

Immigration and the Diffusion of Technology: The Huguenot Diaspora in Prussia*

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Abstract

This paper analyzes the long-term effect of technological diffusion on productivity caused by immigration of skilled workers. In 1685 religious persecution drove highly skilled Huguenots into the backward Brandenburg-Prussia where they established themselves and transferred technological knowledge to natives. We find that textile manufactories installed in towns hosting the Huguenots achieved higher productivity than others due to diffusion, even 100 years after immigration. Identification is based on an instrumental variable approach exploiting variation in the settlement of Huguenots which results from population losses due to plagues during the Thirty Years' War, effectively eliminating worries of selectivity in the settlement pattern.

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1 Introduction

In his principal work Friedrich List (1856) revisited some of the policies utilized by a backward economy (his native Germany) to achieve economic growth and to catch-up to the leading country (the technological frontier). Alongside the German Customs Union and the German railways, which were List's brainchilds to some extent, he argued that immigration of skilled workers and education were preconditions for the consecutive growth in Germany. The role of education in the catch-up process during the Industrial Revolution in Prussia was recently reviewed by Becker et al. (2009).

Analyzing the technological diffusion induced by targeted immigration of skilled workers, a policy pursued by Prussian rulers throughout the 17th and 18th centuries, is subject to the work at hand. Journeymanship and similar migrations of skilled workers were virtually the only way to transfer technical knowledge and diffuse innovations before the Industrial Revolution (Cipolla, 1972). Therefore, the empirical assessment of skilled migration can contribute to the understanding of technological diffusion during that time.

The economic impact of the French Protestants, who fled their country after the Edict of Nantes was revoked in 1685, has been a recurring theme in the literature. As early as in the midst of the 19th century, List (1856, p. 153) found that "Germany owes her first progress in manufactures to the revocation of the Edict of Nantes, and to the numerous refugees driven by that insane measure into almost every part of Germany...". The so called Huguenots came as an exogenous shock to the predominantly Protestant neighbor countries of France, seeking refuge from religious persecution and bringing knowledge and skill in return.

While contemporary and present-day literature provides cost-benefit analysis of Huguenot immigration, effects from knowledge spill-overs between refugees and natives are neglected. It is well known that the Huguenots were highly trained and skilled, and on arrival at their destinations started to use these superior skills to earn a living. Scoville (1952a,b) was the first to conclude that their immigration must have led to a transfer of technical knowledge and to technological diffusion all over Protestant Europe. Nevertheless the consequences are not well studied and Scoville denies immediate returns. In the short-run the technological diffusion neither accelerated economic growth in England, nor closed the technological gap that separated Germany from France, Holland or England.

Nevertheless, Scoville (1960, p. 363) argues that the high costs of accommodating

the Huguenots were easily offset by long-term gains. Accordingly, German scholars agree on the fact that the transfer of knowledge had a certain positive effect on the Prussian economy (Jersch-Wenzel, 1978; Mittenzwei, 1987; Wilke, 1988b). Microeconomic evidence of such a relation has not been provided yet.

Using data from immigration lists which precisely document the number and settlement places of Huguenots in Prussia, we find positive long-term effects of technological diffusion on productivity in textile manufacturing. The data are unique in a sense that Prussia was the only immigration country to keep exact records of the French refugees. We connect these data to firm-level productivity-data from early 19th century, which are, to our knowledge, previously unused in econometric analysis. Finally, we find that textile manufactories in Huguenot settled towns were more productive than others, more than 100 years after immigration to Prussia.

In an instrumental variable approach we show that Huguenot immigration was primarily directed into towns depopulated during the Thirty Years' War (1618-48) and the accompanying occurrence of the Black Death. Thus, we are able to identify variation in the settlement of Huguenots which is exogenous to economic preconditions of immigration and eliminate worries of selectivity in the settlement pattern. Using this IV approach, we find manufactories established in towns that were depopulated by plagues and then repopulated by the Huguenots being more successful in manufacturing textiles than others. For the first time, our empirical results confirm the prevalent view of long-run gains from immigration, which evolved gradually through the transfer of knowledge and skills from Huguenots to Prussian natives.

The remainder of the paper is structured as follows. Section 2 gives insight into migration literature. Section 3 provides the historic background of Huguenot immigration into Brandenburg-Prussia. Section 4 introduces the data, the empirical model and shows basic results. Section 5 presents an instrumental variable approach and related results until Section 6 concludes.

2 Economic Effects of Migration

The economic effects of modern migration are well documented in the literature, especially in labor economics. This field distinguishes three streams of research: the economic performance of immigrants, their effect on employment opportunities and wages of the natives and the assessment of immigration policies for host countries (surveys by Borjas (1994, 1999); Friedberg and Hunt (1995)). The effect of

immigration on natives' wages and labor market responses are certainly the most discussed while macro-economic effects from immigration lack attention in the literature ([Drinkwater et al., 2007](#)). Studies of economic benefits from migration for the host country include [Ben-Gad \(2004\)](#), [Chiswick et al. \(1992\)](#) and [Paserman \(2008\)](#). The impact of immigration on innovation has been studied by [Gauthier-Loiselle and Hunt \(2009\)](#) and [Niebuhr \(2006\)](#). An overview on historic migration and its impact is provided by [Hatton \(2010\)](#).

Theoretically, [Borjas \(1994, p. 1667\)](#) finds that immigrants with high levels of productivity, who adapt rapidly to the labor market in the host country can make a significant contribution to economic growth. [Borjas' \(1995\)](#) influential "immigration surplus" finds immigration beneficial in a case where the immigrant skills are very different from the natives and their characteristics have a certain complementary to the native factors of production. He also finds that the knowledge transfer between natives and immigrants generates external effects leading to increasing returns to scale. In a simple model including capital he detects that benefits from migration are large if the immigrants are skilled, thus having higher complementary with capital. This is even more relevant when the native population is rather unskilled. [Borjas' findings](#) are supported by [Dolado et al. \(1994\)](#) who find that immigration with low human capital is equal to an increase of the population - it slows down per capita growth. Similarly, if immigrants carry high levels of human capital which is complementary to native capital, per capita growth accelerates.

The analysis of knowledge transfers from immigrants to natives is almost impossible since diffusion processes are often affected by indirect channels of communication, like written or electronic media. A time when face-to-face contact was the only way to transfer knowledge would thus be the perfect setting to analyze technological diffusion through migration. Before the onset of the Industrial Revolution, innovation and diffusion rarely resulted from publication of written material or blueprints ([Rosenberg, 1970](#)), but through the migration of skilled craftsmen, financiers and entrepreneurs ([Schilling, 1983, p. 8](#)). Then, the strongest obstacles to technological diffusion were mobility costs ([Epstein, 2004](#)). As indicated by [Cipolla \(1972\)](#) the effects of the printed word on historical diffusion of innovations are overestimated, and direct communication is much more important when it comes to application.

During the 16th and 17th centuries, mercantile policies started to take control over manufacturing and tried to stimulate innovation. [Mokyr \(1990, p.78\)](#) provides some vivid examples of technological diffusion procured by European rulers. They attracted skilled foreign labor in order to apply foreign skills in the new host country

and eventually transfer it to the natives. The literature widely agrees that this was a common way to diffuse knowledge during the Early Modern Ages and that host countries benefited substantially (Ciriaco, 2005; Findlay, 1978). Furthermore, it is agreed that Calvinists contributed substantially to the transfer of knowledge during that time. The most famous example of Calvinist-migration was the exodus of Huguenots from France to the German Brandenburg-Prussia. Religious persecution increased benefits from migration and thus overcame obstacles to technological diffusion. In line with the aforementioned considerations of Borjas, Scoville (1951) argues that diffusion of skills and technologies was facilitated by the fact that Germany was a backward country in 1685.

One important caveat prevalent in the migration literature is that immigrant inflow is rarely accidental and immigration policies are most likely to be highly selective in the attraction of certain characteristics. Furthermore, it is often argued that immigrants are more mobile than natives and will move to regions with higher wages and probability for economic success. Usually this leads to two kinds of selection, selection on the characteristics of the immigrants and selection on their places of settlement. In our case we have the advantage that selection on the characteristics of the individual immigrant is the preferred setting. In order to analyze benefits from the knowledge transfer without observing individual skills of immigrants, we assume that immigrants are pre-selected and more skilled than natives in general. The second form, selection on the place of settlement, can be ruled out in a natural experiment where timing and relocation of immigrants are motivated by a policy free from economic considerations, for example. The problems arising from the possible selection in the location of immigrants will be dealt with in Section 4.5.

3 History of Huguenot Migration to Prussia

The following section will summarize the historic background of Huguenot immigration and provide some important facts.

