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Abstract

Between 1890 and 1913, Russian Empire experienced a rapid transition to an industrial economy, catching up with Western countries. Using accidental elements in German settlement locations in Russia 1763-1861, the paper estimates the effects of the more educated Germans in Russia's industrial transition in 1890-1913. I demonstrate that German settlers had significant external benefits in their regions through improved schooling infrastructure and increased literacy among the local population. Educational benefits translated into a higher share of industrial occupations, per-capita local expenditures and urbanization by 1897. I also find a positive impact of education on productivity, mainly in industries that experienced technological transformation and had higher human capital requirements. Furthermore, panel estimates reveal that German areas experienced a higher industrial growth only after 1890 with the adaption of more progressive technologies. Finally, I find no evidence supporting alternative explanations of the German impact: increased agricultural productivity, lower exposure to serfdom, demographic transition or changes in landownership structure.

JEL Codes: N14; I25; O47

Keywords: Human capital, Russian economic history, Industrialization

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1 Introduction

The role of human capital as one of the critical factors of development is widely accepted in the economic literature (Glaeser et al. 2004; Hanushek and Woessmann 2008; Jones and Romer 2010; Galor 2011; Acemoglu et al. 2014). However, there is still ongoing debate on the importance of human capital in particular stages of development. It is also not clear whether the effect of human capital is driven primarily by upper (high education, science) or lower tail (schooling) knowledge. Current studies provide evidence regarding the importance of knowledge elites, but not widespread literacy for the emergence of Industrial Revolution (Squicciarini and Voigtländer 2015). On the contrary, studies of advanced industrialisation (second half of the 19th century and later) demonstrate the importance of access to primary schooling (Becker et al. 2011; Cinnirella and Streb 2017; Squicciarini 2020). Specifically, Becker et al. 2011 shows complementarity between Prussia's advanced schooling system and technological transfer from abroad that primarily contributed to Prussia's industrial spurt in the second half of the 19th century. This paper contributes to the understanding of the human capital's role in industrial development by exploring the case of the Russian Empire, which experienced its industrial transformation relatively later and relied on the wide adoption of foreign technologies (Kahan 1989). Starting with the seminal paper by Gerschenkron 1962, scholars have been emphasizing the importance of institutional factors in Russia's catch-up development (Buggle and Nafziger 2021; Markevich and Zhuravskaya 2018) with less focus on the role of education.

This paper, for the first time, empirically tests the role of primary education in Russia's industrial transition using the arrival of more educated German migrants in the 18th century as an exogenous shock in schooling. I first provide cross-sectional evidence at the district level using various outcome variables (Table 5) to show that areas exposed to German migration had experienced a higher level of development by 1897. Then, I show positive connections between German settlers and productivity, capital–labour ratio and the adoption of modern technologies using firm-level data (Table 7). Furthermore, I determine how Germans affected different stages of Russia's industrialisation by assembling a unique panel data set to trace development between 1868 and 1913. The estimates reveal the growing importance of Germans during the advanced stage of industrialisation (after 1890) relative to the early stage (Table 9).

The implicit interpretation of these results is that Germans took advantage of their better education, which translated into a relative increase in industrial occupations and productivity gains. To test the relevance of such interpretation, I employ IV strategy using the German population shares, observed in 1867 as an instrument for a level of schooling in 1880, to estimate education's impact on industrial development in 1897[1]. Justifying the validity of the proposed instrument, I argue that the arrival of German settlers in Russia in the 18th and early-19th centuries represents a quasi-experiment that generated a persistent shock in human capital before Russia's industrial transformation. To support this statement, I provide arguments

[1]The level of education observed in 1880 is crucial as it affects workers' skills at age 25-32 - the core part of the labor force at 1897.

against the classical migrant-selection model (Roy 1951) by demonstrating that the havoc following the Seven-Year and then the Napoleonic wars pushed the population to escape German lands in search of a less hostile environment (Table 4)[2]. I also subsequently refer to historical literature showing the importance of idiosyncratic factors in the attraction of German settlers to Russia. The role of the personal motives of Russia's rulers was crucial. Russian Empress Catherine the Great considered German settlers' attraction as part of the general project of Russia's Westernisation that, to a larger extent, reflected her personal views and contradicted Russian elites' interests (Martin 1991). According to Stumpp 1973, Alexander I's interest in the religious movements and his family ties with the Wurttemberg ruling house[3] played a decisive role in the Germans' attraction to the Black Sea region. I also stress that the migration stage was completed between 1763 and the 1860s, before advanced industrialisation occurred in Russia. This approach partially mitigates concerns regarding the reverse causality problems common in the literature[4]. In addition, the colonial settlements were established in distant regions far from the traditional manufacturing centres (i.e., Moscow; Staples 2003). By correlating the German population shares with the size of Russia's urban population in the 1800s (period of active migration), I find no evidence of their selection of more developed areas (Figure 4). Thus, it is unlikely these regions could have had economic conditions favourable for schooling and growth independently of the Germans.

Furthermore, I argue that by the beginning of the migration, German rulers had already promoted the idea of public access to primary education[5]. Besides, the Russian government provided the settlers with relative administrative autonomy that allowed them to transfer Germany's principles of schooling organisation to Russia (Stumpp 1973). Accordingly, the German advantage in schooling had already been present in the pre-industrial period without substantive demand for education[6]. Hence, it is likely that economic factors played little or no role in schooling development in German settlements before the industrial transformation. My estimates also reveal no relative increase in education in German areas in response to an industrial surge in the 1890s (Figure 16).

To strengthen the instrument's validity, I control for the factors that could explain German advantages in schooling and independently affect economic growth. Specifically, these factors

[2]More specifically, my argument is that selection to the areas with relatively higher earnings cannot explain the spatial patterns of Germans' location in Russia due to the involuntary nature of migration. In addition, the colonists experienced a lack of information about the territories allocated to them by the Russian government (German et al. 2005). This argumentation goes in line with empirical results by Blum et al. 2021 that uses data on approximately 11500 individuals, comparing German migrants with the native population in Eastern and Central Europe (1780s–1820s). It documents the substantive advantage of German migrants in literacy compared with natives. Still, it finds no differences between German emigrants and the population they left behind, which suggests the absence of substantial migrant selection.

[3]Wurttemberg was one of the important centers of German emigration

[4]The paper's primary advantage is that Russian government never considered active migration policy to enhance industrial growth of the 1890s as it happened in the US and Latin America, where massive migrants' flow coincided with structural economic changes.

[5]In 1763 the king Frederick II issued a school law, which formed the basis for a system of state-supported primary schools in the lands of the Prussian crown (Helmreich 2013)

[6]I confirm it with regression analysis at the village level, showing superiority of German settlements in schooling relative to Russian state peasants (Table 14)

are early industrial development and access to railroads, the presence of other influential minority groups, and exposure to serfdom.

The IV results (Table 12) show that one standard deviation increase in 1880 enrolment rates (6.5 pupils per 100 children of schooling age relative to the mean of 8) leads to a 0.13 standard deviation increase in % of industrial workers (1.3 pp. relative to the mean of 13.56). Education also increases productivity at the firm level, capital-labor ratio and probability of using modern equipment. Importantly, for the interpretation of the results, I observe a strong positive link between Germans and the literacy of the native population. One factor that could contribute to this improvement in the literacy rate is the provision of schooling funding facilitated by German settlers through local authorities - *Zemstvo*. This indicates that the observed results reflect the general importance of education rather than the specific benefits provided exclusively by German schools for Germans.

The main concern regarding the interpretations of my findings is that exposure to German migration could affect industrialisation through different channels (IV exclusion restriction violation). Addressing this concern I show that landownership structure, level of fertility, agricultural productivity and later migration rates could not explain the German impact (Table 12). I also explicitly test whether proximity to German settlements could explain the transmission of cultural norms, e.g., religion. I find that the distance from German settlements indeed strongly predicts the appearance of Russian Protestants (Table 16). However, I interpret this finding in line with the human capital channel, arguing that the adoption of the basic principles of Protestantism created incentives for human capital investments among natives[7].

Taken together, the results connect to the theoretical framework emphasizing the importance of widespread access to education following the appearance of skill-intensive technologies (Galor and Moav 2006; Benhabib and Spiegel 2005). Moreover, it suggests that the absence of considerable access to primary education can largely explain Russia's struggle to fully modernize its economy during the second half of the 19th century.

The paper contributes to several strands of literature. My results connect to the discussion on the influential forces behind Russian industrialisation initiated by Alexander Gerschenkron, followed by William L. Blackwell, Paul Gregory, Arcadius Kahan and continued in more recent studies by Markevich and Zhuravskaya 2018; Buggle and Nafziger 2021; Gregg 2020; Castañeda Dower and Markevich 2019; Natkhov and Vasilenok 2021; Cheremukhin et al. 2017; Mironov and A'Hearn 2008; Nafziger 2016; Davydov 2016; Nafziger 2010; Nafziger 2011; Dennison and Nafziger 2012 and others. My paper is the first to provide a rigorous quantitative assessment of human capital's role in Russian economic modernisation. These findings provide support for the studies of Tsarist Russia and Soviet scholars that show a positive return on primary schooling for industrial workers (Kozminikh-Lanin 1912; Strumilin 1919; Liustikh 1930).

[7]Several studies emphasize the role of Protestantism in human capital formation (Becker and Woessmann 2009; De Pleijt and Van Zanden 2016). For example, the requirement to read the Bible as a pre-condition for confirmation played an instrumenting role in forming literacy in Protestant communes. Similarly, adoption of the new religion required from Russian and Ukrainian peasants at least the ability to read religious texts (see discussion in the Mechanism section).

Furthermore, my findings connect to historical literature that documents the circumstances of German migration to Russia and their contributions to the economic and educational spheres (Stumpp 1973; Kabuzan 2003; Giesinger 1974; Koch 2010; Vashkau 1998; Zjuss 2007; German and Pleve; Pohl 2009; Klaus 1869).

By showing the importance of primary schooling for industrialisation, the paper connects to the theoretical framework proposed by Nelson and Phelps 1966 and then developed by Benhabib and Spiegel 2005, demonstrating that a stock of human capital at the beginning of catch-up industrialization plays an essential role in fostering the adoption of new technologies. My findings also correspond to a definition of two-stage industrialization Galor 2005. The first stage is based on scalable technologies with minimal human capital requirements (e.g., the textile sector). In contrast, the second stage implies progress in processing industries demanding advanced workers' skills and knowledge. My empirical findings closely correspond to Becker et al. 2011, Cinnirella and Streb 2017, and Squicciarini 2020, showing importance of primary education in Prussia's and France's advanced industrialization. My results also connect to the recent findings showing the importance of state schooling interventions for the 19th-century industrial development in Europe (Milner 2019, and Montalbo 2020). It contrasts with the findings by Squicciarini and Voigtländer 2015, which shows the importance of upper-tail human capital for technological innovations during the first-stage industrialization in 18th century France.

The paper also speaks to a broad literature on migrants' contribution to economic development and modernization, including country-specific studies: Droller 2018 (Argentina); Rocha et al. 2017 (Brazil); González 2020 (Chili), and Sequeira et al. 2020 (US). These studies focus on the short-run benefits of migration that can persist over time. In my paper, I show that the contribution of migrants to schooling development plays an essential role in industrial transition - the channel not previously established in the literature. I also show that the benefits of migration could be delayed and revealed with macro changes in the economic environment.

Finally, the paper contributes to the debates on the role of minorities in the transmission of cultural norms. The relevant examples include Dippel and Heblich 2018, exploring the role of German migrants in the US civil-rights movement; Valencia Caicedo 2019, showing the long-run impact of the human capital intervention of Jesuit order missions in Latin America. In this paper, I stress the importance of indirect channels (religion) explaining the impact of educated minorities (human capital investments) on natives.

The rest of the article is organized as follows. Section II briefly discusses the main features of Russian catch-up industrialization. Section III describes the data. Section IV presents empirical results and discusses their interpretation in line with the human capital hypothesis. Section V concludes.

2 Historical Background

2.1 The cath-up nature of the Russian economic modernization and the role of human capital

The first attempt of large-scale modernization in Russia was implemented by Tsar Peter the Great, who ruled the country between 1682 and 1725. Peter the Great completely reshaped the administrative system that inherited many archaic features from the medieval period. The bureaucratic functions of the government were systematized and organized in a way similar to western countries. In the subsequent period, Russian monarchs - Catherine the Great and her grandson Alexander I continued the course on the country's westernization by improving governance and law quality. Despite these efforts, the absolutists and feudal nature of the Russian state remained largely unchanged between the 17th and the second half of the 19th century.

Russia's defeat in the Crimean War of 1853-1856 questioned her role as a significant player on the European stage. It highlighted the backwardness of the Russian economy and the inability to produce modern types of weapons and equipment. This situation led to a series of the most meaningful reforms in the country's history under the rule of Alexander II. The abolition of serfdom in 1861 was followed by the administrative reform that installed a local self-government institution - *Zemstvo* that played an essential role in enlightening the population in rural areas. It was complemented by establishing the new court system, promoting university education, and government support of railroad construction. Even though some of the reforms were cut back and partially reversed by the successors in the 1880s, they created a necessary basis for economic modernization and the emerging industrial and service sectors.

Accordingly, by the end of the 19th century, Russia demonstrated remarkable growth, exceeding yearly rates of the US, especially after 1905 (Gregory 1982)[8]. The technological level of industries had grown significantly by 1913. For example, in the milling industry, 80 % of semi and fully automated mills by 1909 were built after 1890, and many firms, established earlier, experienced technological renovation (Figure A6)[9]. The share of industrial equipment in Russia's import was consistently growing throughout 1890-1900 (Figure A4)[10] The several Pre-Revolution studies of Russian statisticians followed by works of Soviet scholars demonstrated positive returns on primary education for industrial workers (Kozminikh-Lanin 1912; Strumilin 1919; Liustikh 1930). These studies reveal common patterns in the wage-education relationship, such as the law of diminishing return on education. The survey of primary school teachers

[8] As a result, the country's share in the World GDP grew up from 3.7 to 5.5 % over 1870-1913 (Figure A1, A2)

[9] The fully automated approach represented a technological frontier in the milling industry (Source: "Milling Book").

[10] Despite the visible progress, Russia was behind the world's technological frontier. However, it demonstrated remarkable improvement in particular spheres: the world's first four-engined aircraft, designed by Igor Sikorsky, radio and television transmitting technologies (Alexander Popov; Vladimir K. Zworykin). After 1890 Russia demonstrated solid growth in joint-stock companies' capital size, indicating advancements in corporate and managerial practices Gregg 2020.

in 1911 (Figure A10) shows that primary education is important for maintaining literacy skills and receiving higher education later on (60 % respondents). About 30% of school teachers also mentioned economic benefits of primary education (Eklof 2020). As Kahan 1989 summarizes *"..under the conditions of the pre-revolutionary period there was a clear incentive to invest in education at almost all levels.."*. At the same time, Russia experienced a growing discontent between the rising complexity of her economy and the level of human capital. By 1889 only 31 % old boys and 13 % of girls in the age of 9-15 were literate (Mironov 1991). It created evident obstacles in the adoption of foreign technologies from Western countries with much higher standards of labor force qualification (as Figure A3 suggests, the literacy rates were 2-3 times higher). Russian elites clearly understood that the lack of human capital presents a crucial impediment to further industrial transformation. For example, the Russian Finance minister Vyshnegradskii expressed his concerns regarding the conditions of Russia's educational system and its detrimental effect on industrial development in the 1880s: *"At the present, the large majority of workers in our industrial establishments do not receive a general education..The lack of general education prevents the workers in most cases from elevating themselves to the level of conscious and clear understanding of the operations that they perform in their work and thereby downgrades the dignity of the work performed. A barrier to the necessary improvement of industry is therefore erected.."* (cited from Kahan 1989).

Despite the evident necessity of educational reforms, the Tsarist government initiated massive schooling expansion only after 1905, which explains a substantial regional variation in literacy rates by 1897 (see Figure 5). Accordingly, it stresses the importance of local factors in explaining the human capital variation across regions. The arrival of German colonists represents a unique historical experiment that, to some extent, allows assessing the counterfactual scenario in which the elites would promote schooling expansion several decades earlier.

2.2 The German settlers in the context of Russian economic modernization

2.2.1 Short historical overview

The presence of Germans in Russia has a long history: the first settlers appeared on its territory well before the eighteenth century and played a significant role in economic and political spheres (German et al. 2005). However, the pivotal point in the history of Germans in Russia started with the decree of Catherine the Great, allowing foreign citizens to come to Russia and establish settlements. The Russian government considered potential colonists as providers of skills and knowledge in agriculture and artisan that could spread them among backward Russian peasantry and push the technological frontier. In the 18th century, Russia was an agrarian economy based on extensive usage of land resources. The relatively developed areas were located in the north-western and central parts of the Empire, including Sank-Peterburg and Moscow. In contrast, territories of the Eastern and Southern parts were characterized by low urbanization, population density, and lack of infrastructure. These territories accumulated

a vast stock of land and mineral resources. However, the Russian peasants could not freely move to these territories due to serfdom constraints. Even though serfdom already imposed a significant barrier for development in the second half of the 18th century, any attempts to abolish it met the intense opposition of Russian nobility. Accordingly, Russian monarchs attempted to compensate for the lack of internal migrants by attracting German colonists. The initial phase of colonization started in 1763, with an issue of an official decree. The government offered a substantive package of privileges, including tax exemption for 30 years, administrative autonomy, and religious freedom. Foreign settlers had the right to build churches and hire priests according to their needs. However, they were prohibited from spreading their religious beliefs among locals, except Muslims. Colonists were provided with land allotment evenly distributed among family heads. Additionally, the colonists received an interest-free loan from the government to build houses and buy equipment for agriculture and manufacturing. Importantly, the colonists were not obliged to serve in military service as Russian peasants, which was an essential privilege for Mennonites and other religious minorities whose religious norms prohibited army service

The Russian government started the recruitment process by sending emissaries to European cities, primarily to Germany. This country was especially relevant for recruitment agents as her citizens possessed a high level of literacy, agriculture knowledge, and artisan skills critical for the Russian government. In addition, poverty and havoc caused by Seven-year War and then Napoleonic Wars stimulated people to search for fortune in far-distant Russian lands. Accordingly, war refugees constituted the primary group of German migrants in Russia Stumpp 1973. Figure 3 depicts the primary locations of the migrants in Germany. Table 4 shows that a distance from the major battles during the Seven-Year War / Napoleonic campaign is indeed a significant predictor of the migrants' location. The second group of migrants included religious and political refugees who represented different divisions of protestant religion (Mennonites, Pietists). These people often suffered from the various religious prosecutions in the host countries and were attracted mainly by the religious freedom offered by the Russian government. The administrative data conducted by authorities of Wuerttemberger is a rare source of quantitative data that portrays migrants' economic and demographic characteristics. One can observe that religious motives and poor economic conditions are two main forces that drove migration to Russia and other countries, as pointed out by historians (Figure 7).

Upon arrival, the Russian government did not impose strict restrictions on the movements of the colonists within the Empire. However, they could go back to Germany only after paying a fine (a tenth of wealth earned in Russia). Tax privileges and other benefits were conditional on the colonist status, meaning that migrants should remain on the granted lands, promoting agriculture production and artisan crafts. The decree of 1763 prescribed particular territories for colonization located in the Volga region. Later, the proclamation of 1763 was complemented by the laws issued by Catherine II's son Tsar Paul I 1800 and her grandson Alexander I in 1804. Both documents aimed to attract colonists to the territories of the Black Sea region recently acquired by Russia in long-term wars with the Ottoman Empire.

The territory and scope of migration. The first wave of German colonists moved to the territory of the modern Volga region near Saratov and Volgograd in 1766-1767. According to Pohl 2009 and Stumpp 1973 most of these migrants (approximately 25000) represented the Hesse region in Germany (Table B1). The initial conditions for colonization were harsh, and many first-wave settlers died due to freezing winter and infectious diseases. The Russian government did not allocate settlers according to their needs and professional profile: most of the colonists were settled in rural areas, including artisans, teachers, and priests who did not have prior experience of living in rural areas (German and Pleve). However, after the initial struggle, the settlers could adjust and maintain first-sustainable settlements - mother colonies that provided the foundation for the expansion of Volga Germans in the 19th century. It should be noted that the period of the active migration to the Volga (1760-1770s) was limited as German rulers strictly opposed it by issuing edicts that effectively made emigration illegal (Stumpp 1973).

The second large center of German migration included the Black Sea region (the parts of modern Ukraine) that attracted settlers from central areas of Germany. Between 1804 and 1860, about 120,000 migrants, mainly from West Prussia, Baden Wurttemburg, and Alsace, came to this region Pohl 2009. Other significant waves of German migration involved Bessarabia (modern Moldova) and Volhynia (western part of modern Ukraine). The latter region was targeted by German settlers from Northern Germany and Poland. They purchased the land confiscated by the Russian government from Polish nobles and amounted to about 170,000 migrants from 1831 to 1875 (Pohl 2009; Giesinger 1974; Kabuzan 2003). The Volhynian Germans were different from Volga and Black Sea colonists as they did not receive any specific status and privileges from the government Giesinger 1974. German colonists also created significant clusters near Sankt-Petersburg, a critical transportation hub for settlers on their way to the Volga and the Caucasus. Occasionally, migrants settled in Moscow and other large urban centers in proximity to the colonists' routes. The Baltic region (modern Latvia and Estonia) was another important center of German migration. The first German colonists appeared there much earlier and concentrated mainly in urban areas[11]. Overall, by the 1860s the clusters of German settlements were created in twelve provinces[12].

During the 1860-1900s, the German colonization expanded to Don Cossacks' territories and then to the Asian parts of the Empire and Siberia (especially after implementing the Stolypin land reform). The main driver of German expansion was a substantial population growth that resulted in a shortage of land. The land deficit prompted many colonists to search for other areas or move to cities. Eventually, by 1914 the overall German population in Russia amounted to more than 2,3 million people (Figure 8).

Integration to the local community. In the 1860-1870s, the Russian government implemented several steps to integrate German settlers into the local social and economic environment. First,

[11]Table B2 reports key dates from the history of Baltic Germans. Consequently, their descendants played an important role in Russian Affairs. Examples include Sergei Witte, Russia's finance minister and primal architect of the industrial spurt in the 1890s.

[12]the European part of the Empire consisted of 50 provinces

the government removed a specific status of the colonists and their relative administrative autonomy. The German colonists received Russian citizenship, the same legal rights and duties as the native population, including the obligation to serve in the Russian Army. Second, the government gradually incorporated German schools into local educational boards. As a result, studying the Russian language became obligatory. Even though these changes initially caused opposition from the settlers, they also provided them with an opportunity to contribute to economic development. The German deputies were elected to the local authorities (*Zemstvo*) and affected the distribution of public funds, e.g., schooling expenditures. These changes also prompted many settlers to establish businesses and integrate into the local economic environment.

Soviet period. The pivotal change in government policy and public perception occurred during the First World War when many German families became victims of ethnic violence (pogroms). As a result, many Germans escaped the country and moved mainly to the US and Canada and Latin America to a lesser degree. In the Soviet period, the initial policy toward Germans was quite promising. The descendants of the first colonists were allowed to create the Autonomous German-Soviet Republic that existed until the beginning of the Second World War in 1941. At the first mouths of the war, most Germans were forcefully replaced from the territories of their historical living to Siberia and Kazakhstan.[13]. They remained there until the dissolution of the USSR in 1991. The more substantial part of the descendants of the first German migrants eventually migrated to Germany in the 1990-00s, and the remaining part was partially or completely assimilated.

2.2.2 Contribution to schooling development

The historical literature documents that Germans represent one of the most literate groups of Imperial citizens. As Figure 6 depicts, the Germans of the Russian Empire were represented relatively higher in the industrial sector, and especially in occupations with high human capital intensity (education, science, health care). There are numerous examples of prominent German entrepreneurs, education innovators, engineers, and civil servants (Figure B17).

Schools played an essential role in human capital advancements of the German population, starting from the first generation of settlers who exported the institute of a traditional religious school that existed in Germany in the 18th century (Helmreich 2013). The school served as a transmitter of the settlers' linguistic and cultural identity through generations (Giesinger 1974; Zjuss 2007). It provided basic literacy and numerical skills with a strong emphasis on religious norms[14]. The traditional religious schools mostly remained unchanged until the 1840s, when the government started paying attention to German schools and the necessity of learning the Russian language. The most comprehensive reforms at that period were initiated by the colonist Johan Cornis (Zjuss 2007). He advocated for a balanced teaching approach combin-

[13]The paper by Miho et al. 2019 explores the consequences of German deportation, showing their impact on gender norms among the indigenous population.

[14]The education mainly played a primary role in confirmation

ing religious studies with learning practical skills. The reforms covered the most progressive Mennonite communities, which effectively introduced universal primary schooling in the 1850s. The examples of students' works (Figure B9 B10) show that Mennonite schools were at the frontier of schooling in rural Russia at that period.

The subsequent reforms of the 1870s reinforced these changes. The government removed the administrative autonomy of German settlers and gave them the rights and obligations of native citizens. It coincided with the emergence of the new local government institution - *Zemstvo*. It represented a form of direct democracy and local self-governance relatively independent from the government. The *Zemstvo* allowed different social groups (peasantry, merchants, urban citizens, and noble landowners) to vote for their preferences and influence the allocation of public funds raised primarily from land and property taxes. The *Zemstvo* played a critical role in the provision of public goods at the local level, especially primary education. It offered a specific type of primary school (*Zemstvo* school) that, to some extent, reflected a liberal view on teaching contrary to the conservative religious schools supervised by the Russian Orthodox Church. It coincided with a growing discontent between schooling's scholastic nature in Protestant and Catholic communities and their practical needs. The teacher congress of 1868 brought teachers and community leaders to discuss necessary changes in colonists' schooling. It stressed the importance of learning the Russian language and increasing teaching quality (Kostyleva et al. 2018). As a result, by 1885, 14 high schools were organized to prepare teachers for German schools in the Black Sea region (similar schools were organized in the Volga region). German teachers facilitated communication (methodological conferences) that helped to exchange experiences and improve teaching quality[15]. In parallel, the settlers developed new forms of schooling (*Geselschaftisschulen*) that equipped pupils with more advanced knowledge than traditional religious schools (German et al. 2005).

The German proponents of education participated in *Zemstvo* activities and promoted schooling initiatives, such as universal schooling law (Vashkau 1998). It was a suitable platform where Russian schooling enthusiasts could learn from the German experience and vice versa. By 1876 the Mennonite schools were characterized by advanced schooling programs: most hours were devoted to secular subjects (math, geography, German and Russian languages). Perhaps, the Mennonites were at the center of many educational initiatives in German colonies, especially in Black Sea regions. The progress of other groups of German migrants was less decisive. However, the difference with Russian peasants was striking as many did not have any access to education.

2.2.3 German colonists and the Russian Religious Movement

In the second half of the 19th century, the government approved publishing primary religious texts (New and Old Testament), written in the Russian language that most people could find affordable. It initiated growing interest in religion among the peasantry and led to the

[15] Cherkazyanova 2004 reports that German teachers in Odessa educational district actively subscribed for academic journals.

appearance of separate groups within the Orthodox faith (i.e., Molokans). These groups then found inspiration in Protestant religion and adopted some of its principles, often through direct communication with German Protestants (Prohorov 2012). For example, religious readings common in German communes were publicly open and attracted the attention of many Russian and Ukrainian peasants living nearby (Karev, 1957).

As a result, by the end of the 19th century, Russian Protestants formed numerous religious groups in Southern Ukraine, Caucasus, and Low Volga. Adoption of a new religion promoted significant changes in their lifestyle, such as emphasis on the ability to read religious texts (Prohorov 2012) that effectively made literacy compulsory among Russian Protestants. Furthermore, as religious practices did not require vertical hierarchy, any member of the commune could serve as a priest that also strengthened incentives to obtain literacy. Accordingly, the link between Protestantism and human capital, discussed in the literature, was also relevant for Russian Protestants[16].

3 Data

To quantify the effect of German settlers on economic development, I collect a comprehensive data set at the district and settlement level that spans 1765-1911.

Census 1897. First, I collected population data from Russia's Imperial Census 1897 (Trojnickij, 1905)[17], which provides variation in the district's exposure to German migration (population shares) and information about other important ethnic and religious groups, e.g., Jewish, Muslims. Then, I harmonized 1897 Census data on professional occupations (360 professional categories), which allows me to construct the primary outcome variable - the share of industrial workers in the labor force (I discuss the construction of the samples and variables in the Data Appendix)[18]. In addition, I extract from Census 1897 information about the demographic structure of the population, literacy, place of birth (foreign-born / born in the district), and the number of inhabitants in each linguistic group listed in the Census tables.

German migration. Besides Census 1897, I transcribed German settlement lists compiled by Dizendorf 2006 and added data from Kabuzan 2003 and Rittih (1873). It provides me with a picture of the German population's movement in the Russian Empire throughout the 18-20th century (Figure 8). In addition, I incorporate digital maps with the exact location of German colonial settlements. I also worked with the list of the first migrants, compiled by Stumpp 1973 to get information on the sending region / township in Germany. This data allows me to explore the reasons for German migration to Russia.

Industrialization and Development. Besides census cross-sectional (1897) data on pro-

[16]Stundists represent one of the most prominent groups of Russian Protestants. The word Shtundist is derived from the German word Stunde ("hour"), in reference to the practice of setting aside an hour for daily bible study (Brown 1893).

[17]The definition of the ethnic group is based on reported mother tongue. The population data by mother tongue (at district level) is provided by Demoscope Weekly

[18]The raw data is obtained from the database "Russian Empire Occupations in the Late 19th-Early 20th Centuries. First All-Russia 1897 Census"

fessional occupations, I bring data on the number of industrial workers from Governor Reports (Razdorskij, 2011, 2020). Furthermore, adding data on industrial workers from the 1868 yearbook of the Central Statistical Committee allows me to construct a panel data set covering industrial development in the Russian Empire from 1868-1913 at the district level. To my knowledge, this paper is the first attempt to incorporate this data in quantitative analysis[19]. Besides industrialization, I construct the measure of urbanization growth (between 1800 and 1897) using data from (Bairoch, Batou, Chevre 1988[20]) and calculated the level of per capita expenditures of rural communes transcribing data from 1895 Statistical Yearbook ("Mirskie Rashody i Dohody Krest'jan v 1891"). The data on productivity and technological advancements at the firm level originate from the 1894 Industrial Census[21].

Human capital. I collected data on demand and supply measures of education from schooling censuses of 1880, 1894, and 1911[22]. I complement it with Zemstvo statistics of schooling expenditures from different years (1883, 1900, 1907, and 1911). To examine the origins of the German settlers' schooling advancements, I brought pre-industrial village-level data, prepared by the Russian Ministry of Interna Affairs for 1851-1861 "Spiski Naselennyh Mest." It covers the primary migration areas: Volga, Crimea, and Bessarabia. With such rich data at my disposal, I traced the link between German colonists and human capital throughout 1858-1911. It also allows me to evaluate the potential spillover effect of German settlers on natives' human capital.

