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RURAL TRANSFORMATION, INEQUALITY, AND THE ORIGINS OF MICROFINANCE

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Abstract

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JEL Classification: G21, N23, O16, Q15

Keywords: Microfinance, credit cooperatives, rural transformation, Land Inequality, Prussia

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Rural transformation, Inequality, and the Origins of Microfinance[1]

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1 Introduction

An influential literature stresses the role of finance for growth (King and Levine, 1993; Guiso et al., 2004; Lehmannn-Hasemeyer and Wahl, 2017; Heblich and Trew, 2018). However, we know little about the factors that originally gave rise to differences in financial development, and we know even less about the determinants of financial development over time.[2] Weak financial development is a particular concern in developing countries, especially in rural regions, where large segments of the population are unbanked, and access to financial services could potentially bring the greatest benefit (Burgess and Pande, 2005).

In this paper, we explain the rise and spread of micro finance institutions (MFIs), which are often seen as key institutions in providing financial services to rural areas (Armendariz and Morduch, 2010). Modern data show strikingly large differences in the spread of microfinance even within the same country.[3] Only a relatively small literature has attempted to explain this differential spread of small scale credit institutions across time and space

[2] When attention to the origins of financial development is paid, the aforementioned literature often focuses on one time-invariant factor that can be used to instrument financial development.

[3] In India, for example, calculations on MIX Market data reveal the number of rural inhabitants per microfinance access point to differ substantially between districts. By this definition, outreach differs on average by a factor of 25 between the district with maximum and minimum coverage within the same state.

(Rajan and Ramcharan, 2011; Ahlin et al., 2011; Vanroose, 2016; Colvin et al., 2018; Jaremski and Fishback, 2018). Although these contributions have added insight on the importance of individual variables, the choice of explanatory variables is often not informed by theory, and it is unclear how important individual variables are relative to each other.[4] Another fundamental challenge is simultaneity bias: MFI performance or market entry are observed at the same time as many of the explanatory variables, impeding causal inference. Moreover, as the universe of MFIs is rarely observable, and sampling is usually performed according to the quality of MFI records, selection bias may loom large. Finally, many studies performing tests on modern data pool MFIs operating under different ownership structures, regulatory frameworks, and subsidy schemes (Morduch, 1999). Yet how would micro finance develop without public ownership, subsidization, and under a minimal regulatory environment?

We present what we believe to be as close as possible to such a free market benchmark scenario: the rapid rise and spread of credit cooperatives in 19th century rural Germany. These cooperatives provided small scale savings and loan services to previously unbanked populations. Crucially, they were owned by their members, did not receive subsidies, and were subject to a minimal regulatory framework, the changes in which we can control for (Guinnane, 2003). Moreover, because we observe the *de novo* creation of an entire system of microcredit, we observe most of our independent variables before the appearance of MFIs. This mitigates simultaneity bias. We further strengthen the causality of our arguments by using a range of instrumental variables.

Geographically, we focus on the eastern periphery of Germany before World War I, a setting that has a number of desirable features for our analysis. Its population was comparatively poor, rural, had restricted access to the emerging banking system of the time, and was marked by ethnic and economic inequality. Credit cooperatives thrived in this setting, being among the very first institutions world-wide to develop the principle of small-scale joint liability lending. As such, they influenced the development of micro finance in contemporary developing countries (Armendariz and Morduch, 2010). The microeconomic mechanisms that enabled credit cooperatives to successfully provide small-scale credit has also been the focus of extensive research (Banerjee et al., 1994; Ghatak and Guinnane, 1999; Guinnane, 2001). We are able to build on these contributions to formulate a simple model of the emergence of credit cooperatives.

The basic argument in this theoretical framework is as follows. Faced with a decline in the relative prices of agricultural staples, grain farmers have an incentive to switch to

[4] An exception to the latter point is Ahlin et al. (2011), who do comprehensively consider the dynamic macroeconomic context in which MFIs expand.

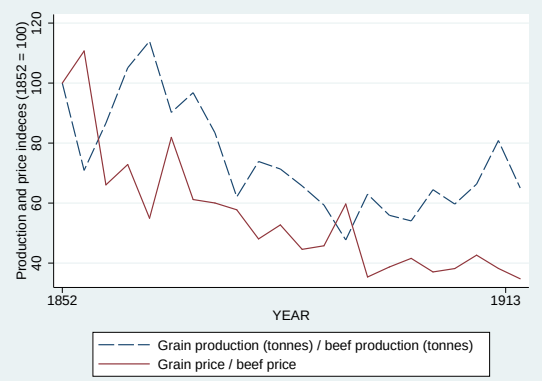
goods whose relative prices are rising (figure 1a and 1b). Switching production requires capital, but farmers are credit-constrained in the sense that they cannot access bank loans unless their private assets exceed a certain threshold. The possibility of pooling assets then provides the incentive to form credit cooperatives. Over time, therefore, the development of rural credit institutions will be determined by the relative output prices of agricultural goods (figure 1c). However, the emergence of cooperatives is constrained by their cost of capital, which decreases in group size and members' assets, but increases in members' ethno-linguistic heterogeneity, the bank lending rate, and economic inequality.[5] Variation in these factors essentially determines the regional spread of microfinance institutions.

We test these predictions using a newly collected data set containing the universe of 4,941 credit cooperatives in the six eastern provinces of the Kingdom of Prussia, which was the largest state of the German Empire at that time. We use this data to construct a panel of 236 eastern Prussian counties, where the number of credit cooperatives entering the market per year at the county level is our main dependent variable.[6] Our analysis spans the entire period from the founding of the first credit cooperative in 1852 until 1913, the last year before the War. The results strongly support the predictions of the model: credit cooperatives are more likely to be founded in regions marked by large farms sizes and commercial banking infrastructure, and less likely to emerge where the land distribution is unequal. Over time, interest rates and relative grain prices are strong predictors of the development of the small scale credit sector. These results are robust to controlling for a wide range of variables, checking for simultaneity bias, and utilizing instrumental variable procedures. Finally, we show how our parsimonious set of predictors successfully explains a large share of the variation in cooperative credit institutions in both the cross section and time dimension.

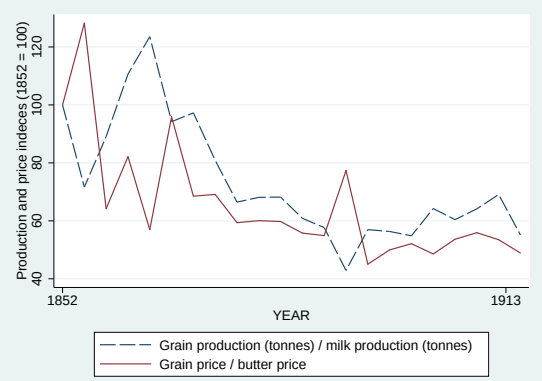
We link the decline in relative grain prices we observe in the data to an influential literature stressing the role of income effects in the process of structural transformation (Kongsamut et al., 2001; Timmer, 2007; Herrendorf et al., 2014). This literature often shows how non-homothetic consumer preferences lead to a decline in the relative demand for agricultural staples as consumer incomes rise (Engel's Law). Moreover, in an open economy, the price of staples, which are to a higher degree tradeable, is also influenced by (potentially lower) world market prices. Declining relative demand and import competition thus lead to a decline in the relative price of basic agricultural goods against capital-intensive goods. This provides an incentive to exit agriculture, thus shifting labor into

[5] Once the number of cooperatives in a region is allowed to exceed 1, the prediction for ethno-linguistic heterogeneity is theoretically ambiguous, as heterogeneity can make it advantageous to split cooperatives according to ethnicity.

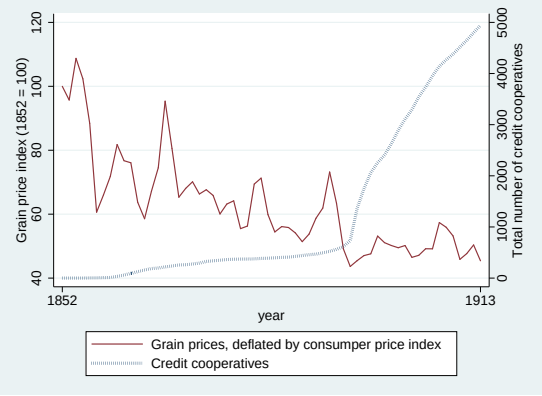
[6] We also have access to detailed balance sheet data for a small group of cooperatives.



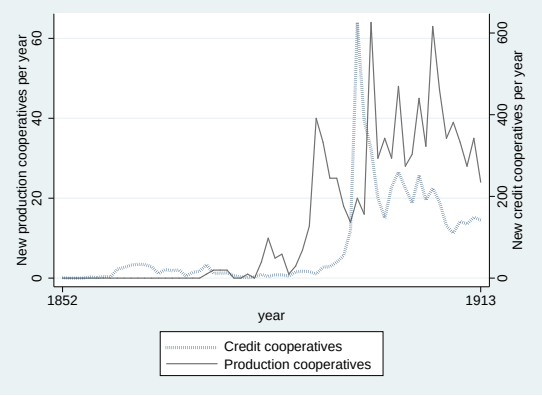
(a) Relative prices and production of grain and meat



(b) Relative prices and production of grain and milk



(c) Relative grain prices and credit cooperatives



(d) Credit and production cooperatives, changes

Figure 1: Rural transformation in Prussia, 1852-1913. Six eastern provinces, grain refers to rye and wheat, weighted by their initial land shares. Source: production data from v. Finckenstein (1960), other sources see text. Calculations: authors.

capital-intensive sectors (Uy et al., 2013; Teignier, 2018). We stress that a similar process was at work *within* 19th century agriculture. Declining prices for staple grains led farmers to exit that sector in favor of more capital-intensive meat and dairy production, a process we term "rural transformation". Apart from showing that relative grain prices crucially determined the creation of credit cooperatives, we provide suggestive quantitative evidence that these cooperatives indeed aided rural transformation. They did so by helping to set up production cooperatives that produced more capital-intensive agricultural products such as milk and meat (figure 1d). This conclusion is further supported by our examination of the Prussian cattle statistics. Such a mechanism is in line with the observations of qualitative economic historians (Kindleberger, 1951), but has to the best of our knowledge not been

empirically investigated. As such, we provide a novel perspective that focuses on the role of MFIs in aiding transformation in developing rural regions.

Our paper is also related to a long-standing debate in the micro finance literature regarding the existence of a tradeoff between outreach and financial sustainability of MFIs (Hermes et al., 2018; Cull et al., 2007). This literature focuses on the role of subsidies or regulation in affecting outreach and survival probability. While our measure of market entry of credit cooperatives is informative with regard to notions of outreach, we do not have anything to say about the survival of our cooperatives. This is both a feature of our data, as we do not observe failing institutions, and a feature of our historical setting: credit cooperatives in 19th century Germany had negligible failure rates (Banerjee et al., 1994). While this is an important caveat, it also provides us with a attractive empirical setting, as attrition is ruled out.

A further theme that is connected to our work is the market structure of the small-scale finance industry. In particular, the literature has analysed the interactions of micro-lenders and banks on market outcomes (Cull et al., 2014; Périlleux et al., 2016). We offer evidence to show that the relationship between both types of institutions is complementary, at least at the point of MFI entry. Intimately related to this is a strand of the literature that empirically analyzes the determinants of institutional features of MFIs, such as the liability structure (Banerjee et al., 1994; de Quidt et al., 2018). We primarily focus on the determinants of MFI entry over space and time, rather than focusing on its institutional structure. We do, however, show that changes in nation-wide liability laws had a large effect on market entry decisions.

