	1,289	1,289	1,289	1,289	1,289	1,289	1,289
R^2	0.541	0.557	0.575	0.595	0.604	0.463	0.404
				Panel B: IV			
Share Europeans	0.690***	0.670***	0.735***	0.739***	0.730***	0.573***	0.744***
	(0.151)	(0.116)	(0.116)	(0.118)	(0.120)	(0.139)	(0.123)
Observations	1,289	1,289	1,289	1,289	1,289	1,289	1,289
$1^{st} stage$ F-stat	17.01	22.38	22.79	22.46	22.46	22.46	22.46
Railway years	✓	✓	✓	✓	✓	✓	✓
No rail	✓	✓	✓	✓	✓	✓	✓
Geo Controls	✓	✓	✓	✓	✓	✓	✓
Region FE	✓	✓	✓				
Land adaptability		✓	✓	✓	✓	✓	✓
Land quality		✓	✓	✓	✓	✓	✓
Dom market access			✓	✓	✓	✓	✓
Int market access			✓	✓	✓	✓	✓
State FE				✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

Table 3: European immigration and farm value, robustness tests

	Farm Value per hectare							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: no immigrant colonies				***Panel B: no large coffee producers***			
Share Europeans	0.549***	0.606***	0.667***	0.656***	0.961**	0.713***	0.823***	0.677***
	(0.149)	(0.124)	(0.123)	(0.122)	(0.425)	(0.213)	(0.212)	(0.154)
Observations	1,159	1,159	1,159	1,159	1,157	1,157	1,157	1,157
1^{st} *stage* F-stat	17.60	21.39	21.53	22.14	7.98	10.61	10.89	13.25
	Panel C: no early railway connections				***Panel D: no large population centers***			
Share Europeans	0.501**	0.566***	0.663***	0.626***	0.781***	0.710***	0.787***	0.748***
	(0.204)	(0.146)	(0.153)	(0.163)	(0.250)	(0.157)	(0.169)	(0.146)
Observations	1,111	1,111	1,111	1,111	967	967	967	967
1^{st} *stage* F-stat	13.68	17.02	16.85	20.58	11.68	14.42	14.42	16.39
Railway controls	✓	✓	✓	✓	✓	✓	✓	✓
Geo controls	✓	✓	✓	✓	✓	✓	✓	✓
Region FE	✓	✓	✓		✓	✓	✓	
Land controls		✓	✓	✓		✓	✓	✓
Market access controls			✓	✓			✓	✓
State FE				✓				✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. All regressions are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities except those indicated in the panel heading. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

Table 4: Potential mechanisms and European immigration

	Population density	**Agricultural emp. density**	**Cultivated share of farms**	**Coffee share**	**Cash crops share (no coffee)**	**Share farms with tools**	**Share farms with machines**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share Europeans	-0.235	-0.115	0.817***	1.019***	0.0225	0.698***	0.0418
	(0.181)	(0.170)	(0.181)	(0.202)	(0.118)	(0.111)	(0.143)
Observations	1,296	1,295	1,287	1,285	1,285	1,289	1,289
1^{st} stage F-stat	22.51	22.54	22.45	22.42	22.42	22.46	22.46
All controls	✓	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. All regressions are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table 5: Farm value and potential mechanisms

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	0.764***	0.770***	0.549***	0.586***	0.643***	0.341***
	(0.106)	(0.0967)	(0.127)	(0.124)	(0.127)	(0.131)
	Panel A: Labor force					
Pop density		0.106**				0.223***
		(0.0519)				(0.0650)
Agr. emp. density		0.167***				-0.0290
		(0.0456)				(0.0407)
	Panel B: Land use					
Cultivated share of farms			0.384***			0.393***
			(0.0589)			(0.0597)
Coffee share				0.218***		0.0519
				(0.0421)		(0.0319)
Other cash crops share				0.125***		0.0900***
				(0.0240)		(0.0200)
	Panel C: Tools & Machines					
Share farms with tools					0.173***	0.174***
					(0.0474)	(0.0390)
Share farms with machines					0.0207	0.00249
					(0.0182)	(0.0159)
Observations	1,231	1,231	1,231	1,231	1,231	1,231
1^{st} *stage* F-stat	25.13	27.55	17.81	17.75	18.60	12.50
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. All regressions are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table 6: Gelbach decomposition for the European share coefficient

	Outcome			
	Farm	**Land**	**Infrastructure**	**Tools & machines**
	(1)	(2)	(3)	(4)
Mechanism				
	Panel A: Labor force			
Pop density	0.058*	0.049*	0.078	0.015
	(0.032)	(0.027)	(0.050)	(0.012)
Agr. emp. density	-0.005	-0.002	-0.014	0.003
	(0.005)	(0.005)	(0.010)	(0.006)
Total labor force	0.053*	0.048**	0.064	0.018*
	(0.029)	(0.024)	(0.042)	(0.010)
	Panel B: Land use			
Cultivated share of farms	0.182***	0.173***	0.178***	0.114***
	(0.041)	(0.041)	(0.039)	(0.030)
Coffee share	0.015**	0.016**	0.004	0.034**
	(0.008)	(0.008)	(0.008)	(0.012)
Other cash crops share	-0.004	-0.004*	-0.002	-0.004
	(0.002)	(0.003)	(0.002)	(0.003)
Total land use	0.193***	0.184***	0.179***	0.144***
	(0.039)	(0.038)	(0.037)	(0.029)
	Panel C: Tools & Machines			
Share of farms with tools	0.060***	0.058***	0.046***	0.083***
	(0.012)	(0.012)	(0.011)	(0.016)
Share of farms with machines	0.000	-0.000	-0.000	0.002
	(0.000)	(0.000)	(0.000)	(0.007)
Total tools & machines	0.060***	0.058***	0.046***	0.085***
	(0.012)	(0.012)	(0.011)	(0.018)
All mechanisms	0.309***	0.285***	0.316***	0.246***
	(0.042)	(0.40)	(0.054)	(0.035)

Notes: *** p<0.01, ** p<0.05, * p<0.1. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. This table presents the results of a Gelbach (2016) decomposition for the coefficient in columns (4)–(7) of panel A of Table 2. These estimates are by OLS.