Other variables. To disentangle the role of education from potential confounding factors (e.g., serfdom legacy, land inequality, fertility), I collected data on the noble landownership from the 1880 Land Census (Central Statistical Committee - CSC); 1858 district-level number of serfs (Trojnitskij, 1861); average grain productivity in 1883-1887 (Zverinskii (1888); a number of births per marriage in 1875 (CSC); *Zemstvo* election results in 1883 (CSC). Further, I collect data from unique surveys of Russian Protestant communes (Fettler, 1911), containing information on their geographical location that allows me to test the effect of German settlers on the spread of Protestantism among natives. In addition, I collected data on the total population by district from different volumes prepared by Central Statistical Committee (1867, 1875, 1883, 1911). I digitized the historical railroad map (1868) to account for early access to transport infrastructure that could affect industrial transformation, especially in a peripheral part of the Empire. I complement it with a geological survey map, prepared by the Geological Committee (Karpinsky et al., 1892) to control the availability of coal deposits that could affect industrial spurt (see Figure B7). Additionally, I digitized historical maps, showing an expansion of Russia's frontier line[23]. To evaluate the German impact heterogeneity across census occupations,

[19]Previously, the province-level data from Governor reports was used by Markevich and Zhuravskaya 2018

[20]Source:https://github.com/JakeRuss/bairoch-1988

[21]The data is provided by Gregg 2020

[22]This data was also independently collected by Nafziger (2021)

[23]Importantly, German settlers were located primarily in frontier regions of the Empire (Figure 3). To disentangle the German impact from the "frontier culture" effect documented in the literature baz, I map the historical frontier line at the period of German migration (see Figure B5 and Figure B6). Accordingly, I calculate distances from the frontier line to the district's centroid and use it as a control variable throughout regression analysis.

I first convert them (360 categories) into broader groups using HISCO classification. Then, by linking each group to professional occupations in the 1940 US Census, I construct a group measure of human capital intensity. In particular, I use profession-specific information on the average years of schooling from the US Census that I then aggregated to the HISCO group level (Data Appendix describes the construction of this variable in detail). Finally, I constructed a comprehensive set of GIS controls using the GAEZ portal (temperature, precipitation, forest coverage, and soil composition). I complimented it with a measure of ruggedness (Puga, 2012) and exogenous soil productivity (Galor and Özak 2016). Table 1 presents summary statistics of the main variables.

4 German colonists and Industrial transformation in the Late Imperial Russia

In this section, I evaluate the link between the presence of German colonists and industrial development in late Imperial Russia. The empirical exercises are based on population Census 1897 (district level) and Industrial Census 1894 (firm-level).

4.1 German colonists and industrialization: district-level cross-section evidence

To guide my regression analysis and choose the appropriate control variables, I perform a covariate-balance test. Table 3 shows the distribution of the geographical and demographic variables across control and treated districts[24]. Some of the differences between the two groups lose magnitude and statistical significance since I add province fixed effects. The remaining discrepancies reflect within province variation and include the geographic location (latitude, longitude, distances to coast, and frontier line). It mainly reflects that the central government deliberately sent German colonists to the distant areas on the frontier's verge. The empirical literature's recent findings show the importance of the frontier region where the distribution of particular cultural traits such as individualism can be different from the "mainland."[25]. Accordingly, I add the district's centroid distance to the frontier line as a control variable.

The treated areas are also different in many environmental measures (temperature, precipitation, forest coverage). It corresponds with a historical narrative stating that German colonists often moved to the Steppe regions, characterized by grassland plains without trees Staples 2003. This region was starkly different compared with environmental conditions in Germany and Russia's inland territories.

Besides, one can observe a negative association between Germans and other minorities (Muslims and Old-Believers). It is an expected result as these minorities often appeared in

[24]The treated are the districts with at least one German settlement established during the active migration phase (by 1867)

[25]The paper by baz provides evidence that the American frontier fostered individualism. The paper by Knudsen 2019 also shows that people with more individualistic traits have a higher propensity to migrate

the region first and then were followed by German colonists; they settled on the land not attained by earlier waves of the settlers from internal Russia's parts. Therefore, I account for ethnic factors, using the index of ethnic fractionalization[26] and including the % of other minority groups (Jewish, Muslims, Old-Believers). Accordingly, I start with an estimation of the following equation:

$$y_i = \alpha + \beta Germans_i + X_i'\sigma + \Gamma_p + \epsilon_i \quad (1)$$

where i refer to the district, $Germans_i$ is a main explanatory variable - the percent of ethnic Germans located in the district according to the Census 1897 records. As an outcome variable, I use the percent of the district's labor force employed in the industrial sector, local level of per capita expenditures[27] and urbanization growth between 1880 and 1897. The vector X includes gender, age-structure characteristics of a labor force, and GIS controls discussed above. I estimate specifications with and without province fixed effects Γ_p. To account for spatial dependencies in the data, I cluster error term at the province level and adjust it with spatial weights (Conley 1999).

My results (Table 5) show the importance of the German settlers for Russia's industrial development at the end of the 19th century. Besides, I reveal the immigrants' strong connection with per capita local expenditures and the pace of urbanization. The effect is statistically significant and economically meaningful: one standard deviation increase in % of Germans results in a 0.05-0.14 standard deviation increase in the outcome variable. The estimates are robust across different regressions specifications and assumptions on a variance-covariance matrix of the error term.

Robustness: I perform a series of robustness checks to ensure that the results are not merely a statistical artifact. First, I relax the linearity assumption on a functional form by including quantiles' dummies instead of continuous measures for the subset of environmental characteristics. Second, I estimate regressions sequentially excluding particular regions (Volga, Baltic, Black Sea, Western Ukraine, and two capitals, Moscow and Sankt-Peterburg). It appears that the results in Table 5 are robust to the exclusion of potential outliers.

Finally, I support the validity of the OLS estimates, running a permutation test. To do that, I randomly assign the explanatory variable to each district, keeping the overall distribution of Germans constant at the province level. I repeat this procedure 1000 times and estimate equation 1 in each iteration. Figure 12 plots the resulted distribution of the regression coefficients. It appears that the distribution is centered around zero, and at least in 90 % of cases, the obtained coefficients are lower than the estimate from Table 5.

[26] The ethnic diversity is an essential factor that can affect development in different ways (Alesina et al. 2003)

[27] The measure reflect the amount of taxes raised by local communes to finance their needs, e.g., administration, school and hospital construction, investments in prevention of agricultural diseases, etc.

4.2 Effect on total factor productivity: firm-level evidence

Proceeding further, I turn to an analysis of productivity level in the industrial sector. In particular, I estimate the following equation:

$$TFP_{icdp} = \beta Germans_d + \mu\Theta_i' + \gamma X_d' + \zeta_c + \Gamma_p + \epsilon_{icdp} \tag{2}$$

where i, c, d and p consequently denote a firm, industry class, district and province. The outcome variable TFP_{icdp} is the residuals obtained from the regressions of the logarithm of nominal output on logarithms of workers and machine horsepower (total factor productivity). Vector X includes the same controls as in the eq. 1. I also add relevant firm-level characteristics (vector Θ includes urban location dummy, firm age), province Γ_p and industry class ζ_c fixed effects[28] The explanatory variable is the % of Germans in the district's population. I expect that Germans' presence at the district level affects the productivity of individual firms through the provision of a qualified labor force and entrepreneurial skills. The effect can be generated by German firms themselves and through positive externalities on locals[29].

Table 6 shows the results of the estimation. I find a positive correlation between Germans and productivity: one standard deviation increase in the explanatory variable leads to a 0.06-0.09 standard deviation increase in productivity. I test the robustness of the findings by performing the same exercises as in the previous section (relaxing functional form assumptions, removing regions, permutation test). Overall, the estimates demonstrate consistency across specifications and indicate the Germans' importance in Russia's industrial sector development.

Productivity gains in modern vs. traditional industries. The paper hypothesizes that human capital advantage allowed Germans to adapt to the rapidly changing environment in the 1890s more efficiently than natives. Accordingly, the German impact should be visible in the industries experiencing abrupt technological changes and requiring a substantive human capital level. Historical studies (Venger 2009; German and Pleve) indicate the importance of German colonists in the food (i.e., flour milling, beer production, baking, dairy, and butter) and machine production industries (i.e., agricultural machines and equipment). The flour milling presents the most vivid example of rapid growth and transformation to a technologically frontier industry. The fast industry's development was a combination of several factors: railroad expansion that opened Russia to foreign markets; technological diffusion from abroad; connection to grain production where Russia remained one of World's leaders[30]. Similarly, the gradual intensification of Russia's agricultural sector increased the demand for agricultural machines and equipment. As German colonists had a connection to a rural area historically, their business

[28] I follow the classification of industry classes, provided by Gregg 2020

[29] One can reasonably assume that Non-German entrepreneurs could hire highly qualified Germans (workers, engineers, managers) that facilitated the adoption of frontier technologies as well

[30] There is considerable evidence on the importance of technological innovations in various food sub-industries. The paper by Nord 2020 discusses the role of technological innovations in the flour milling industry transformation in the US Midwest. Similarly, Perren 1990 stresses the importance of technological factors in flour milling development after the 1850s in Britain, Europe, and the US. Lampe and Sharp 2015 document the importance of technological innovations in the dairy industry for Denmark's caught up with leading countries.

activity covered these two sectors and then expanded to related industries (Venger 2009).

Figure 11 presents estimates of the German impact on productivity across different industries. I start the analysis with aggregated groups following the classification by Gregg 2020 and then look at more specific cases (flour, beer, machinery production, etc.). It appears that German impact is visible primarily in the industries that experienced technological transformation during the 1890s in comparison with traditional sectors (textile, animal (leather, soap, wax, tanning), wood, mineral (bricks, glass, pottery)).

Proceeding further, I focus my analysis on industries historically connected to Germans (flour, beer, machine production). I demonstrate a positive association between German minorities and technological advancements in these industries. Table 7 shows a positive effect on capital accumulation (log capital per worker) and a negative on the usage of pre-industrial technologies (power generated by wheel and water mechanisms contrary to steam machines, turbines, electricity, internal combustion engines). The results suggest the presence of capital-skill complementarity. Human capital advantage allowed adapting modern and more efficient technologies that increased return on qualified labor further.

4.3 Panel data estimates

First, I test the importance of Germans for an earlier stage of industrialization (1868) in a simple cross-section setting. The results of the estimation in Table 8 show no association between Germans and different industrialization measures (% of industrial workers, % of the urban population, steam power capacity, and per capita shipment) in 1868. The results indicate that the lower importance of human capital during earlier industrialization made German human capital advantage less relevant and explains null finding results. It also reassured that Germans were not selected to the areas that experienced early industrial spurt. Hence, it's not likely that the German impact merely reflects some unobservable characteristics of their location. In that case, the role of these factors would be visible in 1868 estimates.

As the next step, I evaluate the magnitude of the German impact in different stages of industrialization via the difference-in-difference framework:

$$\text{Log(Industrial workers)}_{it} = \alpha_i + \gamma_t + \sum_{t=1868}^{1913} \beta_t Germans_{\text{i,1867}} + \sigma_t X_i' + t \times \mu_p + \epsilon_{it} \qquad (3)$$

This specification uses panel data advantages; I control for all time-invariant characteristics by including district fixed effects. Besides, I interact year dummies with exogenous environmental factors, urbanization level, steam power capacity, and railroad proximity in 1868. Similarly, I incorporate to the analysis exposure to other minority groups and historical serfdom[31]. Finally, I restrict variation by including province-specific linear trends / year effects. Such specification allows me to disentangle the German impact from other factors that could trigger industrial-

[31] I use serfdom levels in 1858 normalized to the district's population in 1863. The abolition reform was implemented in 1861; however, it took a long time until the constraints installed by serfdom were removed. Buggle and Nafziger 2021 provides empirical evidence on how serfdom affected development in the 19th century

ization throughout the sample period.

In the beginning, I estimate equation 3 with a binary indicator to measure the German impact on advanced industrialization relative to the early stage (before 1890). Table 9 shows that the effect indeed was more visible after 1890. Then I flexibly estimate equation 3, grouping data in five-year bins. The Figure 14 plots coefficient estimates for each bin, relative to 1868-1872 as a reference category. It corresponds to the binary indicator approach and suggests the growing importance of German settlers at later stages of industrialization when it takes a more advanced form. Overall, this evidence goes in line with a theoretical framework, describing the two-stage model of industrialization, characterized by the shift in the human capital importance (Galor 2005).

4.4 Estimating causal impact of education on Russia's industrialization

This section explores the role of education in Russia's industrial transition utilizing exogenous variation in schooling induced by German settlers in the pre-industrial period. I also discuss the complexity of the German impact on education, providing evidence on improvements in literacy of the native population.

To reconstruct the link between German migration and schooling in dynamic, I bring comprehensive data from three educational censuses, conducted in 1880, 1894, 1911, and complement it with various statistical yearbooks from different periods. Table 10 shows a strong connection between Germans and various schooling development measures (pupils per capita, literacy and high school rates, teacher income, relative expenditures in local budgets). Additionally, I use a difference-in-difference setup and show that areas historically exposed to German migration demonstrated relatively *lower* schooling expansion (pupils per capita) throughout the second half of the 19th century, and especially during the industrial transformation (Table 11). It shows that German advantages in schooling development originated well before the 1890s industrial spurt. It's striking to observe the convergence path of natives throughout the whole period after 1867 Figure 16. Still, by 1897 German districts had superiority in schooling development. Besides, I do not observe evidence of Non-German districts' convergence in relative expenditures (Table 11). It indicates that even though the gap in schooling between Germans and natives decreased over time, the difference in quality remained constant.

To corroborate the previous findings and reveal that the German settlers invested in schooling infrastructure before advanced industrialization, I explore data from the settlement Census for the period of 1859-1864. In particular, I evaluate the difference between German and Non-German settlements using the fact that the German population in rural areas was separated from locals[32]

As a variable of interest, I use a dummy indicator that switches on if a settlement has a

[32]I exclude large urban settlements from the analysis as I do not have information about the proportion of German population there. I narrow the sample to the provinces with historically large German colonization: Volga region, Bessarabia and Tavrida.

colonial status (I also define Bulgarian and Jewish settlements in the South part of the Empire) and zero if otherwise. Similarly, I define settlements that belong to a landlord and an Imperial family. Thus, I use villages that belong to the government as a reference category[33]. Table 14 presents the results of the estimation. The results are robust for different specifications with and without controls and -sub-district dummies[34]. The superiority of Germans in schooling is stark. One can clearly see that schooling infrastructure was developed in German settlements in 1858 before significant reforms and the industrial transition. These results provide additional support to cross-section findings in district-level regressions. Overall, I observe no signs that superior schooling in German districts resulted from increased wealth and demand responding to industrial transformation in the 1890s.

After establishing the positive contribution of Germans in educational development, I then estimate the effect of education on Russia's industrial development employing the following IV strategy:

$$Enroll.rate_{i,1880} = \alpha + \beta Germans_{i,1867} + X_i'\sigma + \Gamma_p + \epsilon_i \tag{4}$$

$$y_{i,1897} = \alpha + \beta \widehat{Enroll.rate}_{i,1880} + X_i'\sigma + \Gamma_p + \epsilon_i \tag{5}$$

The eq. 4 (first-stage) estimates the causal impact of German settlers (1867) on the level of primary education (1880). The eq. 5 (structural form) estimates the causal effect of education on industrial development (1897). The vector X incorporates the same set of controls as in the eq. 1 and additional variables that can confound German impact[35] The validity of the proposed instrument relies on several assumptions:

1. The instrument is orthogonal to other factors that could independently affect development in 1897.

[33]Before the abolition the serfdom in 1861, serfs constituted 43 % of all rural residents in European Russia (1858). Among them, one group of serfs belonged to private landowners and another to Imperial Family. Other categories of the rural population included state and free peasants (e.g., colonists). The colonists' legal status was close to the state's peasants that motivates their choice as a reference category.

[34]I use dummies for each "Stan" that represents the sub-district administrative division in the Russian Empire

[35]In the Appendix section I propose an alternative instrument that draws inspiration from the classical shift-share instrument that I adjust to the cross-sectional structure of the data. In particular I consider the following equation:

$$Enroll.rate_{i,1880} = \alpha + \beta_1 Weight_{i,1867} \times Log(\text{Inverse dist.}) + \beta_2 Log(\text{Inverse dist.}) + X_i'\sigma + \Gamma_p + \epsilon_i$$

where $Weight_{i,1867} = \frac{Migration_{1867}}{Provincepop}$ is a province-specific exposure to German migration, normalized by province population; Log(Inverse dist.) is the logarithm of inverse distance from district's centroid to the frontier line (see Data section for the discussion). Accordingly, all other factors equal, the exposure to migration is larger for the districts with proximity to the frontier line. The interaction term captures the differential effect that proximity to the frontier line had on migrant settlement in the regions with high aggregate migration relative to the regions with low aggregate migration. It should be noted that both $Weight_{i,1867}$ and Log(Inverse dist.) also appear in the regression as separate terms. I exclude the Baltic provinces from the sample as the logic of the instrument applies to the episodes of migration that coincide with Russia's expansion in the second half of the 18th and the beginning of the 19th century. Table A4 shows the results for district-level outcomes. Overall, the estimates are consistent with the main specification; however, weak first-stage results make causal interpretation of these results problematic.

First, I stress that the German migration originated from a combination of idiosyncratic factors (economic turmoil in Germany and individual preferences of the Russian monarchs) rather than fundamental economic forces. Second, the historical sources provide no evidence on migrants' selection to the areas matched with their specific knowledge and previous experience. Instead, it was an opposite situation when the first settlers had to adjust to an entirely new environment (climate, soil type) (Klaus 1869; German et al. 2005). Third, I show that the urbanization rate in 1800 (period of active migration) doesn't correlate with the German population in 1867, making the pre-selection argument more implausible. Finally, I incorporate into the model province fixed effects with a broad set of exogenous environmental variables.

2. The instrument strongly affects educational development.

Tables 10 documents a persistent and robust link between German migrants and educational development. The available historical sources confirm the presence of primary education as a distinctive feature of the German settlements, observed at the very early stage of their migration. (Klaus 1869; German et al. 2005; Vashkau 1998).

3. The instrument does not affect development independently from education.

I show that Germans were orthogonal to economic growth by 1868 (cross-section estimates). This result is supported by the theory suggesting that the economic impact of education appears when structural changes in production processes require a higher level of human capital. Hence, it's unlikely that German settlers generated differences in development earlier (1868) that affected growth at a later stage (1897). Still several alternative mechanisms can explain German impact on development. First, German colonists were not exposed to serfdom that could independently affect development (Buggle and Nafziger 2021). Second, the land grants provided by the government to German colonists could affect the initial distribution of land and reduce its concentration in the hands of noble elites. Accordingly, it might affect the parameters of the local economy and have a lasting effect on development(Martinelli 2014). Third, the German settlers could experience demographic transition earlier due to religious / cultural factors that can affect human capital investments and savings[36]. Fourth, the German's impact could be translated through agricultural productivity as suggested by Natkhov and Vasilenok 2021[37]. Finally, the German areas could be more attractive for external and internal migrants during the industrial spurt of the 1890s[38].

Table 12 presents the results of the estimation of IV-regressions. First, the F-statistics from the first-stage regressions suggest that German population shares in 1867 strongly predict the level of education (enrollment rate) in 1880. Columns (3)-(11) demonstrate the positive impact of primary education on industrial development (% of industrial occupations in 1897). The coefficient on instrumented enrollment rate is statistically significant and has considerable

[36]The role of fertility in human capital investment is widely discussed in the literature, see for example Becker et al. 2012 and Becker et al. 2013

[37]I discuss this channel in detail in section 3.6.

[38]The German areas could be attractive for next generations of migrants due to linguistic and cultural proximity. These people could bring technological knowledge and capital and promote industrialization. Similarly, these territories could attract internal migrants from central regions who could have higher incentives to invest in education

magnitude (one standard deviation increase in 1880 enrollment rates leads to a 0.13 standard deviation increase in % of industrial workers). Importantly, the development measures (% of industrial workers, steam power capacity, urbanization, access to railroad) in 1867-1868 do not predict education in 1880 that stresses the importance of non-economic factors, explaining variation in schooling development before Russia's advanced industrialization. It's also clear that the coefficient is relatively stable when I include the endogenous variables discussed above. Additionally, I find that a higher educational level positively impacts per capita expenditures and urbanization growth. The firm-level IV-regressions show a positive effect of education on productivity, labor-capital ratio, and the adoption of new technologies consistent with theoretical predictions. The Hausman test p-value reported in Table 12 suggests no strong evidence on the presence of omitted variable bias and endogeneity of explanatory variable (schooling enrollment rates in 1880). However, the firm-level estimates indicate a correlation of education with unobservable factors affecting firm productivity[39].

4.5 Did Germans affect human capital of native population?

One of the intriguing questions is whether the schooling progress induced by German colonists affected the native population. To address this question, I estimate baseline regressions specification with % of the Non-German literate population as an outcome variable. Table 15 shows the strong connection between Germans and natives' human capital[40]. Importantly, this result cannot be explained by the presence of other minority groups or the selection of a more literate native population responding to industrialization shock in the 1890s[41]. The previous results Table 10 show that Germans positively associated with schooling expenditures (share in *Zemstvo* budget). Adding it to the regression equation leads to a decrease in the magnitude and significance of the German coefficient. Extending controls to additional measures of schooling supply (per-capita schools % of teachers) lead to an additional decrease in the German coefficient's magnitude, and it becomes statistically insignificant (column 6). Clearly, the results indicate that schooling infrastructure is one of the channels through which German minorities could affect natives' human capital.

I provide a glimpse of how German settlers connect to schooling infrastructure, exploring the potential role of political mechanisms. Figure 19 shows a positive correlation between German migrants and the proportion of seats in local assemblies - *Zemstvo*, held by Non-Gentry groups (urban citizens, merchants, small landowners). As these groups have a larger propensity to human capital investment opposite to noble landowners, it might affect investments in schooling infrastructure[42]. Indeed, as Figure 19 shows, there is a positive link between the proportion of Non-Gentry seats in *Zemsvo* assembly and the share of schooling expenditures. These results

[39] The current literature stresses that estimating firm productivity with a residual approach can be problematic due to simultaneity and selection biases. Several techniques address this problem (see for example Olley and Pakes 1996). However, the current structure of the data doesn't allow their implementation in the paper

[40] This link holds when I consider the literacy of Russian speaking majority.

[41] To account for the selection, I include % of residents born in the district.

[42] Nafziger 2011 explores the critical role of *Zemstvo* in schooling and health infrastructure.

correspond to the historical literature stating that Germans often served as representatives in local authorities and took appreciation from the population due to their diligence in public affairs (German et al. 2005; Vashkau 1998).

4.6 Alternative mechanisms

The paper by Natkhov and Vasilenok 2021 explores the case of Saratov province[43] and shows the importance of German settlers in agricultural equipment adoption among Russian peasants. This result could potentially provide an alternative view on the German importance in Russia's industrialization. The adoption of more efficient agricultural tools (e.g., heavy iron plow) could increase farm productivity and positively affect population density and urbanization rate (Andersen et al. 2016). I evaluate the importance of the agricultural channel by testing whether the German settlers become more critical for industrialization in the areas where plow adoption could generate larger benefits: areas with dominant black soil and high wheat suitability index. Table A3 presents the results: I cannot reject the null hypothesis on the equality of the German's impact on industrialization in the areas less or more suitable for agricultural production. Even though German's impact on agriculture still could be an important factor of development in particular regions (i.e., Saratov), but it doesn't have strong empirical support for the whole sample, including all European and Caucasus provinces.

In addition to schooling, the German settlers could affect development through cultural transmission (spreading religious beliefs among the native population). In Table 16 and Figure 20 I test whether the German colonists contributed to the spread of Protestantism among Russian peasants. Using data on the geographical location of Russian Protestant communes (Fettler, 1911) and location of German settlements[44] I compute distances from each district centroid to the nearest German Protestant settlement. As a dependent variable, I use either a binary indicator or the overall number of the Russian Protestant communes within the district's boundaries. Accordingly, I regress the binary indicator or # of the communes on the distance from the nearest German Protestant settlement and estimate the coefficient of interest via the OLS or Poisson model. The estimation results indicate that the distance from the colonist's settlement strongly predicts Russian Protestant communes' appearance. I interpret these findings in line with the human capital hypothesis. In particular, I argue that a strong connection between Protestantism and education, documented in the literature (Becker and Woessmann 2009), suggests that transmission of cultural norms (religion) could facilitate the educational demand of the native population. The basic principle of Protestantism - *Sola scriptura* states that the primary religious texts (Old and New Testaments) are the only source of divinely revealed knowledge. This principle was widely accepted by Russian Protestants and provided them with incentives to obtain reading skills. The missionary activity of Russian Protestants and the absence of any hierarchy in religious life (perhaps, every adult member of the commune

[43] Saratov province a vital center of German migration in the Volga region.

[44] I obtained geographical coordinates of German settlements from https://www.germansfromrussiasettlementlocations.org/p/maps.html

could serve as a priest) strengthens the incentives to obtain literacy (Prohorov 2012; Shapov 1906-1908). Importantly, the formation of cultural norms that can affect development takes a sufficient amount of time (two and more generations). Historical sources indicate that Protestantism had not existed among Russian peasantry until 1860-1870 and the pick of the religious movement occurred even later (1890-1900s) (Prohorov 2012). Therefore, it's likely that the cultural channel operated through the demand for education (short-term effect) rather than through cultural norms (long-run effect)[45].

Overall, my findings stress the complexity of the German impact on Russia's economic development that involves human capital spillovers on the native population.

4.7 Additional results

Did education increase economic rewards? Addressing this question, I perform analysis by Census 1897 occupation groups (aggregated to HISCO groups)[46]. The idea of the exercise is to test whether the German impact is more substantial for occupations with higher economic rewards (indirect test of returns on human capital, documented by contemporary Russian statisticians (Kahan 1989)). In Table 13 I show that the coefficient on the interaction between Germans and occupation's years of schooling is positive and significant. Figure 17 plots standardized German coefficients for each occupation (aggregated to HISCO groups), showing that effect was mainly concentrated in occupations with higher economic rewards. It suggests the presence of positive returns on education in 19th century Russia that correspond to existing studies.

Primary schooling vs. high education. The important question is whether schooling progress affected industrial development through basic literacy or additional human capital investments (higher education). As Figure A11 suggests, there is a strong correlation between primary school enrollment rates (1880) and both literacy (1897) and high school graduates rates[47]. Literacy is a necessary pre-condition for more advanced education, and one should expect a strong correlation between them. The simple regression analysis of both measures in their relation to economic development reveals a remarkable pattern. As Figure A12 shows, the literacy rate is strongly connected to the % of industrial workers, and this link is barely affected by the inclusion of % of high school graduates. However, the % of high school is orthogonal to the % of industrial workers after conditioning on literacy rate. The opposite pattern appears when I substitute % of industrial workers by the % of human capital sector (education, health, science) workers as an outcome variable. This simple analysis reveals the primary importance of basic human capital (literacy) for Russia's industrial development. This result corresponds to the findings by Becker et al. 2011 for Prussian industrialization. Perhaps,

[45]It doesn't exclude the possibility that cultural norms can explain the persistence of the German impact on the subsequent generations of the population (see Miho et al. 2019)

[46]I first convert 1897 original occupations to HISCO groups and then link them to US 1950 occupation classification in 1940 Census. For each HISCO group, I compute the average years of schooling and average occupational score (see IPUMS). Eventually, I link occupations from the 1897 Census to the measure of human capital intensity / economic rewards, derived from the 1940 US Census

[47]This measure includes all graduates with an educational level above primary

Russia could substitute the lack of the new technologies and, to some extent, engineers and managers by exporting them from abroad (Kahan 1989). However, as the country was not a target for large-scale immigration like the US, the lack of schooling can, to a large extent, explain regional variation in development, documented in the literature (Markevich 2019).

5 Conclusion

In the 1890s, Russia experienced a remarkable pace of industrial growth and technological transformation. Exploiting the exogenous variation in human capital generated by German migrants in the late-18th and early-19th centuries, I demonstrate the importance of primary schooling in adjusting to the rapidly changing economic environment by increasing the proportion of modern occupations and facilitating technological advancements for Russia's firms. The cross-section results correspond to panel estimates demonstrating the growing importance of German settlers in promoting industrialization only after 1890 with the rising complexity of the economy and increasing demand for education. My findings held after various robustness checks; furthermore, they demonstrate consistency after controlling for alternative channels, such as exposure to serfdom, measures of early industrial development (1868), landownership structure, fertility, agricultural productivity and later-stage migration.

Importantly, my estimates reveal substantive external benefits for the local population — an increase in literacy rates. I provide two explanations for the spillover effect - German contribution to schooling provision and transmission of religious norms (Protestantism) that increased educational demand. Therefore, the paper depicts education as one of the critical factors explaining Russia's struggle to catch up with Western countries. Finally, the paper facilitates the discussion on the role of migrants in schooling provision in the absence of considerable government support. In such an environment, the particular groups with a higher propensity for human capital investments become crucial. It provides an additional angle for understanding the origins and persistence of the migrants' effects, as documented in the literature.