A final strand of literature we contribute to analyzes the effects of ethnic and economic heterogeneity on the participation in clubs. In a pioneering paper, Alesina and La Ferrara (2000) show that high levels of ethnic and income inequality are empirically associated with lower participation in social clubs in US cities, with ethnic heterogeneity being the most important driver. Similarly, La Ferrara (2002) finds that an unequal distribution of assets decreases club participation in Tanzanian villages, while Barr et al. (2015) find economic inequalities and ethnicity did not significantly affect the formation of community-based organizations in Zimbabwean villages. Similar arguments have been made less formally for the formation of production cooperatives in industrializing Europe. For example, O'Rourke (2007) argues that ethno-confessional fragmentation and an unequal distribution of land was decisive in holding back dairy cooperatives in Ireland. Fernandez (2014) finds some evidence that land inequality decreased the output produced by production cooperatives in Europe before the Second World War. Similarly to Alesina

and La Ferrara (2000) and La Ferrara (2002) we model the formation of clubs, but we do this specifically for credit cooperatives, rather than social clubs. Furthermore, we stress that the formation of these clubs cannot be understood by solely looking at time-invariant heterogeneity, but that *changes* in economic conditions are key drivers of club formation.

The remainder of the paper is structured as follows. Section 2 introduces our conceptual framework, while section 3 outlines how we take the predictions of that framework to the data. Section 4 analyzes the results, and provides an assessment as to the relative importance of individual determinants of the growth of microcredit institutions. The final section concludes.

2 Conceptual framework

We model one region populated by N small agricultural producers. Producers are identical, with the exception of speaking different languages A, B so that $N_A + N_B = N$.[7] Producers choose between producing two goods: a land-intensive agricultural staple 'grain' and a capital-intensive output which we refer to as 'dairy' . Initially, farmers produce the agricultural staple only. For simplicity, we assume that each good uses only one specific factor of production:

$$\begin{aligned} Y_g &= Z^{\alpha} \\ Y_d &= K^{\beta} \end{aligned} \tag{1}$$

where Z are land inputs and K capital inputs.[8] Being small, each producer maximizes profits given both output prices $\{P_g,\ P_d\}$ and input prices for land and capital $\{x,\ r\}$. Total profits are:

$$\begin{aligned} \Pi &= \pi_g + \pi_d \\ \pi_g &= P_g Z^{\alpha} - xZ \\ \pi_d &= P_d K^{\beta} - rK \end{aligned} \tag{2}$$

[7] We further relax the assumption of identical producers below by allowing for asset inequalities.

[8] The assumption of specific factors eases the exposition of the model, but the results would carry through if we allowed capital to be mobile between sectors, as long as the production of the 'dairy' good is more capital intensive. This would echo the Hansen-Prescott approach to Unified Growth Theory, which seeks to model the structural transformation from an agricultural Malthusian to an industrial Solovian economy (Hansen and Prescott, 2002).

2.1 Cooperatives and the cost of capital

We are primarily interested in the procurement of capital. Farmers can receive a loan for the capital K that maximises profits π_d from a conventional bank at the rate of r_b against their private collateral q. However, we assume that banks are only willing to lend at the rate r_b if a borrower's collateral exceeds a certain threshold: $q \geq q_T$. This may reflect the fact that banks possess limited information on borrower quality, or face fixed monitoring costs, which makes dealing with lowly collaterized individuals unprofitable (Ghosh et al., 2000). The implication of this market imperfection will be that some farmers are credit constrained by a lack of collateral (Karlan and Morduch, 2009).

Producers for whom $q < q_T$ can overcome their lack of private collateral by pooling assets with other producers (Banerjee et al., 1994). Allowing $N_c \leq N$ farmers to join such a cooperative, the cooperative's total assets are then $Q = qN_c$.[9] We assume that the cost of capital r_c to each producer inside the cooperative decreases in both q and N_c. There are three motivations for this scale effect. Firstly, the cooperative may act as both a credit and savings institution, and extend loans to members primarily on internal deposits. In this case, increasing cooperative size may reduce the likelihood of negative shocks to individual members' assets (Guinnane, 1997). Secondly, pooled assets can be used by the cooperative as collateral against which to obtain loans from banks or other financial institutions. Assuming that bank rates are inversely proportional to the amount of collateral provided, pooling will lower the rate obtained. Moreover, given joint liability systems under which members guarantee loans reciprocally, more guarantors implies a higher likelihood that loans will be paid back (which may also improve access to third party financing) (Ahlin, 2015). Therefore, q and N can be thought of as substitutes: cooperatives can be smaller in wealthier regions where deposits are high, but large group sizes are required if average deposits are small.

However, the cooperative is only able to fulfill these functions if it has access to either local information on its members (Guinnane, 2001) or to an enforcement mechanism, such as joint liability lending (Ghatak and Guinnane, 1999). Both may be hampered by existing ethno-linguistic, religious or other cultural differences in the population.[10] In our model, we focus on the extent to which gathering information on and monitoring members is more difficult in the presence of communication costs (Guinnane, 2001), which are likely to run

[9] In practice, roughly a third of cooperative loans were directly collateralized (by land), whereas much of the remainder was guaranteed by co-signers, who had to pledge land or other property, the value of which sometimes exceeded the amount of the loan. See historical appendix G, section G.4.

[10] Ghatak and Guinnane (1999, p. 196) refer to this as "(...) the general idea that people with connections of shared locality or other *bonds based on kinship* and occupation may be able to support credit contracts that would be impossible with conventional banking practices." (emphasis added)

along ethno-linguistic lines.[11] We therefore assume r_c to be increasing in a cooperative's ethno-linguistic heterogeneity H_c, defined as:

$$H_c = 1 - \left| \frac{N_{A,c}}{N_c} - \frac{N_{B,c}}{N_c} \right| \tag{3}$$

where $N_{A,c}$ is the number of club members that belong to ethno-linguistic group A. Note that $0 \leq H_c \leq 1$ by this definition. In sum, therefore, we have for the cost of capital in the credit cooperative:

$$r_c = f(q, N_c, H_c) \tag{4}$$

where $f_q(.) < 0$, $f_N(.) < 0$, $f_H(.) > 0$.

The cost of capital each producer faces is a decreasing function of private assets or collateral q, which by virtue of assumption is identical to the club's average collateral. The remainder of r_c is determined by the the characteristics of the cooperative: the benefits of group size, and the costs of heterogeneity.

2.2 Cooperatives and rural transformation

We now impose some structure on the determinants of r_c. One possible reformulation of equation 4 is as follows:

$$r_c = r_b + \frac{1}{\delta q N_c} + H_c \quad \forall \quad q < q_T \tag{5}$$

where $0 < \delta \leq 1$ is the degree to which a cooperative's total assets qN_c decrease capital costs. This explicit formulation is attractive for two reasons. Firstly, the parameter δ can reflect institutional factors such as the liability structure the co-op chooses, which may be dependent on the legal framework (Banerjee et al., 1994). Changes in the legal framework would therefore influence the cost of capital of all cooperatives through this parameter. Secondly, equation 5 embodies the idea that at the limit, if cooperative membership is homogenous ($H_c = 0$), the cost of capital approaches the bank rate as club size N_c becomes very large.[12]

[11] Alternatively, one could think of social capital Karlan (2007) being smaller between members of different ethno-linguistic groups.

[12] Using micro-data on 135 credit cooperatives for which balance sheet information is available from police records (Polizei Präsidium Posen, 1909), we have also tested whether the relationships implied in equation 5 hold empirically. The results show a negative, though not always statistically significant, relationship between the cost of capital at the co-op level and capital stock per member, as well as between the cost of capital and the total number of members. We do not observe heterogeneity at the co-op level, nor bank rates in this particular data set.

What factors will determine the emergence of cooperatives? Farmers for whom $q < q_T$ will found a credit cooperative to enter capital intensive production and exit grain production if $\pi_d \geq \pi_g$. Substituting 5 into 2 yields:

$$P_d K^{\beta} - (r_b + \frac{1}{\delta q N_c} + H_c)K \geq P_g Z^{\alpha} - xZ \tag{6}$$

Under the (temporary) assumption that only one cooperative can be founded, the region's demographics will mirror cooperative membership in equation 6 ($N = N_c$, $H = H_c$).[13] Simple comparative statics then indicate that:

PROPOSITION 1

1. A decline in relative grain prices (P_g/P_d) shifts resources to the capital-intensive sector and will therefore lead to an increase in demand for cooperative credit. This mechanism is reflected in the pattern in figures 1 in the introduction, and predicts an important role for cooperatives in driving rural transformation.

2. A decrease in bank interest rates r_b or an increase in the pool of members N_c increases the likelihood of cooperatives being founded.

3. Low levels of private assets q will prevent farmers from assembling enough assets in a cooperative. Cooperatives are therefore more likely to appear in wealthier regions.[14] However, this is only true as long as $q < q_T$, as otherwise producers would turn to bank rather than cooperative credit. In sum, we would expect a hump-shaped relationship between q and co-op emergence.

2.3 Heterogeneity and endogenous number of co-ops

According to equation 6, a very heterogeneous population can prohibit the shift to Y_d and deter cooperative formation. This prediction would be in line with the results of the empirical literature stressing the difficulties of cooperatives to form in heterogeneous societies (O'Rourke, 2007). However, as the theoretical literature on fragmentation and club participation (Alesina and La Ferrara, 2000) stresses, this prediction no longer holds once the

[13] H is the heterogeneity in the regional population, defined analogously to equation 3.

[14] Even today, collateral still features heavily in microfinance. For example, Banerjee et al. (2015) report that half of surveyed lenders requested some collateral from borrowers in modern settings, in some cases in contravention of lender's guidelines. Note that cooperatives in the 19th century also demanded a capital contribution from members. In our data, the minimum size of this contribution is 10 Mark, roughly equivalent to 2 weeks' wages for agricultural laborers in the poorer counties.

number of clubs is allowed to exceed 1. In this case, heterogeneity presents an incentive to segregate by ethnicity, which can lead to *more* clubs being founded. In particular, it can be shown that forming two (ethnically segregated) rather than one (ethnically mixed) cooperative lowers the cost of capital under certain conditions:

PROPOSITION 2

Founding two rather than one cooperative will minimize r_c if:

$$qH_N N > \frac{1}{\delta}$$

Therefore, the number of cooperatives can increase in regional population heterogeneity.

PROOF: Appendix

The interpretation is straightforward. The higher heterogeneity in the population, the more costly one mixed club becomes, and the more attractive it is to found two separate cooperatives. Differently from before, the number of cooperatives will now *increase* in population heterogeneity. The relationship between heterogeneity and the number of cooperatives is therefore theoretically ambiguous.

The other variables in Proposition 2 work in the same direction as in Proposition 1: the larger the population, the more viable two segregated (and therefore smaller) clubs will be. Finally, higher levels of collateral in a region will decrease the need for producers to pool resources, so two smaller segregated clubs are more efficient.