The persecution of Reformed Protestants in France started around 1530 and peaked at the St. Bartholomew's Day massacre of 1572 which was followed by a first wave of religious flight. From 1598 the Edict of Nantes granted religious freedom to the Huguenots until its revocation on October 18, 1685 by Louis XIV, the Sun King. Protestantism became illegal again and Huguenots were outlawed in the predominantly Catholic France. Protestant churches and schools were shut down and Huguenots once again became a target of persecution. While there was a constant

outflow as harassment became stronger before the revocation, the movement grew into an exodus soon after. This was unexpected by the King of France who had assumed that only those would leave who were in trouble with creditors or were without property and special skills, and therefore were not connected to their homes as much (Scoville, 1960). Hence, he tried to force the Huguenots to convert to Catholicism and was confident they would do so. Despite severe penalties like death, lifetime imprisonment and deport into slavery, approximately 200.000 fled. Most of them settled in Protestant neighbor countries like England, Germany, Ireland, the Netherlands and Switzerland.

The most famous example for offering refuge was Frederick William, the Great Elector of Brandenburg. Unlike his mostly Lutheran subjects, he was of Reformed faith and felt sympathy for his fellow Christians from France. Three weeks after Louis XIV revoked the Edict of Nantes, Frederick William issued the Edict of Potsdam offering his estates as a refuge to the Huguenots.

Of the estimated 43.000 Huguenots who left France¹ for the German territories, 16.000 to 20.000² alone came to Brandenburg-Prussia, a country of approximately 1.5 million inhabitants at that time. Since there already were some French nobles living in Frederick Williams court, Berlin became the final destination of many Huguenots, following the Edict of Potsdam. By the beginning of the 18th century more than 5.000 Huguenots had settled in Berlin and its outskirts, making up to 20 percent of the town's total population. The rest settled in roughly 40 other towns and few rural parishes. In total, about 90 percent of the Huguenots settled in towns.

Frederick William was anxious that the French would leave if they felt alienated by the natives. So he allowed them to build communities of refugees, so called colonies, in each town of their settlement. These were parishes with their own church and service and, depending on the size, their own jurisdiction, police, and schooling.

The literature agrees that the rich and powerful Huguenots mostly fled to England and the Netherlands. This picture is maintained by various descriptions of impoverished and half naked Huguenots arriving in Brandenburg, having lost everything during the flight. Nevertheless Wilke (1988c) emphasizes that it was neither only the poor nor the second class nobility who came to Prussia. According to him the Huguenots came to Prussia as a complete draft of society. He estimates that

¹Their origin was manifold; centers of emigration were the Languedoc (south), Dauphiné (south-east), the Champagne (north-east) and the Gascogne (south-west).

²Numbers vary with the inclusion of members of the military who were integrated into the Prussian army and thus not counted in colony lists.

the immigrants were composed of 5% nobility, 7% mid-level functionary, 8% trade and manufacturing bourgeoisie, 20% workers and apprentices, 15% farmers and 45% small artisans and craftsmen in 1705.

These figures already draw a clear-cut picture of the occupational composition which resembled a town population much more than the rural society. This was because of two reasons. First of all, Huguenots were generally very well educated and had selected themselves into more skilled occupations already in France.³ Second, in February 1686 Frederick William demanded his delegates to refuse unskilled Huguenot workers to enter Brandenburg-Prussia (Mittenzwei, 1987).

3.1 Economic Impact of French Immigrants

Frederick William, the Great Elector of Brandenburg, came into reign in 1640 during the Thirty Years' War, which left the country depopulated and deserted after the Black Death had finally faded. The Margraviate of Brandenburg, Pomerania and Magdeburg, which made up most of his territory then, were hit hard by the war and were suffering from the aftermath more than most other German states and kingdoms. Therefore Frederick William and his successors became well known for their repopulation policy (*Peuplierung*) and the intake of Huguenots was a major step to fulfil this aim.⁴

An increase in the population was perceived equal to a raise in the number of tax payers as well as a growing potential to recruit more soldiers. Thus the literature identifies economic motives in the intake of Huguenots (Jersch-Wenzel, 1978; Mittenzwei, 1987; Wilke, 1988a), while religious motives and sympathy towards fellow believers are not neglected. Particularly, skilled immigrants were the target of attraction and they were expected to use their knowledge to set up and supervise manufactories. This was very much in line with the German economic thought of the 17th century (*Kameralismus*, a special kind of mercantilism) which was based on a positive balance of trade. The Huguenots were expected to produce 'domestic' goods that otherwise would have to be imported. Thus taking in the Huguenots who were known to be good craftsmen was an act of tolerance first, but became an

³Scoville (1960) explains the economic advantage of the Calvinists over Catholics in France with their dominant role in public finance, their role as a "penalized minority", Protestant individualism and a Protestant ethic á la Max Weber. Incidentally, Scoville mentions Calvinist advocacy of Bible reading. This might have translated into higher accumulation of human capital and skill (see Becker and Woessmann (2009) for similar arguments regarding Protestants in Prussia.).

⁴Frederick the Great pointed out at the beginning of his reign in 1740 that even after three regimes and nearly a century passed, the impact of the Thirty Years' War on the Margraviate, Pomerania and Magdeburg had not yet been made up for completely. Although massive efforts had been undertaken by each ruler to repopulate the land, it was not until the mid of the 18th century when population reached the levels of before the war (Franz, 1979, p. 100).

act of economic policy in hindsight.

Already in the Edict of Potsdam, Frederick William granted support and several privileges to all French refugees. This included exemptions from tariffs when entering the country, free use of abandoned houses and deserted land, exemption from all taxes and impositions except the consumption tax for 15 years, financial and material support for setting up businesses and manufactories, free land for those in agriculture and finally, freedom from guild coercion for 10, and later 15 years. All financial support was provided as a loan to be paid back once the businesses became profitable. This became necessary as many Huguenots had lost all of their possessions during the flight.⁵ Soon the Huguenots went into business and most of them resumed occupations they already had in France - concentrating on textiles and apparel. Approximately 25.7 percent of the Huguenot craftsmen were occupied with production of cloth and 32 percent with other textiles.⁶ As expected, the immigrants used their technological and managerial knowledge to set up manufactories, while attempts of domestic analogs were not able to surpass the lower stages of production ([Jersch-Wenzel, 1978](#), p. 80).

Analyzing the economic impact of the Huguenots can only be attempted using historic sources. Unfortunately, most of the contemporary documentations seem to be strongly clouded and biased in favor of self-adulation of the Prussian rulers. Consequently, current literature suffers from the lack of unbiased sources ([Gwynn, 2001](#), p.74).

This can be seen in some examples outlining the short-term benefits of hosting the Huguenots: When asked if his intentions to bring back Magdeburg to his former prosperity were filled, the King answered that the town had been idle for 40 years after the war, but when the refugees came all buildings had been filled within 18 years. Manufactories have been established which had not been there before, foreign money had come to the town and hundreds of citizen were employed and contribute to consumption ([Jersch-Wenzel, 1986](#), p. 163).

These statements are supported by a comparison of costs and benefits undertaken by the city council for the colony in Magdeburg in 1709, which found that Huguenot economic activities offset investments into them by far. In line with mercantile thoughts, more people would lead to more wealth and costs caused by their privileges and subsidies should be offset by the additional consumption taxes. Based

⁵Nevertheless [Muret \(1885\)](#) finds that some Huguenots purchased real estate, houses and manufactories with their own means and without subsidy.

⁶The data reflect the structure of Huguenot craftsmen in Berlin which, throughout the literature, is often used as a proxy representing all colonies in Brandenburg-Prussia. See [Jersch-Wenzel \(1978, pp. 72-74\)](#) for corresponding numbers in other professions.

on the calculations of the city council [Jersch-Wenzel \(1978\)](#) estimates an annual per Huguenot return of 10 Thalers, over all colonies. This was approximately equal to the annual tax revenue obtained from every native. However, these calculations seem to be somewhat parsimonious and do not account for any external effects like benefits from technological diffusion, for example.

The contemporary impressions of positive short-term benefits are nevertheless rather refused than confirmed in current literature. Refusals are mostly describing the ongoing attempts of Prussian rulers to give out privileges and support to Huguenots to set up manufactories which seldom operated profitably and often went out of business soon after subsidies ran out ([Jersch-Wenzel, 1978](#); [Kindleberger, 1995](#); [Scoville, 1960](#)). Reasons for such failure were most often the lack of demand and markets for luxury goods, which were exactly the products strongly supported by Prussian rulers. It was only the stocking production that succeeded in raising the necessary demand. [Mittenzwei \(1987, p. 124\)](#) resumes that Brandenburg-Prussia had not been ready for large-scale manufacturing at the beginning of the 18th century.