Table 7: Farm values and foreign ownership

	Municipality sample			*Farm-level sample*		
	Foreign-owned farms	**Farm value per hectare**		**Land value per hectare**		
	(1)	(2)		(3)	(4)	(5)
Share Europeans	0.812***	0.884**	Share foreign workers	0.159***		0.199***
	(0.0685)	(0.356)		(0.0241)		(0.0254)
Foreign-owned farms		-0.289	Foreign owner		0.0656	-0.177***
		(0.268)			(0.0533)	(0.0606)
Observations	1,289	1,289		40,693	40,693	40,693
1^{st} stage F-stat	22.46	9.81	R^2	0.395	0.380	0.398
All controls	✓	✓				
Municipality FE				✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. Regressions in columns (1) and (2) are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans in a sample including all municipalities where the unit of observation is a municipality. Regressions in columns (3)–(5) are by OLS using the São Paulo farm-level data. All variables are standardized to have mean zero and standard deviation one. “All controls” includes all controls in column (4) of Table 2.

Table 8: Implications for development and structural change

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: Human capital formation (literacy)							
	Population		**Brazilians**		**Females**		**Children**	
Share Europeans	0.808***	0.812***	0.761***	0.772***	0.735***	0.720***	0.753***	0.766***
	(0.181)	(0.168)	(0.181)	(0.169)	(0.187)	(0.159)	(0.162)	(0.149)
Observations	1,296	972	1,296	972	1,296	972	1,296	972
1^{st} stage F-stat	22.51	16.37	22.51	16.37	22.51	16.37	22.51	16.37
	Panel B: Economic structure							
	Employed Agriculture		**Employed Industry**		**Rentiers**		**Employed Pub. admin**	
Share Europeans	-0.418**	-0.373**	0.279	0.184	0.0969	-0.00726	-0.186	-0.0216
	(0.185)	(0.190)	(0.191)	(0.178)	(0.174)	(0.219)	(0.170)	(0.171)
Observations	1,295	971	1,295	971	1,295	971	1,295	971
1^{st} stage F-stat	22.54	16.41	22.54	16.41	22.54	16.41	22.54	16.41
	Panel C: State capacity							
	Tax		**Tax no exports**		**Public education**		**Public services**	
Share Europeans	0.553*	0.789***	0.751**	0.884***	0.162	0.0167	0.233	0.282**
	(0.326)	(0.235)	(0.324)	(0.273)	(0.143)	(0.120)	(0.204)	(0.130)
Observations	1,237	924	1,097	817	1,031	768	1,031	768
1^{st} stage F-stat	21.55	15.75	20.28	15.35	16.89	12.89	16.89	12.89
	Panel D: Female participation in labor markets (female to male ratio)							
	Population		**Employed**		**Agriculture**		**Industry**	
Share Europeans	-0.459***	-0.521***	-0.195	-0.0594	-0.243	-0.0267	0.274	0.205
	(0.131)	(0.169)	(0.144)	(0.160)	(0.180)	(0.189)	(0.178)	(0.240)
Observations	1,296	972	1,295	971	1,295	971	1,295	971
1^{st} stage F-stat	22.51	16.37	22.54	16.41	22.54	16.41	22.54	16.41
All controls	✓	✓	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. All regressions are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample in columns (1), (3), (5), and (7) includes all municipalities. Columns (2), (4), (6), and (8) exclude municipalities in the top 25 percentiles of population. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Online Appendix for

Effects of Immigration in a Developing Country
Brazil in the Age of Mass Migration

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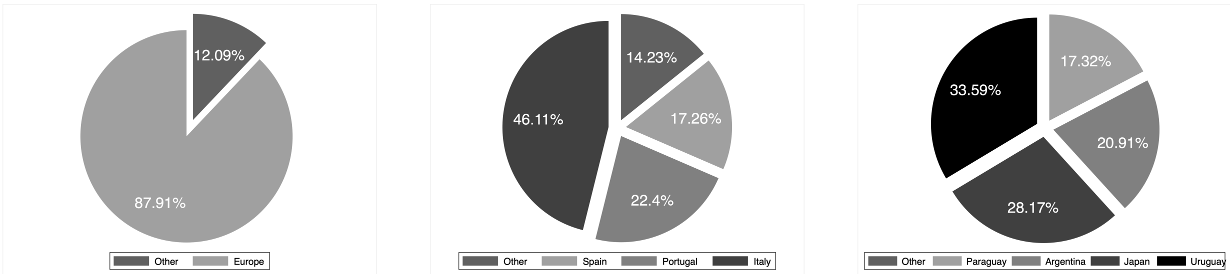
January 17, 2024

A Additional Tables and Figures



(a) Immigrant origins (b) Origin of European immigrants (c) Origin of other immigrants

Figure A.1: Immigrant composition in 1920

Note: This figure shows the share of the immigrant population coming from each country or region of origin.

Source: Directoria Geral de Estatística (1922)

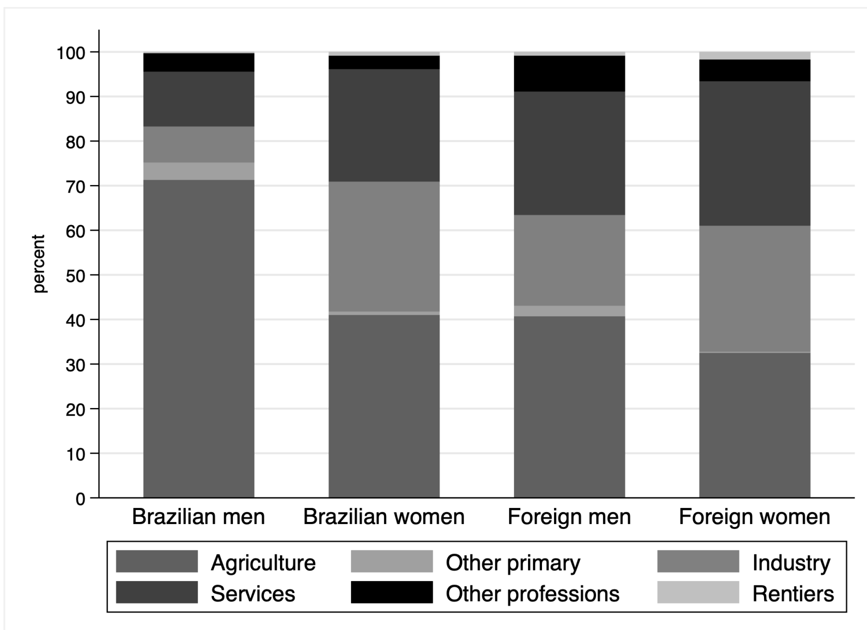


Figure A.2: Occupations of natives and immigrants.