2.4 Inequality

We now allow private assets to differ within the region's population. For simplicity, we assume that individual assets follow a uniform distribution $q_i \sim U(\underline{q}, \overline{q})$. We let the mean of the distribution be equal to the regional mean used in the previous sections ($q = \frac{(\underline{q}+\overline{q})}{2}$). Given constant population N, this also implies that total assets in the region are unchanged. However, inequality can now affect co-op formation through its influence on a cooperative's assets, which can be expressed as:

$$Q = \int_{\underline{q}}^{\overline{q}} \left(\frac{N}{\overline{q} - \underline{q}} \right) dq - \int_{q_T}^{\overline{q}} \left(\frac{N}{\overline{q} - \underline{q}} \right) dq \tag{7}$$

Conditional on mean assets being below the threshold for bank financing, higher asset inequality implies an increasing $\overline{q}$ in equation 7. This increases the size of the second term, and thus decreases cooperative assets. As we know that co-op formation increases with co-op assets from Proposition 1, it follows that:

PROPOSITION 3

For constant mean assets, asset inequality decreases credit cooperative formation conditional on $q < q_T$.

Intuitively, inequality pushes a larger fraction of the population over the collateral barrier q_T required to obtain formal bank financing, and therefore decreases the total assets available for pooling to the remaining co-op members.[15] The effect of inequality will be even larger, if in addition, a minimum level of assets are required for participation due to mandatory capital contributions. If the mean q is held constant, an increasing $\overline{q}$ implies a falling $\underline{q}$, and therefore increases the fraction of the population who will not qualify for participating in the club.[16]

In summary then, we expect that credit cooperatives form in response to falling relative grain prices, as well as low bank interest rates. Moreover, we expect to find more credit cooperatives in regions with lower land inequality and higher private assets, although this latter relationship is likely to be hump-shaped. The relationship with ethno-linguistic heterogeneity is theoretically ambiguous.

3 Data and empirical strategy

3.1 Sample: Prussia's six eastern provinces

Our sample comprises the 236 counties that made up the six eastern provinces of the Kingdom of Prussia in the half-century before World War I. Figure 2a shows the location of these provinces within the Kingdom of Prussia, which from 1871 onward was part of the German Empire.[17] These six provinces are often grouped together on account of their

[15] This prediction is in line with La Ferrara (2002), who shows that rising asset inequality leads to less participation in clubs in developing countries, because the wealthy have less to gain from joining.

[16] For most of the analysis, we interpret higher inequality as implying a larger mass of assets in the upper tail of the distribution, although we do relax this interpretation to investigate the entire asset distribution in empirical section 2.

[17] Each province was subdivided into two or three districts (*Regierungsbezirke*), most of which encompassed between 12-20 counties. See table D.1 for the administrative divisions of Prussia.

geographic location east of the river Elbe, and their joint history as destinations of German settlement and military expansion since the High Middle Ages, thus forming a coherent sample for analysis.[18]

Geography and this settlement history resulted in the creation of large landed estates and a predominantly rural orientation of the economy that marked the six provinces well into the 20th century (Cinirella and Hornung, 2016). Even in 1883, 50% of arable land was devoted to growing staple grains. However, rural transformation was gathering pace from the mid-19th century onwards. Berlin, one of the fastest growing urban agglomerations of the time, was located within Brandenburg, the westernmost of the six provinces. Urban demand for foodstuffs, especially dairy, meats, vegetables and alcohols, was expanding (Burhop, 2011). By rural standards, these were capital-intensive sectors.[19] At the same time, the import competition from land-abundant grain producers in the New World was intensifying, as advances in shipping technology outpaced protectionist measures by German policy makers (Findlay and O'Rourke, 2009). The consequence of increasing relative demand for non-staple foods, and of import competition in grains, was the downwards trend in grain prices identified in Figure 1.

The medieval proliferation of landed estates in the six provinces had resulted in high levels of land-, and hence wealth inequality. Inequality had persisted despite the official liberation of the peasants in 1807 and despite the fact that many had become independent freeholders by the 1850s (Eddie, 2008).

Demographically, Prussia's eastern provinces were highly diverse. Some had been annexed by Prussia from the Polish Commonwealth in the late 18th century and therefore contained large Polish-speaking populations. Ethno-linguistic cleavages between Poles and Germans also largely correlated with religious divisions, with Poles being almost exclusively Catholic, and Germans predominantly Protestant.[20] Jews constituted a third religious group in some regions, although their mean share had fallen to below 1% by the outbreak of World War I due to emigration.

Finally, the six provinces witnessed an unprecedented boom in the foundation of credit cooperatives. Credit cooperatives originated in the early 1850s following the activities of two pioneers, Friedrich Wilhelm Raiffeisen and Hermann Schulze-Delitzsch in western re-

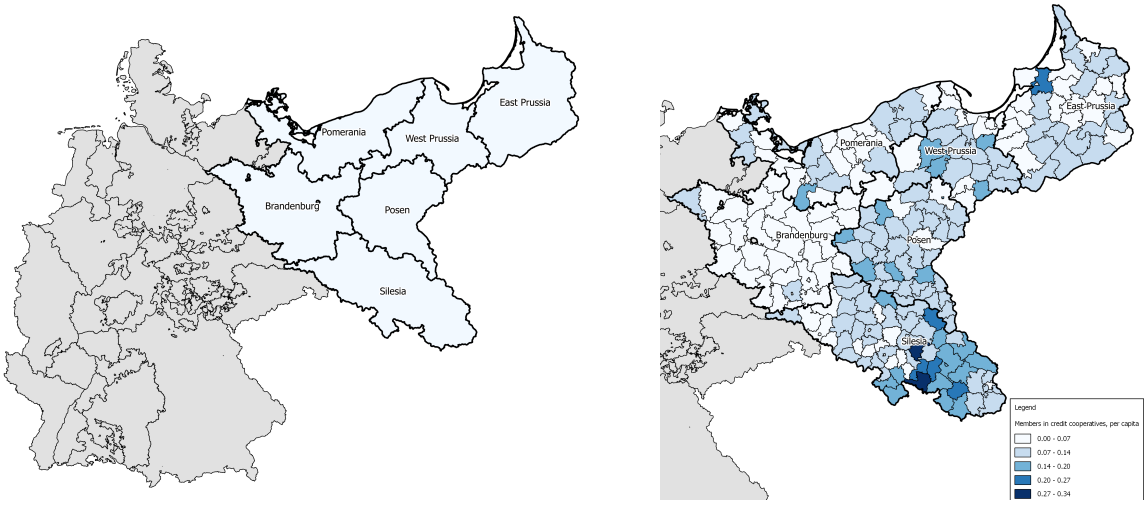
[18] In German historiography, these provinces are often jointly referred to as "East Elbia", a categorization that goes back to the writings of Max Weber (1892). See historical appendix, section G.1.

[19] O'Rourke (2007) mentions dairy creameries in Denmark requiring the milk of at least 400 cows to profitably operate technological innovations such as the cream separator. Procuring cattle was a significant expense for rural populations in Prussia too: In 1883, the price of a single head of beef cattle stood at roughly 187 Mark. Evaluated at the average rural wage rate, this translated into roughly 149 days of labor (See historical appendix, section G.2 for more information).

[20] The correlation between the share of Catholics and Polish speakers at the county level is 0.72.

gions of Germany.[21] While Schulze-Delitzsch focused on urban craftsmen, and Raiffeisen on rural populations, both emphasized the principle of joint-liability lending to overcome the credit constraints of previously unbanked populations (Faust, 1965b). Although membership was required to receive a loan from a credit cooperative, the capital contribution required for membership was relatively small and the co-ops savings facilities were often available for non-members too.(Banerjee et al., 1994) Membership was open to all by residents of a locality and locals constituted the majority of directors and officers of the co-op. As a cooperative only operated in a closely circumscribed locality, and meetings were held in public, lenders and borrowers knew each other (Guinnane, 2001).[22]

As is visible from Figure 2b, credit cooperatives were highly successful in attracting members, with close to 10% of the population being members at the end of our sample period in 1913. Most importantly for our purposes, there is extensive variation in the spread of cooperatives even between adjacent counties.



(a) The six eastern provinces of Prussia

(b) Credit cooperative members per capita, 1913

Figure 2: Provinces, counties and cooperatives in the sample

3.2 Dependent variable: Credit cooperatives

The main data source on credit cooperatives is the 'Address Book of Purchasing and Economic Cooperatives in the German Empire' as produced by the central Prussian cooperative bank (Preußische Central-Genossenschafts-Kasse, 1915). This publication, which

[21] The first credit cooperative in our sample was founded in 1852.

[22] More detailed information on the institutional structure of credit cooperatives is provided in the historical appendix, section G.4.

to the best of our knowledge has not been used before, provides the location and type of each cooperative in Imperial Germany, the year of its foundation, the number of members, the sum for which its members are liable, and the association to which it adheres. We use this data to construct a panel consisting of the number of credit cooperatives for each county from 1852 to 1913. This produces the data plotted in Figures 1 and E.1a. As we observe only cooperatives active in 1915, we do not observe failing cooperatives. Fortunately, our theory concerns the foundation of cooperatives, rather than their demise and apart from a brief episode in the 1880s, failure rates of credit cooperatives were below 1 in 1000 (Banerjee et al., 1994; Guinnane, 2001). Nonetheless, this limitation of our data implies we are not in a position to investigate cyclical patterns of booms and busts in cooperative operation, and focus on long-term growth in the number of cooperatives instead.

We use the same source to construct a panel of non-financial cooperatives, which we use as a robustness check. The most important of these are production cooperatives, which were set up by farmers to jointly produce capital intensive goods such as dairy, meat, alcohol; that is those goods described by Y_d in our model.

3.3 Independent variables

3.3.1 Prices

The theory developed in section 2 predicts that declines in relative grain prices should increase cooperative credit. We use data on German rye and wheat prices from the official Prussian statistics (Preußisches Statistisches Landesamt, 1907, 1925). Rye and wheat are the staple grains most affected by import competition and changing urban demand, and are thus most suited to studying rural transformation.[23] We deflate German rye and wheat prices by the Germany-wide consumer price index calculated by Kuczynski (1961), so that we evaluate the evolution of grain prices relative to all other prices.[24]

A change in grain price defined in this way will be equal for all counties. However, exposure to this price shock will differ locally as the initial reliance on rye or wheat cultivation differs between counties, and because wheat and rye prices may move differently.[25] We therefore weigh relative wheat and rye prices in our price index using the share of total

[23] Barley was produced only in relatively small quantities, while oats were partly used as an animal feed.

[24] The results are similar when using the price of a single good, such as butter, as a deflator (see column (6) in table F.3). While this is closer to the price ratio P_g/P_d in the model's Proposition 1, it does not capture the full range of goods that producers could switch to, which included not only dairy, but also meats, alcohols, and even proto-industrial textiles.

[25] Map E.1c displays the cross-sectional variation in grain cultivation at the county level. The majority of this was rye cultivation, although there are large differences between counties in the crop composition (see summary statistics in table B.2). Graph C.1 displays the movement of the difference between rye and wheat prices over time.

land in each county dedicated to wheat and rye production $Z_i^{rye,\,wheat}$. This captures the degree to which each county was potentially affected by global grain price movements:

$$P_{i,t}^{rel.\,grain} = \left(\frac{P_t^{wheat}}{P_t^{CPI}} Z_i^{wheat}\right) + \left(\frac{P_t^{rye}}{P_t^{CPI}} Z_i^{rye}\right) \tag{8}$$

In most specifications, we employ land use data from 1878, which is the earliest year for which county-level data is available from Meitzen (1901). As land use itself could change as a response to price shocks, we also calculate land use at the beginning of our sample (1852) from province level data, but this does not affect the estimates (see column (2)-(4) in table F.3).[26]

The resulting price index was plotted in Figure 1c in the introduction. Clearly, the series is non-stationary, with the attendant risk of spurious results. We therefore difference the series once to arrive at $\Delta P_{i,t}^{rel.\,grain}$. Finally, it seems reasonable to expect that not just the contemporaneous change in prices affects credit cooperative growth, but recent lags as well. This may be because farmers react to a number of adverse price shocks over recent years, or because setting up a cooperative takes time. Our main explanatory variable "grain prices" is therefore a moving total of $\Delta P_{i,t}^{rel.\,grain}$ over the current and past five years.[27] The differenced price series, and its moving five-year total are plotted in Figure C.2.