The long-term effects from immigration are somewhat controversial, too. [Mittenzwei \(1987, p. 138\)](#) identifies four phases of Huguenot economic activity, a first phase of establishment from 1685 to the turn of the century, a boom phase in small scale manufacturing until 1735/36, a phase of decline until 1767 and a phase of economic growth beyond the beginning of the 19th century. [Mittenzwei's](#) observation of growth around the turn of the 19th century is based on a massive increase in the number of looms for silk and cotton employed by members of the French colony in Berlin. She also observes a persistent downturn in the use of looms in the formerly Huguenot dominated woolen industry.

On the other hand [Jersch-Wenzel \(1986\)](#) finds that the Huguenot impact on the Prussian economy and the industry in particular lasted for nearly the whole 18th century but vanished gradually towards the end. In 1797, a special commission filed a report stating that just in the same way as the number of manufacturers had decreased in the colonies, the manufactories themselves were run-down ([Jersch-Wenzel, 1986, p. 169](#)). This impression might be due to increased assimilation. The homogeneity of the colony population eroded over time. Huguenots married into non-Huguenot families and left the community to live as normal Prussians and vice versa. Obviously, the manufactories had moved out of the colonies along with their entrepreneurs.

Though [Jersch-Wenzel](#) assumes that the commission had not overrated the de-

clining impact of the Huguenot community, she assigns a long lasting impact to the transfer of knowledge. She concludes that knowledge and skill immigrated from France to Prussia and made a successful contribution to the Prussian economy. [Wilke \(1988a\)](#) confirms this stating that the Huguenots brought the knowledge of production in centralized and decentralized manufactories to Prussia, a country that had not yet entered the stage of capitalist-manufactories. Though not being successful in establishing manufactories that endured over the long run (for aforementioned reasons), the Huguenots transferred their technological knowledge to their native apprentices and workers.

This very idea is also target of our empirical research. We presume that even if any direct Huguenot influence on the economy vanished over time, their transferred knowledge was still active and had a positive impact on productivity in manufacturing of textiles.

3.2 Knowledge Lead and Transfer

The diffusion of technical knowledge once concentrated in France is confirmed across all new host countries by [Scoville \(1952a\)](#). As for England, he notes that the Huguenots raised the quality of production and diffused skills that once were secrets of French manufacturers. In Holland the silk and taffeta industry suddenly gained international reputation through Huguenot immigration. In Ireland they had massive influence on the manufacturing of linen and introduced new methods for spinning and weaving flax.

The economic situation of Ireland is most similar to Prussia at that time. Both suffered from the aftermath of a war, and just as for Ireland, it is generally agreed that Brandenburg-Prussia was a backward country at the end of the 17th century. Neither the putting-out system or cottage industry nor centralized manufacturing had advanced in Brandenburg-Prussia. In the late 1670s, Prussian functionaries built few manufactories in Berlin, otherwise there was no larger scale manufacturing. These State-forced enterprises were not driven by markets and thus failed or performed dreadfully.

In total they introduced both more advanced skills and new technologies. [Bekmann \(1751\)](#) found that the Huguenots brought 46 professions to Brandenburg which were unknown before in this country, most of them in the textile industries.⁷ One

⁷Frederick the Great noticed: "When Frederick William (the Great Elector) entered regnancy, this country was producing neither hats and stockings, nor serge or other woolen stuff; French diligence delivered all those goods to us. They fabricated cloth, screen cloth, serge, gentle cloth, drugs, grisets, crepe, woven caps and stockings, beaver- and rabbit-hats, rabbit-hair hats and built dyeing works of all kind." Cited after [Erbe \(1937, p. 83\)](#).

Huguenot carried with him the secret of dyeing fabrics in a special way, another one the art of printing on cotton. Some others introduced the hosiery knitting loom which replaced the manual production of stocking and socks. Furthermore, they introduced silk farming and silk spinning knowledge, a trade very important to Frederick William. He soon ordered to grow mulberry trees to feed the silkworm on schoolyards and assigned special areas for plantation around Berlin.

While it seems to be agreed that the Huguenots were leading in technical knowledge and skill in many trades, examples of actual transfers and diffusion taking place are rare. The segregation into colonies might have set barriers to interactions with natives. Other threats to communication might be the hostility displayed by Catholics and Lutheran natives who sometimes would not even buy from the Reformed Huguenots.

Nevertheless, frequent transfers between Huguenot artisans instructing native apprentices and workers seems to be most likely. This form of interaction was strongly encouraged by Frederick William. When immigrants requested financial support to set up manufactories many of the contracts included a fixed number of employees⁸ as well as the constraint to instruct native apprentices.⁹ In Halle on the Saale public notice was made that citizen should send their children as apprentices to French manufacturers.

Even if these large scale manufactories did not last for long, the aftermath were trained native apprentices and new equipment. The equipment was eventually sold or let to some native and mostly Huguenot craftsmen who set up small businesses which were far more successful.

As [Scoville \(1952a, p. 410\)](#) puts it, the rate of technological diffusion depended on the channels of communication between Huguenots and natives and on the size of the technological gap between France and the immigration country.¹⁰ In the case of Prussia the rate of diffusion was likely to be low. Direct communication between Huguenots and natives, other than the instruction of apprentices, was important to make the immigrants socially accepted and to raise demand for their products. Therefore, it was not until some years into the Huguenot refuge, when assimilation progressed and the native Prussians started to accept the French, that technological diffusion also advanced. Second, the technological gap that separated Brandenburg-

⁸The entrepreneur Orelly was contracted to employ at least 8000 workers, André, Valentin and Claparède had to employ 110 looms.

⁹[Mittenzwei \(1987, p. 118\)](#) lists three examples of contracts including the order to employ native apprentices and to teach them the craft.

¹⁰Many others have found that the size of the technological gap determines the speed of a catch-up process ([Gerschenkron, 1962](#); [Findlay, 1978](#); [Vandenbussche et al., 2006](#)).

Prussia from France was large compared to other host countries like England and the Netherlands, and this state of underdevelopment prevented immediate benefits from accommodating the Huguenots.

The technological change introduced by the Huguenots was likely to be too abrupt to be applied in this country at once. This is in line with [Becker et al. \(2009\)](#) who find that the progress of the textile industry in Prussia was more incremental than disruptive. Nevertheless, the transfer of knowledge increased the rate of applied technological change and lead to a higher growth equilibrium. As we will show subsequently, those towns with a higher share of first generation Huguenot refugees became more productive than other towns in the long run.

4 Evidence on the Impact of Huguenot Immigration

This section provides the empirical analysis of the effects of Huguenot immigration on productivity. For this purpose, we exploit variation in Huguenot settlement and in the productivity of manufactories across Prussian towns between 1700 and 1802.

4.1 The Data

The data on manufacturing is extracted from the “Register of Factories in the Prussian State” conducted by the Prussian Royal Secret Filing Department¹¹ in 1802 ([Krug, 1805](#)). To our knowledge this is the earliest published overview of this kind in Prussia. The register includes all factories established within Prussian borders of 1802 except for those in Ansbach, Bayreuth, Neuchâtel, Silesia and the new territories gained as compensation for losses in the war with France. We excluded a total of 53 observations from the dataset in cases where manufactories were established in rural areas¹² or in areas which did not belong to Prussia after 1807.¹³

The term factory in the title of the register might be misleading towards the notion of an industrial firm. During pre-industrial times the expressions factory and manufactory were used synonymously in Prussia. Distinction was rather made between (manu)factory and craftsman, where craftsmen produced on order and sold to a local demand, while (manu)factories produced larger quantities without order to satisfy national and even international markets ([Hoffmann, 1969](#), p. 19). The latter form of production was also the criterion for inclusion in the survey. The register however does not distinguish between centralized and decentralized manufactories.

¹¹The department became the Prussian Statistical Office in 1805.

¹²We also excluded Huguenots settlements in rural areas since the occupation structure of rural colonies was very different.

¹³These are the spotted areas in [Figure 2](#).

One can only assume that in this proto-industrial environment a good part of the large scale production was based on a putting-out system.

In Figure 1 we present a map of Brandenburg-Prussia where grey areas depict the territory of 1685 and towns with a Huguenot colony are marked with a cross. Most of the colonies which were founded after 1685 are located within these borders, except for the city of Stettin (Szczecin), whose colony was founded soon after the annexation of Swedish Pomerania in 1720. In Figure 2, towns with at least one textile manufactory are marked with a circle and towns with a Huguenot colony are again marked with a cross. We find only eight towns with Huguenot settlement and without large scale textile manufacturing.