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Tables and Figures

Table 1: Summary statistics

Ethnic Shares (Census 1897)	count	mean	sd	min	p50	max
% German	563	0.858	3.134	0.000	0.054	40.306
% Old Believers	563	1.776	3.236	0.000	0.523	23.959
% Muslims	563	8.545	21.931	0.000	0.043	99.881
% Jewish	563	2.878	5.245	0.000	0.108	28.345
Ethnic fractionalization	563	0.257	0.226	0.001	0.234	0.799
Ethnic Shares 1867						
% Germans	488	0.623	3.225	0.000	0.000	41.234
% Old Believers	488	1.415	3.009	0.000	0.333	27.824
% Jewish	488	2.787	5.572	0.000	0.045	50.414
% Muslims	488	3.113	11.059	0.000	0.002	82.348
Development (district level)						
% Industrial workers, 1897	563	13.553	9.872	0.138	10.865	79.274
Urbanisation growth, 1800-1897	563	6.360	3.620	-0.126	8.286	11.980
Local expenditures, percap. 1891	474	0.408	0.368	0.004	0.311	2.492
Urban Population, 1800	563	3602	16522	0.000	0.000	300000
% Urban pop., 1867	488	9.178	10.371	0.000	6.008	89.941
% Industrial workers, 1868	488	0.560	1.887	0.000	0.081	28.459
Steam machines, 1868	488	1.879	15.453	0.000	0.000	322
Total steam horse power, 1868	488	30.092	314.499	0.000	0.000	6823
River shipment kg. per 1,000 pop, 1868	490	0.118	0.566	0	0	7.935
Dist. railroad, km 1868	563	58.375	91.381	0.149	25.301	801.661
Demography						
Population, 1897	563	182109	115596	26381	159024	1317885
Population, 1867	488	129981	62629	16813	119383	599418
% Female, 1897	563	51.258	3.117	39.907	51.068	62.252
% Female, 1867	488	50.812	1.774	38.098	50.795	56.530
% Age $<$ 10 pop, 1897	563	27.877	2.740	13.999	27.918	36.534
% Age $>$ 60 pop, 1897	563	7.259	2.033	3.609	6.868	34.682
Births per marriage, 1875	488	5.379	1.014	2.54	5.288	17.888
Human capital						
% Literate, 1897	563	20.857	12.557	1.196	17.780	81.191
% Literate, female, 1897	563	12.086	13.337	0.132	7.906	82.355
% High school, 1897	563	0.850	0.994	0.017	0.548	9.701
% Literate, Non-German, 1897	563	20.604	12.479	1.195	17.673	81.125
% Literate, Ethnic Russian, 1897	563	23.994	14.207	2.821	19.185	84.466
% Teachers, 1897	563	0.609	0.364	0.033	0.523	2.412
Pupils per capita, 1880	488	1.532	1.433	0.167	1.183	12.961
Female pupils ratio, 1880	488	0.131	0.095	0.003	0.103	0.501
Teacher income, 1880	487	124.991	47.465	0.498	121.680	316.444
Pupils per capita, 1894	549	2.376	1.302	0.050	2.140	9.920
Female pupils ratio 1894	559	0.179	0.094	0.000	0.159	0.567
Teacher income, 1894	476	139.247	68.824	1.667	133.672	410.200
Pupils per capita, 1911	558	4.410	1.698	0.025	4.401	15.933
Female pupils ratio, 1911	562	0.474	1.138	0.000	0.387	26.790
Share schooling expenditures, 1880	343	0.160	0.066	0.002	0.155	0.372
Share schooling expenditures, 1894	358	0.176	0.068	0.008	0.171	0.406
Share schooling expenditures, 1900	358	0.197	0.077	0.031	0.191	0.405
Share schooling expenditures, 1907	358	0.243	0.076	0.069	0.236	0.495
Additional variables						
% Noble landownership $>$ 2700 acres, 1880	488	19.799	14.032	0.000	18.209	65.792
% Serfs, 1858	487	39.630	24.607	0.000	43.434	98.222
% Non-Gentry deputies elected, 1883	359	23.579	22.661	0.000	17.647	100.000
% Born in the district, 1897	563	88.888	10.674	0.000	92.634	100.000
% Foreign born, 1897	563	0.383	1.184	0.000	0.035	11.735

Table 1 (continuation): Summary statistics

Firm Data	count	mean	sd	min	p50	max
Output per worker	13086	1770	5406	1	909	500000
Machine Power	14908	34.3	184	0	2	8242
Number of workers	14669	63	260	0.000	14	10219
Traditional technology	14908	0.227	0.419	0.000	0.000	1.000
Urban location	14908	0.420	0.494	0.000	0.000	1.000
Firm age	12076	22	21	0	17	264
Village data, 1858						
Log population	1681	6.286	1.011	3.296	6.314	9.469
School, dummy	1681	0.168	0.374	0.000	0.000	1.000
Crafts, dummy	1681	0.220	0.414	0.000	0.000	1.000
German colony, dummy	1681	0.157	0.364	0.000	0.000	1.000
Emperor village, dummy	1681	0.023	0.149	0.000	0.000	1.000
Private serfs village, dummy	1681	0.444	0.497	0.000	0.000	1.000
Government peasants village, dummy	1681	0.314	0.464	0.000	0.000	1.000
Bolgar colony, dummy	1681	0.047	0.212	0.000	0.000	1.000
Jewish settlement, dummy	1681	0.015	0.123	0.000	0.000	1.000
Dist. from district capital	1681	69	47	2	62	488
Mail post, dummy	1681	0.036	0.186	0.000	0.000	1.000

Table 3: Covariate balance test

	(1) Control	(2) Treated	(3) Diff	(4) Diff (province fe)
Demography&Ethnic groups (1897 Census)				
% Jewish	2.584	5.209	2.624***	0.544
	(5.127)	(5.626)	(0.741)	(0.565)
% Muslims	9.336	2.265	-7.071***	-3.559**
	(22.992)	(7.732)	(1.413)	(1.734)
% Old Believers	1.849	1.193	-0.656**	-1.173**
	(3.370)	(1.764)	(0.267)	(0.551)
% Female pop	51.494	49.379	-2.115***	-1.097***
	(3.128)	(2.298)	(0.320)	(0.366)
% Age < 10 pop	28.029	26.675	-1.354**	-0.425
	(2.466)	(4.182)	(0.535)	(0.480)
% Age > 60 pop	7.285	7.051	-0.234	-0.452***
	(2.024)	(2.112)	(0.279)	(0.151)
Ethnic fractionalization	0.238	0.405	0.167***	0.075**
	(0.222)	(0.201)	(0.027)	(0.032)
GIS controls				
Ln Dist. from coast	6.014	4.916	-1.098***	-0.261***
	(0.755)	(1.064)	(0.137)	(0.087)
Ln Dist. from Peterburg	6.875	6.694	-0.181	-0.060
	(0.564)	(0.913)	(0.117)	(0.058)
Ln Dist. from Moscow	6.381	6.774	0.393***	0.034
	(0.755)	(0.207)	(0.043)	(0.021)
Ln Dist. from river	4.357	4.303	-0.055	-0.105
	(1.113)	(0.999)	(0.135)	(0.192)
Longitude	39.048	31.852	-7.196***	-0.695**
	(8.097)	(7.134)	(0.964)	(0.289)
Latitude	52.551	51.712	-0.839	-0.375**
	(5.476)	(4.749)	(0.643)	(0.179)
Ln Dist. from frontier	5.474	3.895	-1.579***	-0.363**
	(1.084)	(0.902)	(0.123)	(0.176)
Coal deposits, dummy	0.176	0.063	-0.113***	-0.009
	(0.381)	(0.246)	(0.035)	(0.054)
Temperature	5.535	7.303	1.768***	0.434***
	(2.506)	(1.885)	(0.261)	(0.131)
Precipitation	50.048	46.889	-3.159***	-1.671*
	(12.417)	(7.728)	(1.116)	(0.877)
Temperature range	28.004	25.340	-2.664***	-0.204
	(3.345)	(3.329)	(0.443)	(0.190)
Ln Ruggedness	3.514	3.194	-0.320***	-0.096
	(0.895)	(0.622)	(0.088)	(0.109)
Harvest season, days	161.104	150.750	-10.353*	-0.990
	(35.050)	(42.478)	(5.545)	(2.409)
Share chernozem (black) soil	0.188	0.365	0.177***	-0.014
	(0.289)	(0.377)	(0.049)	(0.047)
Share podzol soil	0.040	0.054	0.014	-0.005
	(0.098)	(0.115)	(0.015)	(0.014)
Ln Caloric suitability	8.262	8.372	0.111***	0.001
	(0.346)	(0.153)	(0.025)	(0.015)
Ln Caloric suitability (rye&wheat)	8.698	8.793	0.096***	-0.015
	(0.412)	(0.137)	(0.025)	(0.016)
Forest coverage	0.318	0.198	-0.120***	-0.048*
	(0.323)	(0.274)	(0.037)	(0.025)
Additional controls				
Log urbanisation, 1800	2.643	4.407	1.763***	1.338
	(4.066)	(4.556)	(0.599)	(0.893)
% Serfs 1858	42.225	29.802	-12.424***	-4.012
	(23.745)	(23.099)	(3.471)	(3.715)
% Noble landownership 1878	18.574	30.815	12.241***	0.674
	(13.231)	(13.875)	(1.880)	(1.984)
% Born in the district 1897	89.841	81.324	-8.517***	-6.777***
	(9.792)	(13.990)	(1.806)	(1.914)
% Foreign born 1897	0.323	0.860	0.536***	0.074
	(1.180)	(1.112)	(0.149)	(0.233)
Observations	500	63	563	563

Note: *** p<0.01, ** p<0.05, * p<0.1

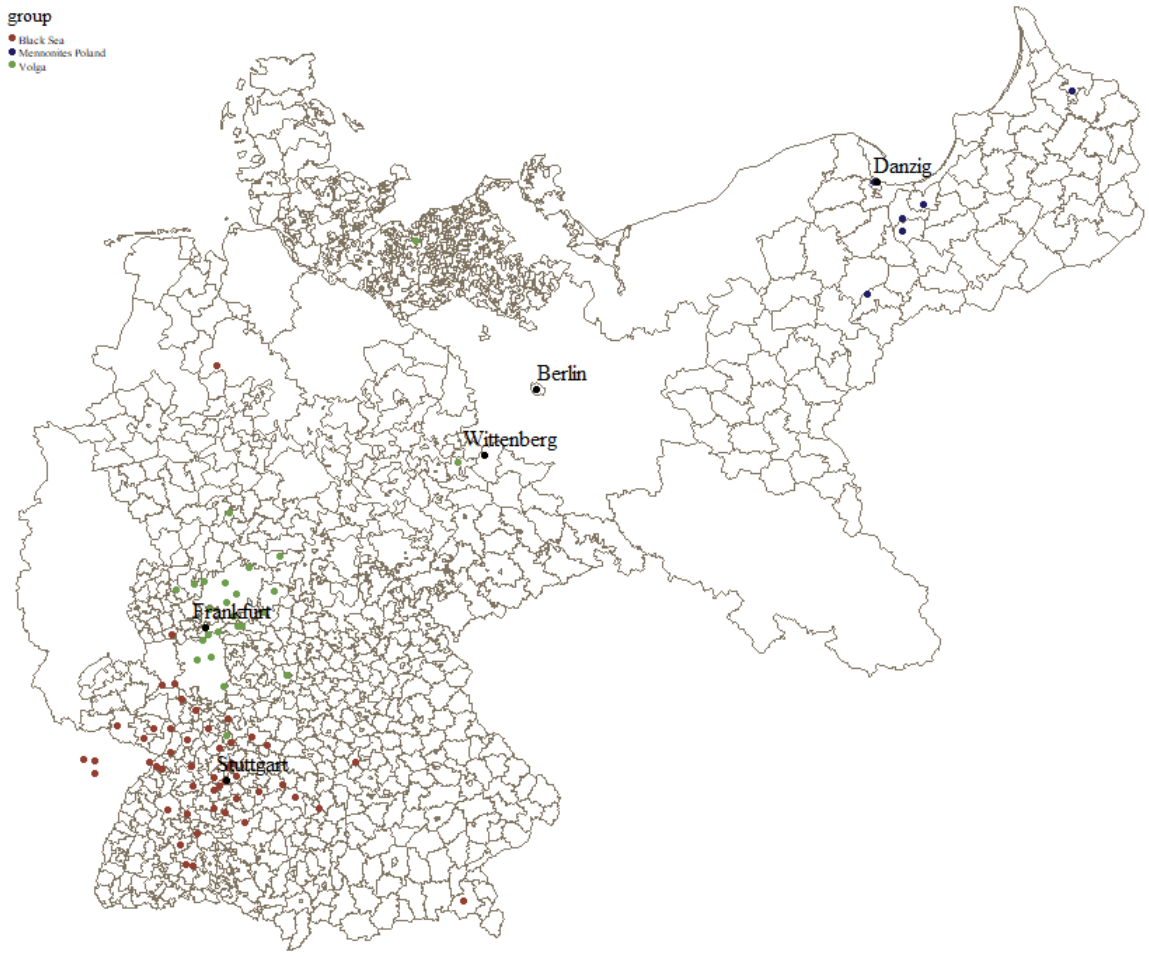


Figure 1: The Distribution of main locations of German emigrants to Russia, based on Stumpp 1973

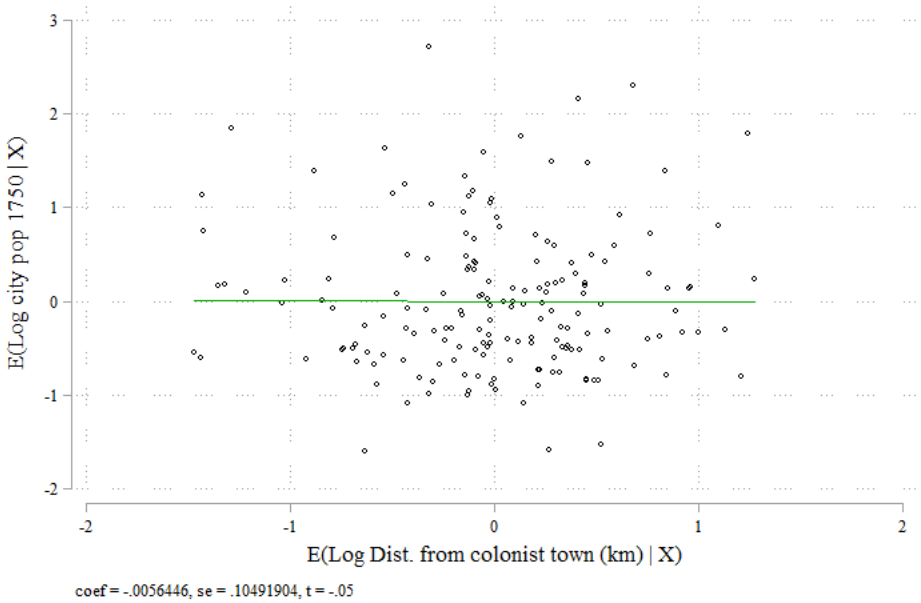


Figure 2: Distance from migrants locations and the size of urban pop in Germany, based on Bairoch (1989)

Table 4: Distance from Battles as predictor of the location German migrants' towns

VARIABLES	(1) Log Migrants	(2) Migrants Town, dummy	(3) Migrants #
Log Dist. from Battle	-0.007***	-0.002***	-0.726***
	0.003	0.001	0.165
Log Dist. from Danzig	0.037**	0.009**	0.897
	0.017	0.004	10.998
Latitude	0.004*	0.001*	0.510
	0.002	0.000	1.173
Longitude	0.003*	0.001*	0.115
	0.002	0.000	0.572
Model	OLS	OLS	Poisson
Region FE	x	x	x
Observations	44,641	44,641	44,641
R-squared	0.004	0.004	

Note: Robust standard errors are in parenthesis.*** p<0.01, ** p<0.05, * p<0.1. The sample consists of modern German cities and towns (geocoded) linked to the historical locations of German emigrants (sending cities/towns). The locations of primary battles on the German territory during Seven-Year War and Napoleonic campaigns (Rhine campaign of 1796) are derived from Black 1994 and Smith 1998

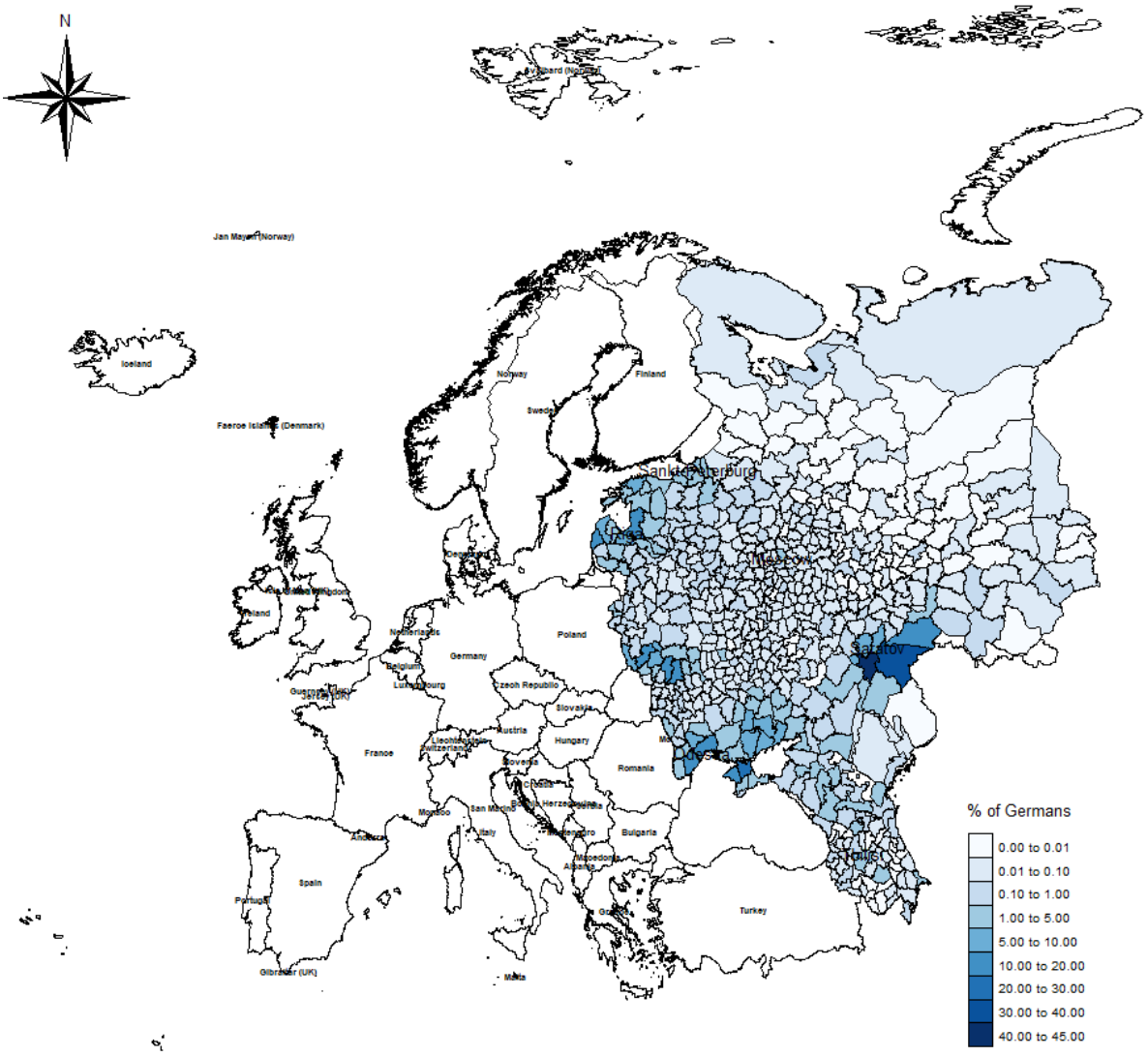


Figure 3: The Distribution of German settlers in the European part of the Russian Empire and territory of Caucasus (excluding Poland and Finland), based on Census 1897.

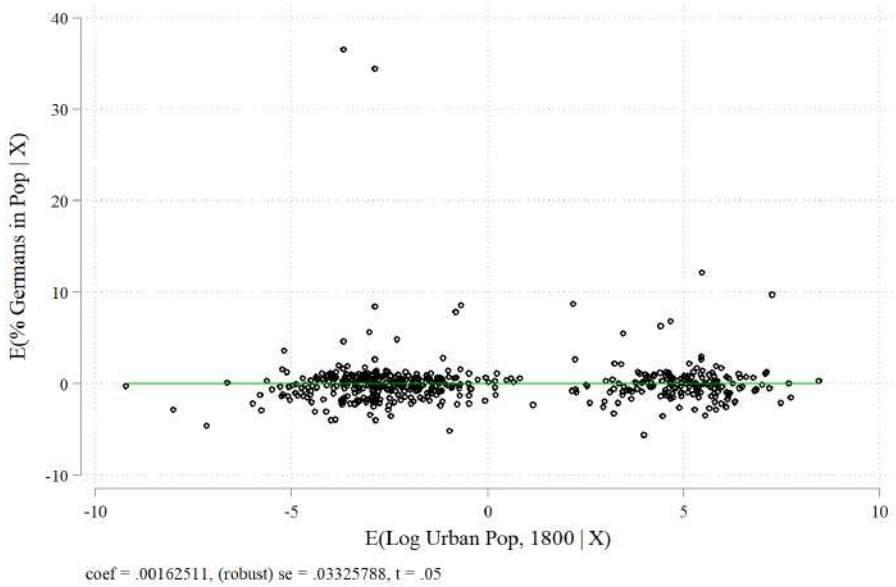


Figure 4: % of Germans (1867) and Log of urban population in 1800 (pre-treatment period)

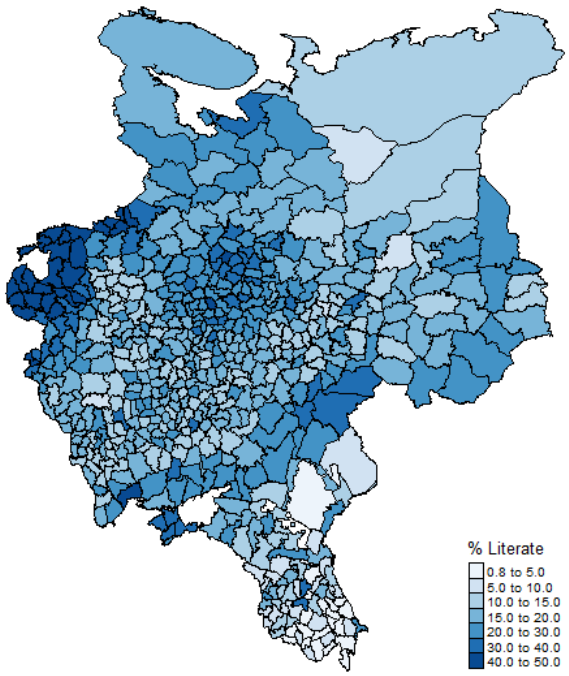


Figure 5: The Distribution of literacy rates across Russia's districts (Census 1897).

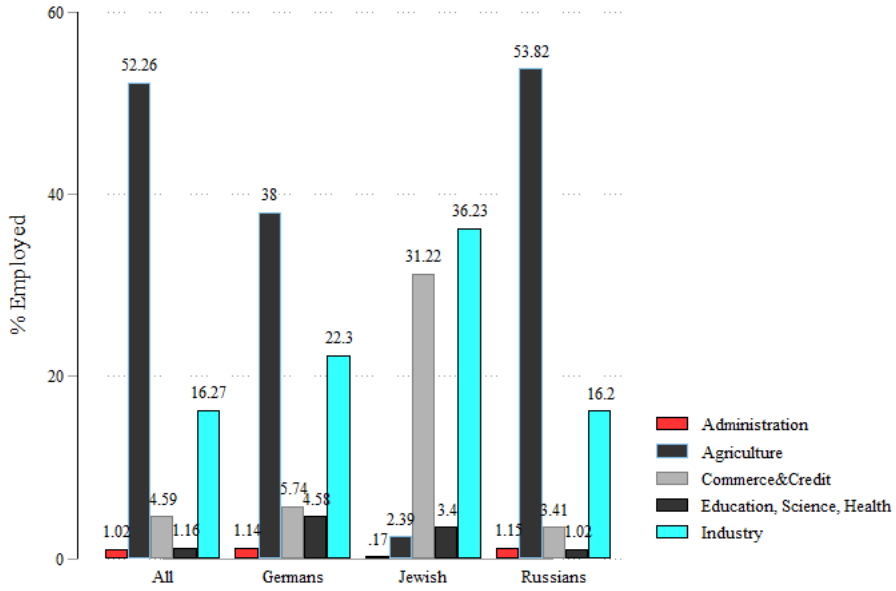


Figure 6: Shares of ethnic minorities in occupation classes (Source: Census 1897)

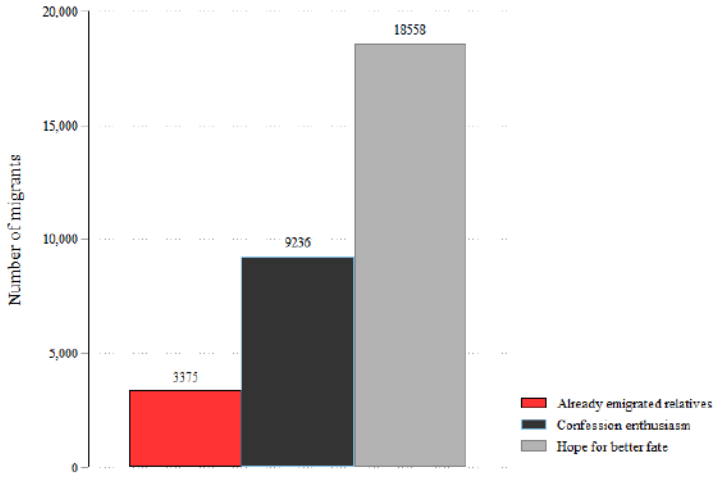


Figure 7: Motives of migration to Russia [a]

[a]The histogram shows reasons of migration of Wuerttemberger citizens. Source: Ostwanderung der Wuerttemberger 1816-1822, Summary (D. Wahl). Stumpp reports that religious reasons played an essential role primarily in Wuerttemberg, where the presence of religious minorities was high. K. Stumpp writes: "Pietists and Chiliasts, Separatists and Stundists or whatever else those pious people called themselves attached much significance to the fact that Czar Alexander I was a deeply religious Christian. After his victory over Napoleon he had granted the Evangelical Bible Society of Russia permission to engage in activity. He himself was in communication with Frau von Krudener who regarded Russia as the haven of refuge of the faithful of the last days...The migratory movement also had an impact beyond the frontiers of Wurtemberg extending into the districts of Dillenburg and Gunzburg in the Swabian section of Bavaria. Here the Evangelical movement was established by Boos and the Catholic professor Gossner, the subsequent founder of the Gossner Evangelical Mission Society in Berlin, and also by Ignatz Lindl (likewise a Catholic pastor) who emigrate to Odessa and..established 80 families from Bavaria and Wurttemberg in the colony of Sarata which he founded in Bessarabia."

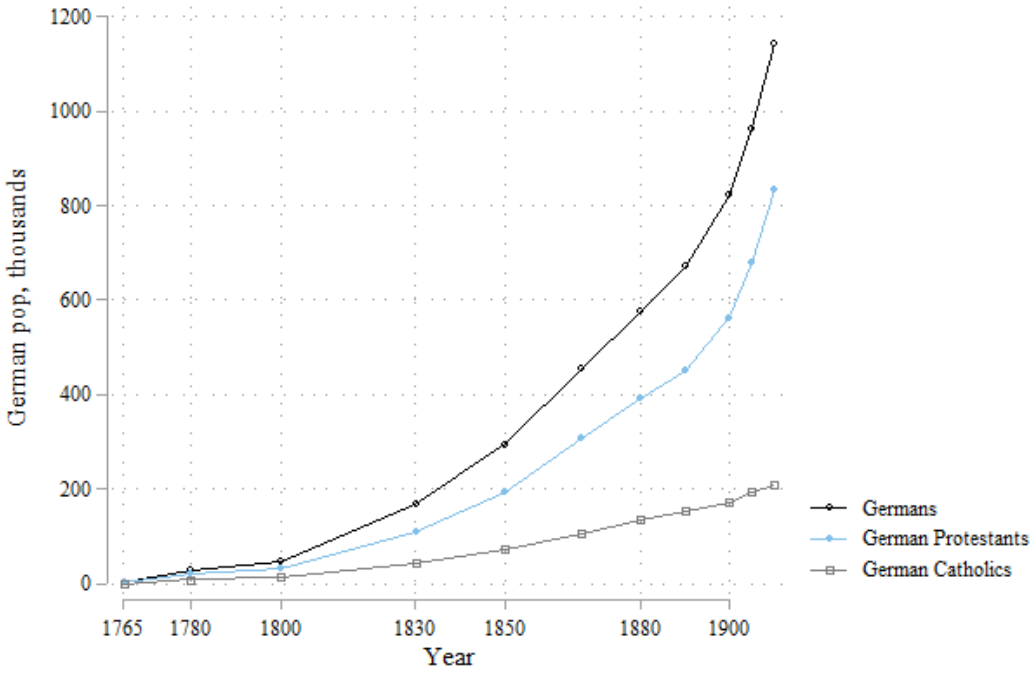


Figure 8: Dynamic of German population in European Russia and Caucasus[a]

[a]Data doesn't include Baltic Germans and urban population, based on German settlement lists by V. Dizendorf. The numbers of Catholics and Protestants are approximate estimates (see Data Appendix)

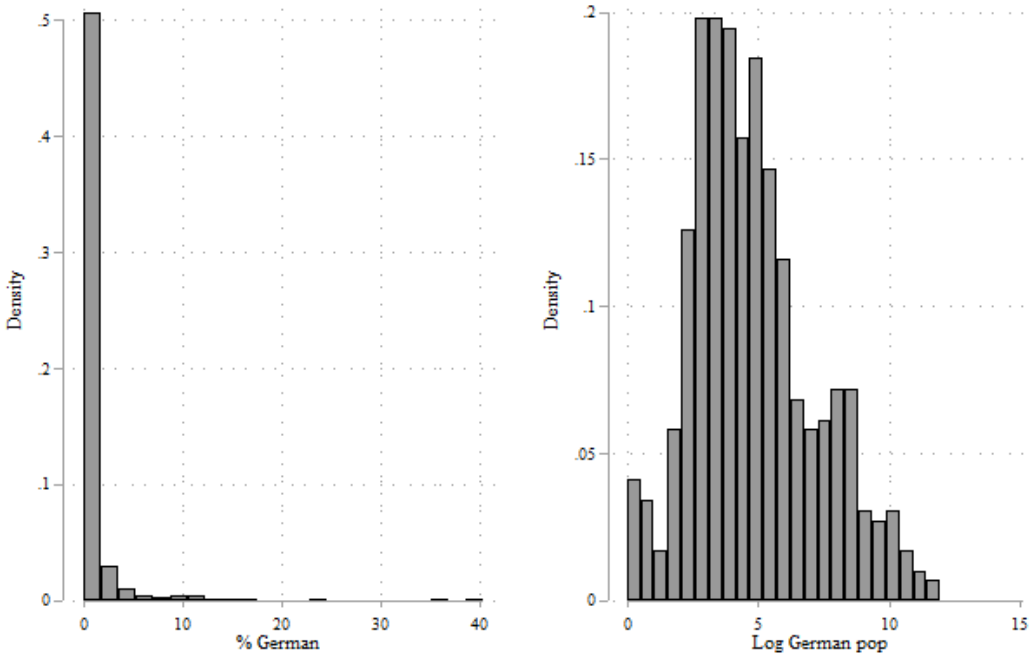


Figure 9: Distribution of German population (Source: Census 1897)

Table 5: German immigrants and development (1897).