3.3.2 Asset size and inequality

Our conceptual framework stresses the role of mean assets per capita q in a region, as well as asset inequality. We use farm size as a proxy for assets. There are three reasons for doing so. Firstly, in an agricultural economy, land is arguably the most important asset. Other assets, such as farm buildings are likely to be correlated with land holdings (Eddie, 2008). Secondly, land is used as collateral in financial transactions, for example when taking a bank loan. Thirdly, land holdings are likely to be correlated with income, which determines the ability to repay loans and make savings deposits.[28] We utilize the 1882 land

[26] The results also carry through when we instrument land use with exogenous variation in soil suitability in column (5) in table F.3. Specifically, we instrument Z_i^{wheat} with the share of fertile land from Meitzen (1901), and Z_i^{rye} with the remaining share of land.

[27] The results are very similar if we enter each lag of $\Delta P_{i,t}^{rel.\,grain}$ separately into the regression, but the exposition and reading of the results is significantly eased by using one cumulative total. The results are also robust to including a different number of lags than the 5-period cut-off.

[28] Losch et al. (2011) report that farm size is still the major determinant of rural incomes in a broad cross section of developing countries. In our context, one might worry that farm value, rather than size, matters. The value of land could trend downward as demand for land slackens. However, interacting farm sizes with decade time trends does not reveal such patterns. Similarly, proxying for farm values by interacting farm size with soil quality, industrialization, demographic variables, or market potential (Kopsidis and Wolf, 2012) does not greatly affect the coefficients on farm size (table F.2).

census as collected in the iPEH-Database (Becker et al., 2014) to calculate mean farm size by simply dividing a county's total farmland in hectares by the total number of farms.

For asset inequality, we utilize the same data source. The data divides all farmland in a county into six size categories, and provides the amount of land in each category. Our preferred measure is simply the share of arable land in a county held by estates in the largest category (over 100 ha). This is consistent with the spirit of $\overline{q}$ in the model and the treatment of inequality as upper-tail inequality.[29] As a robustness check, we also compute a Gini index of farm size inequality, by calculating the area under a discrete Lorenz curve of all six size categories, as well as experimenting with different cut-offs, but the results turn out to be insensitive to these alterations.

3.3.3 Population and heterogeneity

All demographic data stems from the official Prussian censuses, collected by Belzyt (1998). The censuses provide population totals, as well as the breakdown by ethnic and religious groups for each county. For most counties, ten census results are available between 1858 and 1910. We linearly interpolate the data between census years.[30] Although we sometimes allow population to vary over time, we use fixed 1890 population figures in most specifications. This is the census that is available for all counties, and avoids spurious results due to trending population numbers. We also use 1852 numbers (column (6) in table F.1) as a robustness check to forestall the possibility that population itself might adjust to price shocks, for example through migration.

According to our theory, communication costs are more likely to be present when both ethnicities are of roughly equal size. An index of ethnic fractionalisation is one way of capturing these non-linearities. We calculate a generalized formulation of the heterogeneity index in equation 3 that allows for more than two groups (although in the majority of counties, Germans and Poles are the only groups present). For county i we compute our fractionalization index as:

$$frac_i = 1 - \sum_{k=1}^{K} \left(\frac{N_{k,i}}{N_i} \right)^2 \tag{9}$$

[29] Land in this category was officially denoted as *Grossgrundbesitz* (large estate) in Prussia. The measure largely follows Cinirella and Hornung (2016), although the authors use the share of farms rather than the share of land. Note that the threshold for classifying as a large estate in Prussia is quite distinct, and is likely to be much larger, than the collateral threshold required for bank loans q_T in the model.

[30] We use the territorial definitions of counties in 1900. In cases where county boundaries were redrawn, we extrapolate the population shares backwards using the constituent territories' growth rates, with the relative population shares as weights. This yields stable units of observation over time.

where k is a linguistic or religious group. An alternative is a polarization index, as proposed by Esteban et al. (2012), which may be more relevant when focusing on antagonism between two groups, such as Germans and Poles.[31] However, Esteban et al. (2012) emphasize that polarization is a predictor of conflict over public, rather than private goods, and it is the latter that we are primarily interested in. We therefore employ the fractionalization index in most applications.

3.3.4 Banks and other controls

In our setting, controlling for bank presence is important because savings banks were the main substitute to co-ops as sources of finance 19th Century Prussia. In line with our conceptual framework, however, they did not generally target individual small farmers either as savers or borrowers (Burhop, 2011; Born, 1985). Moreover, as they could supply credit to cooperatives, they sometimes acted as complementary institutions. We use the founding date of all savings banks present in the year 1909 (Evert, 1911) to construct a panel of these institutions.

Most other county-level control variables are extracted from the aforementioned iPEH-Database (Becker et al., 2014). A small number of variables (urbanization and soil quality) are taken from Meitzen (1901). Tables B.1 and B.2 provide summary statistics and a short description of all variables. The main variables of interest are also mapped in Appendix E.

3.4 Empirical strategy

3.4.1 Benchmark specification

Based on the comparative statics properties in Proposition 1, we know that a change in grain prices should determine market entry by cooperatives, conditional on fixed county characteristics. Our empirical benchmark specification explains the formation of credit cooperatives at the county level from 1852, the year of the first foundation, to 1913, the last year before World War I. Formally:

$$\Delta C_{i(j),t} = \beta_0 + \beta_1 \Delta P_{i,t}^{rel.\,grain} + \beta_2 N_i + \beta_3 H_i + \beta_4 q + \beta_5 q^2 + \beta_6 \overline{q} + V_t + W_i + \alpha_j + \epsilon_{i,t} \quad (10)$$

where $\Delta C_{i(j),t}$ is the growth in the number of credit cooperatives in county i in year t. The main explanatory variables are those developed in our conceptual framework: β_1 captures the role of grain price changes, β_2 and β_3 examine the effect of population and

[31] See Cinirella and Schueler (2016), who make this point in a Prussian context specifically.

population heterogeneity.[32] β_4 investigates the effect of mean assets, measured by mean farm size, and β_5 takes account of the hypothesized hump-shaped relationship between mean assets and cooperatives. Finally, β_6 tests the association between asset inequality $\overline{q}$ and co-op growth. In the benchmark specification, we include two further control variables in W_i: urbanization (the share of a county's population living in urban settlements), and a dummy for "surburban" counties, which we define as those that encompass a town not part of that county. In some specifications, we control for the number of banks per county at the start of the panel.[33]

We always include three time varying dummies in V_t that capture important policy changes affecting the legal environment in which cooperatives could operate (Faust, 1965b). These are the 1867 incorporation law bestowing legal personhood unto cooperatives, the 1889 law allowing co-ops to elect limited liability on members' assets, and the 1895 founding of the *Preussenkasse*, a central public bank set up to extend loans to cooperatives experiencing short term liquidity crises.[34] In some specifications, we also test for the other time-varying factor from our model: annual bank interest rates r_b from Bundesbank (1976). We also test for the effect of GDP growth, which has been shown to affect the growth of MFIs (Ahlin et al., 2011).

The dependent variable in equation 10 is a discrete non-negative count, and therefore estimated using a Poisson (Cameron and Trivedi, 2015). In most specifications, we pool data across counties and years, although we always employ fixed effects α_j at level of the 14 districts. This is the administrative layer between our 6 provinces and 236 counties, and groups together historically similar counties. We also estimate some models with county or year fixed effects. Standard errors are clustered at the county level.

3.4.2 Causal identification

To what extent will a regression of credit cooperatives on grain prices yield causal estimates? Our counties are too small to have influenced the German price level, so that we can rule out reverse causality. However, third factors, such as large regional harvest shocks, could have affected aggregate grain supply and hence prices. Such harvest shocks could also directly drive credit demand. In this case β_1 in equation 10 may not be picking

[32] Clearly, a higher rate of co-op formation is mechanically expected in larger counties, and β_2 should not be interpreted as measuring the impact of group size N_c from the model.

[33] Although variables like population or banks could be allowed to vary over time, we prefer keep them fixed in most specifications to mitigate their potential endogeneity to grain price shocks, which would lead to a "bad controls" problem.

[34] See Guinnane (2004) for a discussion of the actual role of the *Preussenkasse* and the middle-tier regional "central" banks. Econometrically, these policy dummies account for the higher mean growth rate of co-ops after 1890 visible in Figure 1d.

up the causal effect of prices on credit cooperatives.[35] Ultimately, we are interested in falling grain prices as a feature of structural transformation. These price changes were the result of evolving domestic demand patterns and international integration. We therefore make use of a theoretical result from the literature on structural transformation derived by Teignier (2018): In a small, land scarce, and reasonably open economy, domestic relative prices should be determined by (lower) world market prices for agricultural goods. The resulting lower price ratio can drive structural change. As a grain producer Prussia, and Germany in its entirety, were small relative to the land abundant producers in Argentina, Russia, and the USA that were increasingly dominating German grain markets. Moreover, as non-perishable staple grains were more easily tradeable than dairy or meat, import competition was particularly severe for these goods (Findlay and O'Rourke, 2009). We therefore use US prices for wheat and rye (Jacks, 2013) as an instrument for German prices. The US was one of the largest producers of staple grains in the world, which ensures the instrument is relevant.[36] Moreover, the exclusion restriction that US grain prices affect the creation of local credit cooperatives only through its effect on German prices is likely to hold given that US and local Prussian supply conditions are unlikely to be correlated.

We also exploit the international environment of 19th century globalization to identify the causal effect of other macroeconomic variables. We instrument German bank interest rates, which could conceivably be driven by competition from expanding credit cooperatives, by the Bank of England's official discount rate. The Bank of England acted as the "conductor" of the international monetary system of the 19th century, and national central banks often followed its rate setting policy, transmitting its rates to domestic markets (Eichengreen, 1987). Figure C.5 shows the strong comovement between the Bank of England and German commercial rates.

Similarly, as discussed by Ahlin et al. (2011), a regression of MFI outcomes on GDP growth may not produce causal effects due to omitted variables. In our setting, one possibility may be that, as rural incomes are increasing, this increases GDP growth while at the same time decreasing rural credit demand.[37] We therefore instrument German GDP growth with UK GDP growth, lagged one period. The UK was Europe's largest economy at the time, and Germany's principal trade partner, making the instrument relevant. It also seems unlikely that UK incomes of the past year were driven by current German demand conditions.

[35] Specifically, if domestic grain supply is negatively related to gain prices and demand for credit, β_1 would understate the true negative effect of grain prices on credit cooperatives.

[36] Figure C.3 shows the degree to which US and German prices are indeed correlated. Note that what matters for our instrument is not whether US and German price levels were the same (given trade costs and tariffs), but that the changes were closely correlated.

[37] This would imply that the coefficient would be biased towards 0, which is what we in fact observe in table 3 (columns (3) and (6)).