Firm level data includes the value of manufactured goods, the value of raw materials used as inputs, the number of workers and the number of looms. Summary statistics are presented in Table 1. All manufactories have been classified into 17 categories. Those manufactories classified as producing goods from wool, cotton, linen and silk represent our measure of textile manufacturing while all other categories are used as a control group.¹⁴

According to remarks from the author of the register, the number of reported workers might be exposed to measurement error, mostly due to fluctuations during the year. For reasons unknown, data on the value of raw materials is missing for 96 of the textile manufactories. To be able to use a complete dataset we impute missing values as described in Appendix B.

We also have no information available if a manufactory was Huguenot owned or employed any Huguenots. However, it is the technological diffusion caused by the Huguenots we are interested in and not their physical contribution to the production process.

The knowledge transfer and technological diffusion caused by immigration is proxied by the share of Huguenots in Prussian towns. Data on the quantity of Huguenot immigration is very much unique for Brandenburg-Prussia. Every French immigrant living in a colony was registered annually in the *Rôle général des Français réfugiés dans les Etats de la Majesté le Roy de Prusse*. Because of continuous fluctuations in the first years (Jersch-Wenzel, 1985) we use the number of Huguenots living in towns and the number of Huguenots occupied in textiles in 1700 to estimate the diffusion caused by the first generation - the knowledge bearers.¹⁵ Unfortunately, data on town population do not exist for 1700 and the first extensive census dates

¹⁴Other categories include earthenware, food, glass, leather, metals, powder, etc.

¹⁵The datasource is Muret (1885).

from 1730. The share of Huguenots in Prussian towns is thus defined as number of Huguenots in 1700 over the town’s population in 1730. This definition would lead to an upward bias in the estimates only if the population in towns with Huguenot colonies systematically grew at a slower speed than others and vice versa.

4.2 The Model

In this section we test our central assumption that a higher share of Huguenot population is associated with subsequent higher productivity in the long run. For now, we assume that the settlement pattern is exogenous to pre-immigration productivity. We estimate productivity in textile manufacturing using a production function with technological progress:

$$\ln\left(\frac{Q}{L}\right)_{ij} = \beta_1 \ln(A_j) + \beta_2 \ln\left(\frac{K}{L}\right)_{ij}. \quad (1)$$

Productivity, defined as the ratio of output Q to labor L is determined by the ratio of capital K to labor L as well as technological progress A . Q is measured as the value of goods produced in manufactory i in town j . L is measured as the number of workers and K is represented by two variables: the number of looms and the value of materials used. Q , L and K are calculated in natural logarithms.

The share of Huguenots in a town’s population enters as a measure of technological progress A . This technological progress came as a shock to the Prussian towns and varies with the ratio of Huguenots to natives, since technological diffusion is likely to increase with growing interaction possibilities. We assume that the exogenous technological progress caused by the Huguenots is Hicks neutral. Both capital and labor are augmented; capital through the introduction of new and better looms and labor through the transfer of knowledge for more skillful application of the looms. This leads to the following estimating equation:

$$\begin{aligned} \ln\left(\frac{\text{Output}}{\text{Worker}}\right)_{ij} &= \beta_0 + \beta_1 \left(\frac{\text{Huguenots}}{\text{TownPopulation}}\right)_j + \beta_2 \ln\left(\frac{\text{Materials}}{\text{Worker}}\right)_{ij} \\ &+ \beta_3 \ln\left(\frac{\text{Looms}}{\text{Worker}}\right)_{ij} + X'_j \gamma + \varepsilon_{ij}. \end{aligned} \quad (2)$$

Where X is a vector of characteristics that might have an (indirect) influence on output and productivity (townsize, availability of raw materials, religious composition of the population).

4.3 Basic Results and Robustness

Table 2 shows basic results from OLS regressions for the 693 manufactories producing textiles across 302 Prussian towns. Throughout the regressions we assume

heteroskedasticity, since the errors might be correlated within towns. Unless specified otherwise, we cluster standard errors at the town level.

A simple bivariate regression is shown in Column 1, introducing the share of first generation Huguenots in the town's population in 1700. We find that the share of Huguenots had a positive significant effect on productivity in textile manufacturing.

When controlling for input factors at the firm level in Column 2, we find that the share of Huguenots remains positively associated with productivity. The value of materials per worker is an important determinant of productivity. The number of looms employed also has a positive but smaller effect. Manufactories not using any looms are even more productive. This is no surprise since these are only manufactories producing hats and gloves and thus luxury goods with high output-value.

An increase in the share of Huguenots by one percentage point would translate into a 1.4 percentage points higher productivity. We can conclude that a higher share of skilled immigrants translated into technological diffusion which eventually translated into higher productivity.

Our estimates prove to be robust against the inclusion of several control variables.¹⁶ We control for the size of the town, since productivity and wages are usually higher in larger cities and a large town population might have an effect on prices of outputs sold and inputs purchased. Furthermore, input prices, especially in textiles might be associated with availability of raw materials like wool. Thus we include the number of sheep per capita at the county level. We find both variables not having an effect significantly different from zero. The Huguenot' coefficient is hardly affected.

Also the inclusion of the share of Protestants in Column 4 which might have an effect on the diffusion of Huguenot knowledge, since Protestants were probably less hostile than Catholics,¹⁷ does not enter the model significantly. Furthermore, the inclusion of a dummy controlling for towns that did not belong to Prussia in 1720 does not change the coefficient for Huguenot diffusion. The intuition behind this dummy is to control for Prussian annexations after the big waves of Huguenot immigration. No colonies have been established in these new towns.¹⁸

Because of data scarcity we use the ratio of Huguenots in a town in 1700 to the town's population in 1730. This might lead to upward biased results in a case where towns hosting more Huguenots systematically grew at a slower rate than others.

¹⁶The source for the control variables is (Mützell, 1823-1825).

¹⁷Mokyr (1990) makes the point that Protestants are generally tolerant and thus more open to innovation and technological change

¹⁸Casewise deletion of observations with missing data (see Appendix B for further information) leads to similar results. The Huguenot coefficient is slightly lower at 1.285 with a t-statistic of 7.57.

Otherwise the coefficient of the Huguenot variable would be biased downwards. To test this assumption we replace the number of Huguenots in 1700 by colony list data from 1720 (GStA PK, 1720). Column 5 shows that the coefficient is higher when using the more accurate ratio, thus confirming a downward bias for the earlier date.

In Column 6 we find that the share of Huguenots in 1795 does not have a significant effect on productivity as opposed to earlier dates.¹⁹ There are several reasons for this. First of all, from 1720 on, newly immigrated Huguenots seem to have focused more on agriculture. Most of those immigrants were directed to rural settlements, but even for Berlin a shift in occupation towards farming was observed. During the 18th century the number of Huguenots working as farmers rose up to 20 percent. These were mostly unskilled workers who were pushed off to the countryside (Wilke, 1988c, p. 58). Furthermore, the homogeneity of the group was eroded when natives married into the wealthy Huguenots families. From 1772 on, Prussians could become members of the Colonies even if they were not Reformed Christians. Also many Huguenots left the colonies and became assimilated.

Since only those refugees living in colonies were captured by the lists, growing assimilation led to measurement error in the data. We thus have to concentrate on the first and second generation of immigrants who were the diffusors of technology and knowledge by definition.

While the share of Huguenots in a town's population is a good measure of technological diffusion in general, such a variable might neglect the fact that only Huguenots employed in textiles transferred the relevant knowledge. As an alternative variable of interest, we use the number of Huguenots occupied in textiles in 1700. The results shown in Column 7 are qualitatively similar to previous estimations and prove to be robust against changes in the variable of interest. The number of Huguenots employed in textiles in 1700 is positively associated with productivity in textiles 1802.

4.4 Discussion

Some of the results presented until now, might bring up worries which we will address in the following sections.

Worry 1: Technological diffusion did not stop at city limits. The transfer of tacit knowledge was often limited to cities or even city quarters and processes were kept secret as good as possible especially within guilds. Nevertheless, Huguenots probably traveled to other towns and passed on some of their knowledge there. Also natives,

¹⁹The denominator here is town population in 1802.

that had learned Huguenot knowledge and technology, might have relocated. In any case, if there had been diffusion beyond town limits, we would only underestimate the effect of Huguenot immigration.

Worry 2: Manufactories benefited from an international network between Huguenot settlements. Because of their immigration, Huguenots had many connections into other countries and might have been able to export their goods to other places that hosted Huguenots to become more successful than their native counterparts. This way, towns with Huguenot colonies might just be more connected in international trade than others. Many examples of failing manufactories during the early decades seem to rule out this possibility. It had been the lack of demand that drove almost all of these enterprises out of business. Unfortunately our data does not include the year of establishment of the manufactory. This lack of information might be balanced by a list of Prussian manufactories in 1769 (Hoffmann, 1969). The mean date of establishment of the 558 manufactories which provided this information is 1753 and only 8 were founded before 1700.