VARIABLES	(1) % Indust. workers	(2) % Indust. workers	(3) % Indust. workers	(4) % Indust. workers	(5) Expend. pecap.	(6) Expend. percap.	(7) Urban. growth	(8) Urban. growth
% Germans 1897	0.209**	0.169**	0.214***	0.211***	0.016**	0.014*	0.033**	0.025**
	(0.098)	(0.064)	(0.069)	(0.058)	(0.007)	(0.008)	(0.015)	(0.012)
Log urbanisation, 1800	0.365***	0.351***	0.317***	0.288***	0.004	0.002	-0.878***	-0.893***
	(0.075)	(0.072)	(0.069)	(0.070)	(0.002)	(0.002)	(0.011)	(0.008)
% Jewish 1897				0.349***		-0.005		0.096***
				(0.089)		(0.009)		(0.020)
% Old Believers 1897				0.413		-0.008		-0.003
				(0.258)		(0.007)		(0.011)
% Muslims 1897				-0.081**		-0.008*		-0.021**
				(0.032)		(0.004)		(0.010)
% Female pop 1897	-0.439*	-0.498	-0.518*	-0.668**	0.019	0.024*	-0.102***	-0.108***
	(0.251)	(0.332)	(0.299)	(0.314)	(0.016)	(0.014)	(0.034)	(0.027)
% Age < 10 pop 1897	-0.804***	-0.868***	-0.891***	-0.689**	-0.024*	-0.031*	-0.116***	-0.100***
	(0.212)	(0.307)	(0.272)	(0.283)	(0.014)	(0.016)	(0.043)	(0.036)
% Age > 60 pop 1897	-0.080	-0.182	-0.163	-0.172	-0.003	0.001	-0.032	-0.018
	(0.187)	(0.187)	(0.200)	(0.194)	(0.007)	(0.006)	(0.034)	(0.028)
Ethnic fractionalization 1897	1.020	1.422	0.703	-0.420	0.140	0.348*	-0.077	-0.242
	(2.533)	(2.594)	(2.526)	(2.488)	(0.171)	(0.200)	(0.384)	(0.384)
Ln Dist. from coast	1.658	0.263	-0.977	-2.105**	-0.127	-0.049	-0.052	-0.331**
	(1.150)	(1.384)	(1.024)	(0.976)	(0.111)	(0.092)	(0.201)	(0.146)
Ln Dist. from Moscow	-8.783***	-6.539**	-6.731**	-6.636**	-0.257***	-0.205**	-0.129	-0.263*
	(1.581)	(2.911)	(2.616)	(2.709)	(0.093)	(0.099)	(0.128)	(0.150)
Ln Dist. from frontier	-1.083**	-1.110**	-1.261***	-0.874**	-0.069	-0.063*	-0.120	-0.090
	(0.464)	(0.506)	(0.447)	(0.409)	(0.049)	(0.035)	(0.098)	(0.088)
Coal deposits, dummy	0.031	0.441	1.052	1.353	-0.061*	-0.064	0.101	0.048
	(1.789)	(1.450)	(1.056)	(1.152)	(0.034)	(0.041)	(0.080)	(0.075)
Outcome mean	13.55	13.55	13.55	13.55	0.41	0.41	6.36	6.36
Outcome sd	9.88	9.88	9.88	9.88	0.37	0.37	3.63	3.63
Stand. beta	(0.066)	(0.054)	(0.068)	(0.067)	(0.143)	(0.119)	(0.028)	(0.022)
Conley s.e. (250 km cutoff)	[0.123]*	[0.059]***	[0.070]***	[0.064]***	[0.005]***	[0.007]*	[0.014]**	[0.012]**
Province FE		x	x	x	x	x	x	x
Observations	563	563	563	563	474	474	563	563
R-squared	0.380	0.602	0.615	0.638	0.658	0.690	0.959	0.966

Note: Mean % Germans = 0.87, SD = 3.13. % Germans and other ethnic / religious minorities represent their percent in population. Other controls include % of female pop; % of pop age < 10 and > 60; ethnic fractionalization index (Alesina et al. 2003); average temperature, precipitation, ruggedness (Nunn and Puga 2012), temperature range, logarithm of caloric suitability index (Galor and Özak 2016); share of land with 75 % coverage by forest; distances from the nearest river, coast line, frontier line, Moscow and Sankt-Peterburg (in logarithms). Columns (1)-(3), (5) and (7) presents estimates of regressions with linear controls. Columns (4), (6), (8) include estimates of the regressions with quantile dummies of environmental controls (temperature, precipitation, ruggedness, forest coverage and soil caloric index) All regressions are estimated for the sample of 50 European provinces and Caucasus region (see Figure 3). Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

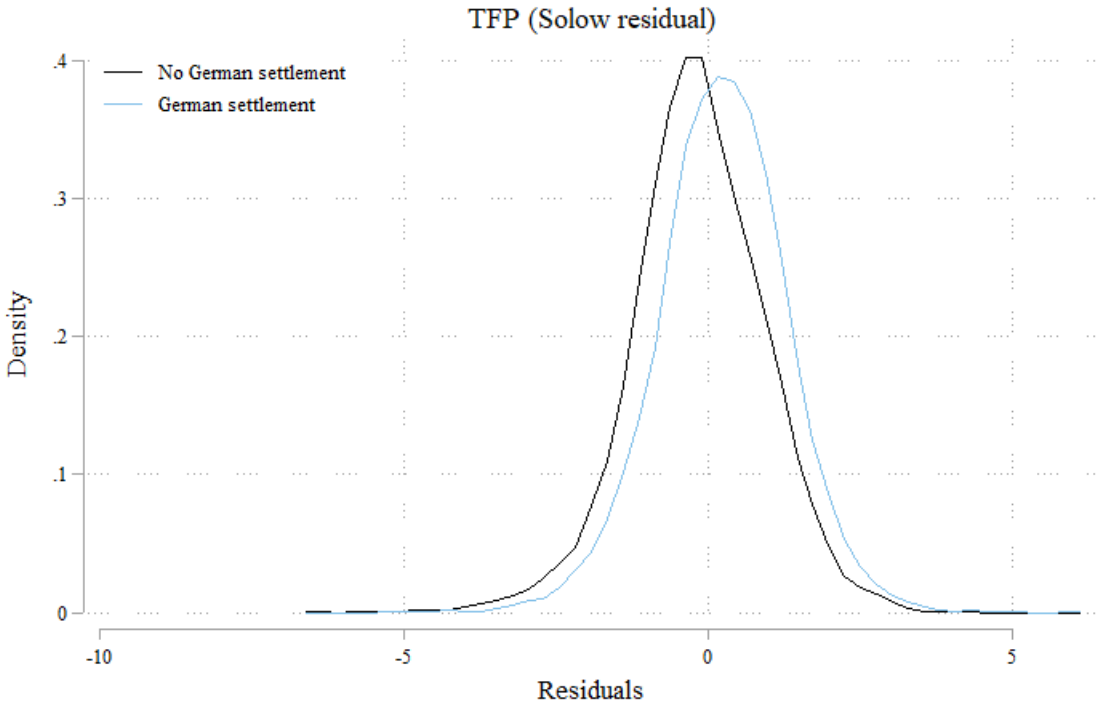


Figure 10: Distribution of TFP in districts with and without German colonies

Table 6: Productivity gains in the industrial sector (firm level evidence).

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total factor productivity (Solow residual)				
% Germans 1897	0.025***	0.023***	0.019**	0.020**	0.015*
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Urban location		0.374***	0.374***	0.358***	0.377***
		(0.043)	(0.041)	(0.043)	(0.039)
Firm age				0.003***	
				(0.001)	
Log Urban pop, 1800	0.021***	0.012**	0.013**	0.012***	0.014***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
% Jewish 1897			0.000	-0.000	0.004
			(0.010)	(0.010)	(0.010)
% Muslims 1897			-0.007	-0.007	-0.006
			(0.005)	(0.005)	(0.005)
% Old Believers 1897			0.007	0.011	0.006
			(0.016)	(0.015)	(0.013)
Ethnic fractionalization 1897	0.101	0.004	0.076	0.075	0.157
	(0.168)	(0.159)	(0.188)	(0.220)	(0.196)
% Female pop 1897	-0.057***	-0.051***	-0.051***	-0.050***	-0.061***
	(0.014)	(0.015)	(0.014)	(0.013)	(0.018)
% Age < 10 pop 1897	-0.009	0.004	0.002	0.001	0.008
	(0.015)	(0.015)	(0.016)	(0.016)	(0.018)
% Age > 60 pop 1897	0.014	0.012	0.010	0.015	0.023
	(0.024)	(0.025)	(0.025)	(0.022)	(0.021)
Ln Dist. from Moscow	0.092	0.070	0.060	0.038	0.097
	(0.109)	(0.103)	(0.076)	(0.071)	(0.072)
Ln Dist. from frontier	-0.112**	-0.086	-0.077	-0.066	-0.101**
	(0.053)	(0.053)	(0.052)	(0.054)	(0.046)
Coal deposits, dummy	-0.076	-0.097	-0.089	-0.128	-0.064
	(0.071)	(0.071)	(0.079)	(0.086)	(0.080)
stand. beta	(0.077)	(0.070)	(0.057)	(0.061)	(0.045)
Conley s.e. (250 km cutoff)	[0.010]**	[0.009]**	[0.009]**	[0.009]**	[0.008]*
Controls	Linear	Linear	Linear	Linear	Flexible
Province FE	x	x	x	x	x
Industry FE	x	x	x	x	x
Observations	13,086	13,086	13,086	10,746	13,086
R-squared	0.221	0.238	0.238	0.246	0.243

Note: Mean % Germans = 0.87, SD = 3.13. Mean outcome = 0.000, SD = 1.1. The regressions are based on 1894 Industrial Census data (Gregg 2020). The regressions include all other controls from the Table 5. All regressions are estimated for the sample of 50 European provinces and Caucasus region. Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

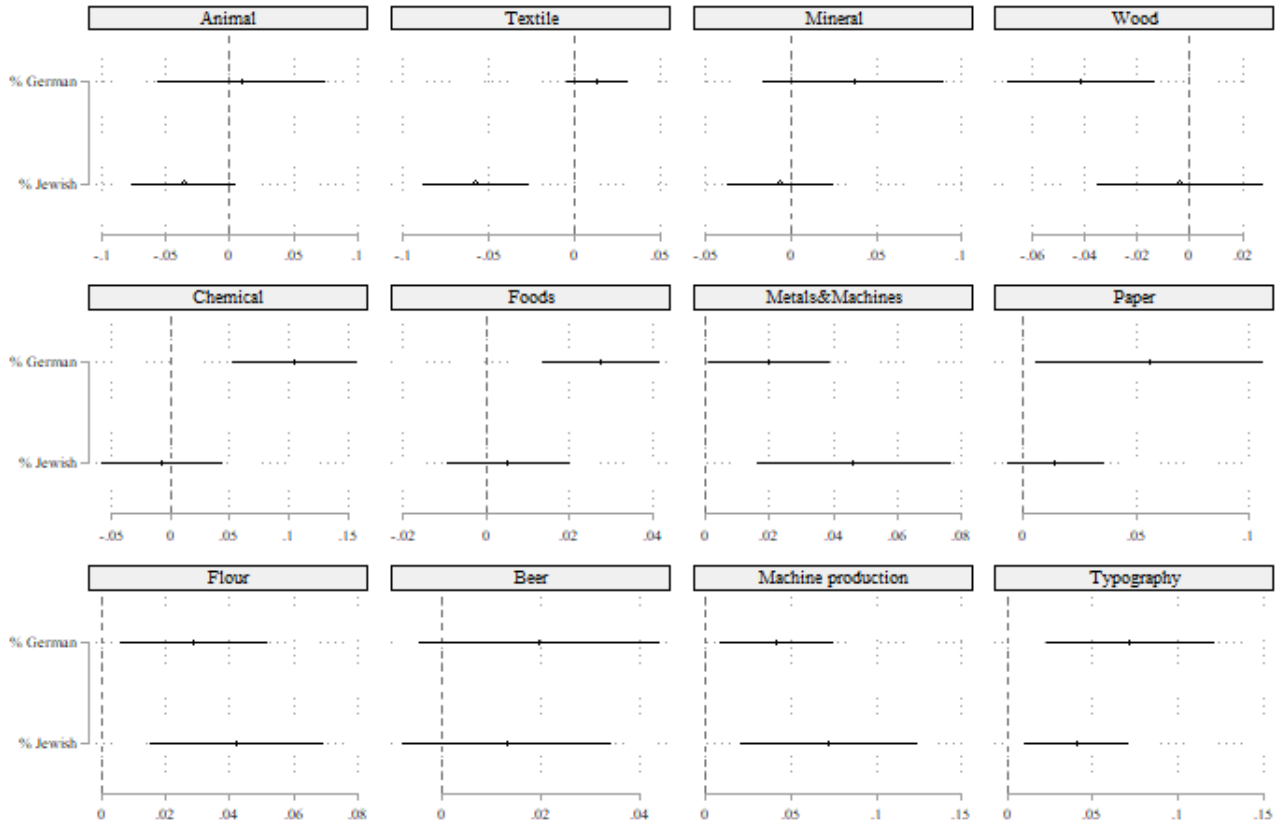


Figure 11: German impact on productivity (TFP) across industries[a]

[a]The regressions are estimated for the samples of firms belonging to particular industry(sub-industry). The regressions specification is the same as in the column 4 Table 6

Table 7: Technological advancements in the industrial sector (firm level evidence).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	TFP	Log Capital per worker					Pre-industrial technology, dummy				
% Germans 1897	0.033***	0.027***	0.027***	0.023***	0.013***	0.022***	-0.014**	-0.014***	-0.012**	-0.010*	-0.009*
	(0.009)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Urban location			-0.029	-0.022	-0.085	-0.032		-0.153***	-0.150***	-0.123***	-0.137***
			(0.054)	(0.054)	(0.059)	(0.052)		(0.039)	(0.039)	(0.036)	(0.034)
Firm age					-0.004***					0.005***	
					(0.001)					(0.001)	
Log Urban pop, 1800	0.010	-0.015*	-0.015*	-0.013*	-0.009	-0.011	-0.004	-0.001	-0.001	-0.002	-0.002
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Outcome mean	0.000	0.44	0.44	0.44	0.44	0.44	0.23	0.23	0.23	0.23	0.23
Outcome sd	1.1	0.63	0.63	0.63	0.63	0.63	0.42	0.42	0.42	0.42	0.42
stand. beta	(0.105)	(0.124)	(0.124)	(0.110)	(0.066)	(0.102)	(-0.113)	(-0.115)	(-0.097)	(-0.085)	(-0.075)
District demography controls	x	x	x	x	x	x	x	x	x	x	x
District GIS controls	x	x	x	x	x	x	x	x	x	x	x
Industry FE	x	x	x	x	x	x	x	x	x	x	x
Province FE	x	x	x	x	x	x	x	x	x	x	x
Controls	Linear	Linear	Linear	Linear	Linear	Flexible	Linear	Linear	Linear	Linear	Flexible
Observations	2,005	2,005	2,005	2,005	1,616	2,005	2,898	2,898	2,898	2,260	2,898
R-squared	0.198	0.205	0.205	0.208	0.235	0.212	0.429	0.443	0.448	0.455	0.463

Note: Pre-industrial technology is an indicator that equals one if a firm uses equipment powered by wind and water contrary to steam, electricity and oil (modern engines). The table shows the estimates for the subsample of industries (sub-industries) historically connected to German entrepreneurs (Flour milling, Beer, Machine and mechanical tools production). The regression specification is the same as in the column 4 Table 6. Other controls include % of ethnic / religious minorities (Jewish, Muslim, Old-Believers), distances from Moscow and frontier line (in logarithms). Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

Table 8: German migrants and early-stage industrialization (1868)

VARIABLES	(1) % Industrial workers	(2) % Industrial workers	(3) % Urban 1867	(4) % Urban 1867	(5) Log Steam power	(6) Log Steam power	(7) Shipement percap	(8) Shipment percap
% Germans 1867	-0.015*	-0.002	0.039	0.114	-0.010	0.015	-0.007	-0.000
	(0.008)	(0.011)	(0.104)	(0.138)	(0.018)	(0.020)	(0.005)	(0.005)
% Jewish 1867	0.022	0.007	0.495***	0.646***	0.013	0.018	-0.004	-0.004
	(0.015)	(0.009)	(0.117)	(0.223)	(0.017)	(0.021)	(0.004)	(0.003)
% Old Believers 1867	0.078	0.086	0.042	-0.001	0.011	0.003	0.006	0.006
	(0.057)	(0.062)	(0.119)	(0.119)	(0.019)	(0.015)	(0.007)	(0.007)
% Muslim 1867	-0.009	-0.001	-0.016	-0.017	-0.010	-0.000	-0.002*	-0.001
	(0.006)	(0.004)	(0.031)	(0.044)	(0.007)	(0.006)	(0.001)	(0.003)
Log Urban pop 1800	0.018	0.025	1.030***	0.958***	0.047**	0.041**	0.021***	0.023***
	(0.013)	(0.016)	(0.088)	(0.091)	(0.018)	(0.020)	(0.008)	(0.008)
% Female 1867	-0.237***	-0.261***	-2.402***	-2.410***	-0.205**	-0.187***	-0.033	-0.016
	(0.074)	(0.093)	(0.555)	(0.668)	(0.086)	(0.064)	(0.028)	(0.014)
Ln Dist. from Moscow	-1.679***	-1.123*	-4.822***	-5.312**	-0.939***	-1.107***	-0.065	0.023
	(0.313)	(0.581)	(0.968)	(2.433)	(0.155)	(0.362)	(0.044)	(0.105)
Ln Dist. from frontier	-0.386***	-0.120	-0.996	-2.817**	-0.296**	-0.453**	-0.098**	-0.102
	(0.094)	(0.151)	(0.798)	(1.372)	(0.130)	(0.191)	(0.045)	(0.084)
Coal deposits, dummy	-0.734***	-0.460	-2.133**	-1.208	-0.423*	-0.379	-0.108	-0.021
	(0.263)	(0.300)	(1.019)	(1.262)	(0.225)	(0.324)	(0.067)	(0.060)
GIS controls	x	x	x	x	x	x	x	x
Province FE		x		x		x		x
Observations	488	488	488	488	488	488	488	488
R-squared	0.279	0.438	0.617	0.680	0.210	0.335	0.148	0.240

Note: All regressions are estimated for the sample of 50 European provinces. Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

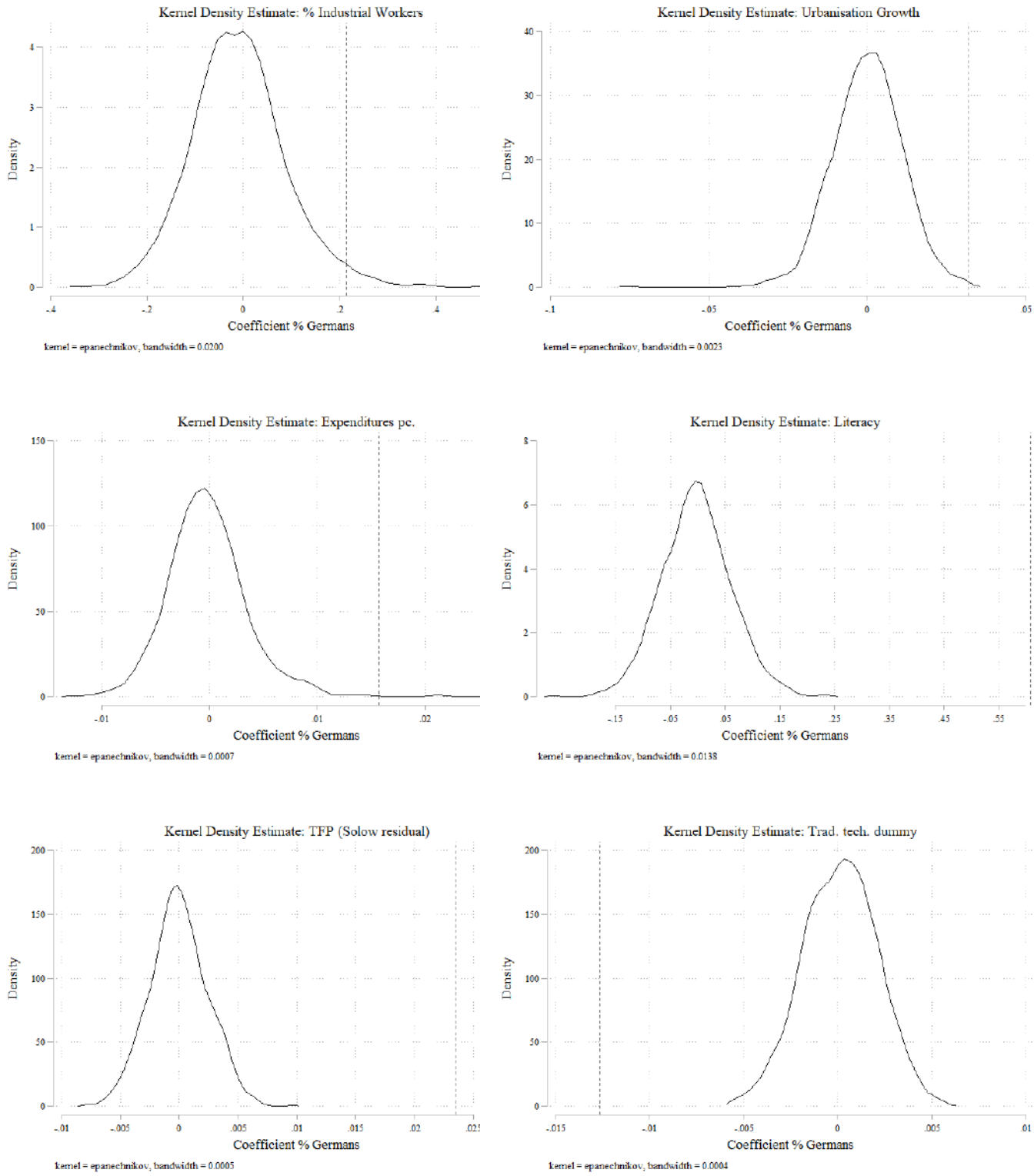


Figure 12: Permutation test on the main regression results

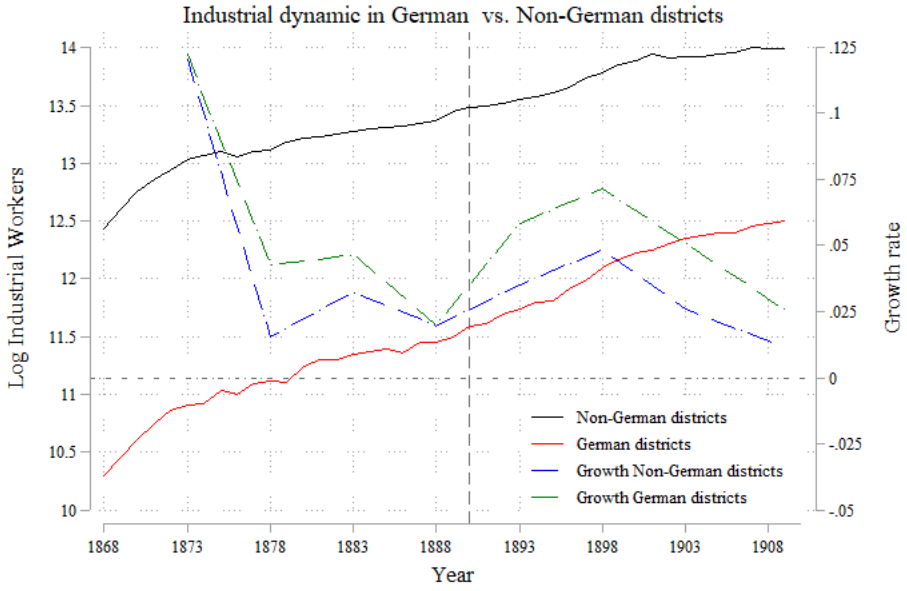


Figure 13: The Dynamic of industrial workers in German vs. Non-German districts

Table 9: Advanced vs. early stage of industrialization: difference-in-difference analysis

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log Industrial workers					
Post1890×% Germans 1867	0.053***	0.028***	0.025***	0.026***	0.027***	0.024***
	(0.019)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Post1890×Log Urban pop 1800		-0.005	-0.006	-0.006	-0.006	-0.006
		(0.009)	(0.009)	(0.010)	(0.010)	(0.009)
Post1890×% Old-Believers 1867			0.022	0.020	0.020	0.021
			(0.013)	(0.012)	(0.012)	(0.014)
Post1890×% Jewish 1867			0.013***	0.012***	0.013***	0.009
			(0.004)	(0.004)	(0.004)	(0.006)
Post1890×% Muslims 1867			-0.008	-0.008	-0.007	-0.007
			(0.006)	(0.006)	(0.006)	(0.007)
Post1890×Log Railroad distance 1868				-0.028	-0.028	-0.021
				(0.031)	(0.031)	(0.030)
Post1890×% Serfs 1858					0.002	0.001
					(0.003)	(0.003)
Year FE	x	x	x	x	x	x
GIS controls × Year FE		x	x	x	x	x
District FE	x	x	x	x	x	x
Province-specific linear trends			x	x	x	
Province × Year FE						x
Observations	10,885	10,885	10,885	10,885	10,885	10,860
R-squared	0.824	0.851	0.851	0.851	0.851	0.876

Note: All regressions are estimated for the sample of 50 European provinces. Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

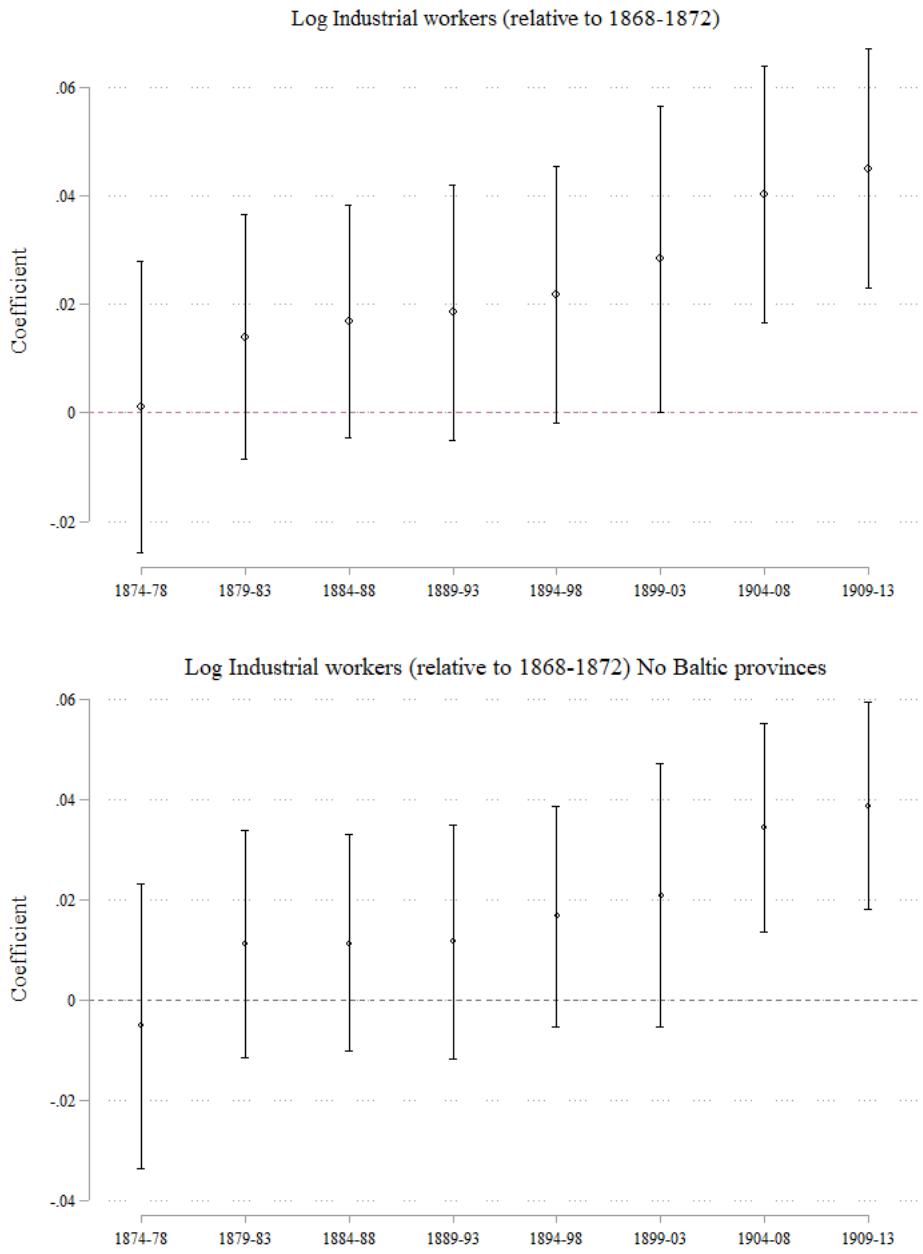


Figure 14: The progression of the German impact throughout industrialization: difference-in-difference analysis[a]

[a]The graph depicts coefficients and 95% confidence intervals from regression equation 3. The coefficients capture German impact on industrialization relative to 1868-1872.