A different strategy is required for cross-sectional variables, such as land inequality. Here we exploit the unique history of settlement of the Prussian eastern provinces. Specifically, we focus on the fact that these territories were settled by colonists from the High Middle Ages onwards, and that there were, roughly, two motivations for settlement. One was economic: farmers, craftsmen and merchants were drawn to the East because it offered relatively sparsely populated land. The other was military: parts of the East were populated by pagan peoples, which drew a number of crusading military orders to the region, the most notorious being the Teutonic Order (Herrman, 2015). These crusaders established large landed estates centered around military strongholds on the land conquered from pagan peoples. Although the crusading orders themselves had been abandoned by 1525, and many of their strongholds were ruins by the 19th century, their settlements planted the seed for the unequal land distribution in the region (Torbus, 1998). We therefore measure the distance from each county capital to these historical military strongholds to arrive at an instrument for land inequality.[38] The instrument's validity is predicated on the notion in the historical literature that the location of these military settlements were driven by the shifting security situation of the middle ages, rather than the economic considerations of the 19th century (see Torbus (1998, p. 56-57), Leighton (2016) and Piana and Carlsson (2014)).[39]

For other variables, we are not able to employ instrumental variables. Yet we do utilize another key feature of our historical setting by exploiting the precedence in timing of our covariates. For example, we can hold county-level ethno-linguistic heterogeneity or the development of the banking system fixed at their 1852 values, before credit cooperatives even existed. Although this does not completely rule out the possibility of "deep" county-specific omitted variables, it does decrease their likelihood and rule out reverse causality.[40]

4 Results

4.1 Benchmark results

The main results in table 1 strongly support the predictions of our theoretical framework. We commence in column (3) by showing the results of the full benchmark specification

[38] We use a historical atlas (Zeissig, 1964) to code the location of the principal strongholds. The atlas identifies 17 such settlements.

[39] We include soil quality to control for potential economic determinants of settlement, but this does not affect our estimates. Soil quality is used as an instrument for land inequality by Cinirella and Hornung (2016) in their study of education. We do not use it for this purpose, as soil quality will have affected rural cooperatives through influencing the local crop mix (see section 3.3.1.

[40] One important variable that we only observe mid-way in our sample period (1886) is farm size q. However, we also run our benchmark regression solely on data after that year, and find that the coefficient on q has not changed significantly compared to the benchmark, thus suggesting that endogeneity of farm sizes to cooperative foundation is not a major confound (see column (4), table F.6).

derived in section 3.4.1. The coefficient on grain prices is negative and strongly statistically significant, suggesting that falling relative grain prices played a role in the rise of credit cooperatives in counties heavily reliant on grain production. Introducing year fixed effects decreases the precision of the estimator, but the coefficient is left intact (column (6)).

The coefficient on farm size is positive while its quadratic term is negative: high levels of rural assets encourage the formation of credit cooperatives, but beyond a certain threshold, asset wealth actually decreases cooperative growth. This is consistent with the hypothesized hump-shaped relationship between private assets and small-scale credit arising from the presence of bank lending with collateral requirements. The coefficient on land inequality is negative, showing that counties with a higher share of land held in large estates provided a less hospitable environment for the growth of microfinance institutions.

The impact of linguistic fractionalization is as ambiguous empirically as it is in theory. Although the coefficient is generally positive, in line with Proposition 2, it is only statistically significant in column (2) before the introduction of urbanization controls. As the coefficient on the urbanization variable shows, most credit cooperatives thrived in rural areas. These rural areas were also disproportionally fractionalized, accounting for the strength of the positive correlation in (2).

As can be expected, population is a strong predictor of cooperative growth, but this relationship is partly mechanical. Finally, the time-varying policy dummies indicate that the institutional environment had a strong effect on co-op growth: the introduction of limited liability laws, and the founding of the cooperative central bank seem to have played a large role in encouraging credit cooperative formation.

The above results are robust to the introduction of a wider set of control variables, for example the percentage of the workforce employed in manufacturing, and market potential in column (4).[41] The variables themselves emphasize the idea that, conditional on the distribution of private land assets, credit cooperatives were more likely to form in less industrialized and more remote areas. In column (5) we also examine whether the geographical spread of the cooperative idea itself mattered (Jensen et al., 2018), but find that credit cooperatives were no more likely to form if they were closer to Neuwied, the location where Raiffeisen propagated his ideas.

We include more controls, including 1892 wage levels, labour income growth between 1880-1905, migration rates between 1895-1905, illiteracy, and population density in table F.1, but do not include these in the main specifications as they may be affected by the

[41] Market potential is the distance from each county capital to all other German counties and foreign capitals, weighted by the size (population) of these markets (Kopsidis and Wolf, 2012).

Table 1: Determinants of credit cooperative growth, county level, Prussia: **Benchmark**

	(1) No fixed effects	(2) No urbanization	(3) Benchmark	(4) Controlling for trade & industrialization	(5) Controlling for ideas transmission	(6) Year fixed effects
	Dependent Variable: Number of new credit cooperatives per county					
Δ grain prices	-41.6120***	-38.2984***	-38.3988***	-38.3154***	-38.3955***	-38.3075**
	(3.2788)	(3.0438)	(3.0575)	(3.0454)	(3.0567)	(13.4610)
limited liability	1.6035***	1.5914***	1.5920***	1.5917***	1.5920***	
	(0.1547)	(0.1539)	(0.1540)	(0.1540)	(0.1540)	
central bank	1.3803***	1.3892***	1.3888***	1.3891***	1.3888***	
	(0.1419)	(0.1410)	(0.1411)	(0.1412)	(0.1411)	
incorporation	0.0821	0.0664	0.0667	0.0663	0.0667	
	(0.1313)	(0.1312)	(0.1313)	(0.1313)	(0.1313)	
population	0.0056***	0.0060***	0.0067***	0.0080***	0.0068***	0.0068***
	(0.0016)	(0.0015)	(0.0013)	(0.0016)	(0.0013)	(0.0013)
ling. fractionalisation	0.0442	0.4315**	0.1481	0.0503	0.1518	0.1528
	(0.1730)	(0.1640)	(0.1523)	(0.1419)	(0.1532)	(0.1518)
farm size	0.0925*	0.1956***	0.1408***	0.1289***	0.1414***	0.1406***
	(0.0359)	(0.0367)	(0.0348)	(0.0365)	(0.0347)	(0.0352)
farm size squared	-0.0037**	-0.0057***	-0.0039**	-0.0036**	-0.0039**	-0.0039**
	(0.0013)	(0.0014)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
land inequality	-0.4752*	-0.9721***	-0.8487***	-0.8878***	-0.8632***	-0.8521***
	(0.2391)	(0.2189)	(0.2019)	(0.2008)	(0.2122)	(0.2009)
urbanization			-1.3505***	-1.2294***	-1.3498***	-1.3493***
			(0.2740)	(0.2581)	(0.2741)	(0.2740)
suburbs			-0.1205	-0.0615	-0.1204	-0.1210
			(0.1184)	(0.1109)	(0.1183)	(0.1186)
industrial employment				-1.0096+		
				(0.5608)		
market potential				-0.5397*		
				(0.2288)		
Raiffeisen distance					0.0105	
					(0.0505)	
District F.E.		✓	✓	✓	✓	✓
Year F.E.						✓
Observations	14632	14632	14632	14632	14632	14632
No. of cooperatives	4941	4941	4941	4941	4941	4941

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices refers to the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Limited liability, central bank and incorporation are time varying policy dummies. Other variables are time invariant. See tables B.1 and B.2 in the appendix for further definitions. Poisson model with standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

price shocks themselves. These variables are not time varying, but we get similar results when allowing population to vary over time in column (5) of the same table. Column (6) in table F.1 fixes population and fractionalization at their 1852 values. This precludes simultaneity bias, although it may also increase measurement error. Nonetheless, the conclusions of the benchmark regression carry through despite these alterations.

We will now investigate the mechanism behind each of our main variables, and investigate their causal effects.

4.2 Inequality

The benchmark regression uses the share of land in large estates as a measure for land inequality, reflecting the focus in our theoretical framework on the share of top assets $\overline{q}$. In column (1) of table 2, we extend this definition to include the top two land size categories, with little difference to the results. In column (2) we depart from this approach by taking the whole land distribution of a county into account through a Gini-coefficient. The results are statistically slightly weaker, but still indicate a negative effect of land inequality on rural financialization at conventional significance levels.[42]

However, an important concern could be that our measures of land inequality pick up omitted variables correlated with both land holdings and rural credit. For example, county-level natural endowments, including soil quality, could conceivably affect both measures. As a first step, we check whether our measure behaves in line with the historical evidence on land inequality (Eddie, 2008). We know from existing work that even though land inequality itself was not necessarily decreasing during the 19th century, its effect diminished as peasants were gradually freed from their manorial obligations and acquired full ownership rights over plots (Cinirella and Hornung, 2016). Our findings are in line with this interpretation: Once we interact land inequality with a decadal time trend in column (3), we find that the effect of inequality on credit cooperatives does indeed diminish over time, although we cannot rule out attenuation bias here.

Although evidence from time trends makes it less likely that our findings are confounded by county characteristics, the effect of such confounders could conceivably be time-varying too. We therefore utilize distance to medieval military settlements as an instrument for the share of land under large estates as described in section 3.4.2. Column (4) demonstrates that after instrumentation, the coefficient on inequality remains significant

[42] We also excluded land inequality or farm size squared from the regression, but found that it left the main effect of farm sizes qualitatively similar. Reversely, we experimented with dropping all land-related variables and instead included all bins of land size save one in the regression. This too produced the predicted hump-shaped relationship between asset size categories and cooperative foundation.

Table 2: Determinants of credit cooperative growth, county level, Prussia: **Land inequality**

	(1) Top two land inequality	(2) Gini land inequality	(3) Gini with decade effects	(4) Instrumenting land inequality	(5) Instrument & soil quality	(6) Instrument & public goods	(7) Instrument & state funding
	Dependent Variable: Number of new credit cooperatives per county						
Δ grain prices	-38.4079***	-38.4126***	-29.4269***	-38.3059***	-38.3129***	-38.2945***	-38.5345***
	(3.0645)	(3.0714)	(2.9270)	(3.0319)	(3.0340)	(3.0357)	(3.0323)
population	0.0067***	0.0068***	0.0068***	0.0062***	0.0062***	0.0063***	0.0045**
	(0.0013)	(0.0014)	(0.0014)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
ling. fractionalisation	0.0926	0.0781	0.0826	0.4646**	0.4850**	0.3864*	0.3238*
	(0.1548)	(0.1536)	(0.1537)	(0.1793)	(0.1762)	(0.1698)	(0.1571)
farm size	0.1361***	0.1253***	0.1276***	0.2094***	0.2034***	0.2075***	0.1072**
	(0.0346)	(0.0342)	(0.0342)	(0.0451)	(0.0431)	(0.0434)	(0.0355)
farm size squared	-0.0037**	-0.0036**	-0.0037**	-0.0059***	-0.0058***	-0.0058***	-0.0032**
	(0.0012)	(0.0012)	(0.0012)	(0.0015)	(0.0015)	(0.0014)	(0.0011)
land inequality	-0.7688**			-1.3200*	-1.1674*	-1.2606*	-0.9868*
	(0.2348)			(0.6496)	(0.5729)	(0.6046)	(0.4948)
Gini		-1.2476*					
		(0.4960)					
-1854 $\times$ Gini			-7.8558***				
			(1.7538)				
1855-1864 $\times$ Gini			-3.3025**				
			(1.1036)				
1865-1874 $\times$ Gini			-3.0109**				
			(1.0923)				
1875-1884 $\times$ Gini			-4.3488***				
			(1.1016)				
1885-1894 $\times$ Gini			-3.9138***				
			(0.8789)				
1895-1904 $\times$ Gini			-0.5905				
			(0.5375)				
1905-1913 $\times$ Gini			-1.1339*				
			(0.5480)				
Berlin distance				0.0504			
				(0.0694)			
soil quality					0.1195		
					(0.1513)		
pupil-teacher ratio						0.0055	
						(0.0042)	
state public spending							0.1441
							(0.1760)
District F.E.	✓	✓	✓	✓	✓	✓	✓
Urbanization controls	✓	✓	✓				✓
Policy dummies	✓	✓	✓	✓	✓	✓	✓
Observations	14632	14632	14632	14632	14632	14632	14632
No. of cooperatives	4941	4941	4941	4941	4941	4941	4941

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices refers to the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Policy dummies refers to time varying dummies capturing reform of limited liability, central bank and incorporation law. Other variables are time invariant. Urbanization controls include the share of the population resident in urban areas and a dummy for suburban counties. Specifications (4)-(7) instrument land inequality (share of large estates) with distance to medieval military settlements. See tables B.1 and B.2 in the appendix for further definitions. (1), (2) & (3) Poisson, (4)-(7) GMM. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.
Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

and negative.[43] As the location of these settlements was dictated by the military situation facing medieval crusaders, rather than the agricultural conditions prevailing six centuries later, the estimate should now be free from omitted confounders.[44] Moreover, column (5) shows that the instrument is not affected by controlling for soil quality directly.