Source: Directoria Geral de Estatística (1922)

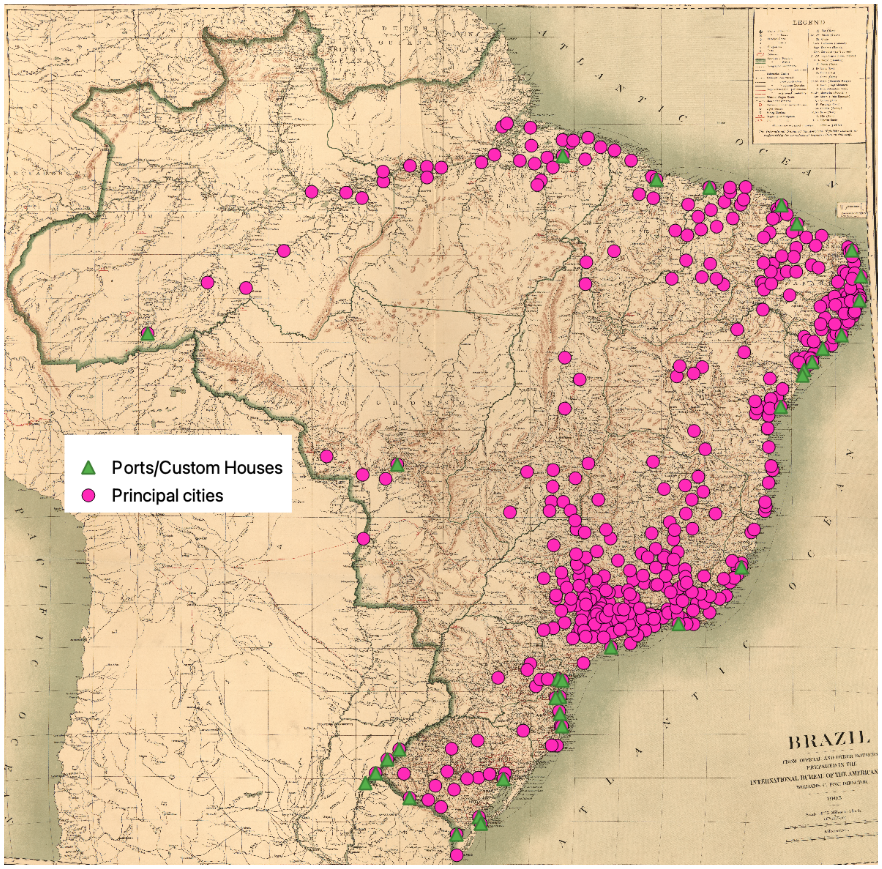


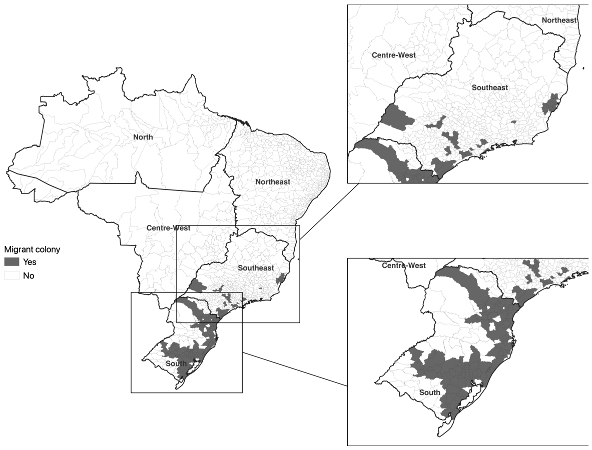
Figure A.3: Ports, custom houses, and principal cities in 1905

Source: International Bureau of the American Republics (1905)

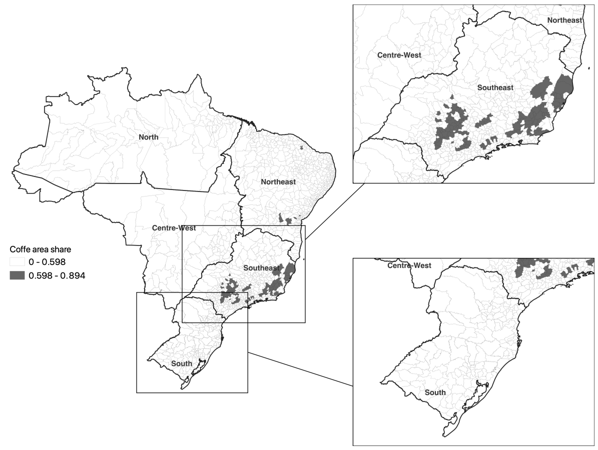
Figure A.4: Geographic divisions of Brazil

Source: Instituto Brasileiro de Geografia e Estatística (2011)