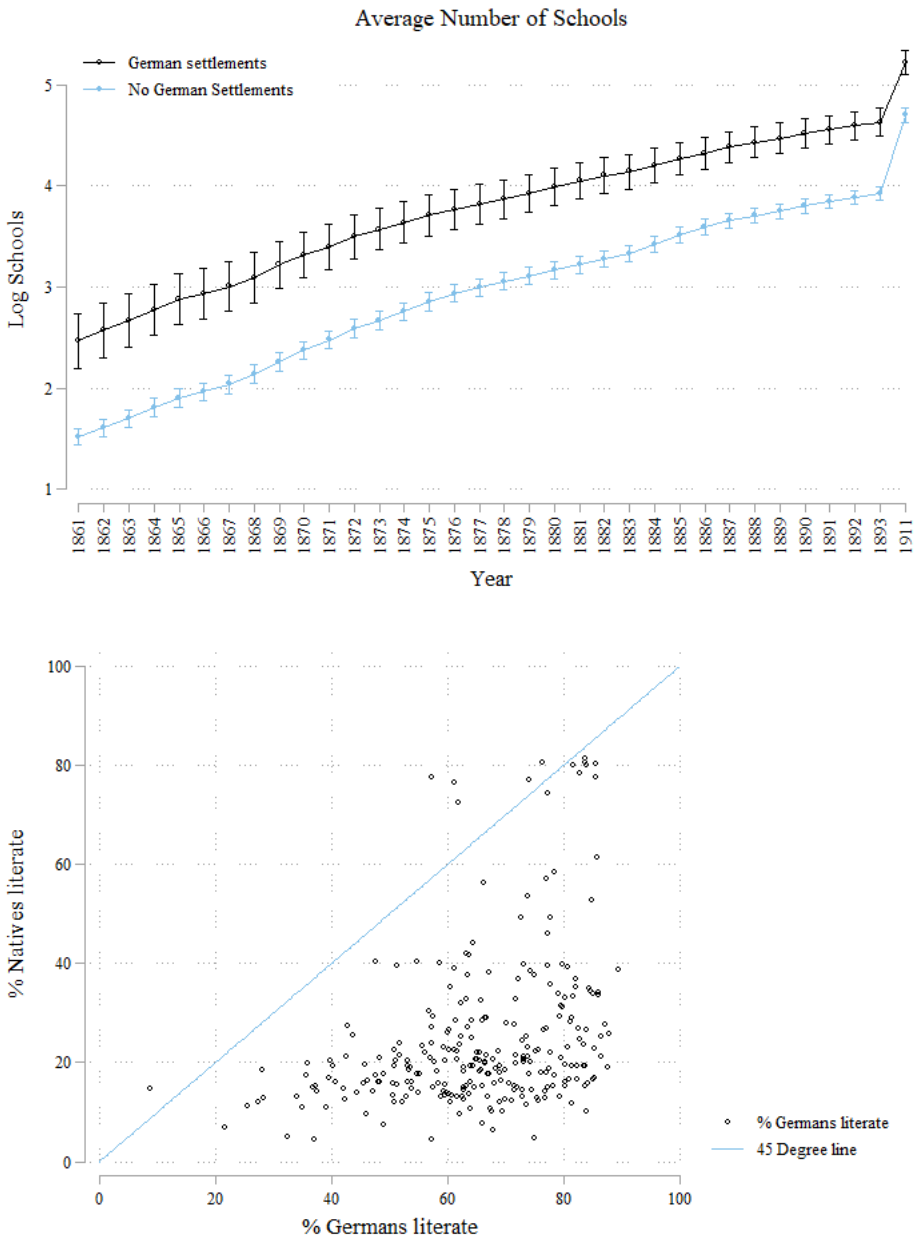


Figure 15: German settlers and Schooling / Literacy

Table 10: German immigrants and schooling / human capital development

VARIABLES	(1) Pupils percap	(2) Female pupils ratio	(3) Teacher income	(4) School exp. share	(5) % Teachers	(6) % Literate	(7) % Literate female	(8) % High school
% Germans 1867	0.143***	0.010***	1.673**	0.002***	0.011***	0.560***	0.577***	0.022***
	(0.019)	(0.003)	(0.832)	(0.001)	(0.002)	(0.101)	(0.107)	(0.007)
Log urban., 1800	0.014*	-0.002	0.679*	0.000	0.024***	0.238***	0.184***	0.075***
	(0.007)	(0.003)	(0.364)	(0.001)	(0.003)	(0.053)	(0.055)	(0.008)
Outcome mean	2.83	0.27	132.04	0.168	0.62	21.36	12.42	0.86
GIS controls	x	x	x	x	x	x	x	x
Province FE	x	x	x	x	x	x	x	x
Year FE	x	x	x	x				
Observations	1,463	1,463	961	699	488	488	488	488
R-squared	0.800	0.090	0.440	0.427	0.665	0.914	0.925	0.680

Note: Column 1-2 present results from pooled regressions, based on the data from three educational censuses (1880, 1894 and 1911). The columns 2-4 represent the estimates, based on 1880 and 1894 samples. The columns 6-8 show cross-section regression, based on 1897 Census data. Standard errors are clustered at province level. Additional controls include shares of Jewish, Old-Believers and Muslim population; % female population in 1867 in pooled regressions and also % of population below 10 and above 60 in cross-section regressions. All regressions are estimated for the sample of 50 European provinces. Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

Table 11: German immigrants and schooling / human capital development: difference-in-difference analysis

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Share school expenditures			Pupils per capita		
% Germans 1867	0.003***			0.196***		
	(0.001)			(0.022)		
1894×% Germans 1867	-0.001	-0.001	-0.000	-0.027*	-0.030**	-0.009
	(0.001)	(0.001)	(0.001)	(0.015)	(0.015)	(0.019)
1900×% Germans 1867	-0.000	-0.000	0.000			
	(0.001)	(0.001)	(0.001)			
1907×% Germans 1867	-0.001	-0.001	-0.001			
	(0.001)	(0.001)	(0.001)			
1911×% Germans 1867				-0.100***	-0.108***	-0.086***
				(0.016)	(0.019)	(0.026)
Year FE	x	x	x	x	x	x
GIS controls × Year FE	x	x	x	x	x	x
Province FE	x			x		
District FE		x	x		x	x
Province×Year FE			x			x
Observations	1,415	1,415	1,415	1,463	1,463	1,463
R-squared	0.525	0.787	0.853	0.836	0.917	0.961

Note: The dependent variable in columns (1)-(3) is the share of local (*Zemstvo*) budget expenditures spent on schooling. Standard errors are clustered at province level. Other controls are the same as in the Table 3. The dependent variable in columns (4)-(6) is the number of primary school pupils normalized by district's population. All regressions are estimated for the sample of 50 European provinces. Standard errors are clustered at province level. *** p<0.01, ** p<0.05, * p<0.1

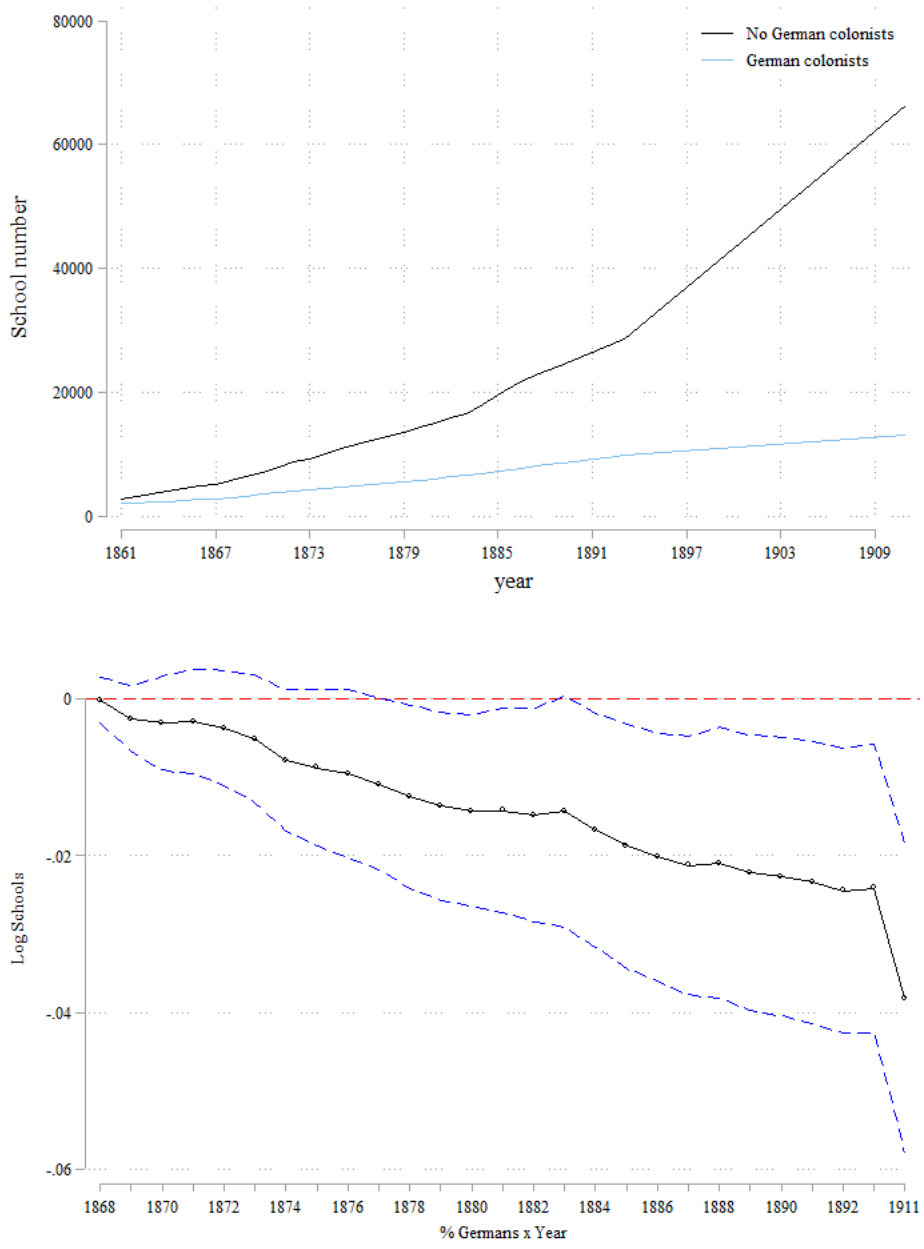


Figure 16: Expansion of schools in the districts with and without German settlements [a]

[a] The bottom figure depicts coefficients (β) obtained from the regression $Ln(School)_{it} = \alpha_i + \gamma_t + \sum_{t=1868}^{1894} \beta_t \%Germans_{i,1867} + \sigma_t X_i' + \epsilon_{it}$ The path of the coefficients shows expansion of schooling in areas with different intensity of German migration **relative** to the baseline period (1867). The baseline specification includes district and year fixed effects; GIS controls interacted with year dummies. The results are robust for the inclusion of province years-specific fixed effects.

Table 12: Education and Industrial Development: IV-estimates

	(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
VARIABLES	School enroll. 1880	% Industrial workers									Local expend. percap.	$\Delta Urban.$ 1800-1897	TFP	Log Capital	Trad. tech.
% Germans 1867	0.882***	0.165***													
	(0.125)	(0.059)													
School $\widehat{\text{enrollment}}$ 1880			0.185***	0.214***	0.218***	0.188***	0.215***	0.219***	0.219***	0.207***	0.022***	0.019**	0.049**	0.031***	-0.024***
			(0.065)	(0.070)	(0.071)	(0.073)	(0.072)	(0.071)	(0.071)	(0.075)	(0.008)	(0.009)	(0.023)	(0.011)	(0.007)
% Noble landownership 1880					0.012					0.005	-0.001	0.003	0.003	0.006**	-0.005***
					(0.057)					(0.057)	(0.001)	(0.003)	(0.004)	(0.003)	(0.001)
% Born in district 1897						-0.218***				-0.217***	-0.004	-0.053***	-0.027***	-0.014***	0.010***
						(0.068)				(0.066)	(0.003)	(0.006)	(0.008)	(0.004)	(0.003)
% Foreign born 1897							-0.080			-0.379	-0.039	-0.089	-0.041	0.019	0.016
							(0.700)			(0.664)	(0.039)	(0.072)	(0.089)	(0.055)	(0.032)
Fertility 1875								-0.505**		-0.479*	0.012	-0.062***	-0.035	0.050**	0.027**
								(0.257)		(0.259)	(0.024)	(0.023)	(0.034)	(0.022)	(0.012)
Grain prod. (1883-88 aver.)									-0.152	-0.157	-0.035***	-0.022	-0.037	-0.031	0.013
									(0.434)	(0.410)	(0.011)	(0.029)	(0.049)	(0.036)	(0.019)
% Serfs 1858				0.060***	0.056	0.059***	0.060***	0.059***	0.062***	0.058	0.000	-0.005**	0.002	0.004*	-0.001
				(0.022)	(0.036)	(0.022)	(0.022)	(0.022)	(0.023)	(0.036)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)
% Industrial workers 1868	-0.074	1.433***	1.448***	1.383***	1.390***	1.277***	1.383***	1.364***	1.379***	1.259***	-0.011	0.006	0.061***	0.004	-0.012*
	(0.061)	(0.287)	(0.257)	(0.271)	(0.272)	(0.300)	(0.271)	(0.274)	(0.271)	(0.302)	(0.008)	(0.012)	(0.023)	(0.015)	(0.007)
Log Steam power 1868	0.127	0.766**	0.741***	0.765***	0.760***	0.732***	0.765***	0.770***	0.768***	0.733***	0.007	0.042**	-0.021	-0.007	-0.005
	(0.133)	(0.308)	(0.275)	(0.277)	(0.284)	(0.280)	(0.276)	(0.273)	(0.278)	(0.283)	(0.007)	(0.018)	(0.028)	(0.020)	(0.013)
Log Dist. from railroad 1867	-0.054	-0.747**	-0.740***	-0.643**	-0.645**	-0.527*	-0.644**	-0.632**	-0.651**	-0.535**	-0.004	-0.055**	-0.018	-0.007	-0.013
	(0.145)	(0.282)	(0.256)	(0.269)	(0.266)	(0.272)	(0.271)	(0.272)	(0.276)	(0.272)	(0.010)	(0.023)	(0.038)	(0.031)	(0.016)
% Old Believers 1867	-0.042	0.563***	0.565***	0.571***	0.572***	0.582***	0.571***	0.576***	0.569***	0.585***	-0.004	0.005	-0.038	-0.004	0.004
	(0.041)	(0.210)	(0.199)	(0.194)	(0.194)	(0.197)	(0.194)	(0.194)	(0.195)	(0.200)	(0.004)	(0.010)	(0.026)	(0.010)	(0.005)
% Muslim 1867	-0.084**	-0.097	-0.082	-0.079	-0.079	-0.080	-0.077	-0.078	-0.071	-0.065	-0.003**	-0.007	0.001	0.004	0.000
	(0.032)	(0.063)	(0.058)	(0.055)	(0.056)	(0.052)	(0.058)	(0.055)	(0.063)	(0.059)	(0.001)	(0.008)	(0.011)	(0.005)	(0.003)
% Jewish 1867	-0.063	0.084	0.095	0.136	0.135	0.108	0.136	0.122	0.137	0.098	-0.001	0.006	0.015	0.019**	-0.001
	(0.046)	(0.083)	(0.078)	(0.084)	(0.084)	(0.077)	(0.084)	(0.080)	(0.085)	(0.074)	(0.003)	(0.009)	(0.013)	(0.009)	(0.005)
Sample	dist.	dist.	dist.	dist.	dist.	dist.	dist.	dist.	dist.	dist.	dist.	dist.	firm	firm	firm
OLS estimate			0.261***	0.265***	0.267***	0.263***	0.265***	0.269***	0.271***	0.274***	0.017***	0.013	-0.002	0.015*	-0.009**
stand. beta			(0.119)	(0.137)	(0.139)	(0.120)	(0.138)	(0.140)	(0.140)	(0.132)	(0.285)	(0.034)	(0.28)	(0.32)	(-0.38)
Hausman p-value			0.485	0.631	0.590	0.323	0.499	0.496	0.488	0.503	0.323	0.425	0.001	0.129	0.051
First-stage F-stat			49.64	49.44	46.37	52.59	58.98	49.37	49.34	59.19	273.05	59.18	13.32	13.32	11.93
GIS	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Demography	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Province FE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Observations	487	488	487	487	487	487	487	487	486	486	471	486	1,915	1,915	2,696
R-squared	0.821	0.705	0.711	0.716	0.717	0.725	0.716	0.718	0.716	0.726	0.770	0.986	0.215	0.204	0.428

Note: Mean School enrollment 1880 = 8.03, SD = 6.51. Other controls include Log urban pop. in 1800, distances from Moscow and Sankt-Peterburg (in logarithms), distance from frontier line, indicator of urban location for firm-level-regressions. All regressions are estimated for the sample of 50 European provinces. Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

Table 13: Does German migrants impact industries with higher human capital intensity?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	% Workers							
Years schooling×% Germans 1897	0.028		0.020**					
	(0.017)		(0.009)					
Log(occscore)×% Germans 1897		0.307		0.292*				
		(0.187)		(0.166)				
𝟙[50th percentile y.s.]×% Germans 1897					0.058*		0.043**	
					(0.035)		(0.019)	
𝟙[50th percentile occ.s.]×% Germans 1897						0.113		0.100*
						(0.071)		(0.057)
Controls		x		x		x		x
HISCO code FE	x	x	x	x	x	x	x	x
District FE	x	x	x	x	x	x	x	x
Observations	12,364	12,364	12,364	12,364	12,364	12,364	12,364	12,364
R-squared	0.824	0.824	0.827	0.828	0.824	0.824	0.827	0.827

Note: The table presents the results of the estimation of difference-in-difference model. The coefficient on interaction term captures a differential impact of Germans on occupations with higher human capital intensity. All regressions are estimated for the sample of 50 European provinces and Caucasus region. Standard errors are clustered at province level. *** p<0.01, ** p<0.05, * p<0.1

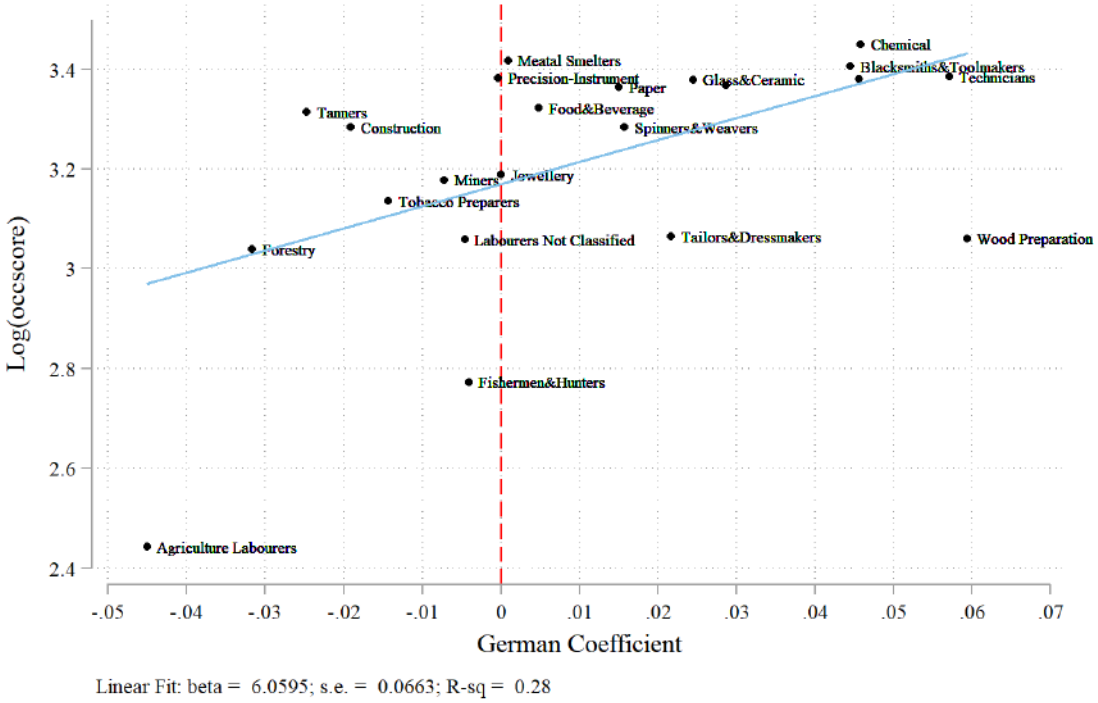


Figure 17: Does Germans impact industries with higher economic rewards?[a]

[a]The graph depicts standardized "German" coefficients from cross-section regressions for different HISCO categories

Table 14: German colonists and schools in pre-emancipation period. Village-level analysis (1858)

	(1)	(2)	(3)	(4)
VARIABLES	School dummy			
German colony	0.763***	0.758***	0.769***	0.746***
	(0.045)	(0.042)	(0.043)	(0.060)
Emperor village	0.040	0.046	0.071	0.048
	(0.056)	(0.056)	(0.059)	(0.067)
Private serfs village	-0.008	0.006	0.035*	0.036
	(0.020)	(0.021)	(0.020)	(0.023)
Bolgar colony	-0.007	-0.024	-0.063*	-0.056
	(0.025)	(0.043)	(0.034)	(0.033)
Jewish settlement	0.099	0.108	0.142**	0.139*
	(0.074)	(0.073)	(0.069)	(0.070)
Log population	0.074***	0.076***	0.084***	0.087***
	(0.010)	(0.010)	(0.010)	(0.010)
Dist. from district capital	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Mail post, dummy	0.133**	0.136**	0.137**	0.125**
	(0.052)	(0.054)	(0.050)	(0.053)
Fixed effects	No	Province	District	Sub-district
Observations	1,681	1,681	1,681	1,681
R-squared	0.643	0.645	0.656	0.667

Note: The regressions are estimated at village-level covering the primary areas of German migration (Volga and Black Sea regions). The state-peasant settlements represents a reference category. Standard errors are clustered at sub-district ("Stan") level. *** p<0.01, ** p<0.05, * p<0.1

Table 15: Germans and human capital of natives

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	% Non-German literate 1897					
% Germans 1867	0.271**	0.202**	0.166*	0.122	0.155*	0.036
	(0.120)	(0.089)	(0.091)	(0.081)	(0.077)	(0.081)
% Born in district 1897		-0.300***	-0.249***	-0.304***	-0.335***	-0.236***
		(0.050)	(0.055)	(0.045)	(0.048)	(0.041)
% Teachers 1897			3.289**			3.742***
			(1.280)			(1.015)
School pc. 1880				81.047***		116.778***
				(20.230)		(16.307)
Share school expenditures 1883					9.921***	2.980
					(3.006)	(2.555)
Log Urban pop 1800	0.245***	0.161***	0.100**	0.146***	0.181***	0.128***
	(0.049)	(0.041)	(0.038)	(0.040)	(0.039)	(0.042)
% Jewish 1867	0.247***	0.146	0.024	0.136	0.328*	0.201
	(0.089)	(0.108)	(0.091)	(0.101)	(0.186)	(0.122)
% Old Believers 1867	0.066	0.107	0.134	0.112	-0.018	0.082
	(0.083)	(0.086)	(0.087)	(0.084)	(0.068)	(0.083)
% Muslims 1867	-0.026	-0.022	-0.029	-0.001	0.027	0.061
	(0.065)	(0.056)	(0.055)	(0.053)	(0.059)	(0.044)
Zemstvo provinces only				x	x	x
Province FE	x	x	x	x	x	x
Observations	481	481	481	358	358	358
R-squared	0.822	0.852	0.871	0.855	0.857	0.863

Note: All regressions are estimated for the sample of 50 European provinces. Standard errors are clustered at province level. *** p<0.01, ** p<0.05, * p<0.1

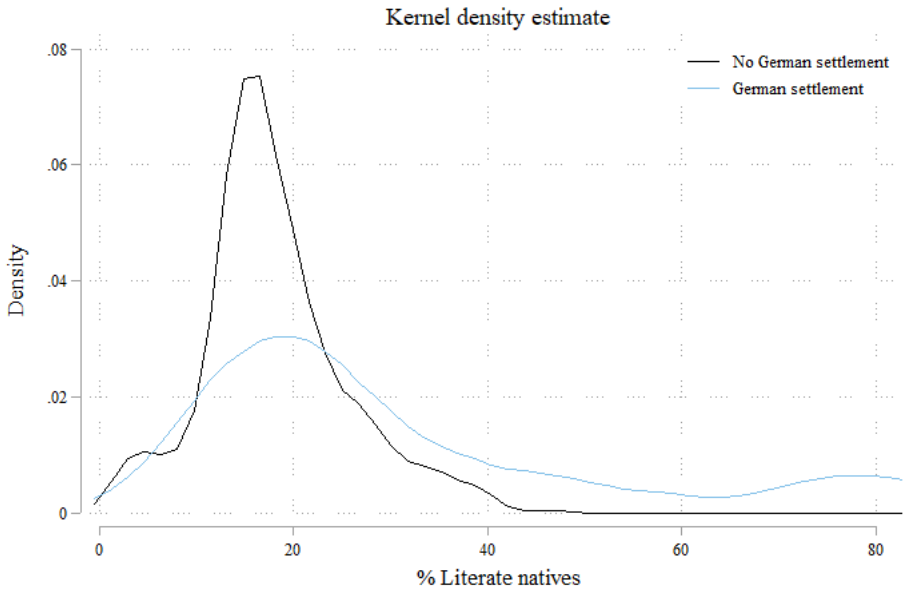
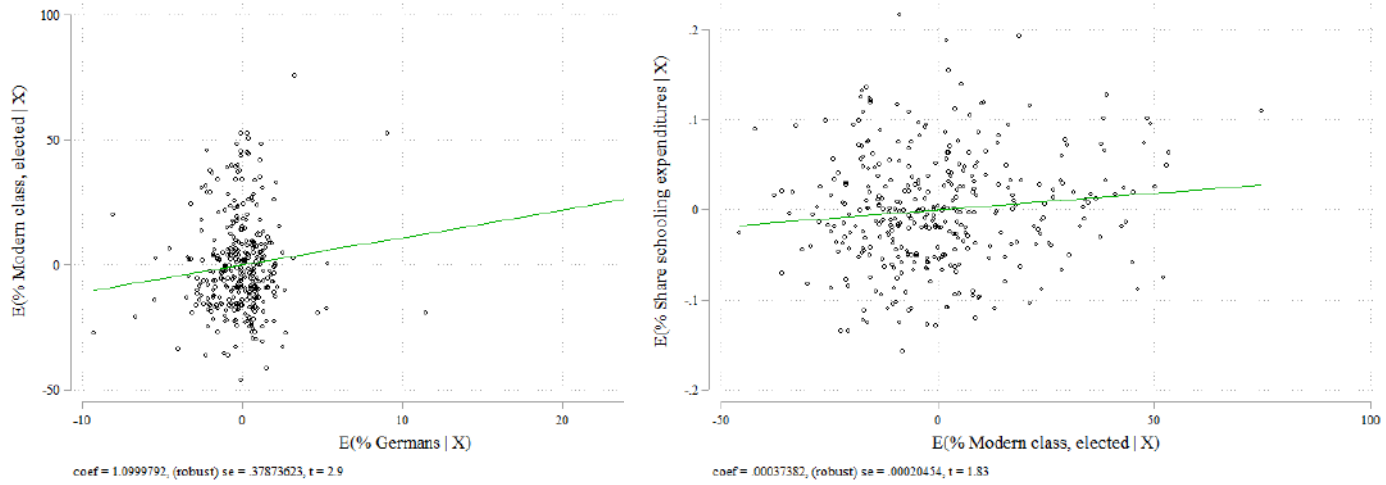


Figure 18: Distribution of Non-German literate population in the districts with and without German colonies



(a) % Modern class, elected

(b) Share expenditures

Figure 19: The role of German settlers in political process[a]

[a]The figure depicts residuals from the regression of % of modern class (urban citizens, merchants, small landowners (peasants)) elected in local authorities on % of Germans (Figure a). The Figure (b) shows residuals from the regression of % of elected modern class on the share of educational expenditures in (*Zemstvo*) budgets at district level.

Table 16: Germans and the spread of Russian Protestantism

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Russian Protestant commune, dummy			# of Russian Protestant communes		
Dist. from German settlement	-0.062***	-0.056**	-0.061*	-0.355***	-0.279***	-0.255**
	(0.018)	(0.022)	(0.034)	(0.056)	(0.086)	(0.111)
Dist. from Moscow		-0.053*	-0.144		-0.468	-1.613**
		(0.029)	(0.086)		(0.300)	(0.776)
Dist. from frontier		-0.043	-0.045		-0.240**	-0.070
		(0.028)	(0.036)		(0.100)	(0.131)
Model	OLS	OLS	OLS	Poisson	Poisson	Poisson
GIS controls		x	x		x	x
Province FE			x			x
Observations	564	564	564	564	564	564
R-squared	0.072	0.179	0.424			

Note: Standard errors are clustered at province level. *** p<0.01, ** p<0.05, * p<0.1. All distances are in logarithms.

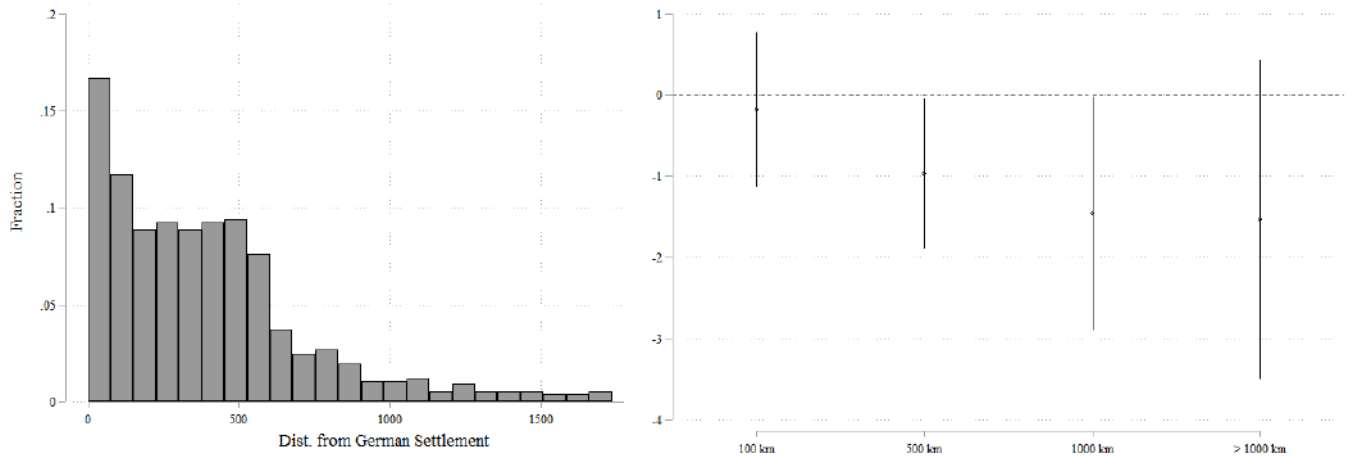


Figure 20: Russian Protestant communities vs. Distance from the nearest German Settlement [a]

[a] The LHS figure depicts distribution of the Russian protestant communes; RHS figure shows the coefficients with 95 % CI, obtained from the Poisson regressions. I regress number of Russian Protestant communes on the indicators of distance from the nearest German settlement. Observations are split between distance bins: below 50km; 50km < dist. <= 100km; 100km < dist. <= 500km; 500km < dist. <= 1000km; dist. > 1000km. Dist. below 50km is an omitted category.