Worry 3: The results might be driven by unobserved inherent town effects only. If Huguenot colonies were established in towns that also hosted successful manufactories only by accident, we should observe their effect also in industries not advanced by the immigrants. We show that the positive effect of Huguenot diffusion can be observed in all categories of textile manufacturing in Table 3, but in almost no category in the non-textile sectors in Table 4. Column 1 shows estimates for all 695 non-textile manufactories which are also included in the survey. We do not find that Huguenot diffusion had an effect different from zero on these manufactories. Further disaggregation into categories in Columns 2-12 shows that a Huguenot effect can only be observed in the manufacturing of paper and soap and was thus mostly restricted to textile production.²⁰

Throughout the literature we find examples of Huguenots who advanced many different trades, besides the textiles, in their host countries. In Brandenburg-Prussia they were also known to be excellent watchmakers, goldsmiths, wigmakers, tobacco farmers and producers of glass, paper, and small metal goods (needles and pins). Nevertheless, since we do not find any significant effect on industries other than paper and soap²¹ we conclude that the knowledge transfer might not have been crucial for large scale non-textile production.

²⁰Categories with few observations might not have sufficient asymptotic properties to reasonably interpret the results.

²¹Scoville (1952b) mentions that Huguenots in Brandenburg-Prussia produced soaps to wash and improve the quality of wool.

4.5 Selectivity in the Settlement Pattern of Huguenots

As mentioned before, selectivity in choosing the place of settlement threatens identification. In such a case Huguenots might have selected themselves into towns with a high probability for success in textiles. If settlement of Huguenots in Prussia only reflects the occurrence of pre-immigration textile production our estimates would be driven by a path dependency prevalent in textiles. It might be that textile production in cities that hosted Huguenots achieved higher productivity in 1802 simply because the town had produced textiles for so long.

In the following section we will present anecdotal evidence that the Huguenots were assigned to those towns the Prussian rulers found adequate. In a subsequent section we will deal with the remaining worry that this allocation was selective itself.

The literature rarely touches the question why the Huguenots settled in certain towns. The Edict of Potsdam declared that the Huguenots were free to choose their place of settlement but at the same time made recommendations for several towns²² with enough livelihood (*Nahrung*).²³ Many of the *bürgerliche Nahrungen* still remained vacant after the Thirty Years' War and the Huguenots were invited to fill these gaps. [Jersch-Wenzel \(1978\)](#) assumes that the towns recommended in the Edict of Potsdam were chosen because they were the few bigger ones that could profit from the Huguenots. [Klingebiel \(1990\)](#) finds that the settlement pattern of the Huguenots reflected the structural requirements of the German regions after the Thirty Years' War. [Schilling \(1983, p. 9\)](#) identifies this as a case where an absolutist bureaucracy controlled the settlement of Huguenots and determined the scope and the direction of their economic activities.

We can only conclude from contemporary literature how the immigration took place. The Edict of Potsdam suggests that the flight to Brandenburg-Prussia was well organized by Frederick William. Already in the Edict he advised the Huguenots from the north to head to Amsterdam where they would be welcomed by his delegates. From there they would be shipped through Hamburg into his realm. The Huguenots from the south were told come to Frankfurt on the Main or Cologne where they would receive everything necessary and passage down the river Rhine to Cleves.²⁴ All immigrants were registered and their means and circumstances were

²²See [Appendix A](#) for the corresponding paragraph in the Edict of Potsdam.

²³*Nahrung* in these times was defined as the occupation which one performs to subsist. When a village was granted market rights or town privileges the right to perform "*bürgerliche Nahrungen*" (crafts), as opposed to agriculture, was associated. However, the number of *Nahrungen* was limited to assure sufficient subsistence of the artisans and to guarantee the supply of the town's population with the manufactured product for adequate prices. Supervising authority was the guild.

²⁴For a more detailed description of migration routes see [Klingebiel \(2000\)](#).

asked.

Afterwards, the Huguenots were assigned to a colony or settling place. According to Muret (1885) the receiving delegates were to place the French where they would fit best and transfer money required for their settlement from church collections. The commander of Lippstadt, Henri de Briquemault for example, placed all refugees from the Champagne in the cities of Hamm, Soest, Minden and Lippstadt (Erbe, 1937, p. 34). A well known example is the “Mannheimer” colony in Magdeburg. Before the refugees came, two French delegates visited settlement places all over Brandenburg-Prussia which were suggested by the Great Elector to finally choose Magdeburg (Gabriel, 1990). Another example is the rural French settlement in East Prussia. The Black Death ravaged here from 1708-10 and depopulated a total of 8411 farms. Soon after Frederick I called for new settlers the Huguenots came and established themselves in the assigned areas of Insterburg and Gumbinnen.

The aforementioned facts lead to the conclusion that the place of settlement was not as arbitrary as announced in the Edict. The Huguenots were rather assigned to where they were needed most to repopulate and revitalize the deserted towns. Those were exactly the towns depopulated by the Thirty Years’ War and the Black Death. As repopulation was one of the crucial motives to attract the Huguenots, they were obviously assigned to towns that suffered the most losses.

However, if Prussian officials deliberately assigned Huguenots to towns with higher production in textiles, estimates still might be biased.

We deal with this worry by controlling for the progress attained in textiles before the Huguenots arrived. An Edict from 1680 documented the economic conditions of Brandenburg-Prussia and found that due to the prevalent impact of the war on most towns, the economy had still not reached its level of before 1618. The only craft of nationwide relevance was cloth production which was located in 24 towns (Mittenzwei, 1987). Since quantitative information of the state of textile production is not available for this time we construct a dummy identifying those towns. Column 1 in Table 5 shows the estimates when including the dummy. The dummy is not significantly associated with textile production in 1802, showing that pre-immigration textile towns are not the same as post-immigration textile towns.

4.6 Population Losses during Thirty Years’ War as an Instrument

We have established the view that Huguenots, who came as an exogenous shock to the towns of Brandenburg-Prussia, were not able to select themselves into cities which already had a comparative advantage over other towns. Even though their

place of settlement was not randomly assigned, they were located into towns which had been war strapped and depopulated by plagues. Depopulation in this case being an event independent of economic activities of the town, since epidemic mortality did not depend, for example, on social classes or size of settlement (Voigtländer and Voth, 2009). In the following, this fact will be utilized for an instrumental-variable strategy, where population losses during the Thirty Years' War (1618-1648) serve as an instrument.

We instrument the share of Huguenots in a town's population in Equation 2 with the population losses. Exogeneity comes from the fact that the largest part of population losses did not emerge due to the act of war itself but through the occurrence of the Black Death in the 1620s and 1630s. The epidemics were spread by roaming troops, returning soldiers and fleeing peasants seeking refuge in towns (Pfister, 2007). The hygienic situation eventually translated into plague, dysentery and typhus and resulted in massive decimation. Moreover, high infant mortality reduced long-term population growth and baptisms as an indicator remained very low even for the generation to follow. This instrument is not affected by any measure associated with textile production, and resulting estimates show the causal effect of Huguenot diffusion on textile manufacturing.

The Thirty Years' War is one of the darkest spots in German demographic research. Even parish and tax registers, usually reliable sources for calculation of the population are sparse. The only part of Prussia with sufficient information on population losses in towns is the Margraviate of Brandenburg. For other areas we have to draw on sources not exclusively taken for this purpose. We use population data for the closest pre-war date available and the closest post-war date available from the German handbook of towns (Keyser, 1939-1941) to interpolate²⁵ them and calculate population losses at the town level. Where available, we also use data from Behre (1905) and Wohlfeil (1976) and calculate the average population loss over the three data sources. Unfortunately, information is unavailable for many towns in our dataset and so the number of observations is reduced.

Column 2 in Table 5 reports the results when using a small sample for which data on population losses is available. The smaller sample behaves similar to the large sample and the coefficient for Huguenots is slightly higher.

The reduced-form relationship between population losses in the Thirty Years' War and productivity in textile manufacturing 1802 (Column 3) is positive and significant. A resulting worry might be a violation of the exclusion restriction if the

²⁵See Appendix C for details.

instrument had a causal effect on the outcome. If, for example, towns which suffered high population losses because of plagues, subsequently experienced increasing real wages, decreasing interest rates or changes in the institutional framework and were thus able to become more productive our estimates might only reflect this effect (Pamuk, 2007). Consequentially, a positive selection might arise if Huguenots subsequently settled in these high wage, low interest towns. When we exclude towns with Huguenot colonies from the regression, we find a negative but insignificant correlation between population losses during the Thirty Years' War and productivity in textile manufacturing (not shown). This means that, if we only compare towns without Huguenot immigrations, we find that towns which had higher population losses subsequently achieved lower productivity. We thus find no violation of the exclusion restriction. Any reduced form relationship is fully borne by Huguenot influence.