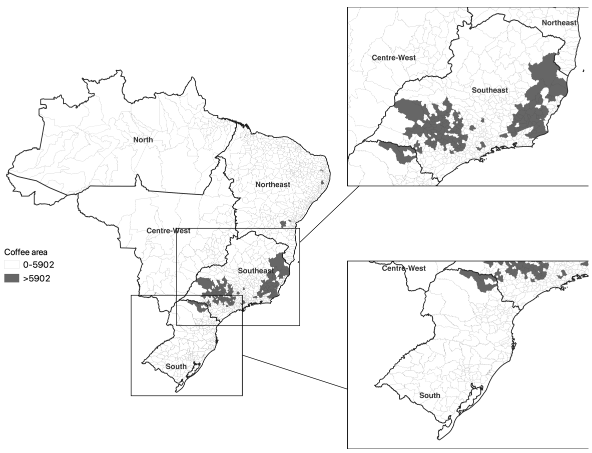
(a) Immigrant colonies



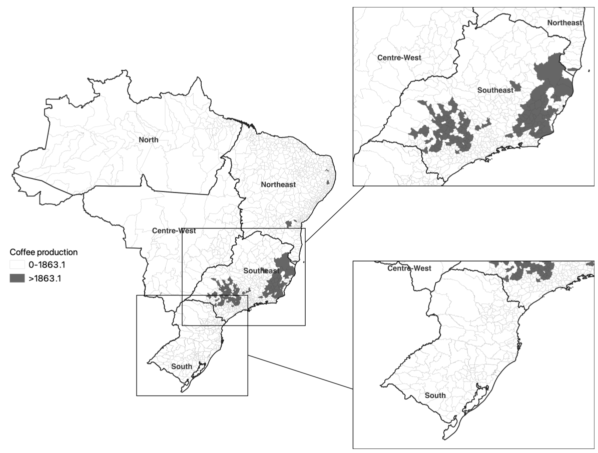
(b) Coffee land share



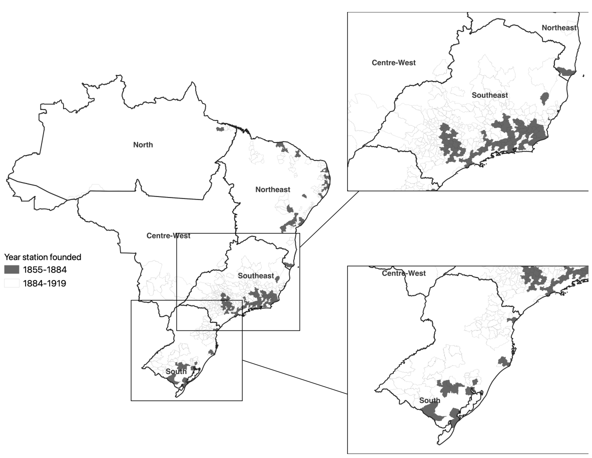
(c) Coffee land



(d) Coffee production



(e) Early rail connections



(f) Large population centers

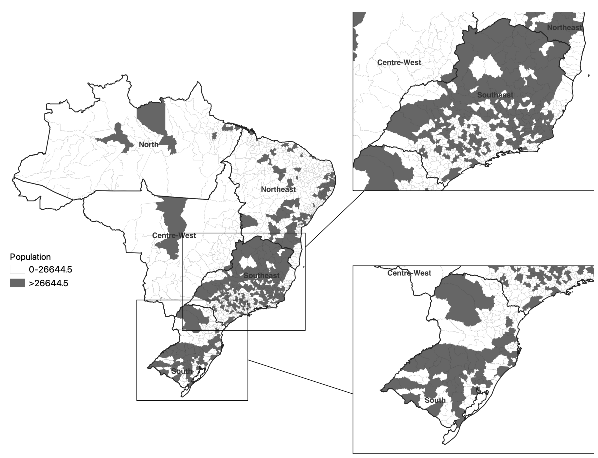


Figure A.5: Municipalities dropped in robustness checks

Note: Each panel indicates the municipalities removed from the sample in our various robustness checks.

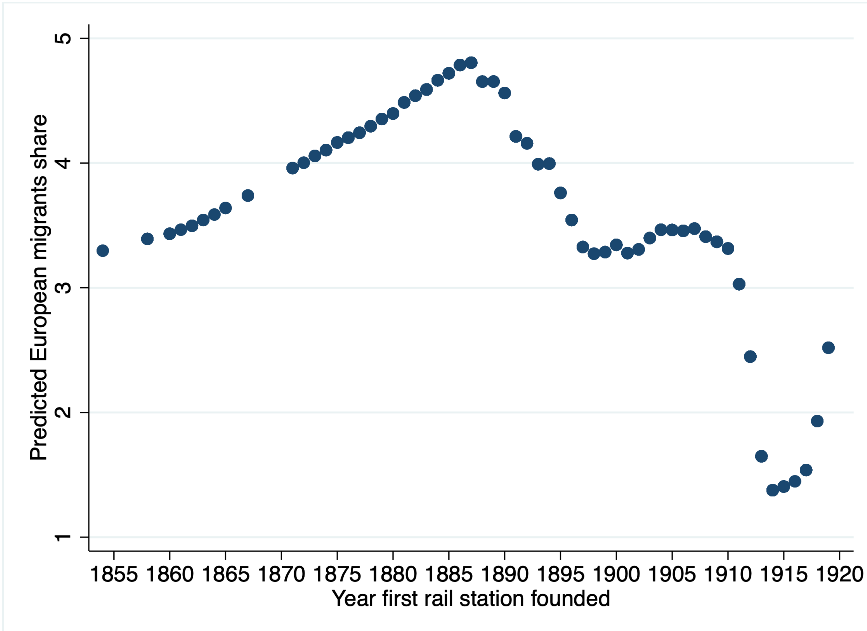


Figure A.6: Predicted European migrants by year first rail station founded.

Note: This figure shows the predicted number of European immigrants (i.e., the value of the instrument) by the year in which a municipality was first connected to the rail network.

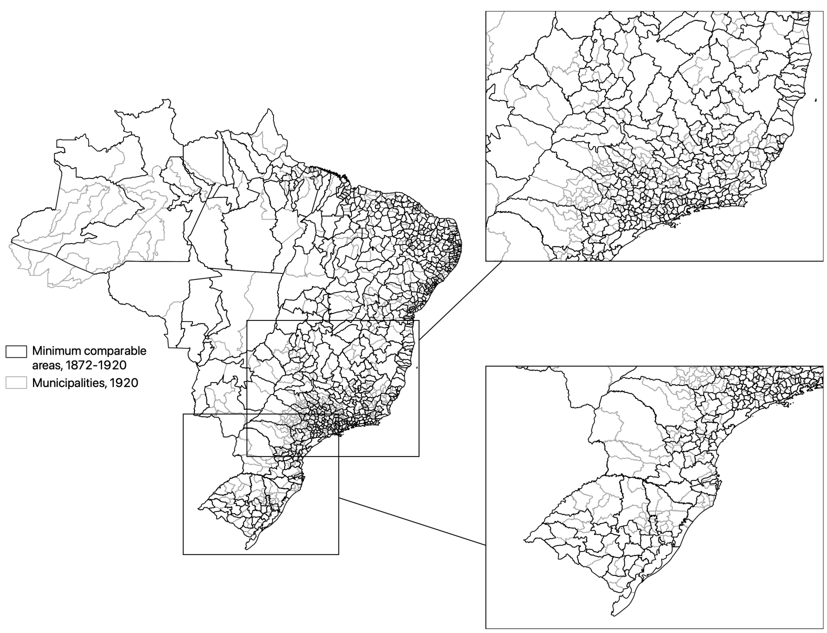


Figure A.7: Municipalities and minimum comparable areas

Source: Ehrl (2017) and Instituto Brasileiro de Geografia e Estatística (2011, 2023)

Note: The minimum comparable areas are created in order to maintain comparability between the 1920 municipalities on which our analysis is based and data from earlier censuses used in our balance tests.