Additional Tables and Figures

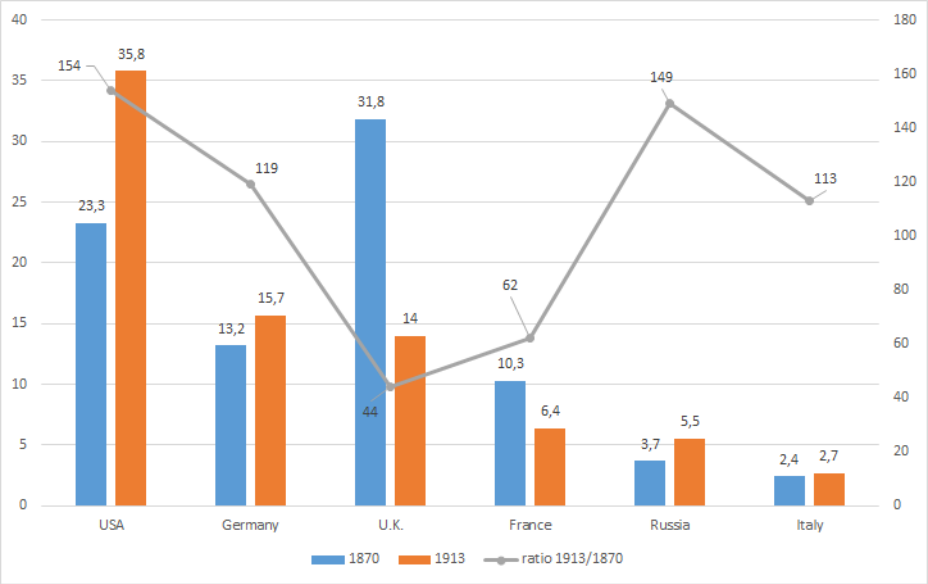


Figure A1: Share in World industry: cross-country comparison in 1870 and 1913

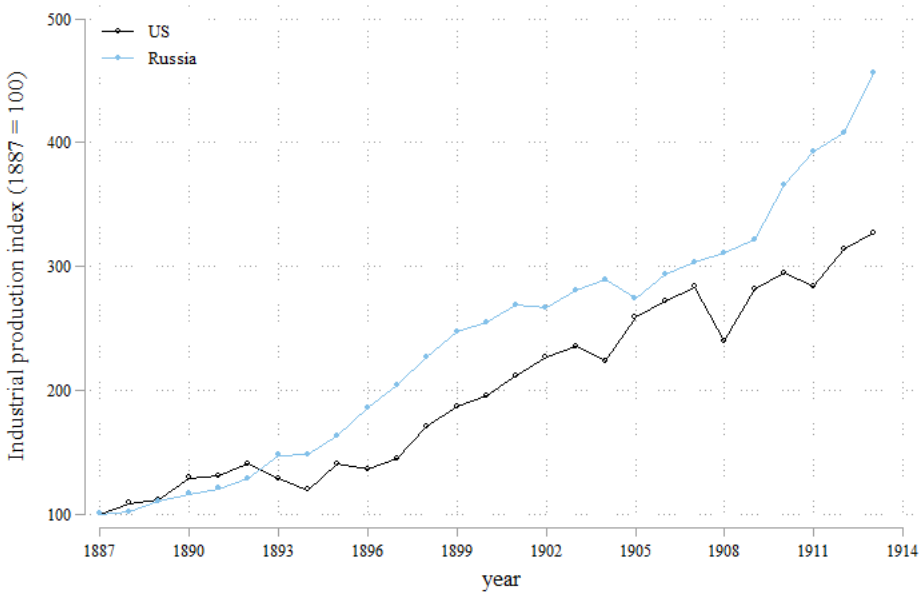


Figure A2: Industrial production dynamic in the US and Russia[a]

[a]Source: Gregori 1999 for Russia's time series and Davis 2004 for the US. The Russia's data is reported by Borodkin http://www.hist.msu.ru/Dynamics/05_scl.htm

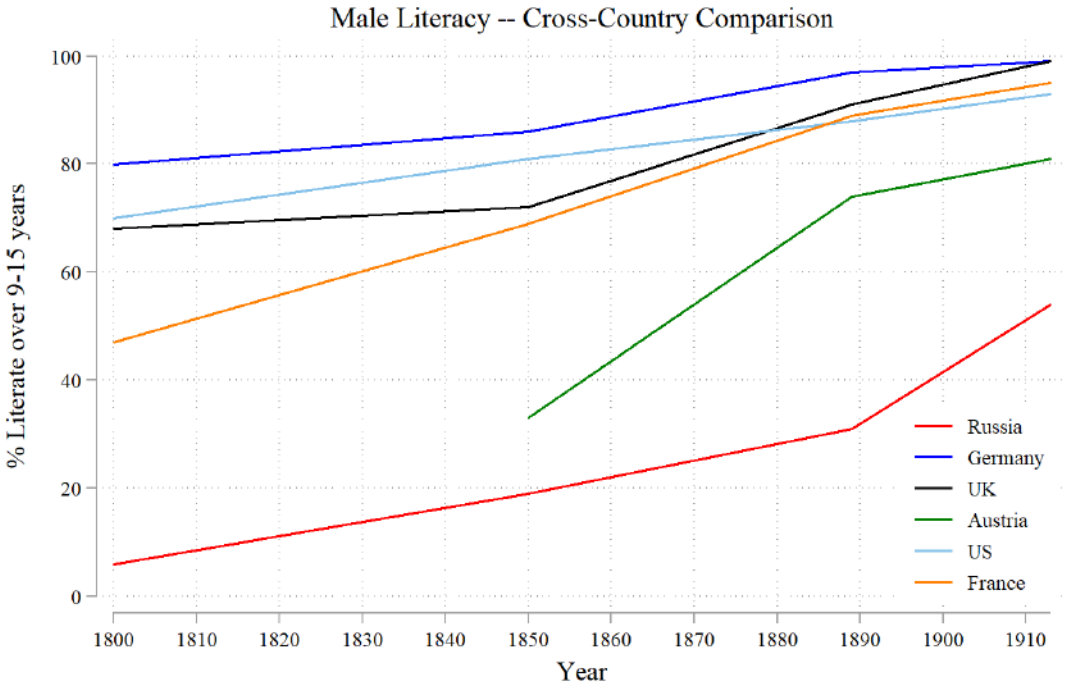


Figure A3: Literacy in Russia and Western countries (Source:Mironov 1991)

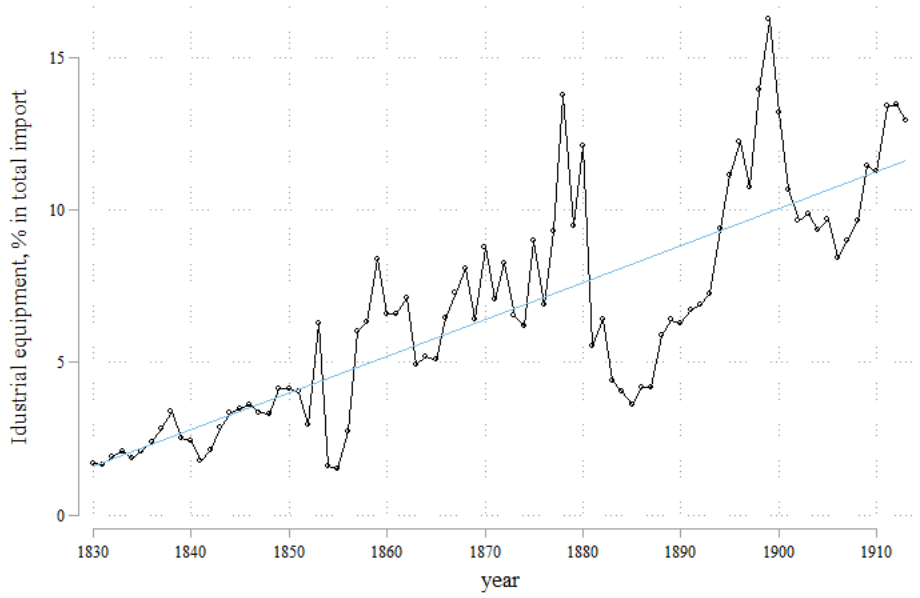


Figure A4: The dynamic of machinery equipment import in Russian Empire[a]

[a]The data is reported by Borodkin http://www.hist.msu.ru/Dynamics/05_scl.htm

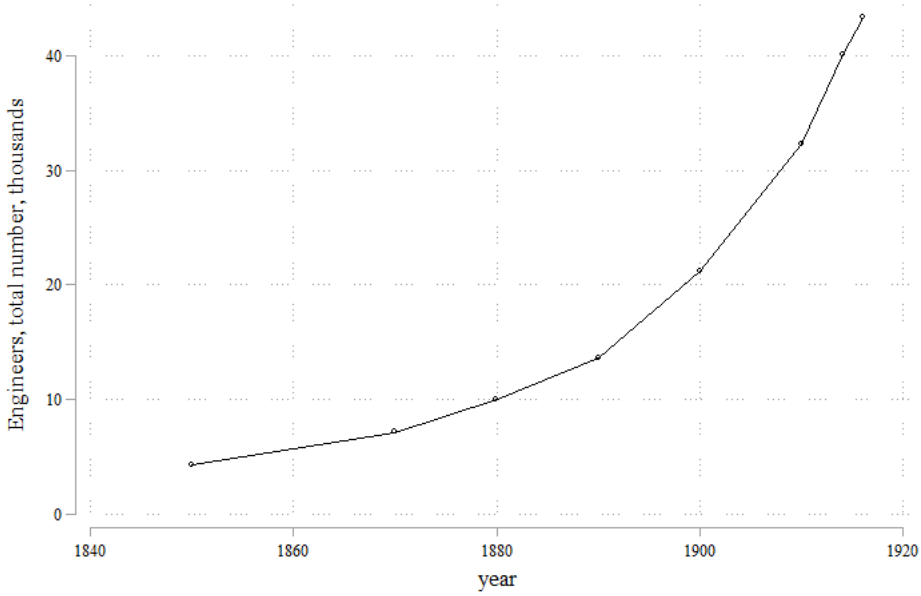


Figure A5: The dynamic of engineers in Russian Empire[a]

[a]The Russia's data is reported by Borodkin http://www.hist.msu.ru/Dynamics/05_scl.htm

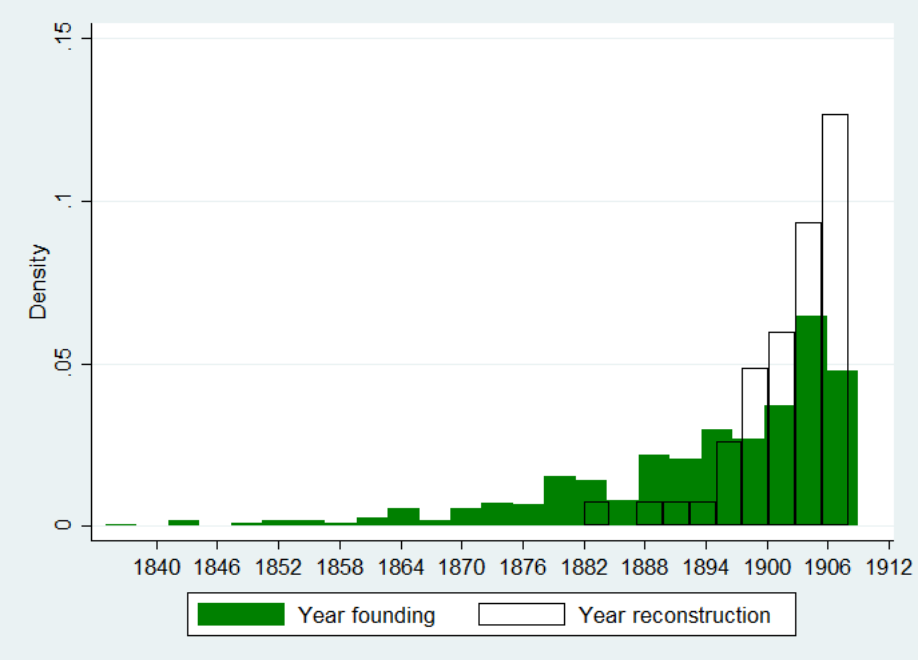


Figure A6: Technological transformation of flour milling industry

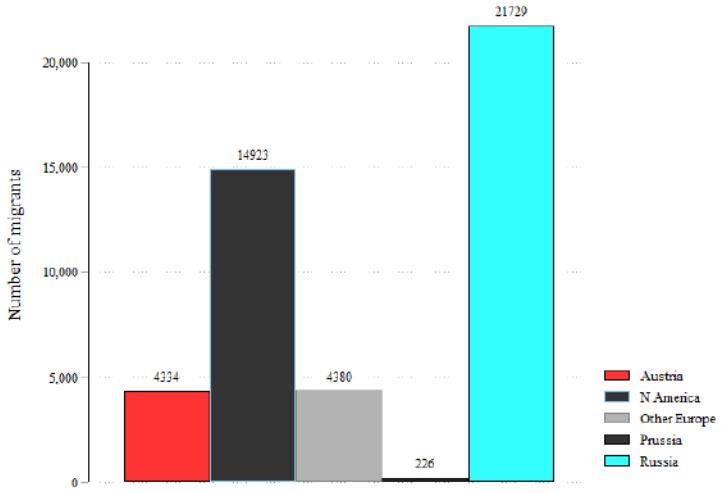
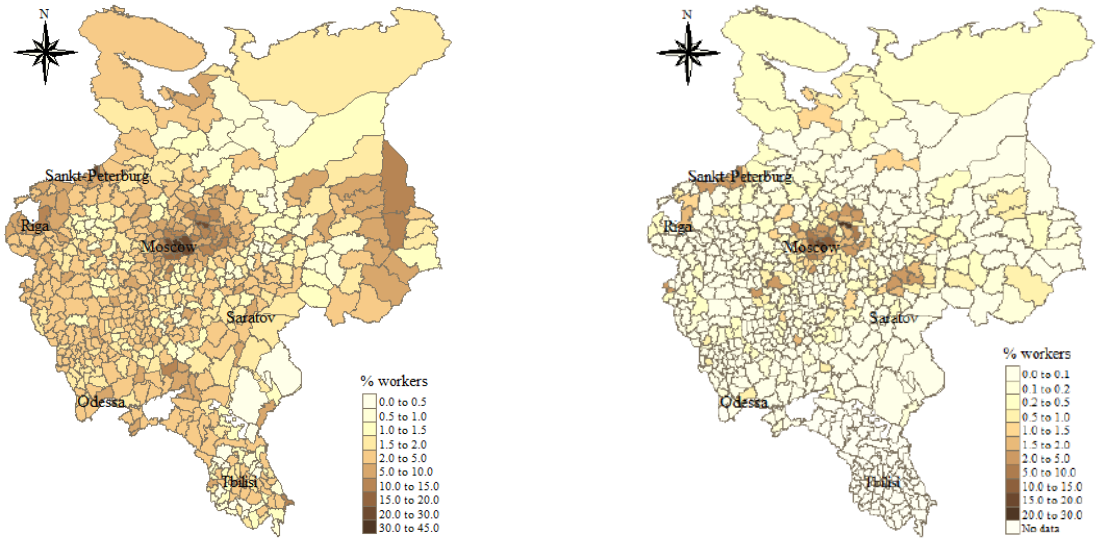


Figure A8: Distribution of migrants by destination country[a]

[a]Source: Ostwanderung der Wuert-temberger 1816-1822, Summary (D. Wahl).



(a) 1897 (b) 1868

Figure A9: Different stages of Russian industrialization (per capita workers in industrial sector)

Table A1: German immigrants and development. Heterogeneity across regions

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	% Industrial workers						
% Germans 1897	0.283*	0.210***	0.156***	0.176**	0.139**	0.165***	0.178***
	(0.150)	(0.074)	(0.055)	(0.069)	(0.056)	(0.060)	(0.063)
Log Urban pop 1800	0.341***	0.366***	0.351***	0.313***	0.367***	0.337***	0.330***
	(0.069)	(0.072)	(0.069)	(0.069)	(0.075)	(0.068)	(0.070)
% Female pop 1897	-0.510	-0.497	-0.489	-0.877**	-0.524	-0.550*	-0.370
	(0.314)	(0.331)	(0.316)	(0.327)	(0.320)	(0.324)	(0.306)
% Age < 10 pop 1897	-0.866***	-0.856**	-0.875***	-0.834**	-0.865***	-0.862***	-1.102***
	(0.298)	(0.323)	(0.294)	(0.399)	(0.299)	(0.302)	(0.237)
% Age > 60 pop 1897	-0.202	-0.178	-0.173	0.003	-0.175	-0.165	-0.257
	(0.180)	(0.177)	(0.179)	(0.200)	(0.179)	(0.183)	(0.169)
Ethnic fractionalization 1897	0.607	0.697	1.237	1.820	1.119	1.063	1.931
	(2.611)	(2.421)	(2.507)	(2.796)	(2.618)	(2.453)	(2.425)
Ln Dist. from Moscow	-6.626**	-6.218**	-6.403**	-6.261*	-6.426**	-6.572**	-8.829***
	(2.801)	(2.648)	(2.721)	(3.374)	(2.823)	(2.795)	(3.277)
Ln Dist. from frontier	-0.883*	-1.259**	-1.080**	-0.965	-1.066**	-1.068**	-1.120**
	(0.468)	(0.504)	(0.502)	(0.634)	(0.496)	(0.483)	(0.474)
Coal deposits, dummy	0.503	-0.038	0.468	0.385	0.460	0.460	-0.275
	(1.360)	(1.352)	(1.373)	(1.519)	(1.377)	(1.373)	(1.423)
Sample	No Volga	No Black Sea	No Baltic	No Caucasus	No W Ukraine	No Peterburg	No Moscow
Demographic controls	x	x	x	x	x	x	x
GIS controls	x	x	x	x	x	x	x
Province FE	x	x	x	x	x	x	x
Observations	534	534	549	490	515	555	550
R-squared	0.605	0.606	0.600	0.608	0.605	0.599	0.582

Note: Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

Table A2: Productivity gains in the industrial sector. Heterogeneity across regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Total factor productivity						
% German 1897	0.019	0.024**	0.018*	0.021*	0.025***	0.024***	0.022***
	(0.013)	(0.009)	(0.011)	(0.012)	(0.008)	(0.009)	(0.008)
Urban location	0.370***	0.378***	0.374***	0.389***	0.426***	0.377***	0.390***
	(0.047)	(0.046)	(0.046)	(0.045)	(0.035)	(0.045)	(0.045)
Ln Urban pop 1800	0.014***	0.015***	0.014**	0.015***	0.010**	0.013**	0.014***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
% Female pop	-0.044***	-0.053***	-0.047***	-0.039**	-0.059***	-0.046***	-0.061***
	(0.016)	(0.016)	(0.015)	(0.014)	(0.015)	(0.017)	(0.021)
% Age < 10 pop	0.009	0.003	0.000	0.004	0.012	-0.001	-0.005
	(0.014)	(0.017)	(0.016)	(0.015)	(0.015)	(0.016)	(0.015)
% Age > 60 pop	-0.000	0.015	0.012	0.002	0.012	-0.002	0.019
	(0.033)	(0.027)	(0.029)	(0.030)	(0.028)	(0.030)	(0.022)
Ethnic fractionalization 1897	0.002	-0.009	-0.046	0.056	-0.053	-0.078	0.012
	(0.195)	(0.162)	(0.159)	(0.171)	(0.172)	(0.162)	(0.154)
Ln Dist. from Moscow	0.091	0.153	0.098	0.101	0.106	0.126	-0.340***
	(0.115)	(0.115)	(0.114)	(0.111)	(0.120)	(0.123)	(0.119)
Ln Dist. from frontier	-0.028	-0.039	-0.064	-0.029	-0.110*	-0.076	-0.088
	(0.062)	(0.069)	(0.065)	(0.066)	(0.065)	(0.066)	(0.062)
Coal deposits, dummy	-0.130*	-0.136*	-0.110	-0.095	-0.111	-0.114	-0.076
	(0.074)	(0.072)	(0.072)	(0.074)	(0.078)	(0.074)	(0.076)
Sample	No Volga	No Black Sea	No Baltic	No Caucasus	No West Ukraine	No Peterburg	No Moscow
District demography	x	x	x	x	x	x	x
District GIS controls	x	x	x	x	x	x	x
Province FE	x	x	x	x	x	x	x
Industry FE	x	x	x	x	x	x	x
Observations	12,367	12,150	11,975	12,603	11,839	12,404	11,883
R-squared	0.233	0.222	0.221	0.229	0.242	0.231	0.242

Note: Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

Table A3: Robustness to interaction with soil type / wheat productivity

	(1)	(2)	(3)	(4)
VARIABLES	% Industrial workers			
% Germans	0.147	0.193*		
	(0.103)	(0.099)		
Chernozem soil×% Germans	0.280*	0.145**		
	(0.153)	(0.060)		
% Germans			0.216*	0.167**
			(0.111)	(0.065)
Wheat suitability×% Germans			0.170	0.182
			(0.124)	(0.175)
H0: (Chernozem = 1)×% German = (Chernozem = 0)×% Germans p-value	0.413	0.641		
H0: (Wheat suit. = 1)×% Germans = (Wheat suit. = 0)×% Germans p-value			0.753	0.931
GIS controls	x	x	x	x
Demographic controls	x	x	x	x
Province FE		x		x
Observations	563	563	563	563
R-squared	0.380	0.602	0.380	0.602

Note: Standard errors are clustered at province level. Chernozem soil is a binary indicator switching on for the share of chernozem (black) soil above 75th percentile. Wheat suitability is a analogous measure, based on caloric suitability index for wheat, reported by Galor and Özak 2016. *** p<0.01, ** p<0.05, * p<0.1

Table A4: Education and Industrial Development: alternative IV estimates

VARIABLES	(1) School enroll. 1880	(2) % Industrial workers	(3) % Humcap sector	(4) Local exp. pc	(5) Urban growth	(6) % Literate	(7) % Literate natives
Weight×Log(inverse front. dist.)	0.612***						
	(0.168)						
$\widehat{\text{School enrollment 1880}}$		0.514*	0.035**	-0.005	0.043*	0.687***	0.460***
		(0.287)	(0.015)	(0.013)	(0.023)	(0.221)	(0.175)
Log(inverse front. dist.)	-0.428	0.104	-0.096**	0.099***	0.112	0.771*	0.972**
	(0.664)	(0.538)	(0.040)	(0.038)	(0.085)	(0.431)	(0.432)
First-stage F-stat	7.43	7.43	7.43	7.43	7.43	7.43	7.43
Observations	473	472	472	471	472	472	472
R-squared	0.501	0.722	0.766	0.732	0.985	0.891	0.881

Note: The sample excludes Baltic provinces. The regression specification is the same as in Table 12, column 11. Standard errors are clustered at province level.*** p<0.01, ** p<0.05, * p<0.1

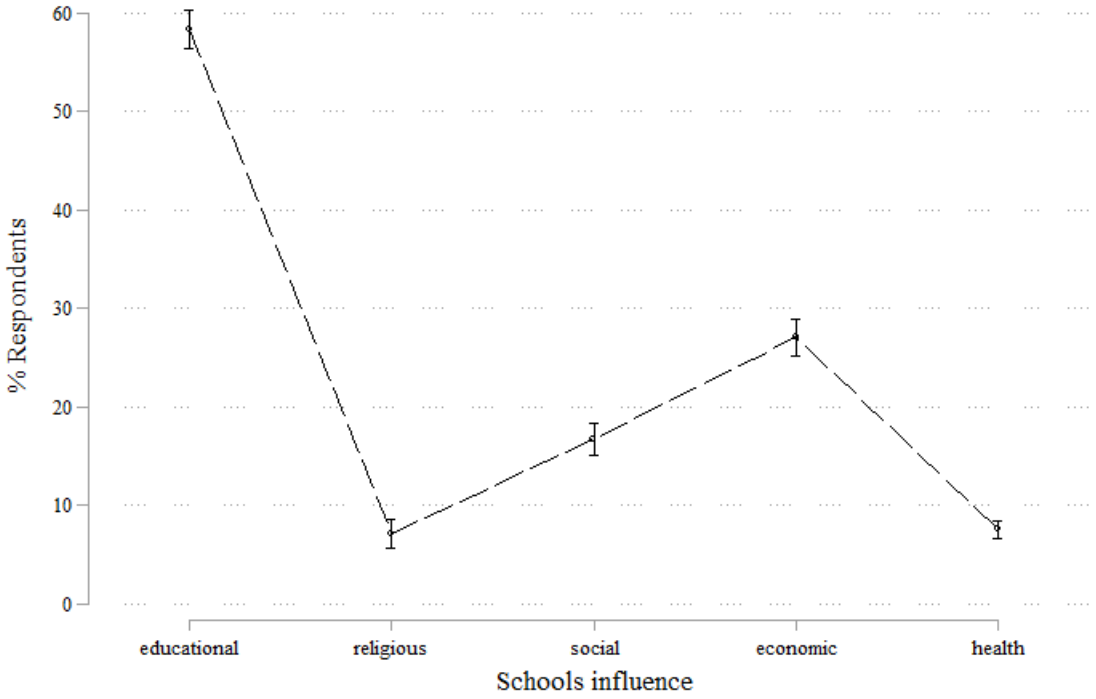


Figure A10: School teachers' survey: factors of schooling importance (averages based on reported numbers from 50 European provinces)

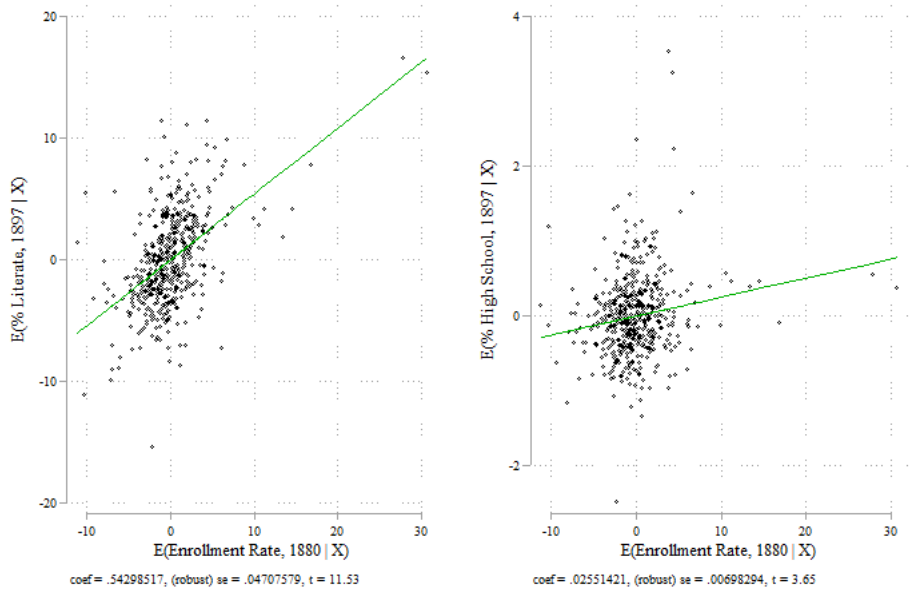


Figure A11: Schooling enrollment rates, literacy and high school rates

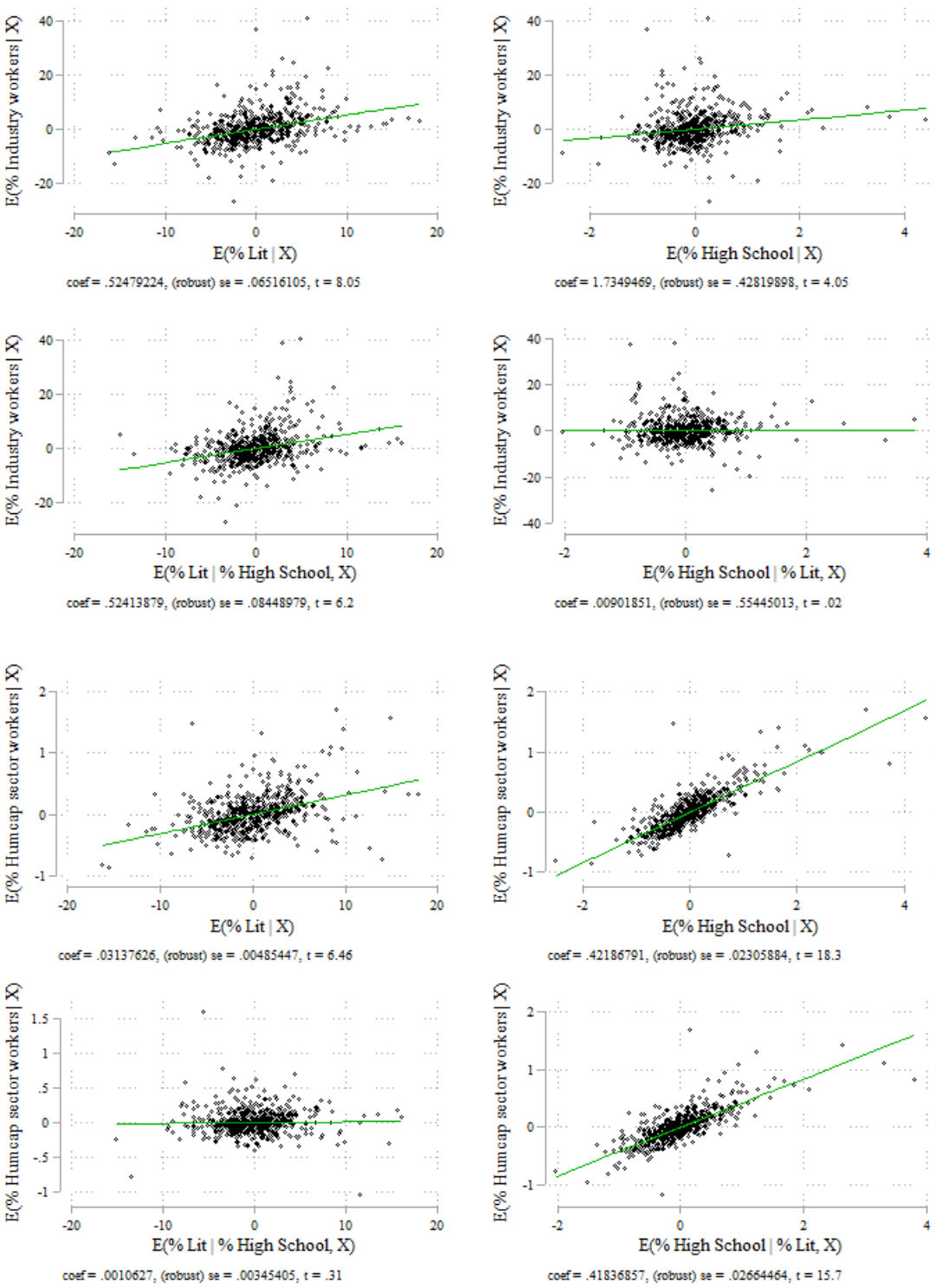


Figure A12: Basic vs. upper human capital in Russia's industrialization (conditional scatter plots)

Historical background (additional materials)

Table B1: The key dates of German migration to Russia (Source: Stumpp 1973)

Period of emigration	Countries of origin	Areas of settlement	Religion
1763-68	Hesse, Rhineland, the Palatinate Wuerttemberg, Switzerland, Saxony	Volga	evang.-cath.
1765	Sulzfield, Wuerttemberg	Riebensdorf	evang.
1766	Hesse, Wuerttemberg, Brandenburg	near Peterburg	
1766	Hesse	Belowesh	evang.-cath.
1782	Sweden	Alt Schwedendorf	evang.
1786	Prussia	Alt-Danzig	
1780	Prussia, Wuerttemberg, Bavaria	near the Dnieper	
1789-90	Danzig, West Prussia	Chortitza	Mennonites
1804-06:			
(a)	Alsace, the Palatinate, Baden	near Odessa	cath.
(b)	Wuerttemberg, Alsace, Baden Hungary	near Odessa	evang.
(c)	Danzig, West Prussia	Halbstadt, Molotschna	Mennonites
(d)	Wuerttemberg, Baden, Hesse	Prischib, Molotschna	evang.-cath.
(e)	Wuerttemberg, Switzerland	Crimea	evang.-cath.
1808-10:			
(a)	Wuerttemberg, Alsace, Palatinate, Baden, Hungary	Odessa	evang.
(b)	Alsace, Baden, Poland		cath.
(c)	Alsace, Baden, Palatinate	Beresan and Odessa	evang.
1817-18	Wuerttemberg	South Caucasus	evang.
1812-27	Wuerttemberg, Baden, Hesse	Prischib, Molotschna	evang.
1821-34	Wuerttemberg, Prussia, Poland	Odessa	
1822-31	Wuerttemberg	Berdjansk	evang.
1823-42	Danzig, West Prussia, Rhine-Hesse	Grunau area	evang.-cath.
1853-1862	Danzig, West Prussia	Volga (Samara)	Mennonites

Table B2: The key dates in the history of Baltic Germans (Source: Giesinger 1974)

Period	Event
ca. 1150	German traders first sailed up the Dvina river
1200	German knights founded the city of Riga
1200-1300	Teutonic knights extended its rule over Courland, Livonia and Estonia
1520-1550	The German knights and their subject people accepted Lutheranism
1565-1585	Estonia and Livonia came under Swedish and Courland under Polish rule
1700-1721	The Northern War of Peter the Great
1721	The treaty of Nystadt made Livonia and Estonia as a part of the Russian Empire
1795	Courland became a Russian province as a result of partition of Poland
1800-1880	Baltic German barons played a major role in Russian affairs
1882-1890	The russification measures of Alexander III deprived of the Baltic Germans from their special status
1919	The Baltic provinces became independent states
1939	Baltic Germans were “repatriated” to Hitler’s Germany and Baltic states were occupied by Soviets

Manifesto 1863[48]

By the Grace of God!

We, Catherine the second, Empress and Autocrat of all the Russians at Moscow, Kiev, Vladimir, Novgorod, Czarina of Kasan, Czarina of Astrachan, Czarina of Siberia, Lady of Pleskow and Grand Duchess of Smolensko, Duchess of Esthonia and Livland, Carelia, Twer, Yugoria, Permia, Viatka and Bulgaria and others; Lady and Grand Duchess of Novgorod in the Netherland of Chernigov, Resan, Rostov, Yaroslav, Beloosena, Udoria, Obdoria, Condinia, and Ruler of the entire North region and Lady of the Yurish, of the Carhlinian and Grusinian czars and the Cabardinian land, of the Cherkessian and Gorisian princes and the lady of the manor and sovereign of many others. As We are sufficiently aware of the vast extent of the lands within Our Empire, We perceive, among other things, that a considerable number of regions are still uncultivated which could easily and advantageously be made available for productive use of population and settlement. Most of the lands hold hidden in their depth an inexhaustible wealth of all kinds of precious ores and metals, and because they are well-provided with forests, rivers and lakes, and located close to the sea for purpose of trade, they are also most convenient for the development and growth of many kinds of manufacturing, plants, and various installations. This induced Us to issue the manifesto which was published last Dec. 4, 1762, for the benefit of all Our loyal subjects. However, inasmuch as We made only a summary announcement of Our pleasure to the foreigners who would like to settle in Our Empire, we now issue for a better understanding of Our intention the following decree which We hereby solemnly establish and order to be carried out to the full.

1. We permit all foreigners to come into Our Empire, in order to settle in all the gouvernements, just as each one may desire.

2. After arrival, such foreigners can report for this purpose not only to the Guardianship Chancellery established for foreigners in Our residence, but also, if more convenient, to the governor or commanding officer in one of the border-towns of the Empire.

3. Since those foreigners who would like to settle in Russia will also include some who do not have sufficient means to pay the required travel costs, they can report to our ministers in foreign courts, who will not only transport them to Russia at Our expense, but also provide them with travel money.