Population losses are also not correlated with the size of a town before the outbreak of the war.²⁶ This means that it was not the relatively bigger towns with a higher potential for recovery that suffered the most losses.

The first stage of the instrumental variable approach (Column 4) shows that population losses can be used as an instrument for the share of the Huguenot population in 1700. A decrease in the population by 50 percentage points is associated with a higher share of Huguenots in a town's population by 5 percentage points. The second stage estimate is significant and slightly higher than the OLS estimate.²⁷

We also report the Kleibergen-Paap test statistic which identifies weak instruments. Our IV estimates fail to match the critical value of 10 developed by Stock and Yogo (2005) for this first stage F-statistic (Column 5). The critical value was developed for cases where the model errors are independent and identically distributed only. Unfortunately, no such critical values are available when the model error structure requires robust forms of heteroskedasticity and clustering.²⁸ Given the results of this test statistic and the shortcomings of the critical value we cannot conclude with certainty if the instrument is sufficiently strong.

As shown earlier, we can use the number of Huguenots employed in textiles as an alternative measure to the share of Huguenots. In Column 7 we find this measure of technological diffusion instrumented by the population losses during the Thirty Years' War being significantly associated with productivity. For this specification

²⁶The correlation is -3.5%.

²⁷To test if the results are driven by the massive Huguenot immigration and large scale manufactories in Berlin, we also estimate the model excluding this city. All results remain qualitatively unaffected (not shown).

²⁸When we employ robust standard errors instead of clustering at the town level the model passes the weak instrument test using the proposed critical value of 10 (not shown).

the Kleibergen-Paap test passes with a value of more than 10 in the presence of clustered standard errors at the town level.

5 Conclusion

The analysis undertaken in this paper empirically confirms the existence of positive long term effects of the technological diffusion and the knowledge transfer from skilled Huguenot immigrants to the natives in Prussia on productivity in textile manufacturing. Most of the existing literature on this topic suffers from possible bias of historical sources which might have drawn an one-sided picture and concentrated on few bright examples. Furthermore, econometric evidence was missing completely. We are able to connect data from immigration list from the 17th and 18th century to completely unrelated manufacturing data from the 19th century to finally give an comparative overview over all colonies and towns.

Our estimates suggest that there has indeed been a diffusion of technologies and knowledge resulting from targeted immigration of skilled workers. The impact of this transfer can be observed more than a 100 years later in the industry, that was the main field of activity for the immigrants - in textile manufacturing. Moreover, the effects are restricted to this particular industry which strongly supports the assumption of intra industry spill-overs from specialized immigrants.

This result also adds to the discussion of how much journeymen and traveling apprentices contributed to technological diffusion before the Industrial Revolution. While the attraction of skilled workers and apprentices to successful towns results in knowledge transfers that are highly endogenous, we are able to identify variation the immigration of skilled workers which is exogenous to pre-migration success of a town.

Our empirical identification strategy employed the exogenous instrument of population losses due to plagues and war and allows us to interpret the results as a causal relationship. We are confident to use a valid instrument since the relationship between the population losses during the Thirty Years' War and the immigration of Huguenots is confirmed throughout the literature. Thus, we are able to isolate only the part of variation in immigration which results from factors exogenous to the outcome - textile manufacturing.

The results confirm [List \(1856\)](#)'s argument that Germany might owe some of her early growth to the immigration of skilled human capital, in a way that could not have been observed by contemporaries. This might be one of the rare examples

where we are able observe the transfer of knowledge through migration unaffected from any indirect means of communication. The effects of such transfers can be verified only in the long run and might be often neglected in short-term analysis.

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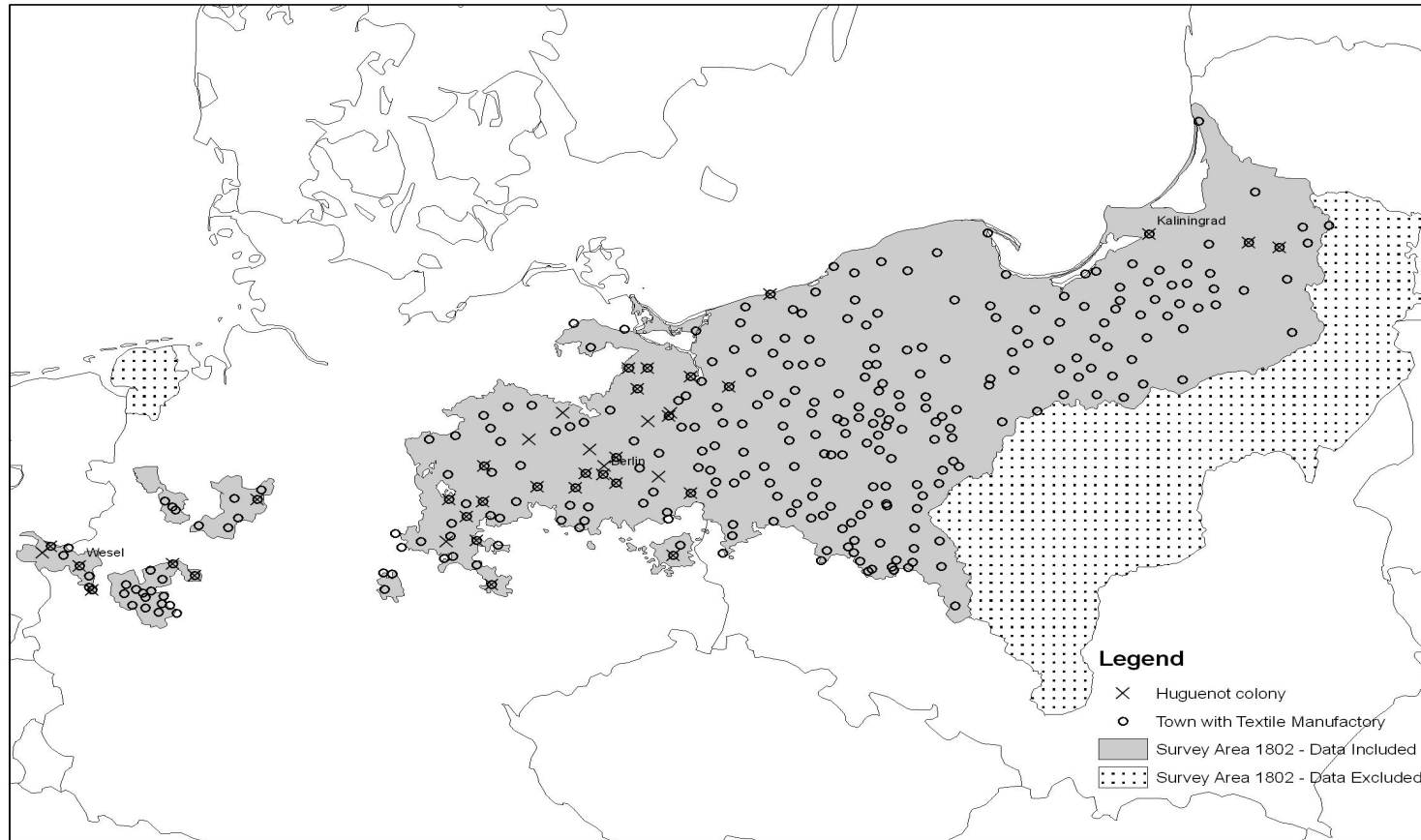
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Figure 1: Towns with Huguenot colonies in Prussia, 1685-1795



The Map shows the territory of Brandenburg-Prussia at the time of the Edict of Potsdam in 1685. Urban Huguenot colonies which were founded after 1685 are marked by a cross. Source: Own illustration; see main text for details.

Figure 2: Towns with textile manufactories in Prussia, 1802



The Map shows the Prussian territory which was included in the survey in 1802. Spotted areas are excluded from our analysis. Towns with at least one textile manufactory are marked with a circle. Urban Huguenot colonies which were founded after 1685 are marked by a cross. Source: Own illustration; see main text for details.