Although the instrument strengthens the argument that land inequality affects credit cooperatives, it does not pin down a mechanism. While the model emphasizes the impact of land inequality through the distribution of bankable assets, other explanations are plausible. Large landowners could have underprovided public goods such as education, thus hampering co-op growth. They could also have used their political power to stymie the growth of new credit institutions (Rajan and Ramcharan, 2011). Although it is difficult to conclusively rule out these mechanisms, we are able to provide suggestive evidence against them. In column (6) we control for the pupil-teacher ratio as a proxy for educational provision. In column (7) we control for the share of school funding that comes from the state, rather than other (local) sources. This proxies the degree to which large landowners may have substituted for state organs, and thus gauges their political power. In both cases, we find the coefficient on land inequality unaffected.

4.3 Rural transformation

According to our conceptual framework, a decline in staple prices encourages farmers to found microfinance institutions. These institutions allow credit-constrained producers to enter the production of capital-intensive agricultural goods, driving rural transformation. In this section, we show that the empirical evidence strongly supports the causal impact of relative grain prices on the formation of credit cooperatives. There is also suggestive evidence that these cooperatives aided rural transformation.

We first examine the effect of relative grain price changes in a setting with county fixed effects in column (1) of table 3. The coefficient on grain prices is virtually unchanged from the benchmark regression.[45] However, German grain prices could be endogenous to domestic supply conditions. Using US grain prices as an instrument in (4) takes care

[43] Similarly, the reduced form relationship (columns (6) and (7) in table F.4) shows that distance to medieval settlements predicts co-op formation six centuries later. Note that we do not include urbanization controls in most of the instrumental variable regressions concerning inequality, as patterns of urbanization will have been historically determined by the instrument itself.

[44] One common problem with geographical instruments is that the distance to a single point could be correlated with unobserved spatial variables. In this case, however, we use the sum of distances to 17 settlements, making such coincidental correlation unlikely as long as the initial allocation of settlements is as good as random. Consequently, our instrument is robust to the inclusion of other distance-based measures.

[45] We use the Poisson conditional fixed effect model with the robust sandwich error estimator proposed by Hausman et al. (1984), which has the benefit of being robust to a misspecification of the underlying count distribution, serial correlation, as well as time-invariant spatial dependence (Bertanha and Moser, 2016). We loose observations from two counties with zero co-op growth, and from

Table 3: Determinants of credit cooperative growth, county level, Prussia: **Prices and other time varying variables**

	(1) Prices, county fixed effects	(2) Controlling for bank interest rates	(3) Controlling for GDP growth	(4) Instrumenting with US prices	(5) Instrumenting with UK interest rates	(6) Instrumenting with UK growth rates	(7) Controlling for price volatility
	Dependent Variable: Number of new credit cooperatives per county						
Δ grain prices	-37.21***	-35.30***	-37.99***	-46.74***	-33.96***	-33.35***	-32.30***
	(3.16)	(3.38)	(3.02)	(4.87)	(3.33)	(3.54)	(2.86)
limited liability	1.58***	1.87***	1.59***	1.65***	1.85***	1.77***	1.59***
	(0.15)	(0.22)	(0.15)	(0.15)	(0.21)	(0.26)	(0.15)
central bank	1.39***	1.63***	1.39***	1.35***	1.68***	1.42***	1.48***
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
incorporation	-0.12		0.06	-0.03		0.028	0.32*
	(0.13)		(0.13)	(0.14)		(0.14)	(0.15)
interest rates		-0.28***			-0.34***		
		(0.033)			(0.040)		
GDP growth			0.0112			0.3404*	
			(0.0133)			(0.1410)	
population				0.0067***	0.0064***	0.0067***	
				(0.0013)	(0.0014)	(0.0013)	
ling. frac.				0.1268	0.2043	0.1332	
				(0.1515)	(0.1604)	(0.1517)	
farm size				0.1345***	0.1341***	0.1394***	
				(0.0339)	(0.0348)	(0.0340)	
farm size sq.				-0.0037**	-0.0035**	-0.0038**	
				(0.0012)	(0.0013)	(0.0012)	
land inequality				-0.8173***	-0.9006***	-0.8145***	
				(0.2013)	(0.2121)	(0.2017)	
price volatility							8.07***
							(1.66)
District F.E.				✓	✓	✓	
County F.E.	✓	✓	✓				✓
Urbanization controls				✓	✓	✓	
Observations	13572	8740	14508	13572	8740	14508	14508
No. of cooperatives	4940	4591	4941	4940	4714	4591	4941

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var.: year-on-year change in number of credit cooperatives per county; grain prices refers to the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Price volatility is the five year standard deviation of the change in deflated rye and week prices. Limited liability, central bank and incorporation are time varying policy dummies. GDP growth is annual change in German GDP, interest rate is the lending rate of German commercial banks (available from 1876). Other variables are time invariant. Urbanization controls include the share of the population resident in urban areas and a dummy for suburban counties. See tables B.1 and B.2 in the appendix for further definitions. Specification (3) instruments relative grain prices using US prices (available from 1856), (4) instruments interest rates using the UK Bank of England discount rate, (5) instruments GDP growth with UK GDP growth lagged by 1 year. Specifications (1), (2), (3), (7) are county fixed effects Poisson regressions (234 counties). (4), (5) and (6) are GMM with fixed effects at the level of 14 districts. Standard errors clustered at county level (236 counties). All regressions exclude Berlin.
Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

of this concern. Movements in US prices impacted German grain price changes, and this encouraged farmers in those counties of Prussia heavily reliant on grain production to set up credit cooperatives. The coefficient on grain prices increases, suggesting that domestic harvest shocks affecting prices and credit demand simultaneously biased the coefficient towards zero.[46] We obtain similar conclusions in the reduced form (column (2) in table F.4), as well as when instrumenting rye and wheat cultivation with exogenous variation in soil quality (column (5) in table F.3). Theoretically, trade policy could have affected the pace of financial development in rural areas by shielding domestic grain producers. In column (5) and (6) of table F.6 we separately consider the years before and after Germany's landmark 1879 tariffs (Lehmann, 2010). Yet we find the direct effect of US grain prices to be *higher* in the decades after the tariffs, suggesting technology-driven market integration outpaced policy markers.

In the model, bank lending rates act as a floor for cooperative lending rates. High bank interest rates will therefore negatively impact the formation of credit unions. This assertion finds support in column (2) in table 3, where the annual mean interest rates of German commercial banks is shown to be negatively correlated with the co-op growth rate. Exploiting exogenous interest rate shocks from the Bank of England, the results in column (5) suggest that this relationship is causal: increases in the discount rate in the UK changed the lending practices of German banks, which decreased the attractiveness of setting up credit cooperatives.

Although not explicitly a part of our model, we also investigate the role of the GDP growth rate on microcredit, as rising incomes are intimately related to structural transformation (column (3)). In column (6), we instrument German GDP growth with lagged UK GDP growth, and find there to be a statistically significant impact on co-op formation. This supports the conclusions Ahlin et al. (2011) draw from correlational evidence on modern data. We interpret this result as being related to structural transformation: an exogenous increase in German per capita incomes shifts relative demand away from staples. With prices fixed by world markets, this implies a smaller output share for staples, increasing the demand for loans to aid exiting that sector. This is supported by the observation that the coefficient on GDP growth is not different from 0 if we ignore endogeneity in column (3): domestic German GDP growth partially reflects increasing farm incomes, and this decreases credit demand.

four years without US price data. We obtain similar results in a specification allowing for both county and year fixed effects (column (1) in table F.3).

[46] Incidental parameters imply that we cannot use county fixed effects in this GMM set-up, so that the IV results are comparable to the benchmark in column (3), table 1 rather than the fixed effects specification.

Table 4: Determinants of cooperative growth, county level, Prussia: **Savings banks and other cooperatives**

	(1) Explaining production cooperatives	(2) production co-ops with fixed credit co-ops	(3) Credit cooperatives with banks	(4) Controlling for bank growth	(5) Controlling for lagged cooperatives	(6) Placebo: other cooperatives
Dependent Variable:	New production co-ops per county		New credit cooperatives per county			Other co-ops
Δ credit cooperatives	0.2186***					
	(0.0197)					
credit cooperatives 1873		0.0981*				
		(0.0476)				
lag credit cooperatives					-0.0119***	
					(0.0034)	
Δ grain prices			-38.4872***	-37.1641***	-34.0767***	6.7631+
			(3.0761)	(3.1637)	(3.1267)	(3.6497)
limited liability			1.5923***	1.5840***	1.5759***	2.7979***
			(0.1539)	(0.1534)	(0.1532)	(0.2047)
central bank			1.3887***	1.4876***	1.5582***	1.2151***
			(0.1411)	(0.1403)	(0.1430)	(0.1130)
incorporation			0.0671	-0.1431	-0.0092	
			(0.1313)	(0.1361)	(0.1322)	
population			0.0077***	0.0076***	0.0068***	0.0053**
			(0.0016)	(0.0015)	(0.0014)	(0.0019)
ling. fractionalisation			0.1822	0.0988	0.3132+	-0.5203
			(0.1579)	(0.1640)	(0.1818)	(0.3702)
farm size			0.1353***	0.1402***	0.1568***	0.3012***
			(0.0338)	(0.0359)	(0.0383)	(0.0677)
farm size squared			-0.0037**	-0.0038**	-0.0043**	-0.0078***
			(0.0012)	(0.0013)	(0.0014)	(0.0021)
land inequality			-0.7830***	-0.8917***	-0.9641***	-0.6886
			(0.2049)	(0.2161)	(0.2619)	(0.6314)
banks, 1852			0.1379**	0.1524**	0.1773***	0.1103
			(0.0477)	(0.0504)	(0.0504)	(0.1046)
Δ banks				-0.0065		
				(0.0562)		
income growth			-0.0010	-0.0013		
			(0.0020)	(0.0021)		
market potential			-0.4298*	-0.5100**		
			(0.2003)	(0.1847)		
soil quality			0.0193	0.0573		
			(0.1372)	(0.1433)		
population, 1870		0.0001+				
		(0.0000)				
County F.E.	✓					
District F.E.		✓	✓	✓	✓	✓
Urbanization controls		✓	✓	✓	✓	✓
Observations	11781	9912	14632	12508	14396	14632
No. of cooperatives	898	898	4941	4375	4940	2000

Sample: Six eastern provinces of Prussia, 1873-1913 in (1) - (2);1852-1913 in (3), (5) & (6), 1852-1909 in (4). Dep. Var. for specifications (1) - (2): year-on-year change in number of production cooperatives per county; (3), (4) and (5): year-on-year change in number of credit cooperatives per county, (6): year-on-year change in number of other cooperatives per county. Banks refers to the time-varying number of banks per county, available before 1909 only, except banks 1852, which refers to the count of banks at that date. See tables B.1 and B.2 in the appendix for further definitions. All specifications are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.
Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Although the effect of grain prices on credit cooperatives is robust, there are alternative interpretations of this relationship that do not draw on structural change. Rather than exiting grain production, farmers could have accessed credit to smooth consumption or insure against risk (Fafchamps and Gubert, 2007). Although cooperatives did mainly extend loans for productive purposes rather than for consumption or debt refinancing, this rule was not always followed (Guinnane, 2001). We therefore include grain price volatility as a covariate in column (7) in table 3.[47] The coefficient on price volatility has a positive sign and is statistically significant, suggesting that price volatility is an alternative channel leading to the development of rural credit markets. However, the results for grain prices remain largely unaffected. Even more, the effect of price volatility is economically small (section 4.6), and price volatility was generally declining as market integration proceeded (figure C.4).