4. As soon as these foreigners arrive in Our residence and report at the Guardianship Chancellery or in a border-town, they shall be required to state their true decision, whether their real desire is to be enrolled in the guild of merchants or artisans, and become citizens, and in what city; or if they wish to settle on free, productive land in colonies and rural areas, to take up agriculture or some other useful occupation. Without delay, these people will be assigned to their destination, according to their own wishes and desires. From the following register* it can be seen in which regions of Our Empire free and suitable lands are still available. However, besides those listed, there are many more regions and all kinds of land where We will likewise permit people to settle, just as each one chooses for his best advantage.

5. Upon arrival in Our Empire, each foreigner who intends to become a settler and has reported to the Guardianship Chancellery or in other border-towns of Our Empire and, as already prescribed in 4, has declared his decision, must take the oath of allegiance in accordance with his religious rite.

6. In order that the foreigners who desire to settle in Our Empire may realize the extent of Our benevolence to their benefit and advantage, this is Our will:

1. We grant to all foreigners coming into Our Empire the free and unrestricted practice of their religion according to the precepts and usage of their Church. To those, however, who

[48]The translation is provided by Stumpp 1973

intend to settle not in cities but in colonies and villages on uninhabited lands we grant the freedom to build churches and belltowers, and to maintain the necessary number of priests and church servants, but not the construction of monasteries. On the other hand, everyone is hereby warned not to persuade or induce any of the Christian co-religionists living in Russia to accept or even assent to his faith or join his religious community, under pain of incurring the severest punishment of Our laws. This prohibition does not apply to the various nationalities on the borders of Our Empire who are attached to the Mahometan faith. We permit and allow everyone to win them over and make them subject to the Christian religion in a decent way.

2. None of the foreigners who have come to settle in Russia shall be required to pay the slightest taxes to Our treasury, nor be forced to render regular or extraordinary services, nor to billet troops. Indeed, everybody shall be exempt from all taxes and tribute in the following manner: those who have been settled as colonists with their families in hitherto uninhabited regions will enjoy 30 years of exemption; those who have established themselves, at their own expense, in cities as merchants and tradesmen in Our Residence St. Petersburg or in the neighboring cities of Livland, Esthonia, Ingermanland, Carelia and Finland, as well as in the Residential city of Moscow, shall enjoy 5 years of tax-exemption. Moreover, each one who comes to Russia, not just for a short while but to establish permanent domicile, shall be granted free living quarters for half a year.

3. All foreigners who settle in Russia either to engage in agriculture and some trade, or to undertake to build factories and plants will be offered a helping hand and the necessary loans required for the construction of factories useful for the future, especially of such as have not yet been built in Russia.

4. For the building of dwellings, the purchase of livestock needed for the farmstead, the necessary equipment, materials, and tools for agriculture and industry, each settler will receive the necessary money from Our treasury in the form of an advance loan without any interest. The capital sum has to be repaid only after ten years, in equal annual installments in the following three years.

5. We leave to the discretion of the established colonies and village the internal constitution and jurisdiction, in such a way that the persons placed in authority by Us will not interfere with the internal affairs and institutions. In other respects the colonists will be liable to Our civil laws. However, in the event that the people would wish to have a special guardian or even an officer with a detachment of disciplined soldiers for the sake of security and defense, this wish would also be granted.

6. To every foreigner who wants to settle in Russia We grant complete duty-free import of his property, no matter what it is, provided, however, that such property is for personal use and need, and not intended for sale. However, any family that also brings in unneeded goods for sale will be granted free import on goods valued up to 300 rubles, provided that the family remains in Russia for at least 10 years. Failing which, it will be required, upon its departure, to pay the duty both on the incoming and outgoing goods.

7. The foreigners who have settled in Russia shall not be drafted against their will into the military or the civil service during their entire stay here. Only after the lapse of the years of tax-exemption can they be required to provide labor service for the country. Whoever wishes to enter military service will receive, besides his regular pay, a gratuity of 30 rubles at the time he enrolls in the regiment.

8. As soon as the foreigners have reported to the Guardianship Chancellery or to our border towns and declared their decision to travel to the interior of the Empire and establish domicile there, they will forthwith receive food rations and free transportation to their destination.

9. Those among the foreigners in Russia who establish factories, plants, or firms, and produce goods never before manufactured in Russia, will be permitted to sell and export freely for ten years, without paying export duty or excise tax.

10. Foreign capitalists who build factories, plants, and concerns in Russia at their own expense are permitted to purchase serfs and peasants needed for the operation of the factories.

11. We also permit all foreigners who have settled in colonies or villages to establish market days and annual market fairs as they see fit, without having to pay any dues or taxes to Our treasury.

7. All the afore-mentioned privileges shall be enjoyed not only by those who have come into our country to settle there, but also their children and descendants, even though these are born in Russia, with the provision that their years of exemption will be reckoned from the day their forebears arrived in Russia.

8. After the lapse of the stipulated years of exemption, all the foreigners who have settled in Russia are required to pay the ordinary moderate contributions and, like our other subjects, provide labor-service for their country. Finally, in the event that any foreigner who has settled in Our Empire and has become subject to Our authority should desire to leave the country, We shall grant him the liberty to do so, provided, however, that he is obligated to remit to Our treasury a portion of the assets he has gained in this country; that is, those who have been here from one to five years will pay one-fifth, while those who have been here for five or more years will pay one-tenth. Thereafter each one will be permitted to depart unhindered anywhere he pleases to go.

9. If any foreigner desiring to settle in Russia wishes for certain reasons to secure other privileges or conditions besides those already stated, he can apply in writing or in person to our Guardianship Chancellery, which will report the petition to Us. After examining the circumstances, We shall not hesitate to resolve the matter in such a way that the petitioner's confidence in Our love of justice will not be disappointed.

Given at the Court of Peter, July 22, 1763 in the Second Year of Our Reign.

The original was signed by Her Imperial Supreme Majesty's own hand in the following manner:

Printed by the Senate, July 25, 1763.

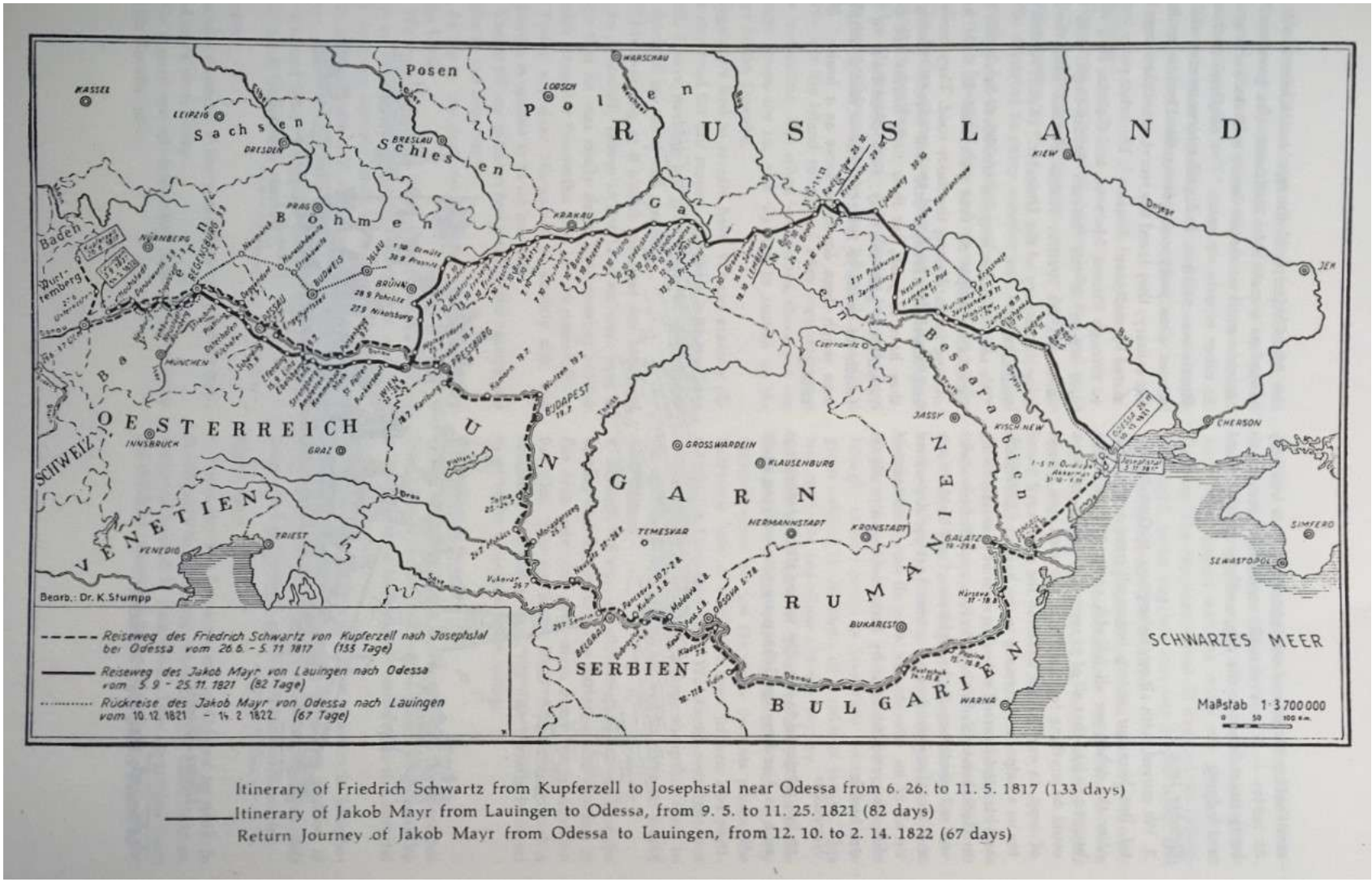


Figure B1: Itinerary of German colonists in Black Sea region (Source: Stumpp 1973)

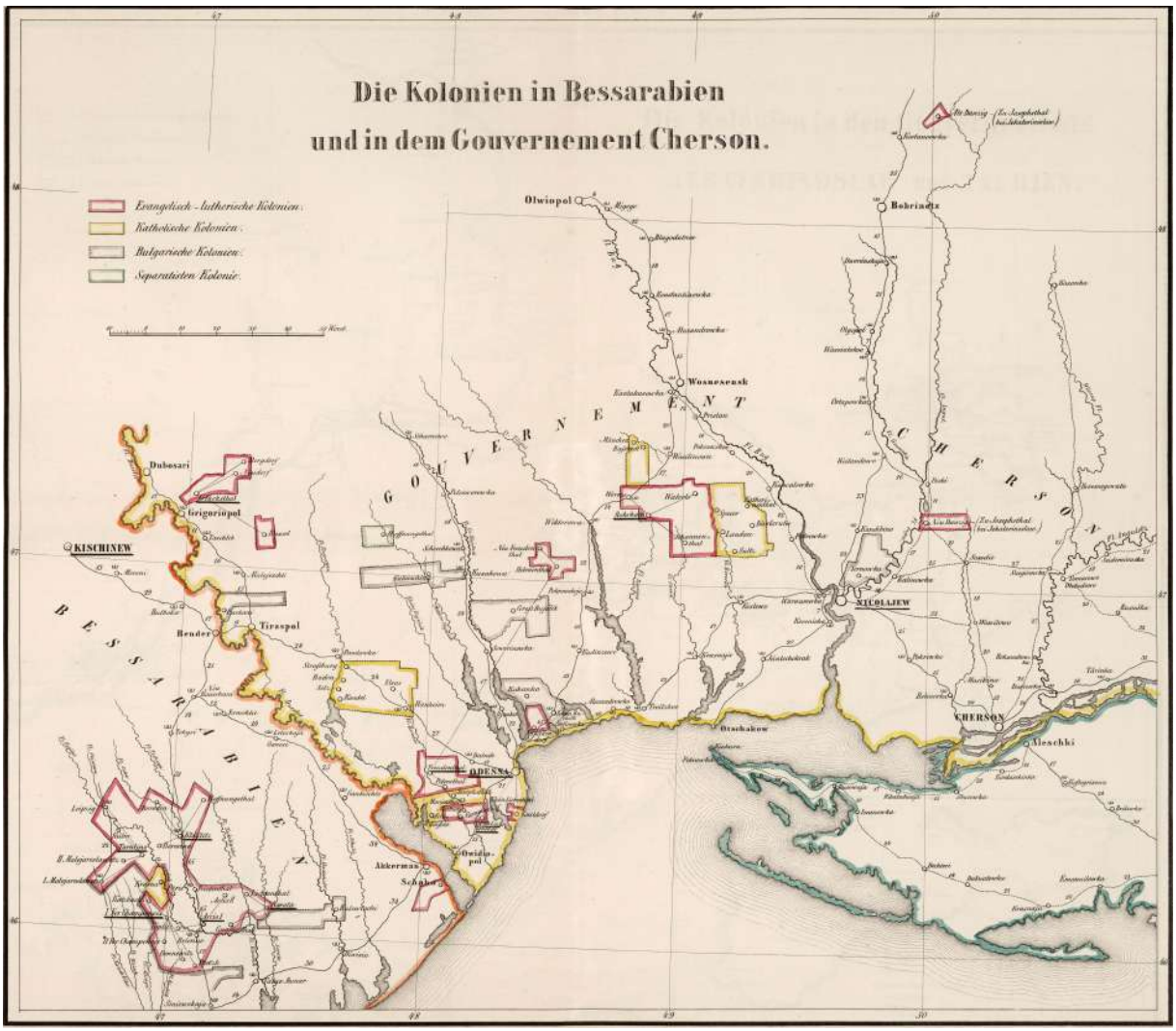


Figure B2: Location of German colonies in Bessarabia and Herson province (by religious denomination)

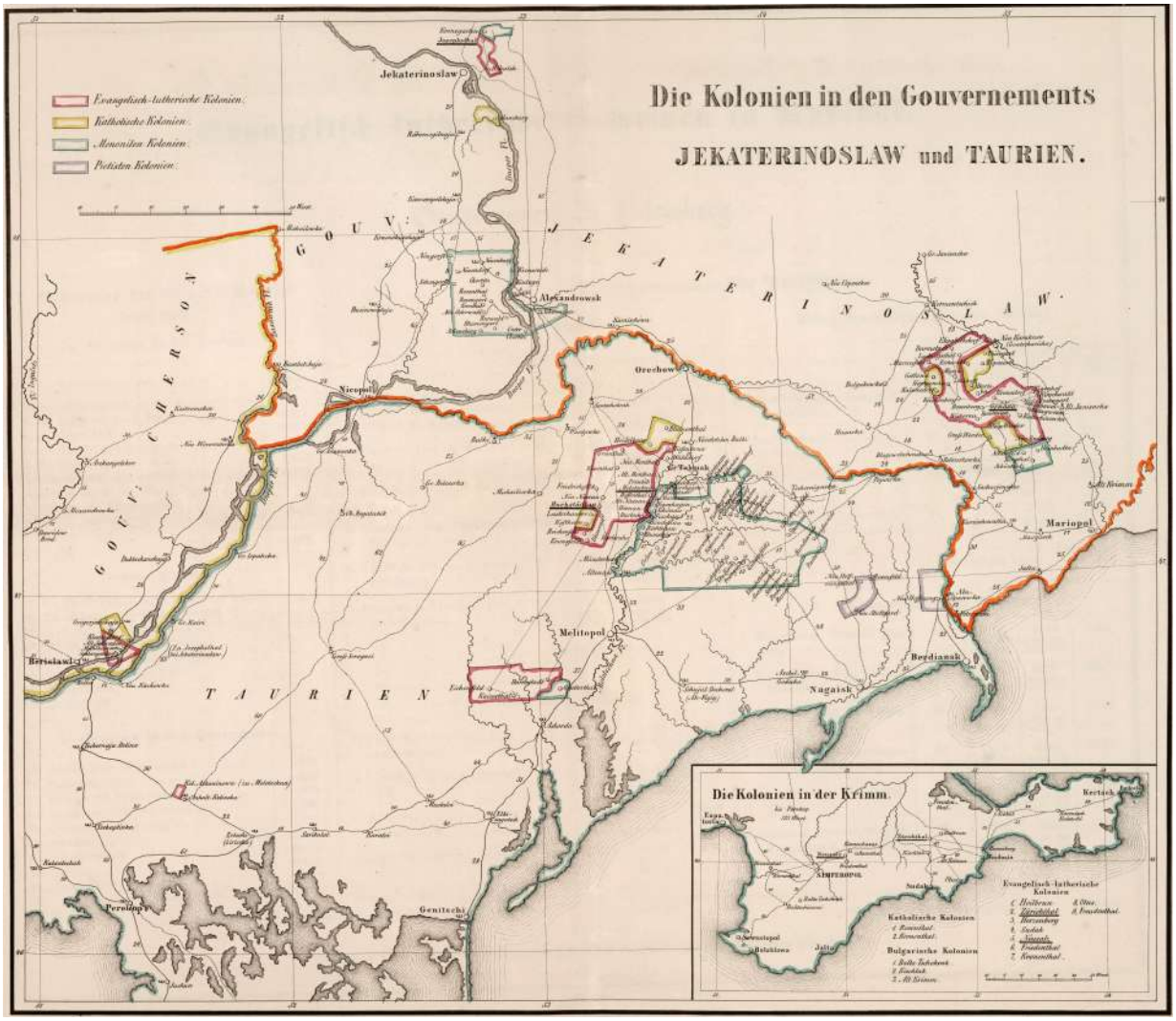


Figure B3: Location of German colonies in Tauren and Ekaterinoslav provinces (by religious denomination)

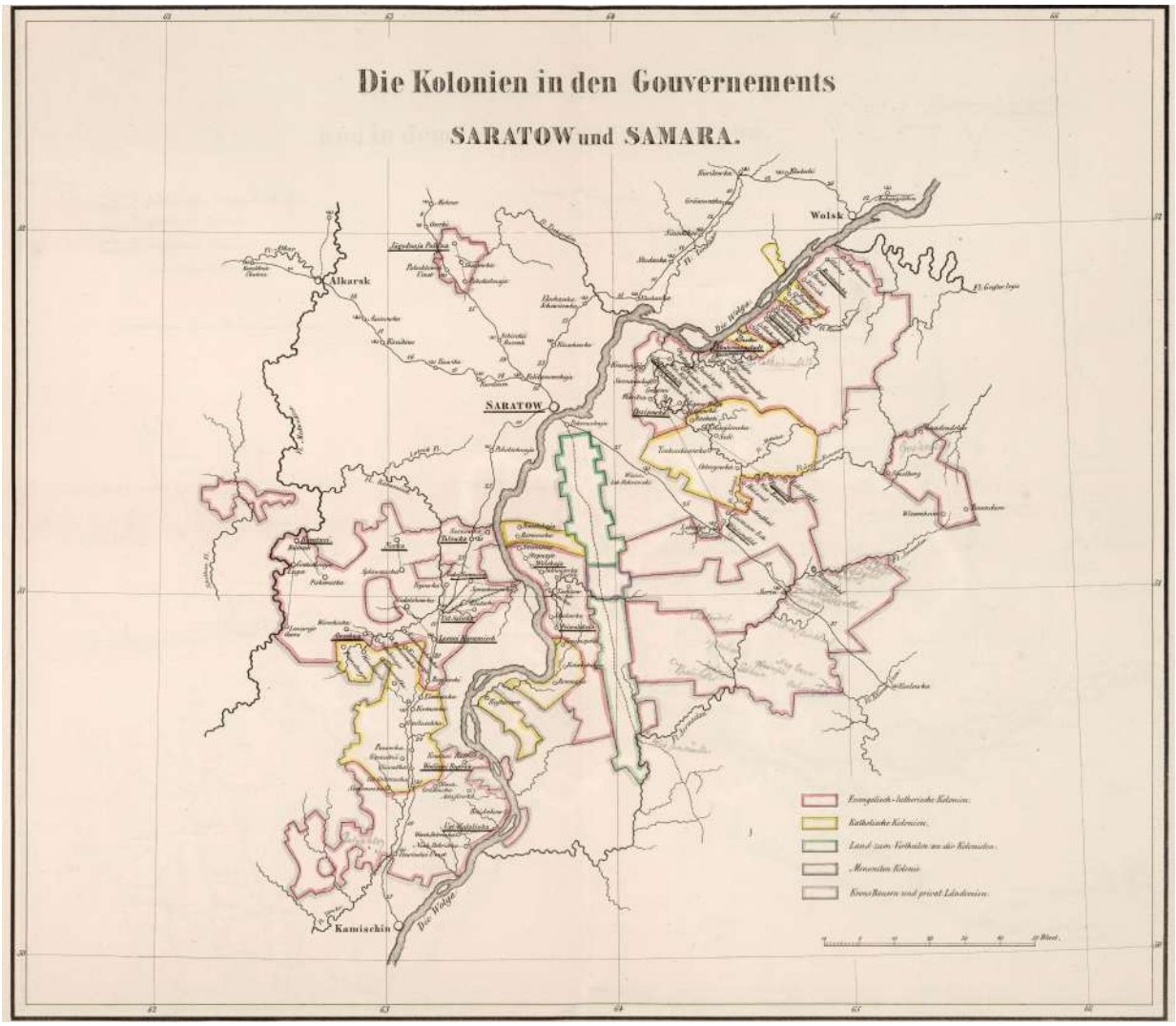


Figure B4: Location of German colonies in Volga region (by religious denomination)

Figure B5: Expansion of Russia's frontier to the West and South (17th-19th centuries)

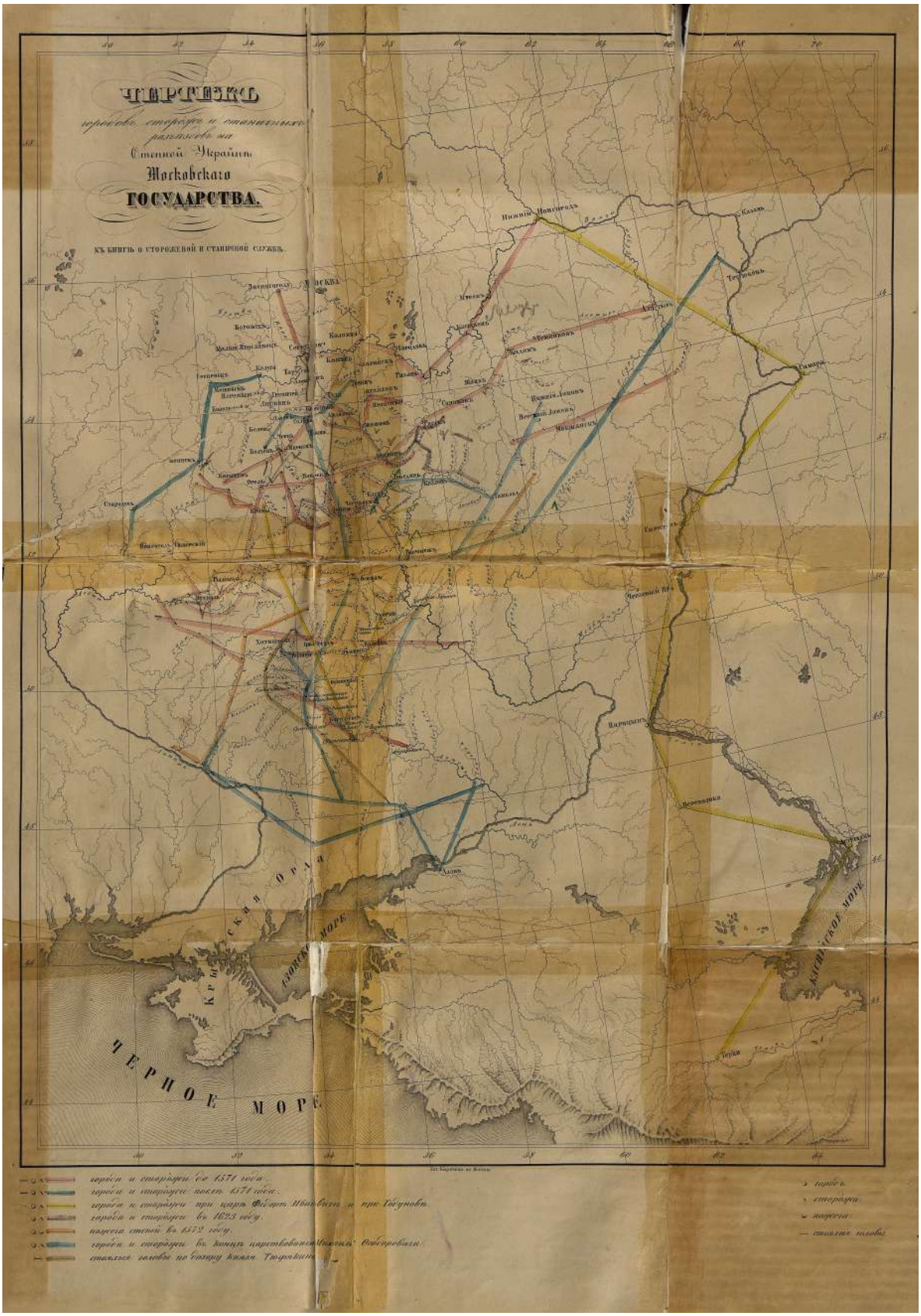


Figure B6: Expansion of Russia's frontier to the East (17th century)

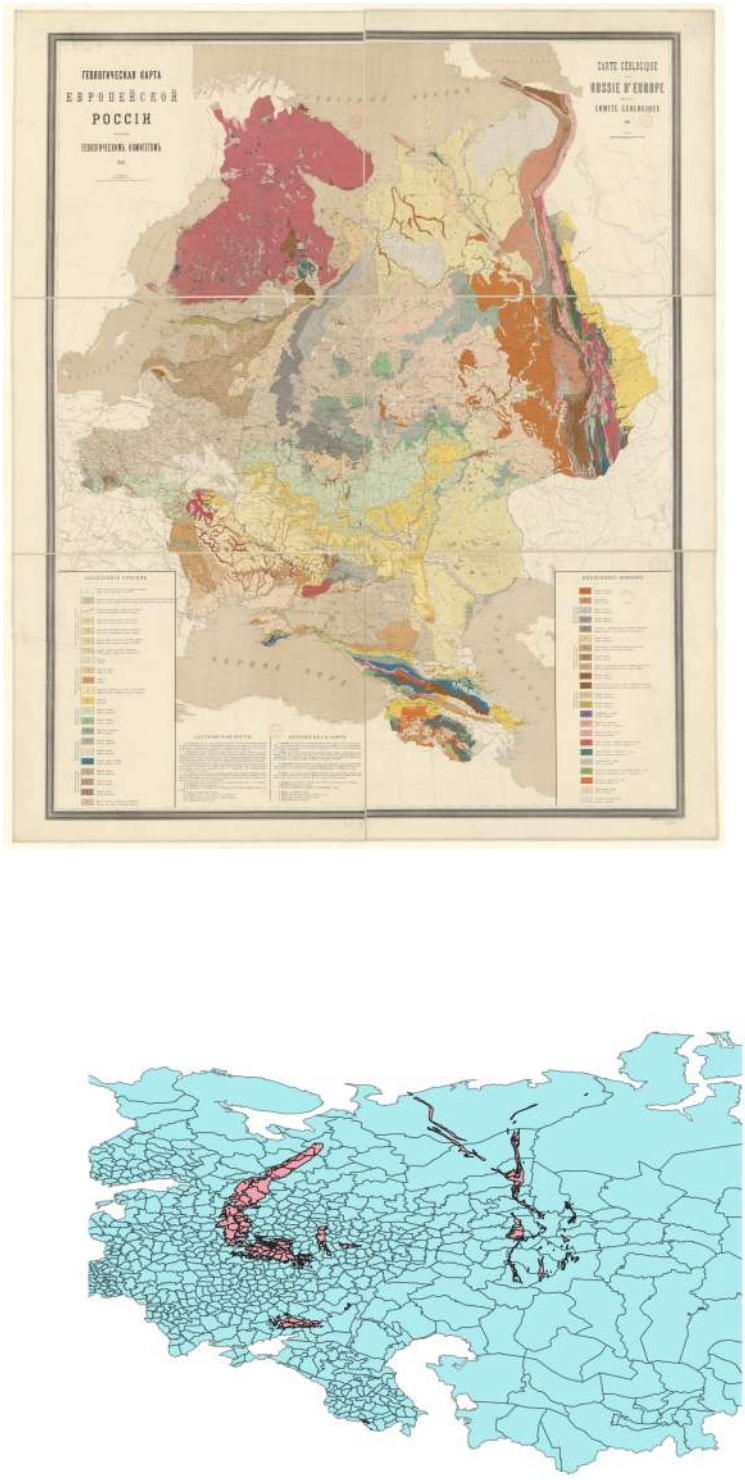


Figure B7: Geological Survey of Russian Empire (Karpinsky et al., 1892)[a]

[a]The bottom map depicts the intersection of the district boundaries with coal deposits, drawn from the map on the top.