Table 1: Descriptive Statistics

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|------------------------------------|--------|-----------|--------|--------|-----|
| (ln) Output per Worker | 5.032 | 0.849 | 1.951 | 7.536 | 693 |
| (ln) Value of Materials per Worker | 4.47 | 0.947 | 0.887 | 7.271 | 693 |
| (ln) Looms per Worker | -1.146 | 1.296 | -7.005 | 0.560 | 693 |
| (ln) Workers | 2.963 | 1.684 | 0 | 8.534 | 693 |
| % Huguenots 1700 | 0.011 | 0.044 | 0 | 0.28 | 693 |
| % Huguenots 1720 | 0.009 | 0.029 | 0 | 0.151 | 693 |
| % Huguenots 1795 | 0.005 | 0.016 | 0 | 0.129 | 693 |
| (ln) Huguenots in textiles 1700 | 0.425 | 1.248 | 0 | 6.047 | 693 |
| (ln) Town Population 1802 | 7.991 | 0.996 | 5.746 | 11.939 | 693 |
| Merino sheep p.c. 1816 (county) | 0.068 | 0.111 | 0 | 0.847 | 693 |
| % Protestant | 0.751 | 0.295 | 0.02 | 0.999 | 693 |
| Not Prussia in 1720 (dummy) | 0.348 | 0.477 | 0 | 1 | 693 |
| Pop losses in 30 Years' War | 0.524 | 0.33 | -0.591 | 0.925 | 186 |

Source: Data for textile manufactories taken from [Krug \(1805\)](#), Huguenot data taken from [Muret \(1885\)](#) and [GStA PK \(1720\)](#), all other data taken from [Mützell \(1823-1825\)](#), except for Pop losses in 30 Years' War (see [Appendix C](#) for sources and construction of this variable). Missing data in the variable Value of Materials per worker are imputed (see [Appendix B](#) for methodology). Output and Value of Materials are measured in Prussian Thalers from 1802.

Table 2: Huguenot Population and Productivity in Textile Manufactories in Prussia, 1802

| DepVar: (ln) Output per Worker | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| % Huguenots 1700 | 2.884*** (0.666) | 1.390*** (0.082) | 1.351*** (0.153) | 1.348*** (0.161) | | | |
| % Huguenots 1720 | | | | | 1.795*** (0.606) | | |
| % Huguenots 1795 | | | | | | 1.347 (0.916) | |
| (ln) Huguenots in textiles 1700 | | | | | | | 0.044** (0.019) |
| (ln) Value of Materials per Worker | | 0.800*** (0.021) | 0.799*** (0.022) | 0.799*** (0.022) | 0.799*** (0.022) | 0.801*** (0.022) | 0.798*** (0.022) |
| (ln) Looms per Worker | | 0.062*** (0.014) | 0.064*** (0.015) | 0.064*** (0.015) | 0.063*** (0.015) | 0.068*** (0.016) | 0.066*** (0.015) |
| Not using looms (dummy) | | 0.231*** (0.039) | 0.233*** (0.040) | 0.233*** (0.040) | 0.232*** (0.040) | 0.233*** (0.040) | 0.235*** (0.040) |
| (ln) Town Population 1802 | | | 0.004 (0.015) | 0.004 (0.016) | 0.006 (0.016) | 0.026 (0.021) | -0.002 (0.020) |
| Merino sheep p.c. 1816 (county) | | | 0.091 (0.186) | 0.092 (0.190) | 0.085 (0.190) | 0.087 (0.191) | 0.076 (0.190) |
| % Protestant | | | | -0.002 (0.077) | 0.005 (0.077) | -0.026 (0.078) | 0.012 (0.078) |
| Not Prussia in 1720 (dummy) | | | | 0.002 (0.044) | -0.002 (0.045) | 0.025 (0.045) | -0.007 (0.046) |
| Dummy for imputed values | | 0.013 (0.035) | 0.011 (0.036) | 0.011 (0.037) | -0.004 (0.038) | -0.004 (0.039) | 0.006 (0.038) |
| Constant | 5.001*** (0.041) | 1.444*** (0.109) | 1.409*** (0.141) | 1.409*** (0.140) | 1.395*** (0.144) | 1.248*** (0.157) | 1.457*** (0.160) |
| Observations | 693 | 693 | 693 | 693 | 693 | 693 | 693 |
| R-squared | 0.02 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |

Notes: Table shows OLS estimates at the firm level. Standard errors, clustered at the town level, in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1. See main text for data sources and details.

Table 3: Huguenot Population and Productivity in Different Textile Manufactories

| DepVar: (ln) Output per Worker | Wool (1) | Linen (2) | Cotton (3) | Silk (4) |
|------------------------------------|---------------------|---------------------|---------------------|---------------------|
| % Huguenots 1700 | 0.801*** (0.200) | 2.816*** (0.384) | 1.725** (0.715) | 1.845*** (0.476) |
| (ln) Value of Materials per Worker | 0.819*** (0.028) | 0.765*** (0.041) | 0.737*** (0.132) | 0.841*** (0.020) |
| (ln) Looms per Worker | 0.086*** (0.016) | 0.019 (0.077) | -0.009 (0.124) | 0.514*** (0.066) |
| Not using looms (dummy) | 0.253*** (0.039) | 0.147 (0.340) | 0.106 (0.741) | 1.301*** (0.145) |
| Constant | 1.079*** (0.161) | 1.730*** (0.348) | 2.646** (1.006) | 1.895*** (0.611) |
| Observations | 521 | 123 | 27 | 22 |
| R-squared | 0.84 | 0.88 | 0.89 | 0.99 |

Notes: Table shows OLS estimates at the firm level. Standard errors, clustered at the town level, in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Additional controls: Town population 1802, Sheep per capita, Share of Protestants, Dummy if not Prussia 1720, and a Dummy for imputed values. See main text for data sources and details.

Table 4: Huguenot Population and Productivity in Different non-Textile Manufactories

| | (1) | (2) | (3) | (4) | (5) | (6) |
|------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|
| DepVar: (ln) Output per Worker | Non-textile | Leather | Metal | Tobacco | Flour mills | Paper mills |
| % Huguenots 1700 | 0.289 (0.335) | -0.597 (0.603) | -0.706 (0.732) | 0.008 (0.337) | 0.971 (1.858) | 14.581*** (2.865) |
| (ln) Value of Materials per Worker | 0.812*** (0.019) | 0.826*** (0.023) | 0.826*** (0.038) | 0.840*** (0.074) | 0.839*** (0.058) | 0.742*** (0.134) |
| Constant | 1.835*** (0.188) | 1.492*** (0.198) | 1.472*** (0.335) | 1.398** (0.537) | 1.393*** (0.447) | 2.211* (1.241) |
| Observations | 695 | 371 | 80 | 43 | 32 | 21 |
| R-squared | 0.89 | 0.89 | 0.95 | 0.89 | 0.96 | 0.84 |
| | (7) | (8) | (9) | (10) | (11) | (12) |
| DepVar: (ln) Output per Worker | Soap | Powder | Sugar | Wax | Vinegar | Misc. |
| % Huguenots 1700 | 3.996*** (0.662) | 3.708 (2.355) | 1.257 (1.281) | -0.482 (1.055) | 11.077 (11.605) | -0.333 (0.615) |
| (ln) Value of Materials per Worker | 0.744*** (0.062) | 0.876*** (0.046) | 0.154 (0.208) | 0.968** (0.323) | 0.866*** (0.052) | 0.592*** (0.108) |
| Constant | 2.910*** (0.658) | 1.772** (0.708) | 8.478*** (2.341) | -0.030 (2.295) | 6.330 (3.775) | 3.496*** (0.603) |
| Observations | 21 | 20 | 10 | 10 | 9 | 78 |
| R-squared | 0.96 | 0.99 | 0.79 | 0.94 | 1.00 | 0.72 |

Notes: Table shows OLS estimates at the firm level. Standard errors, clustered at the town level, in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Additional controls: Town population 1802, Sheep per capita, Share of Protestants, Dummy if not Prussia 1720, and a Dummy for imputed values. See main text for data sources and details.