Table A.1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Municipality sample					
Outcome variables					
Farm value per hectare	1289	110.94	125.148	2.081	1148.963
Land value per hectare	1289	82.426	95.278	1.565	895.033
Infrastructure value per hectare	1289	23.987	30.655	0.085	317.585
Tools value per hectare	1289	4.474	7.374	0	78.964
Literacy	1289	0.204	0.093	0.039	0.619
Brazilian Literacy	1289	0.198	0.089	0.039	0.613
Female Literacy	1289	0.157	0.09	0.027	0.606
Child Literacy	1289	0.161	0.103	0.019	0.653
Employed in Agriculture (share)	1288	0.754	0.155	0.056	0.979
Employed in Industry (share)	1288	0.094	0.074	0.003	0.525
Rentiers (share)	1288	0.001	0.002	0	0.04
Employed in public admin. (share)	1288	0.002	0.003	0	0.042
Tax per capita	1231	4.069	5.979	0.078	68.213
Tax pc ex. exports	1092	0.406	1.475	0	33.919
Pub edu. expend.	1026	0.178	0.324	0	4.013
Pub serv. expend.	1026	1.914	3.698	0	68.518
Sex ratio population	1289	0.984	0.088	0.435	1.309
Sex ratio employed	1288	0.168	0.124	0.01	1.014
Sex ratio agriculture	1288	0.105	0.112	0.004	0.79
Sex ratio industry	1288	1.002	1.723	0	17.128
Main explanatory variables					
Share Europeans	1289	0.029	0.059	0	0.353
Foreign-owned farms	1289	0.086	0.147	0	0.872
Mechanisms					
Population density	1289	22.776	48.404	0.02	1086.668
Agr. employment density	1288	4.445	5.374	0.005	55.507
Cultivated share of farm	1287	0.0835	0.108	0	0.894
Coffee cultivated share	1285	0.157	0.238	0	0.894
Cash crops cultivated share	1285	0.261	0.281	0	1
Share farms with tools	1289	0.097	0.176	0	1.087
Share farms with machines	1289	0.22	0.218	0	1
Controls					
Railway years	1289	10.453	16.219	0	66
No rail	1289	0.618	0.486	0	1
Ruggedness	1289	103.15	70.833	4.472	482.708
Altitude	1289	444.863	314.838	5.098	1376.206
Area (1000s sq m.)	1289	4.791	10.209	0.026	94.488
Latitude	1289	-15.372	8.35	-33.18	2.26
Longitude	1289	-44.591	5.931	-71.594	-34.845
Lat×Long	1289	705.15	430.884	-127.982	1759.234
Land adaptability	1289	0.015	6.388	-23.097	9.51
Land quality 1	1289	-0.003	1.922	-6.273	3.636
Land quality 2	1289	0.001	1.855	-5.006	3.084
Port/cust. house dist. (int. markt. acc.)	1289	251.916	219.331	4.281	1460.116
Sq. of port/cust. house dist.	1289	111530.3	200638.4	18.331	2131938
City dist. (dom. markt. acc.)	1289	55.248	74.002	.341	855.185
Sq. of city dist.	1289	8524.373	35756.15	0.116	731340.8
Panel B: Farm-level sample					
Land value per hectare	40693	245.333	269.56	1.21	7260
Foreign workers share	40693	0.248	0.391	0	1
Foreign owner	40693	0.17	0.375	0	1

Table A.2: Summary statistics for selected variables by region

Variable	**Brazil**	**North**	**Northeast**	**Center-West**	**Southeast**	**South**
			Panel A: Outcome variables			
Farm value per hectare	110.94	30.056	78.385	12.904	180.449	101.337
N	1289	81	525	70	460	153
SD	125.148	26.388	87.333	9.213	158.866	59.291
Land value per hectare	82.426	19.414	54.762	10.103	137.741	77.489
N	1289	525	70	460	153	
SD	95.278	15.424	63.882	7.187	121.399	41.838
Infrastructure value per hectare	23.987	9.791	20.006	2.616	35.58	20.083
N	1289	81	525	70	460	153
SD	30.655	12.633	25.377	2.735	38.537	19.403
Tools value per hectare	4.474	0.85	3.485	0.185	7.128	3.765
N	1289	81	525	70	460	153
SD	7.374	1.809	6.995	0.303	8.571	5.268
Literacy	0.204	0.241	0.153	0.19	0.225	0.303
N	1289	81	525	70	460	153
SD	0.093	0.067	0.066	0.079	0.08	0.111
Employed in Agriculture (share)	0.754	0.77	0.759	0.696	0.766	0.725
N	1288	81	524	70	460	153
SD	0.155	0.152	0.158	0.167	0.14	0.177
Employed in Industry (share)	0.094	0.056	0.102	0.125	0.09	0.084
N	1288	81	524	70	460	153
SD	0.074	0.037	0.082	0.104	0.063	0.062
			Panel B: Main explanatory variables			
Share Europeans	0.029	0.008	0.001	0.005	0.061	0.051
N	1289	81	525	70	460	153
SD	0.059	0.018	0.002	0.009	0.079	0.061
Foreign-owned farms	0.086	0.074	0.006	0.019	0.153	0.194
N	1289	81	525	70	460	153
SD	0.147	0.073	0.014	0.046	0.173	0.197
			Panel C: Rail controls			
Railway years	10.453	1.173	7.429	0.771	17.585	8.732
N	1289	81	525	70	460	153
SD	16.219	5.289	15.515	2.36	17.577	13.089
No rail	0.618	0.938	0.752	0.9	0.372	0.595
N	1289	81	525	70	460	153
SD	0.486	0.242	0.432	0.302	0.484	0.493
			Panel D: Mechanisms			
Population density	22.776	3.425	25.317	1.536	29.186	14.753
N	1289	81	525	70	460	153
SD	48.404	7.174	59.509	1.763	46.545	21.345
Agricultural employment density	4.445	0.814	4.928	0.345	5.662	2.932
N	1288	81	524	70	460	153
SD	5.374	1.422	6.801	0.428	4.035	3.569
Cultivated share of farm	0.083	0.024	0.056	0.006	0.141	0.074
N	1289	81	525	70	460	153
SD	0.108	0.051	0.075	0.01	0.132	0.09
Coffee cultivated share	0.157	0.033	0.057	0.055	0.347	0.036
N	1285	80	522	70	460	153
SD	0.238	0.059	0.139	0.085	0.271	0.109
Cash crops cultivated share	0.261	0.389	0.451	0.095	0.11	0.079
N	1285	80	522	70	460	153
SD	0.281	0.283	0.303	0.07	0.119	0.142
Share farms with tools	0.097	0.006	0.026	0.018	0.146	0.279
N	1289	81	525	70	460	153
SD	0.176	0.019	0.094	0.041	0.174	0.273
Share farms with machines	0.22	0.089	0.195	0.193	0.293	0.166
N	1289	81	525	70	460	153
SD	0.218	0.145	0.213	0.188	0.209	0.238