In table 4 we provide additional indirect evidence on the role of credit cooperatives in helping farmers to exit staple production. Because annual data on changes in agricultural output at the county level is lacking, we use the founding of production cooperatives as a proxy for annual changes in rural production. These cooperatives produced income elastic goods such as dairy and meat. Column (1) shows that a higher growth rate of credit cooperatives is indeed associated with a contemporaneous increase in the foundation of production cooperatives. Although this regression controls for county-fixed effects, it could still be that time varying omitted factors drive both growth rates. In column (2), we rule this out by fixing the number of credit cooperatives at the 1873 value, the year in which the first production cooperative was founded (see figure 1d).

In table 5, we turn to direct evidence for rural transformation by regressing the change in livestock numbers between 1868 and 1906 on the growth in credit cooperatives during this period at the county level. The correlation is statistically strong and economically meaningful for all three livestock categories: dairy cattle, beef cattle, and pigs.[48] One additional cooperative is associated with 130 additional heads of dairy cattle during this period, and with more than 400 pigs. The results are robust to controlling for a range of covariates, including 1868 livestock levels, as well as urbanization levels and income and population growth. Although these particular results are suggestive rather than causal, they do lend support to the interpretation that credit cooperatives helped grain producing regions to diversify farm output and switch to more capital-intensive production.[49]

[47] The variable is calculated as the standard deviation of changes in our relative grain price index over the past five years.

[48] Data on livestock numbers stems from the Prussian cattle censuses (Meitzen, 1901; Preußisches Statistisches Landesamt, 1908). We calculate beef cattle as total cattle subtracting cows and calves.

[49] We find, on the contrary, little evidence that credit cooperatives are associated with stalling structural transformation in the wider economy, for example by hindering emigration or industrial employment in counties where they were active.

Table 5: Non-grain rural production, county level, Prussia: **Change in livestock 1868-1906**

	(1) Dairy cattle	(2) Beef cattle	(3) Pigs	(4) Dairy cattle, controls	(5) Beef cattle, controls	(6) Pigs, controls
	Dependent Variable: Δ livestock headcount 1868-1906					
Δ Credit cooperatives 1868-1906	131.14*	297.51***	474.8***	131.2**	266.7***	416.9***
	(51.5)	(54.0)	(77.8)	(42.9)	(47.9)	(71.5)
dairy cattle, 1868	-0.013			-0.115		
	(0.113)			(0.132)		
beef cattle, 1868		-0.546**			-0.616***	
		(0.171)			(0.166)	
pigs, 1868			0.991***			0.865***
			(0.187)			(0.196)
population growth				-532.2+	-1217.1*	-689.7
				(274.4)	(495.9)	(463.9)
income growth per capita				-13.25	-34.42*	4.32
				(12.6)	(15.9)	(42.9)
District F.E.	✓	✓	✓	✓	✓	✓
Urbanization controls				✓	✓	✓
Observations	236	236	236	236	236	236
R-squared	0.446	0.426	0.596	0.513	0.482	0.618

Sample: Six eastern provinces of Prussia 1868-1906. Dep. Var. total change in headcount of lifestock (dairy cattle, beef cattle, pigs) per county over the entire period. Urbanization controls include the share of the population resident in urban areas and a dummy for suburban counties; See tables B.1 and B.2 for further definitions. All regressions are OLS with fixed effects at the level of 14 districts with robust standard errors. All regressions exclude Berlin.
Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

How does the availability of other financial institutions impact the development of small-scale credit? In our theoretical framework, banks and microcredit institutions serve segmented markets of individual lenders due to the presence of collateral requirements. For borrowers at the threshold, one would expect banks credit and micro credit to be substitutes (Cull et al., 2014; Colvin and McLaughlin, 2014). However, individuals founded cooperatives partly to access bank loans as a group, in which case both institutions would exercise complementary roles (Ahlin et al., 2011; Périlleux et al., 2016). If the latter is true, one might also be concerned that our count of cooperatives simply captures regional financial development. The results in column (3) of table 4 show that this concern is unsubstantiated: controlling for the number of banks at the county level at the start of the sample does not affect the other coefficients. The coefficient on the number of banks does support the interpretation of complementarity, although it cannot be ruled out that omitted variables at the county level affect the creation of both institutions. Similarly, controlling for growth in the number of banks in column (4) does not change these conclusions,

and the results continue to show that small scale credit was still more likely to develop in counties where banks were present early on.

The market entry of a credit cooperative may also be conditional on the existence of other credit cooperatives. The presence of existing cooperatives could encourage the formation of new cooperatives through through learning and demonstration effects, or make market entry less attractive through competition and market saturation effects. To this end, column (5) includes the stock of cooperatives, lagged one period, as a regressor. The coefficient is negative and statistically significant, suggesting the presence of saturation effects. The other coefficients are largely unchanged.[50]

Finally, we might be concerned that our results are driven by factors that determine cooperative activity over time more generally, but that have nothing to do with credit cooperatives per se. This we investigate with a placebo test in column (6), where we regress the change in the number of all non-credit cooperatives on our benchmark variables.[51] Grain prices are, if anything, positively related to the growth of these other cooperatives, which may reflect income effects. Banks are now no longer statistically significant.

4.4 Ethno-linguistic heterogeneity

Our conceptual framework showed that heterogeneity among the population could hinder the appearance of rural small scale credit by imposing high costs on transactions between group members (equation 6). On the other hand, per Proposition 2, these costs can also provide an incentive to create a larger number of ethnically segregated cooperatives. There is indeed historiographical evidence that credit cooperatives in Prussia's eastern provinces became heavily segregated in the last decades of the 19th century (Lorenz and Müller, 2006). However, the benchmark results did not support a strong role for ethno-linguistic fractionalization in affecting cooperative growth. Column (1) of table 6 shows that the same is true for religious fractionalization. Although the coefficient now has a negative sign, it is still not statistically significant. This does not change when we use polarization measures in column (2). We cannot attribute these results to the endogeneity of the population distribution to price shocks or cooperative growth itself (column (6), table F.1).

However, the effect of fractionalization could be obscured, if ethno-linguistic or confessional groups differ by characteristics that are relevant to founding or operating MFIs.

[50] Splitting the sample at the spike in the year 1894 reveals that the saturation effect is only present in later years, whereas the coefficient on lagged stocks in earlier years is positive and thus consistent with demonstration effects. We also included the lagged *growth* of cooperatives as regressors in an AR(5) and AR(10) model, but this similarly left the coefficients on prices and the cross-sectional variables of interest unaltered.

[51] Other cooperatives include production, consumption, and resource cooperatives. The latter two were mainly concerned with attaining monopsony power in purchasing consumption goods or raw materials.

Table 6: Determinants of credit cooperative growth, county level, Prussia: **Ethno-linguistic heterogeneity**

	(1) Religious fractionalization	(2) Linguistic polarization	(3) Share of Polish speakers	(4) Share of Protestants	(5) Inequality interaction	(6) Ethnic inequality
	Dependent Variable: Number of new credit cooperatives per county					
Δ grain prices	-38.4109***	-38.4040***	-38.3615***	-38.4115***	-38.4364***	-38.4159***
	(3.0575)	(3.0580)	(3.0464)	(3.0583)	(3.0635)	(3.0509)
population	0.0069***	0.0068***	0.0067***	0.0069***	0.0067***	0.0066***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
ling. fractionalisation			0.3259+		-0.2814	0.1686
			(0.1682)		(0.4115)	(0.1540)
farm size	0.1422***	0.1403***	0.1327***	0.1422***	0.1361***	0.1387***
	(0.0345)	(0.0347)	(0.0347)	(0.0343)	(0.0345)	(0.0348)
farm size sq	-0.0039**	-0.0039**	-0.0037**	-0.0039**	-0.0037**	-0.0038**
	(0.0012)	(0.0013)	(0.0012)	(0.0012)	(0.0013)	(0.0013)
land inequality	-0.8495***	-0.8465***	-0.7204***	-0.8511***	-1.0044***	-0.8324***
	(0.2003)	(0.2019)	(0.2163)	(0.2005)	(0.2809)	(0.2045)
rel. fractionalisation	-0.2082			-0.2106		
	(0.2789)			(0.2740)		
ling. polarization		0.0746				
		(0.0805)				
Polish share			-0.2996*			
			(0.1345)			
Protestant share				0.0049		
				(0.1623)		
ling. frac. $\times$ land inequality					1.0399	
					(0.9815)	
religious inequality						0.4579
						(0.4674)
District F.E.	✓	✓	✓	✓	✓	✓
Urbanization controls	✓	✓	✓	✓	✓	✓
Policy dummies	✓	✓	✓	✓	✓	✓
Observations	14632	14632	14632	14632	14632	14632
No. of cooperatives	4941	4941	4941	4941	4941	4941

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices refers to the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Policy dummies refers to time varying dummies capturing reform of limited liability, central bank and incorporation law. Other variables are time invariant. Urbanization controls include the share of the population resident in urban areas and a dummy for suburban counties. See tables B.1 and B.2 in the appendix for further definitions. All specifications are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

For example, an influential literature accords higher human capital formation (Becker and Wößmann, 2009) or entrepreneurial productivity (Hornung, 2014) to Protestants in Prussia. Moreover, ethnic Poles were likely to have received less education than Germans, as ethnically Polish areas received less funding from the Prussian government (Cinirella and Schueler, 2016). In this case, our fractionalization indices could be capturing the effect of moving along the population's skill distribution. In column (3) and (4) we therefore control for the share of Polish speakers and Protestants respectively. In the first case, the positive coefficient on linguistic fractionalization becomes marginally significant. The sign on the share of Polish speakers shows that Polish areas were indeed somewhat less likely to see credit cooperatives develop.

It could also be that ethnic heterogeneity only matters if it is correlated with economic inequality (Alesina et al., 2016). For example, O'Rourke (2007, p. 1375) shows for Irish cooperatives that it is "this coincidence between religious, national and class divisions within Ireland that was crucial for the slow spread of cooperation". On the other hand, in the context of the model in section 2, if the wealthy resort to bank loans, and wealth and ethnicity overlap, the remaining cooperative group could be more homogenous. This could actually lower their internal transaction costs. We tackle these possibilities by interacting linguistic fractionalization and land inequality in column (5) as well as calculating our own measure of religious inequality in column (6).[52] However, neither measure yields significant results. Importantly, none of the other coefficients in the model are affected, including our baseline measure of land inequality. We therefore conclude that there is no consistent role for population heterogeneity in our results.