Table 5: Instrumenting Huguenot Settlement with Population Losses during the Thirty Years' War

| DepVar: | OLS | | | IV | | | |
|--|------------------------|---------------------|---------------------|----------------------|---------------------------|------------------------------------|---------------------------|
| | (ln) Output per Worker | | | % Huguenots 1700 | (ln) Output per worker | (ln) Huguenots in textiles 1700 | (ln) Output per worker |
| | Large Sample (1) | Small Sample (2) | Reduced Form (3) | 1st Stage (4) | 2nd stage (5) | 1st Stage (6) | 2nd stage (7) |
| % Huguenots 1700 | 1.318*** (0.204) | 1.526*** (0.298) | | | 1.775** (0.882) | | |
| (ln) Huguenots in textiles 1700 | | | | | | | 0.077** (0.037) |
| Pop losses in 30 Years' War | | | 0.179* (0.096) | 0.101** (0.042) | | 2.321*** (0.592) | |
| (ln) Value of Materials per Worker | 0.799*** (0.022) | 0.791*** (0.039) | 0.791*** (0.041) | -0.000 (0.004) | 0.791*** (0.038) | 0.078 (0.125) | 0.785*** (0.036) |
| (ln) Looms per Worker | 0.064*** (0.015) | 0.111*** (0.029) | 0.129*** (0.030) | 0.012** (0.006) | 0.108*** (0.029) | 0.110 (0.143) | 0.121*** (0.024) |
| Not using looms (dummy) | 0.234*** (0.040) | 0.362*** (0.070) | 0.391*** (0.074) | 0.019* (0.010) | 0.358*** (0.069) | 0.396** (0.192) | 0.361*** (0.068) |
| Relevant textile production before 1685 (dummy) | 0.011 (0.048) | 0.147* (0.076) | 0.145* (0.082) | 0.002 (0.020) | 0.141* (0.076) | -0.369 (0.367) | 0.174** (0.079) |
| Constant | 1.414*** (0.143) | 1.954*** (0.498) | 1.284*** (0.478) | -0.448*** (0.158) | 2.081*** (0.629) | -15.131*** (2.465) | 2.454*** (0.884) |
| Observations | 693 | 186 | 186 | 186 | 186 | 186 | 186 |
| R-squared | 0.84 | 0.89 | 0.88 | 0.61 | 0.89 | 0.75 | 0.89 |
| Kleibergen-Paap rk Wald F statistic | | | | | 5.747 | | 15.38 |

Notes: Columns 1-3 show OLS estimates at the firm level. Columns 4-7 show the first and second stage estimates of an IV approach where population losses in the Thirty Years' War serve as an instrument. Columns 2-7 show estimates in a smaller sample for which the instrument was available. Standard errors, clustered at the town level, in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1. Additional controls: Town population 1802, Sheep per capita, Share of Protestants, Dummy if not Prussia 1720, and a Dummy for imputed values. See main text for data sources and details.

Appendix A The Edict of Potsdam

Article 3

German original

Weilen Unsere Lande nicht allein mit allen zu des Lebens Unterhalt erfordernten Nothwendigkeiten wol und reichlich versehen, sondern auch zu établiung allerhand Manufacturen, Handel und Wandels zu Wasser und zu Lande sehr bequem, als stellen Wir denen, die darinn sich werden setzen wollen, allerdings frey, denjenigen Ort, welchen sie in Unserm Herzogthum Cleve, den Graffschafften Marck und Ravensberg, Fürstenthümern Halberstadt und Minden, oder auch in dem Herzogthum Magdeburg, Chur-Marck-Brandenburg und Herzogthümern Pommern und Preussen zu ihrer Profesion und Lebens Art am bequemsten finden werden, zu erwählen; Und gleichwie Wir dafür halten daß in gedachter Unserer Chur-Marck-Brandenburg die Städte Stendal, Werben, Rathenow, Brandenburg und Franckfurt und in dem Herzogthum Magdeburg die Städte Magdeburg, Halle und Calbe, wie auch in Preußen die Stadt Königsberg, so wol deßhalb weil daselbst sehr wolfeil zu leben als auch wegen der allda sich befindenden facilität zur Nahrung und Gewerb vor sie am bequemsten seyn werden Als haben Wir die Anstalt machen lassen befehlen auch hiemit und Krafft dieses so bald einige von erwehnten Evangelisch-Reformierten Französischen Leuten daselbst ankommen werden daß alßdan dieselben wol auffgenommen und zu allemdem so zu ihrem établisement nöthig ihnen aller Möglichkeit nach verholffen werden soll.

English translation

Because our country is convenient with everything one needs for a living and for establishment of manufactories, trade and commerce by water and land we make available for those who want to settle at whichever place they find in Our Duchy of Cleves, the Counties of Mark and Ravensberg, Principalities of Halberstadt and Minden or in the Duchy of Magdeburg, the Margraviate of Brandenburg and the Duchies of Pomerania and Prussia convenient for their profession and lifestyle; Although we recommend the cities Stendal, Werben, Rathenow, Brandenburg and Frankfurt in Our Margraviate of Brandenburg, Magdeburg, Halle and Calbe in the Duchy of Magdeburg, as well as the city of Königsberg in Prussia because they are most comfortable to live in as well as there is enough facility for food and craft and We already ordered and hereby command that as soon as some of the mentioned evangelic-reformed French people arrive, that they shall be accommodated and given everything needed and possible for their establishment (Source: Own translation).

Appendix B Imputation

Historical records often suffer from missing data for reasons unknown and irreparable. The data used in this work was taken from the “Register of Factories in the Prussian State” conducted by the Prussian Royal Secret Filing Department in 1802 (Krug, 1805). The information was collected by inspectors who regularly surveyed all manufactories in their area of responsibility and had to send in standardized and printed tables with the requested information on type, location, workers, and prices of inputs and outputs. The only category we use in our empirical analysis which also has missing data is the value of raw materials, where missings amount to 14 percent. While the mechanism generating the missing data is unknown, we are able to observe a geographical pattern. Almost every province is missing few (2-5) observations, the exception being the provinces *Kurmark* and *Littauensches Department*, where all observations are missing. We assume that the assigned inspectors simply did not collect or report this information. This would imply that the values of the missing observations are not dependent on the value of the variable itself but on the location. Dropping all observations with missing data would reduce the sample size severely and introduce bias if the remaining observations are not representative of the full population of interest. This makes imputational methods the first choice to address the problem (Rubin, 1987; Little and Rubin, 2002).

We impute the missing data using univariate multiple imputation methods for continuous variables, integrated in Stata 11 (StataCorp, 2009). To attain a complete dataset, we impute missing data in the explanatory variable “Value of Materials” with all other variables used for the extensive regression in Column 5 of Table 2, the value of outputs, the number of workers, the number of looms, the share of Huguenots, the town population, sheep per capita, the share of Protestants and a dummy for towns not belonging to Prussia before 1720.

Since the process that generated the missing values is unknown, the probability to have a missing value might depend on unobserved characteristics not included in the imputation. These unobservables again might influence output of the manufactory systematically. In such a case we would predict identical values for manufactories with identical observed but possibly different unobserved characteristics and bias the estimates in an unknown direction.

To make sure our estimates are not driven by imputed data, which might be driven by unobserved characteristics we include an imputation dummy in all of our regressions. The dummy becomes 1 if data were originally missing for the

observation.

Appendix C Construction of the Instrument

We have compiled a database for population losses during the Thirty Years' War for those towns with textile manufactories in 1802. The data were assembled from three different sources, each providing a consistent overview over a certain area.

The most extensive source is the *Deutsches Städtebuch* (Handbook of German Towns) by [Keyser \(1939-1941\)](#). The compendium provides information for all German towns and includes data on population for various points in time. To calculate the population losses during the war period we need to have population data for the years 1625 and 1652, which are the breaks also used in other sources ([Wohlfeil, 1976](#)). Unfortunately, information about town population for the period in question is very rare and data for these exact years is even more scarce.

When available, we used data as close as possible to said years and interpolated them to match the beginning and the end of the war. The earliest date being 1550 and the latest date being 1685. The interpolation was undertaken using population growth rates for Germany calculated in [Pfister \(2007\)](#).

Table C-1: Population Growth in Germany (1914).

| Period | Growth Rate |
|-----------|-------------|
| 1541-1550 | 7.2 |
| 1551-1560 | 7.1 |
| 1561-1570 | 5.8 |
| 1571-1580 | 4.6 |
| 1581-1590 | 4.1 |
| 1691-1600 | 3.2 |
| 1601-1625 | 3.2 |
| 1626-1650 | -13.4 |
| 1651-1700 | 8-10 |

Growth rate in per mil calculated after [Pfister \(2007, p.10\)](#)

Example: If a town had a population of 1000 in the year 1600 we use the growth rates to estimate a population of 1080 in 1625. If the population had reached 700 in 1660 we estimate a population of 650 in 1652. The population loss would thus be 40%, instead of 30% if do not interpolate.

We only included towns if information on the number of residents, households, fireplaces or citizen was available before and after the war. Finally we used only those pieces of information where the unit of observation was the same for both

dates. Cases which, for example, reported the the number of houses in a town before the war and the number of fireplaces after the war, were excluded. Comparability between towns with different units of observation is granted since we calculated growth rates. A total of 57 towns matched the criteria for inclusion.

The second source is a map by [Wohlfeil \(1976\)](#) showing the percentage of population losses in towns during the Thirty Years' War in the Margraviate of Brandenburg between 1625 and 1652/53. A total of 46 towns matched the criteria for inclusion.

The third source is a population table for towns in the *Kurmark* and the *Neumark* before and after the Thirty Years' War, published in [Behre \(1905\)](#). Here the number of residents is given for 1625 and 1645. A total of 37 towns matched the criteria for inclusion.

In total we gathered information for a total of 71 different towns for which we also had data on textile manufactories and Huguenot immigration. If information for the same town was available from different sources we calculated the mean to level possible overstatements.