B Results with Conley Standard Errors

Table B.1: European immigration and farm value, Conley standard errors

	Farm Value per hectare (1)	**Land** (2)	**Infrastructure** (3)	**Tools & Machines** (4)
Share Europeans	0.701***	0.677***	0.574***	0.717***
Distance cutoff				
50 km	(0.132)	(0.134)	(0.136)	(0.133)
100 km	(0.122)	(0.116)	(0.141)	(0.149)
200 km	(0.137)	(0.133)	(0.141)	(0.169)
300 km	(0.125)	(0.125)	(0.113)	(0.154)
Observations	1,289	1,289	1,289	1,289
1^{st} *stage* F-stat	22.56	22.56	22.56	22.56
All controls	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses permitting spatial correlation between the errors of municipalities within the listed distance of each other. The IV regressions are estimated using the 2SLS estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table B.2: Potential mechanisms and European immigration, Conley standard errors

	Population density (1)	**Agricultural emp. density** (2)	**Cultivated share of farms** (3)	**Coffee share** (4)	**Cash crops share (no coffee)** (5)	**Share farms with tools** (6)	**Share farms with machines** (7)
Share Europeans	-0.176	-0.0822	0.724***	0.820***	0.0119	0.671***	0.0411
Distance cutoff							
50 km	(0.151)	(0.171)	(0.163)	(0.164)	(0.108)	(0.114)	(0.176)
100 km	(0.169)	(0.183)	(0.159)	(0.207)	(0.118)	(0.0973)	(0.202)
200 km	(0.198)	(0.205)	(0.135)	(0.221)	(0.107)	(0.0863)	(0.220)
300 km	(0.213)	(0.213)	(0.122)	(0.253)	(0.110)	(0.0960)	(0.259)
Observations	1,296	1,295	1,287	1,285	1,285	1,289	1,289
1^{st} stage F-stat	22.51	22.54	22.45	22.42	22.42	22.46	22.46
All controls	✓	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1.Standard errors in parentheses permitting spatial correlation between the errors of municipalities within the listed distance of each other. The IV regressions are estimated using the 2SLS estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table B.3: Farm value and potential mechanisms, Conley standard errors

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	0.748***	0.756***	0.514***	0.581***	0.629***	0.333**/***
Distance cutoff						
50 km	(0.117)	(0.111)	(0.104)	(0.124)	(0.131)	(0.117)
100 km	(0.0965)	(0.0944)	(0.107)	(0.121)	(0.136)	(0.136)
200 km	(0.112)	(0.105)	(0.124)	(0.133)	(0.136)	(0.110)
300 km	(0.111)	(0.0852)	(0.0931)	(0.132)	(0.134)	(0.105)
			Panel A: Labor force			
Pop density		0.108*/**				0.224***
Distance cutoff						
50 km		(0.0563)				(0.0695)
100 km		(0.0566)				(0.0701)
200 km		(0.0527)				(0.0685)
300 km		(0.0548)				(0.0758)
Agr. emp. density		0.167/*/**				-0.0302
Distance cutoff						
50 km		(0.0653)				(0.0412)
100 km		(0.0752)				(0.0413)
200 km		(0.0978)				(0.0377)
300 km		(0.106)				(0.0380)
			Panel B: Land use			
Cultivated share of farms			0.393***			0.395***
Distance cutoff						
50 km			(0.0812)			(0.0857)
100 km			(0.0888)			(0.0961)
200 km			(0.108)			(0.114)
300 km			(0.0980)			(0.110)
Coffee share				0.220***		0.0530
Distance cutoff						
50 km				(0.0476)		(0.0395)
100 km				(0.0462)		(0.0498)
200 km				(0.0602)		(0.0487)
300 km				(0.0648)		(0.0438)
Other cash crops share				0.125***		0.0900***
Distance cutoff:						
50 km				(0.0267)		(0.0213)
100 km				(0.0294)		(0.0256)
200 km				(0.0345)		(0.0264)
300 km				(0.0354)		(0.0211)

Table continues

Table B.4: Farm value and potential mechanisms, Conley standard errors (continued)

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	0.748***	0.756***	0.514***	0.581***	0.629***	0.333**/***
Distance cutoff						
50 km	(0.117)	(0.111)	(0.104)	(0.124)	(0.131)	(0.117)
100 km	(0.0965)	(0.0944)	(0.107)	(0.121)	(0.136)	(0.136)
200 km	(0.112)	(0.105)	(0.124)	(0.133)	(0.136)	(0.110)
300 km	(0.111)	(0.0852)	(0.0931)	(0.132)	(0.134)	(0.105)
	Panel C: Tools & Machines					
Share farms with tools					0.176***	0.176***
Distance cutoff						
50 km					(0.0533)	(0.0439)
100 km					(0.0650)	(0.0524)
200 km					(0.0582)	(0.0456)
300 km					(0.0564)	(0.0493)
Share farms with machines					0.0205	0.00238
Distance cutoff						
50 km					(0.0232)	(0.0198)
100 km					(0.0239)	(0.0207)
200 km					(0.0206)	(0.0173)
300 km					(0.0187)	(0.0151)
Observations	1,231	1,231	1,231	1,231	1,231	1,231
1^{st} *stage* F-stat	25.13	27.55	17.81	17.75	18.60	12.50
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses permitting spatial correlation between the errors of municipalities within the listed distance of each other. The IV regressions are estimated using the 2SLS estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. “All controls” includes all controls in column (4) of Table 2.