Figure B8: 18th century school in German colonies. Source: Zjuss 2007)

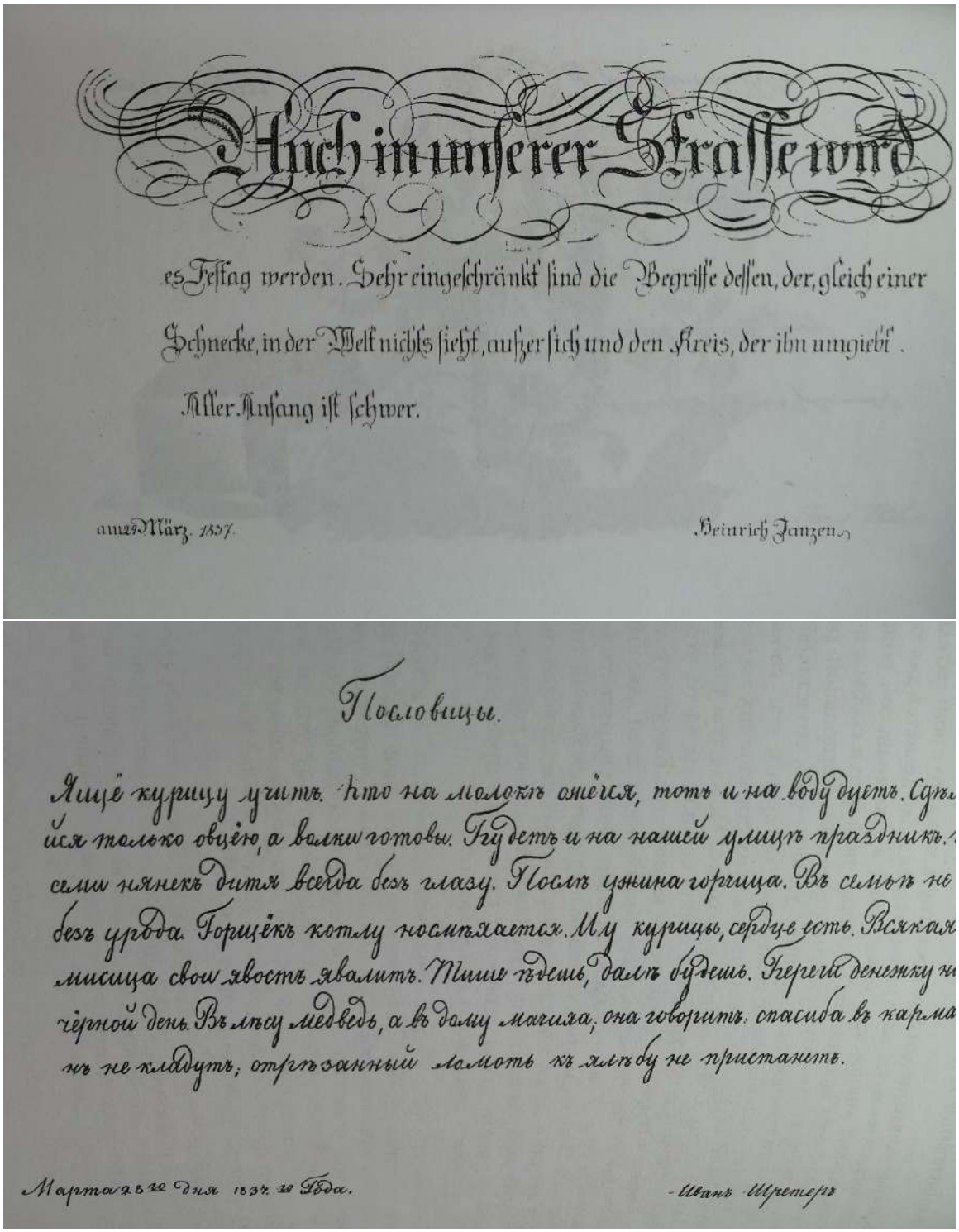


Figure B9: The example of student's works in Mennonite schools in Black Sea region, 1837 (writing in German and Russian. Source: Zjuss 2007)

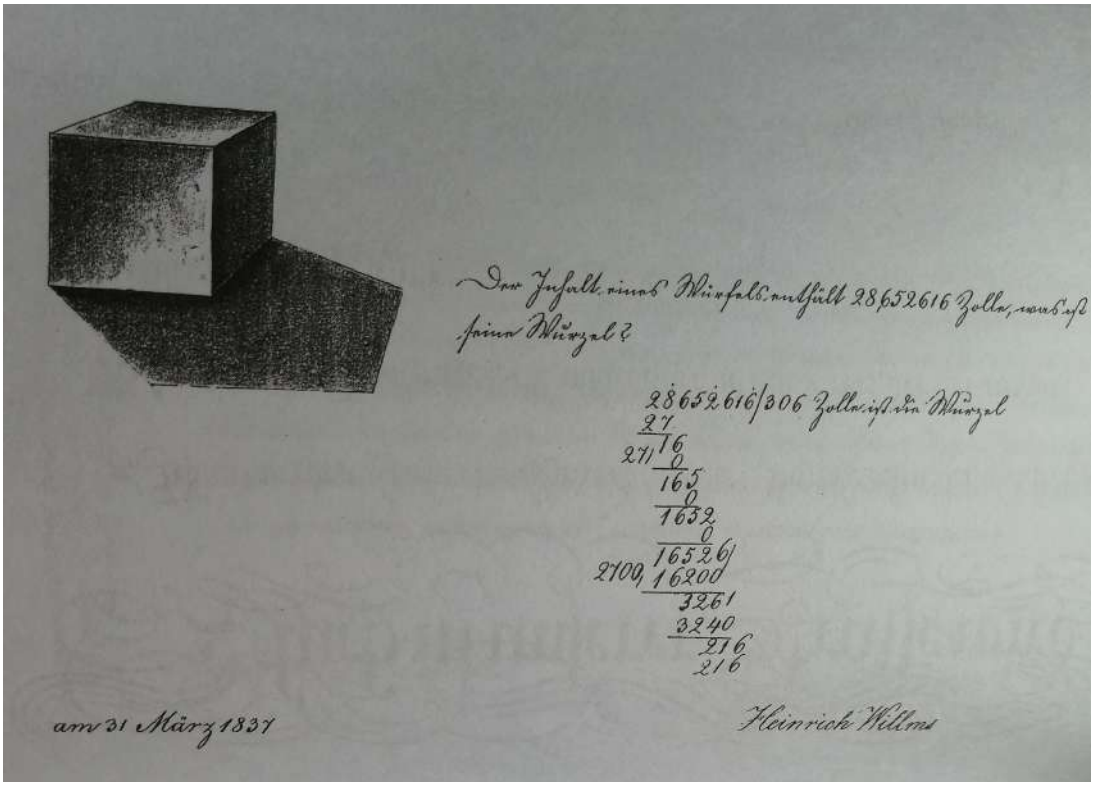
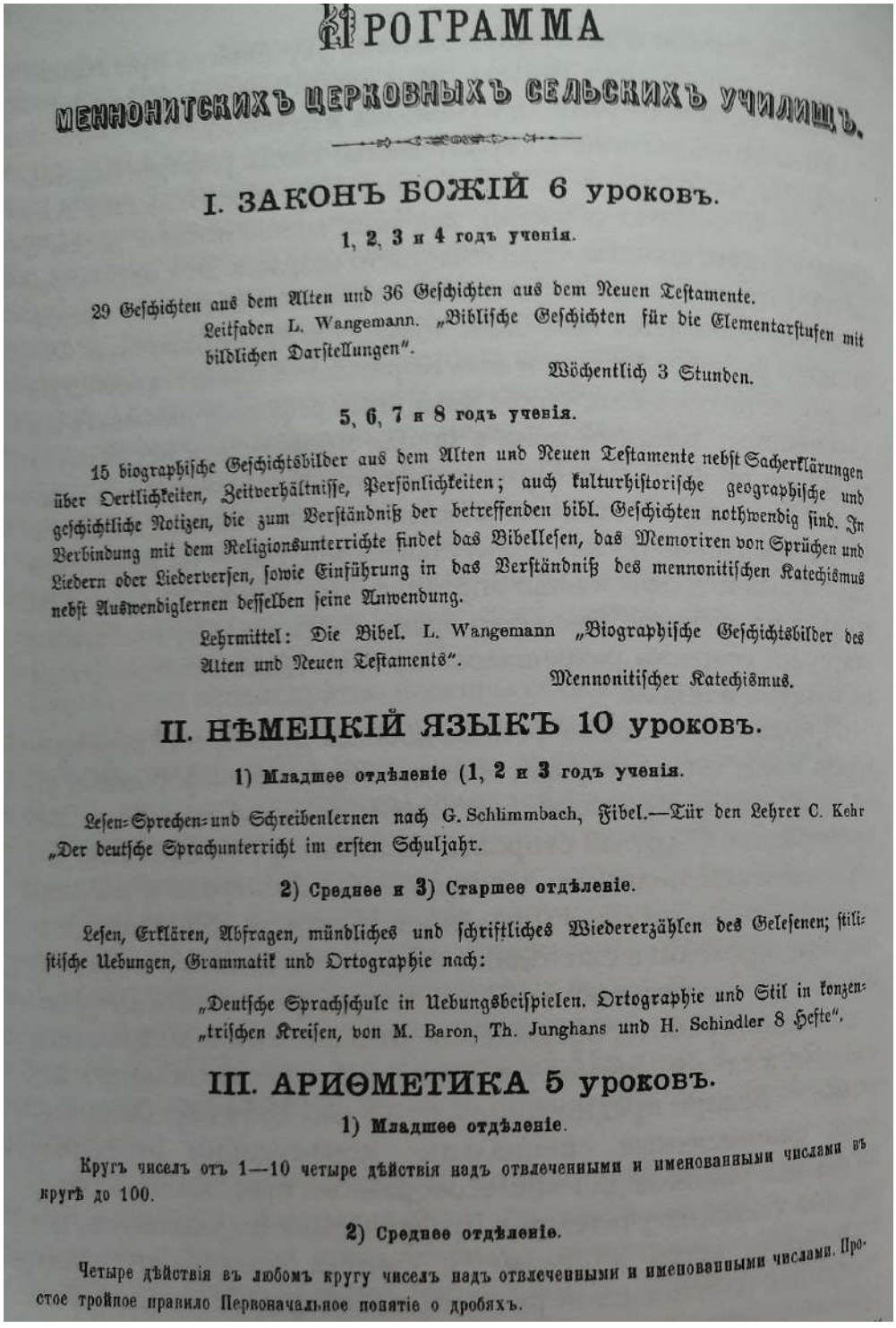


Figure B10: The example of student's works in Mennonite schools in Black Sea region, 1837 (arithmetic and drawing exercises. Source: Zjuss 2007)



ПРОГРАММА

МЕННОНИТСКИХЪ ЦЕРКОВНЫХЪ СЕЛЬСКИХЪ УЧИЛИЩЪ.

I. ЗАКОНЪ БОЖІЙ 6 уроковъ.

1, 2, 3 и 4 годъ ученія.

29 Geschichten aus dem Alten und 36 Geschichten aus dem Neuen Testamente. Leitfaden L. Wangemann. „Biblische Geschichten für die Elementarstufen mit bildlichen Darstellungen".

Wöchentlich 3 Stunden.

5, 6, 7 и 8 годъ ученія.

15 biographische Geschichtsbilder aus dem Alten und Neuen Testamente nebst Sacherklärungen über Oertlichkeiten, Zeitverhältnisse, Persönlichkeiten; auch kulturhistorische geographische und geschichtliche Notizen, die zum Verständniß der betreffenden bibl. Geschichten nothwendig sind. In Verbindung mit dem Religionsunterrichte findet das Bibellesen, das Memoriren von Sprüchen und Liedern oder Liederversen, sowie Einführung in das Verständniß des mennonitischen Katechismus nebst Auswendiglernen desselben seine Anwendung.

Lehrmittel: Die Bibel. L. Wangemann „Biographische Geschichtsbilder des Alten und Neuen Testaments".

Mennonitischer Katechismus.

II. НѢМЕЦКІЙ ЯЗЫКЪ 10 уроковъ.

1) Младшее отдѣленіе (1, 2 и 3 годъ ученія.

Lesen-Sprechen- und Schreibenlernen nach G. Schlimmbach, Fibel.—Tür den Lehrer C. Kehr „Der deutsche Sprachunterricht im ersten Schuljahr.

2) Среднее и 3) Старшее отдѣленіе.

Lesen, Erklären, Abfragen, mündliches und schriftliches Wiedererzählen des Gelesenen; stilistische Uebungen, Grammatik und Ortographie nach:

„Deutsche Sprachschule in Uebungsbeispielen. Ortographie und Stil in konzentrischen Kreisen, von M. Baron, Th. Junghans und H. Schindler 8 Hefte".

III. АРИѲМЕТИКА 5 уроковъ.

1) Младшее отдѣленіе.

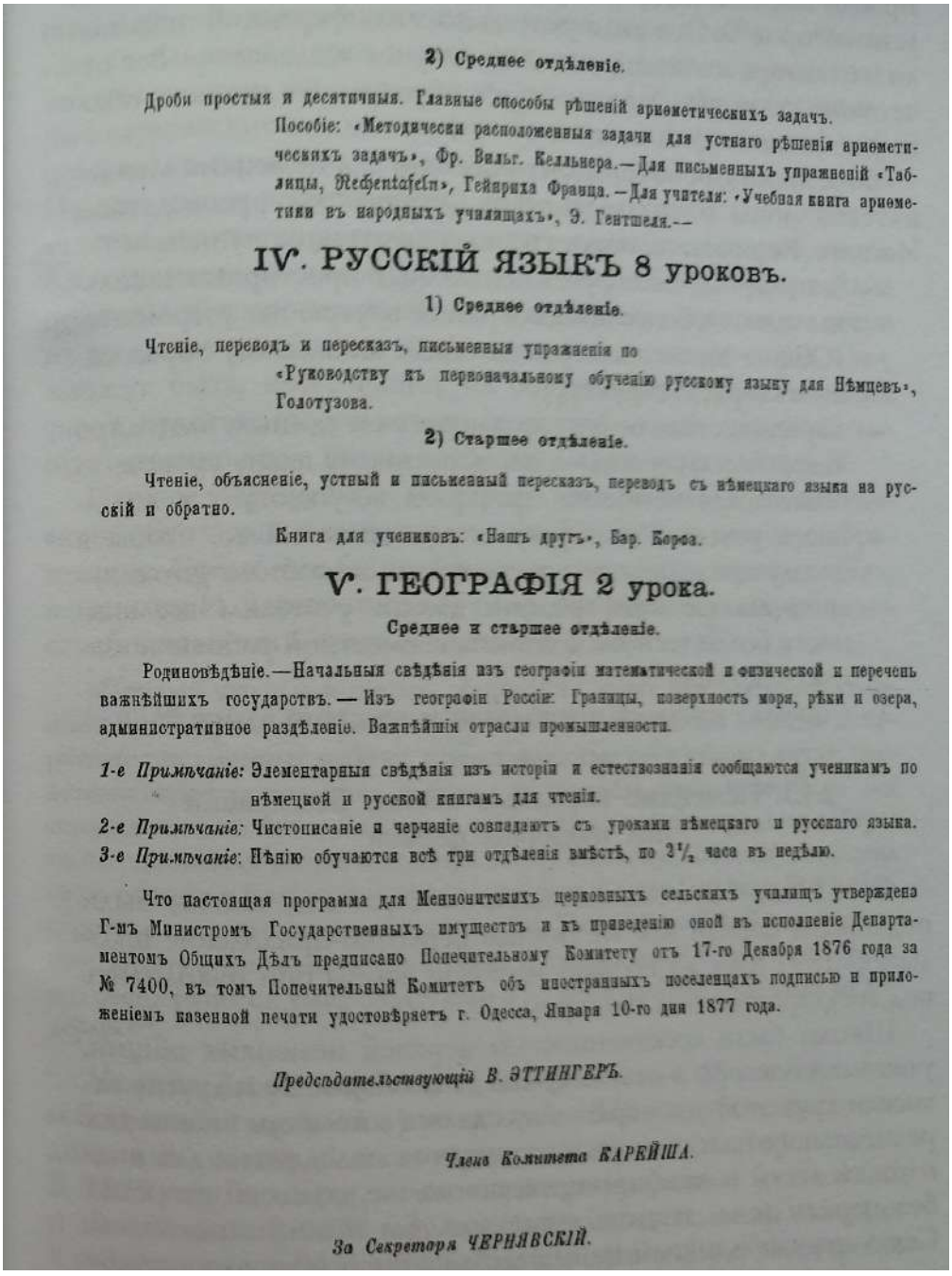
Кругъ чиселъ отъ 1—10 четыре дѣйствія надъ отвлеченными и именованными числами въ кругѣ до 100.

2) Среднее отдѣленіе.

Четыре дѣйствія въ любомъ кругу чиселъ надъ отвлеченными и именованными числами. Простое тройное правило Первоначальное понятіе о дробяхъ.

Figure B11: Curricula in Mennonite rural school (1876)[a].

[a]Section I describes educational content in religious subject (God's law) for eight year educational cycle. Sections II and III describes educational content in German language and arithmetic: operations with numbers up to 100 for junior class pupils; operations with simple and decimal fractions, arithmetical problems (with a list of textbooks) for middle class pupils



2) Среднее отдѣленіе.

Дроби простыя и десятичныя. Главные способы рѣшеній ариѳметическихъ задачъ.

Пособіе: «Методически расположенныя задачи для устнаго рѣшенія ариѳметическихъ задачъ», Фр. Вильг. Келльнера.—Для письменныхъ упражненій «Таблицы, Rechentafeln», Гейнриха Франца.—Для учителя: «Учебная книга ариѳметики въ народныхъ училищахъ», Э. Гентшеля.—

IV. РУССКІЙ ЯЗЫКЪ 8 уроковъ.

1) Среднее отдѣленіе.

Чтеніе, переводъ и пересказъ, письменныя упражненія по «Руководству къ первоначальному обученію русскому языку для Нѣмцевъ», Голотузова.

2) Старшее отдѣленіе.

Чтеніе, объясненіе, устный и письменный пересказъ, переводъ съ нѣмецкаго языка на русскій и обратно.

Книга для учениковъ: «Нашъ другъ», Бар. Борна.

V. ГЕОГРАФІЯ 2 урока.

Среднее и старшее отдѣленіе.

Родиновѣдѣніе.—Начальныя свѣдѣнія изъ географіи математической и физической и перечень важнѣйшихъ государствъ. — Изъ географіи Россіи: Границы, поверхность моря, рѣки и озера, административное раздѣленіе. Важнѣйшія отрасли промышленности.

1-е Примѣчаніе: Элементарныя свѣдѣнія изъ исторіи и естествознанія сообщаются ученикамъ по нѣмецкой и русской книгамъ для чтенія.

2-е Примѣчаніе: Чистописаніе и черченіе совпадаютъ съ уроками нѣмецкаго и русскаго языка.

3-е Примѣчаніе: Пѣнію обучаются всѣ три отдѣленія вмѣстѣ, по 3½ часа въ недѣлю.

Что настоящая программа для Меннонитскихъ церковныхъ сельскихъ училищъ утверждена Г-мъ Министромъ Государственныхъ имуществъ и къ приведенію оной въ исполненіе Департаментомъ Общихъ Дѣлъ предписано Попечительному Комитету отъ 17-го Декабря 1876 года за № 7400, въ томъ Попечительный Комитетъ объ иностранныхъ поселенцахъ подписью и приложеніемъ казенной печати удостовѣряетъ г. Одесса, Января 10-го дня 1877 года.

Предсѣдательствующій В. ЭТТИНГЕРЪ.

Членъ Комитета КАРЕЙША.

За Секретаря ЧЕРНЯВСКІЙ.

Figure B12: Curricula in Mennonite rural school (continuation)[a]. Source: Zjuss 2007

[a]Section IV describes educational content for Russian language study for middle and senior classes (grammar rules, reading, retailing, e.g. in written format, translation from German to Russian). Section V describes educational content in Geography (Basic knowledge in political, physical and economic Russia's geography). Additional lessons include painting, singing and natural science (basic concepts).

Figure B13: Lutheran church in Saratov (Volga region)[a]

[a]Source: https://archiv.wolgadeutsche.net/

Камышинскій уѣздъ.

Жит. 338.175, состоятъ изъ малороссовъ, нѣмцевъ-колонистовъ и великороссовъ. Кромѣ земледѣлія, развиты: садоводство, бахчеводство и табаководство. Значительныя мукомольни; фабрики сарпинки. ⊡ и Тлгф. въ сс.: *Тиловкѣ, Каменкѣ* и *Усть-Золихѣ*; ⊠⊠ въ с. *Верхней Добринкѣ*; ⊠ въ сс.: *Золотомъ* и *Красномъ Яру*.

СБЕРЕГАТЕЛЬНЫЯ КАССЫ:

При почтовой конт. въ с. Верхней Добринкѣ.
При почтово-телеграфн. отдѣл. въ сс.: Каменкѣ, Тиловкѣ и Усть-Золихѣ.
При почтов. отдѣл. въ сс.: Золотомъ и Красномъ Яру.

Фабрики и заводы.

КОЖЕВЕННЫЙ: НАУЛИ, Карлъ Ив., Севастьяновка, 20 т. п., 50 чановъ, 10 раб.

КРАСИЛЬНЫЙ: «БР. ШМИДТЪ», Т. Д., с. Усть-Золиха, 20 куб.

МЕЛЬНИЦЫ: [illegible]

САРПИНО-ТКАЦКІЕ: [illegible]

МАНУФАКТ. ТОВ.: [illegible]

МУКА: [illegible]

ХЛѢБЪ-ЗЕРНО: [illegible]

ЧУЛКИ: ТОКАРЕВЪ, Як. Андр., пос. Дубовка; ФЕДОРОВЪ, Як. Ив., пос. Дубовка.

Figure B14: German names in the list of industrial producers in Kamyshin district (Volga region)[a]

[a]Source: Statistical and Economic description of Russian Empire by Suvorin (1897 volume 2)

Мелитопольскій уѣздъ.

Жит. 328,394, населеніе состоитъ, главнымъ образомъ, изъ русскихъ (великороссовъ 62%, малороссовъ ок. 30%) и нѣмцевъ-колонистовъ (6,4%). Земледѣльческій у. Почва—черноземъ; пески и солончаки встрѣчаются въ Ю. части у., по берегамъ лимановъ, опредѣленно. Вишедѣліе и садоводство. Торговля у. значительна, особенно отпускная. Главный предметъ отпуска—хлѣбъ, соль, шерсть; главные пункты отправленія, по Лозово-Севастоп. жел. дорогѣ, ст.: *Михайловка* (7,600 ж.), свыше 1 мил. п. груз., *Акимовка*, *Федоровка*. По Днѣпру: пристань *Лепетиха* (4 т. ж.), груз. 1. 400т. п. Пристань *Мал. Знаменка* (6 т. ж.), груз. до 800 т. п.

✉✉ и Тлф. въ сс.: *Михайловкѣ* и *Большой Лепетихѣ*; ✉ и Тлф. въ сс.: *Рубановкѣ* и *Нижнихъ Сырогозахъ*; ✉ въ сс.: *Большой Бѣлозеркѣ*, *Веселомъ*, *Верхней Бѣлозеркѣ*, *Верхнемъ Рогачикѣ*, *Ельянъ-Заячьемъ* (Новогригорьевскія), *Каменкѣ* (Малая Знаменка), *Петровкѣ*, *Алтаганахъ*, *Сырогозахъ* и *Акимовкѣ*.

СБЕРЕГАТЕЛЬНЫЯ КАССЫ:

При почтово-телеграфн. конт. въ сс.: Михайловкѣ и Большой Лепетихѣ.

При почтово-телеграфн. отдѣл. въ сс.: Рубановкѣ и Нижнихъ Сырогозахъ.

При почтов. отдѣл. въ сс.: Верхнемъ Рогачикѣ, Акимовкѣ, Алтаганахъ, Большой Бѣлозеркѣ, Веселомъ, Верхней Бѣлозеркѣ, Ельянъ-Заячьемъ, Кизиковкѣ и Сырогозахъ.

Фабрики и заводы.

МАСЛОБОЙНЫЕ: [illegible] (паровушка), с. Бѣлозерка, 1 гид. хоп.; [illegible] Осадчій, с. Акимовка, механич. прав.

МЕЛЬНИЦЫ: [illegible] Нет., с. Васильево; [illegible] Як. Георг., с. Фридрихсфельдъ, пар. 17 с.; ЕВСТРАТОВЪ, Митрофр. Ив., с. Михайловка; [illegible] Фед. Вас., с. Михайловка; [illegible] Герш. Вы., с. Веселое, пар. 12 с.; [illegible] Евс. Самоил., с. Васильево; [illegible] Ман. Зельман., с. Акимовка, пар. 32 с., 11 раб.; [illegible] Нет. Якимб., с. Кронсфельдъ, пар. 14 с.

ПИВОВАРЕННЫЙ: [illegible] с. Пришибъ, котловъ 3, заторный чанъ 1, перепускной чанъ 1.

РЫБНЫЙ: [illegible] Ив. Нет., ураз. фелотона хоса.

ЧЕРЕПИЧНЫЙ: ФИНКЕЛЬШТЕЙНЪ, І. Н., с. Верхній Рогачикъ.

ЧУГУННО-ЛИТЕЙНЫЕ: [illegible] Ив. Никл., с. Б. Бѣлозерка, 25 раб.; [illegible] Абр. Абр., колон. Сереѣовка, 50 раб.; [illegible] Як. Як., с. Кизикрз; [illegible] Кори. Як., с. Лепетиха, 25 раб.; [illegible] Григ., колон. Ольгофельдъ.

Торгово-промышленныя предпріятія.

АПТЕКИ: [illegible] Іос. Анг., с. Бѣлозерка; [illegible] Вас., с. Рейхенфельдъ; [illegible] Як. Бор., с. Верхн. Рогачикъ; [illegible] Іос. Алдр., с. Веселое; [illegible] Соломонъ, с. Б. Лепетиха; [illegible] Ег. Ил., с. Григорьевки; [illegible] Давид. с. Верхн. Бѣлозерки.

БАКАЛЕИ: [illegible] Ив. Ос., с. Верх. Рогачикъ; [illegible] Гитя Элеонова, с. Михайловки; [illegible] Ив. Ив., с. Лепетиха; [illegible] Вас. Мих., с. Верх. Рогачикъ; [illegible] Ал-дѣ Никиф. (мануфакт. тов.), с. Веселое; [illegible] Тар. (мануфакт. тов.), с. Б. Лепетиха; [illegible] Евс. Самойл., с. Васильево; [illegible] Ив. Афан. (мануфакт. тов.), с. Веселое; [illegible] Сура Герш. (мануфакт. тов.), с. Рубановки.

ВИНО (скл.): [illegible] Сем. Куз., с. Дмитровки; [illegible] Март. Христ., с. Приволье; [illegible] Аронъ Исаак., с. Атайманы.

ЗЕМЛЕДѢЛ. ОРУДІЯ: [illegible] Генр. Нет., нам. Богдеталь; [illegible] Фридр. Вильг., с. Ельянъ-Заячьемъ; [illegible] Як. Як., с. Дарьевкѣ.

КНИГИ: [illegible]

КОНЯ: [illegible] Дан. Юдов., с. Михайловки; [illegible] Аронъ Леонт., с. Васильево; [illegible] Элихъ Лейб. (бакалея), с. Тохмачевка.

ЛѢСЪ: [illegible] Аронъ Леонт., с. Васильево; [illegible] Григ. Як., Михайловскій возд.; [illegible] Сам. Моор., Михайловскій возд.; [illegible] Тар. Конст., с. Б. Лепетиха; [illegible] Алдръ Ив., с. Екатеринка; [illegible] Куп. Як., с. Карабулуш; [illegible] Вонифат. Ив., с. Лепетиха; [illegible] Викт. Залман. (уголь), Михайловскій возд.

МАНУФАКТ. ТОВ.: [illegible] Анг. Готлиб., с. Дурлешахъ; [illegible] Дав. Афан., с. Атайманы; [illegible] Ив. Ив. (2), с. Лепетиха; [illegible] Мих. Сем. (2), с. Атайманы; [illegible] Афан. Як., с. Петровка; [illegible] Анна Ив. (2), сс.: Атайманы и Рейхенфельдъ; [illegible] Анна Тих. (3), сс.: Тохмачевка, Пришибъ и Михайловка; [illegible] Ал-дѣй Никиф. (3), сс.: Тихоновка, Гольштедтъ и Михайловка; [illegible] Рахиль Григ., с. Верхн. Рогачикъ; [illegible] Демьянъ Мих., с. Верхн. Рогачикъ; [illegible] Солом. Як. (бакалея), с. Нижн. Сырогозы; [illegible] Ив. Евел. (2), сс.: Рейхенфельдъ и Кайзерталь; [illegible] Вел. Григ., с. Михайловка; [illegible] Ваас., с. Кронсфельдъ.

ОПТОВЫЕ СКЛ.: [illegible] Степ. Вас., м. Ново-Александровка; [illegible] Любовь, с. Нижн. Сырогозы; [illegible] Ег. Як., с. Григорьевки.

ПАРОХОДН. КОНТОРА: [illegible] ОБ-ВА ПАРОХОДСТВА И ТОРГ. (2), сс.: М. и Б. Лепетихѣ.

ПИВО И МЕДЪ (скл.): [illegible] Тихофѣй, с. Б. Лепетиха.

СПИРТЪ (скл.): [illegible] Вульфъ Нухим., с. Михайловки; [illegible] Люб. Абр., с. Михайловки; [illegible] Нико Вонціан., с. Екатеринки; [illegible] Аронъ Исаак., с. Бугаевки.

УГОЛЬ КАМЕННЫЙ: [illegible] Лаз. Лейб., Михайловскій возд.

ХЛѢБЪ-ЗЕРНО: [illegible] Евелй (2), с. Лепетихѣ; [illegible] Леонидъ, с. Горѣлое; [illegible] Фед. Вас., с. Михайловки; [illegible] Ил. Конст. (2), с. Акимовки; [illegible] Сам. Ефр., с. Васильево; [illegible] Тар. Конст., с. Б. Лепетиха.

Figure B15: German names in the list of industrial producers in Melitopol district (Black Sea region)[a]

[a]Source: Statistical and Economic description of Russian Empire by Suvorin (1897 volume 2)

Фабрики и заводы.

МЕЛЬНИЦЫ ПАРОВ.: [2] БУХВИЦЪ, Мих. Майтесон., с. Лейпцигъ, пар. 40 с., 6 раб.; [2] ГЕРНЕРЪ, Мих. Готфрид., с. Лейпцигъ, пар., 10 с., 4 раб.; [2] ГАНЗЕНЪ, Готл. Готл., с. Сарата, пар. 20 с., 6 раб.; [2] ГАРНУНЪ, Як. Як., с. Гнадентал., пар. 20 с., 5 раб.; [2] ГРОСГАНСЪ, Иоан., с. Фриденсталь, пар. 34 с., 6 раб.; [2] ДИТРИХЪ, Іоганнесъ, с. Гершам. пенуазъ II, 3 раб.; [2] ЗАЙЦЪ, Якубъ, с. Деневецъ, 3 раб.; [2] ЗДЗЕНЦКІЙ, Никитій, с. Кубей, пар. 18 с., [2] ЗОММЕРФЕЛЬДЪ, Михаилъ, с. Мансбургъ, пар. 15 с.; [2] ИВЕРТЪ, Вальт. Дан., м. Татарбунаръ, пар. 18 с.; [2] КЕЛЛЕРЪ, Готл. Сам., с. Гафнунгефельдъ, 3 раб.; [2] КИЗОНЪ, Христофоръ, с. Эйгенгеймъ; [2] ЛАНЕРЪ, Карл. Карл., с. Лихтенталь, пар. 26 с., 5 раб.; [2] МАТИСЪ, Александръ, с. Деневецъ, 3 раб.; [2] МИЛЬ, Фридрихъ, с. Волонтировка, пар. 16 с., 6 раб.; [2] ПОПОВЪ, Павелъ, с. Сергѣевка, пар. 12 с.; [2] РАЛЛЕ, Фридрихъ, с. Исталь; [2] РАШЪ, Фердинандъ, с. Старо-Арцизъ, пар. 20 с., 7 раб.; [2] ФРИДРИХЪ, Ферд. Карл., с. Тарутино, пар. 25 с., 10 раб.; [2] ЦЕЛЛЕРЪ, Фед. Люд., с. Гофнунгсталь, пар. 25 с., 7 раб.; [2] ШОКЪ, Фридр. Готфр., с. Бородино, 8 раб.; [2] ШТЕЛЬТЕРЪ, Даніилъ, с. Плоцкъ, 3 раб.; [2] ЯНКЕ, Андрей, с. Эйгенгеймъ.

СУКНОВАЛЬНИ: [2] ИВЕРТЪ, Вальт. Дан., м. Татарбунаръ, 6 раб.; [2] ИВЕРТЪ, Карл. Дан., с. Тарутино, 6 раб.; [2] ШТЕЙНЕРЪ, Леопольдъ, с. Тарутино, 6 раб.

ЧУГУННО - ЛИТЕЙНЫЙ: [2] ГОББАХЕРЪ, Франц. Франц., с. Сарата, 26 раб.

Торгово-промышленныя предпріятія.

АПТЕКИ: [2] ГОЙХЕРЪ, Вольфъ Гершуновъ, с. Старо-Арцизъ; [2] ЛЕЙЗЕРМАНЪ, Григ. Солом., с. Волонтировка.

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Figure B16: German names in the list of industrial producers in Akkerman district (Black Sea region)[a]

[a]Source: Statistical and Economic description of Russian Empire by Suvorin (1897 volume 1)

Figure B17: Reineke industrial flour company (founded by descendants of German colonists in Volga region. One of the biggest Russia's flour operator with fully automated technological process)

Figure B18: Advertisement card, showing examples of industrial equipment, produced by Sheffer's factory (founded by descendants of German colonists from Black Sea region in 1880)

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