C Instrument Based on Distance to Rail

In this appendix, we repeat our instrumental variables estimation, but instead of defining the instrument on the basis of a municipality's own rail connectedness, municipalities are defined to have been connected to the rail network if any municipality within 100 kilometers was connected.

Table C.1: European immigration and farm value, distance-based instrument

	Farm Value per hectare				**Land**	**Infrastructure**	**Tools & Machines**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share Europeans	2.022***	1.459***	1.313***	1.691***	1.525***	1.126***	1.078***
	(0.498)	(0.321)	(0.229)	(0.346)	(0.269)	(0.234)	(0.323)
Observations	1,289	1,289	1,289	1,289	1,289	1,289	1,289
$1^{st} stage$ F-stat	13.54	13.29	11.30	7.95	7.95	7.95	7.95
Railway years	✓	✓	✓	✓	✓	✓	✓
No rail	✓	✓	✓	✓	✓	✓	✓
Geo Controls	✓	✓	✓	✓	✓	✓	✓
Region FE	✓	✓	✓				
Land adaptability		✓	✓	✓	✓	✓	✓
Land quality		✓	✓	✓	✓	✓	✓
Dom market access			✓	✓	✓	✓	✓
Int market access			✓	✓	✓	✓	✓
State FE				✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans, constructed such that any municipality within 100km of rail is considered linked. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

Table C.2: Potential mechanisms and European immigration, distance-based instrument

	Population density (1)	**Agricultural emp. density** (2)	**Cultivated share of farms** (3)	**Coffee share** (4)	**Cash crops share (no coffee)** (5)	**Share farms with tools** (6)	**Share farms with machines** (7)
Share Europeans	1.255***	3.097**	0.848*	-117.1	0.435	1.438***	0.441
	(0.402)	(1.506)	(0.470)	(724,787)	(0.580)	(0.438)	(0.392)
Observations	1,296	1,295	1,287	1,285	1,285	1,289	1,289
1^{st} stage F-stat	8.07	8.08	7.94	7.88	7.88	7.95	7.95
All controls	✓	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans, constructed such that any municipality within 100km of rail is considered linked. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table C.3: Farm value and potential mechanisms, distance-based instrument

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	1.781***	1.467***	1.560***	1.632***	2.030**	1.178**
	(0.378)	(0.400)	(0.445)	(0.375)	(0.858)	(0.478)
Panel A: Labor force						
Pop density		0.0108				0.0686
		(0.0614)				(0.0896)
Agr. emp. density		0.140***				0.0790
		(0.0471)				(0.0672)
Panel B: Land use						
Cultivated share of farms			0.0866			0.200
			(0.141)			(0.121)
Coffee share				-0.0639		-0.0627
				(0.116)		(0.0779)
Other cash crops share				0.105***		0.0955***
				(0.0362)		(0.0287)
Panel C: Tools & Machines						
Share farms with tools					-0.231	-0.0173
					(0.261)	(0.118)
Share farms with machines					0.0513	0.0170
					(0.0371)	(0.0226)
Observations	1,231	1,231	1,231	1,231	1,231	1,231
$1^{st}\,stage$ F-stat	6.98	3.99	4.67	7.70	3.22	3.01
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans, constructed such that any municipality within 100km of rail is considered linked. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

D Instrumental Variables Estimates with State-Level Heterogeneity

Our main instrumental variables analysis allows the relationship between the instrument and the endogenous regressor to vary at the level of the region. In this appendix, we allow the relationship between the instrument and the endogenous regressor to vary at the state level.

Table D.1: European immigration and farm value, IV with state-level heterogeneity

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: OLS			***Panel B: IV (LIML)***		
Share Europeans	0.601***	0.606***	0.607***	0.804***	0.860***	0.881***
	(0.0654)	(0.0666)	(0.0664)	(0.129)	(0.121)	(0.133)
R^2	0.572	0.586	0.595			
$1^{st}stage$ F-stat				22.88	17.46	17.80
Railway years	✓	✓	✓	✓	✓	✓
No rail	✓	✓	✓	✓	✓	✓
Geo Controls	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓
Land adaptability		✓	✓		✓	✓
Land quality		✓	✓		✓	✓
Dom market access			✓			✓
Int market access			✓			✓
Observations	1,289	1,289	1,289	1,289	1,289	1,289

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with state indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

Table D.2: Potential mechanisms and European immigration, IV with state-level heterogeneity

	Population density (1)	**Agricultural emp. density** (2)	**Cultivated share of farms** (3)	**Coffee share** (4)	**Cash crops share (no coffee)** (5)	**Share farms with tools** (6)	**Share farms with machines** (7)
Share Europeans	0.0453	-0.00653	0.717***	0.922***	-0.0345	0.650***	0.127
	(0.114)	(0.116)	(0.121)	(0.171)	(0.0729)	(0.0963)	(0.101)
Observations	1,296	1,295	1,287	1,285	1,285	1,289	1,289
1^{st} stage F-stat	17.95	17.94	17.75	17.72	17.72	17.76	17.76
All controls	✓	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with state indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

Table D.3: Farm value and potential mechanisms, IV with state-level heterogeneity

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	0.876***	0.828***	0.697***	0.745***	0.751***	0.424**
	(0.116)	(0.105)	(0.148)	(0.135)	(0.136)	(0.169)
	Panel A: Labor force					
Pop density		0.0987**				0.208***
		(0.0491)				(0.0662)
Agr. emp. density		0.166***				-0.0176
		(0.0447)				(0.0440)
	Panel B: Land use					
Cultivated share of farms			0.342***			0.374***
			(0.0626)			(0.0660)
Coffee share				0.180***		0.0418
				(0.0421)		(0.0339)
Other cash crops share				0.121***		0.0906***
				(0.0244)		(0.0202)
	Panel C: Tools & Machines					
Share farms with tools					0.144***	0.156***
					(0.0466)	(0.0426)
Share farms with machines					0.0223	0.00355
					(0.0183)	(0.0159)
Observations	1,231	1,231	1,231	1,231	1,231	1,231
$1^{st}stage$ F-stat	18.55	17.83	15.91	15.40	13.19	10.13
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the LIML estimator with the predicted share of Europeans interacted with state indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

E Two-Stage Least Squares Estimates

Our main estimation using our instrument is performed by LIML. In this appendix, we show that our results are robust to using two-stage least squares instead.

Table E.1: European immigration and farm value, two-stage least squares estimation

	Farm Value per hectare				**Land**	**Infrastructure**	**Tools & Machines**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share Europeans	0.620***	0.632***	0.682***	0.701***	0.677***	0.574***	0.717***
	(0.115)	(0.0999)	(0.0968)	(0.105)	(0.102)	(0.132)	(0.119)
Observations	1,289	1,289	1,289	1,289	1,289	1,289	1,289
1^{st} *stage* F-stat	16.76	22.31	22.82	22.56	22.56	22.56	22.56
Railway years	✓	✓	✓	✓	✓	✓	✓
No rail	✓	✓	✓	✓	✓	✓	✓
Geo Controls	✓	✓	✓	✓	✓	✓	✓
Region FE	✓	✓	✓				
Land adaptability		✓	✓	✓	✓	✓	✓
Land quality		✓	✓	✓	✓	✓	✓
Dom market access			✓	✓	✓	✓	✓
Int market access			✓	✓	✓	✓	✓
State FE				✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the 2SLS estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one.

Table E.2: Potential mechanisms and European immigration, two-stage least squares estimation

	Population density	**Agricultural emp. density**	**Cultivated share of farms**	**Coffee share**	**Cash crops share (no coffee)**	**Share farms with tools**	**Share farms with machines**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share Europeans	-0.176	-0.0822	0.724***	0.820***	0.0119	0.671***	0.0411
	(0.158)	(0.150)	(0.134)	(0.143)	(0.101)	(0.103)	(0.140)
Observations	1,296	1,295	1,287	1,285	1,285	1,289	1,289
1^{st} stage F-stat	22.51	22.54	22.45	22.42	22.42	22.46	22.46
All controls	✓	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the 2SLS estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table E.3: Farm value and potential mechanisms, two-stage least squares estimation

	Farm Value per hectare					
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	0.748***	0.756***	0.514***	0.581***	0.629***	0.333***
	(0.0959)	(0.0909)	(0.0958)	(0.107)	(0.111)	(0.106)
	Panel A: Labor force					
Pop density		0.108**				0.224***
		(0.0526)				(0.0644)
Agr. emp. density		0.167***				-0.0302
		(0.0458)				(0.0396)
	Panel B: Land use					
Cultivated share of farms			0.393***			0.395***
			(0.0544)			(0.0573)
Coffee share				0.220***		0.0530*
				(0.0394)		(0.0303)
Other cash crops share				0.125***		0.0900***
				(0.0239)		(0.0200)
	Panel C: Tools & Machines					
Share farms with tools					0.176***	0.176***
					(0.0445)	(0.0352)
Share farms with machines					0.0205	0.00238
					(0.0181)	(0.0159)
Observations	1,231	1,231	1,231	1,231	1,231	1,231
1^{st} *stage* F-stat	25.13	27.55	17.81	17.75	18.60	12.50
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. The IV regressions are estimated using the 2SLS estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

F Additional results for farm value components

Table F.1: European immigration and farm value, robustness tests for the components of farm value

	Land (1)	**Infrastructure** (2)	**Tools & Machines** (3)	**Land** (4)	**Infrastructure** (5)	**Tools & Machines** (6)
	Panel A: no immigrant colonies			***Panel B: no large coffee producers***		
Share Europeans	0.638***	0.524***	0.674***	0.660***	0.559***	0.692***
	(0.121)	(0.145)	(0.128)	(0.163)	(0.169)	(0.143)
Observations	1,159	1,159	1,159	1,157	1,157	1,157
$1^{st}stage$ F-stat	22.14	22.14	22.14	13.25	13.25	13.25
	Panel C: no early railway connections			***Panel D: no large population centers***		
Share Europeans	0.602***	0.547***	0.617**	0.735***	0.569***	0.770***
(0.167)	(0.201)	(0.248)	(0.151)	(0.149)	(0.171)	
Observations	1,111	1,111	1,111	967	967	967
$1^{st}stage$ F-stat	20.58	20.58	20.58	16.39	16.39	16.39
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. All regressions are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities except those indicated in the panel heading. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

Table F.2: Farm value components, European immigration, and potential mechanisms

	Land		Infrastructure		Tools & machines	
	(1)	(2)	(3)	(4)	(5)	(6)
Share Europeans	0.758***	0.357**	0.597***	0.218	0.727***	0.366**
	(0.108)	(0.147)	(0.129)	(0.172)	(0.114)	(0.158)
Panel A: Labor force						
Pop density		0.183***		0.327**		0.0302
		(0.0554)		(0.134)		(0.0369)
Agr. emp. density		-0.00574		-0.102		0.0425
		(0.0395)		(0.0779)		(0.0452)
Panel B: Land use						
Cultivated share of farms		0.354***		0.446***		0.210***
		(0.0625)		(0.0713)		(0.0567)
Coffee share		0.0549*		0.00917		0.114**
		(0.0328)		(0.0401)		(0.0467)
Other cash crops share		0.0995***		0.0336		0.0969***
		(0.0199)		(0.0274)		(0.0285)
Panel C: Tools & Machines						
Share farms with tools		0.167***		0.136***		0.223***
		(0.0431)		(0.0492)		(0.0518)
Share farms with machines		-0.00553		-0.0194		0.201***
		(0.0167)		(0.0168)		(0.0275)
Observations	1,231	1,231	1,231	1,231	1,231	1,231
1^{st} stage F-stat	25.13	12.50	25.13	12.50	25.13	12.50
All controls	✓	✓	✓	✓	✓	✓

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. All regressions are by instrumental variables estimated using the LIML estimator with the predicted share of Europeans interacted with region indicators as the instruments for the actual share of Europeans. Sample includes all municipalities. The unit of observation is a municipality. All variables are standardized to have mean zero and standard deviation one. "All controls" includes all controls in column (4) of Table 2.

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