4.5 Cooperative characteristics and further robustness

Until this point, we have pooled all credit cooperatives in our data set. However, our data does allow us to differentiate cooperatives according to their characteristics, in particular the liability structure and deposit requirements adopted at the end of the sample. We first exclude all cooperatives in counties with an urban population above the median in column (1) of table F.5. We do this as urban cooperatives often followed the organizational model of Schulze-Delitzsch rather than the Raiffeisen model, which dominated in rural areas. However, we do not find that this changes the results. Similarly, we do not find in column (2) that only including cooperatives that had opted for unlimited joint liability by 1913

[52] We measure the extent to which members of either the Protestant or Catholic confession are overrepresented among land-holding farmers in a county. Data is from the 1882 Prussian occupational census. For groups A, B in county i:
$religious\ inequality_i = \left| \frac{Farmers_{A,\,i}}{Total\ employed\ in\ agriculture_{A,\,i}} - \frac{Farmers_{B,\,i}}{Total\ employed\ in\ agriculture_{B,\,i}} \right|$

affects our conclusions.[53] The subset of unlimited liability cooperatives can be further decomposed according to the minimum capital contribution required by the cooperative. Reassuringly, we find cooperatives requiring "large" contributions (above 100 Mark) in column (4) to be more affected by the distribution of assets in their county than those at or below this threshold in column (3).[54] The role of price shocks is apparent for both categories.

One remaining concern could be that our results are driven by a few instances of particularly drastic price changes. One episode that stands out in figure 1c is the rapid fall in grain prices in the early 1890s, which preceded a large growth episode for credit cooperatives. In column (2) of table F.6 we check whether excluding this spike affects our conclusions. Although the coefficient on grain prices turns out to be smaller, we conclude that this episode alone does not drive our story. A related worry could be that this large price shock acted as a structural break, fundamentally altering the relationship between our variables. Yet inspecting columns (3) and (4) does not suggest that significant differences exist before and after the shock, although the effect of land inequality is weaker after the 1890s as noted in section 4.2.

We also check whether our benchmark results are robust to changes in the cross-sectional sample composition. Table F.7 follows a Jackknife approach and drops all observations from one of our six provinces in turn. The stability of the coefficients show that our results are unlikely to be driven by outliers.

Finally, we investigate the sensitivity of our results to changes in the econometric specification. Three issues in particular are important. Firstly, one might worry about the large proportion of zero-outcomes in our data. Our Poisson model pooled the zero and non-zero outcomes, while the data generating process for both could be different. One common remedy are zero-inflated models, which allow both processes to differ (Cameron and Trivedi, 2013). We implement these models in column (1) and (2) of table F.8, but do not find that it affects our conclusions. Secondly, we relax our assumption that co-op growth follows a Poisson distribution. Columns (3) and (4) implement a regular and zero-inflated Negative Binomial model respectively. Once again, this does not change our results. Thirdly, we regress our count variable on the natural logarithms of all independent variables in column (5) using Ordinary Least Squares. In column (6), we do the same for the logarithmic transformation of the co-op growth rate. Although these are not our

[53] The principle of unlimited liability was largely followed by Raiffeisen cooperatives, and was one of the main distinguishing features of that organisational model.

[54] 100 Mark was equal to roughly 50 days of work at 1913 average wages.

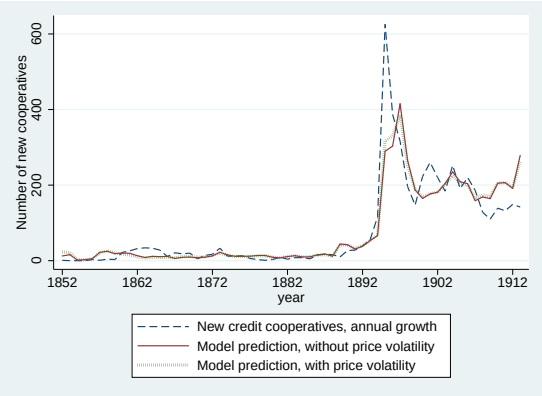
specifications of choice, as they ignore the count nature of the data, it is reassuring that our conclusions do not depend on specific functional forms.

4.6 Model fit, economic significance and counterfactual analysis

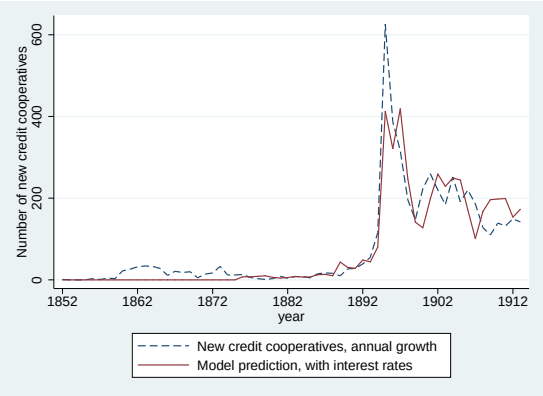
The previous sections have been mainly concerned with investigating the extent to which the data supported the predictions of our theoretical framework. Now we turn to economic significance: to what degree have we actually explained the rise of credit cooperatives?

Our first concern is model fit over time. Figure 3a plots the data on aggregate growth of cooperatives (dashed line) against the aggregate annual predicted values from the benchmark specification (red solid line). This solid line only reflects price changes and policy dummies. The prediction tracks the data quite closely. Clearly, the policy dummies account for the level differences after the 1890s, highlighting the importance of the institutional environment for small scale credit. Still, the grain price variable is able to replicate many turning points in the data. Would including more time-varying determinants further improve model fit? The third line in panel 3a plots the benchmark specification after the inclusion of price volatility. However, price volatility does not add much explanatory power. In panel 3b we substitute price volatility for interest rates, which creates a very good model fit. We conclude that we are able to largely explain the development of rural microcredit with reference to only prices and interest rates.

Figure 3: Model fit over time



(a) Data outcome and model fit with price volatility

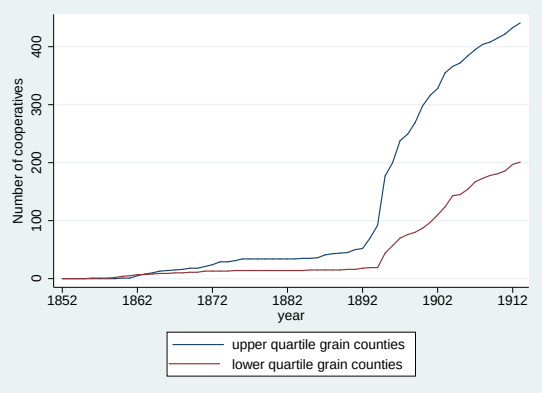


(b) Data outcome and model fit with interest rates

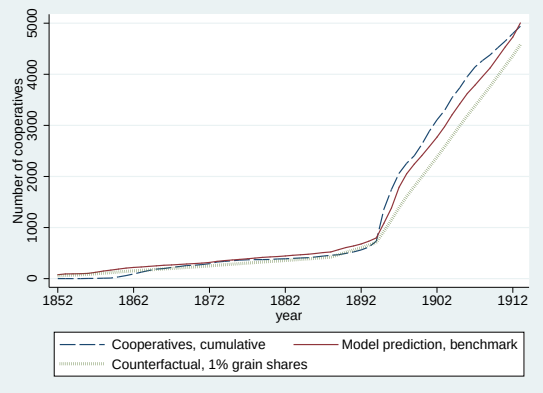
Our price variable consists of the interaction between temporal price changes and local land use structure. How important is local variation in land use in determining the final number of cooperatives? In figure 4a we plot the rapid increase in the cumulative num-

ber of cooperatives for the counties in the highest quartile of the distribution for both rye and wheat cultivation. This is in contrast to the sluggish evolution of co-ops in low-grain countries. This descriptive evidence suggests that differences in cross-sectional reliance on grain may be an important determinant of the final number of cooperatives. Figure 4b engages in a counterfactual experiment by setting local rye and wheat shares to the first percentile in their respective distributions. The counterfactual evolution of cooperatives is slower than the benchmark model prediction, although cross-sectionally induced differences seem relatively small compared to high average growth rates over time.

Figure 4: Role of rye and wheat cultivation for cumulative growth of cooperatives: Descriptive statistics and counterfactual



(a) Lowest and highest quartile grain countries



(b) Counterfactual grain shares at lowest 1%

Having established the explanatory power of our model over time, our next interest is the relative importance of individual variables. In table 7 we list all statistically significant coefficients from our benchmark specification. The coefficients are converted into a count data equivalent of standardized β-coefficients (last column).[55] Grain price movements clearly had a large impact: One standard deviation increase in relative grain prices decreases the growth rates of credit cooperatives by a factor of 0.66. Asset size plays a large role too- a one standard deviation sized increase in farm sizes almost doubles co-op growth. The role of population is more muted, and the increase in the co-op growth rate to an increase in population is underproportional. Similarly, asset inequality seems to have exercised a modest influence. However, this could partially be attributed to the relatively limited variation in inequality in our sample. To examine this, we turn to counterfactual simulations.

[55] $\beta_{standard}$ shows the factor change in the co-op growth rate as a response to a change in the independent variable. A value close to 1 thus signifies a small effect.

Table 7: Economic significance: Factor change in growth rate of credit cooperatives after one standard deviation change in independent variables (last column)

Variable	Coefficient (β_x)	Incidence Rate Ratio (IRR)	Standard deviation of independent variable σ_x	$\beta_{standard}$
Δ grain prices	-38.399	2.107E-17	0.011	**0.66**
Population	0.007	1.007	32.74	**1.25**
farm size	0.141	1.151	4.81	**1.97**
farm size squared	-0.004	0.996	133.61	**0.59**
land inequality	-0.849	0.428	0.172	**0.86**
urbanization	-1.351	0.259	0.211	**0.75**
limited liability	1.592	4.914	(dummy)	(dummy)
central bank	1.389	4.010	(dummy)	(dummy)

coefficient (β_x): as displayed in the benchmark regression (3), table 1

IRR: Factor change in co-op growth after 1 unit change in independent variable ($\exp(\beta_x)$)

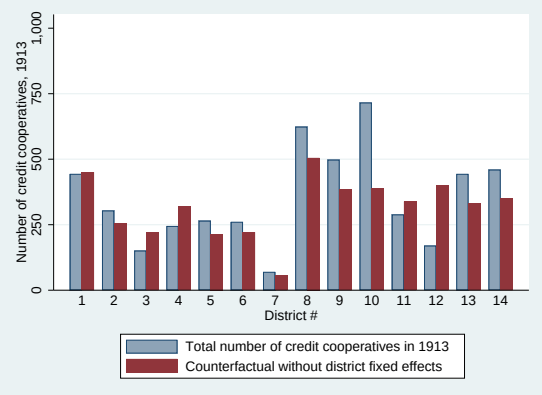
$\beta_{standard}$: Factor change in co-op growth after 1 std. dev. change in independent variable ($\exp(\beta_x * \sigma_x)$)

Graph 5a plots the final number of credit cooperatives in 1913 for all of our 14 districts.[56] By virtue of the district fixed effects, this is equal to the predicted values of the benchmark regression by district (not shown). The first counterfactual consists of setting the fixed effects to 0, and shows that a large share of the variation is explained by the remaining covariates.

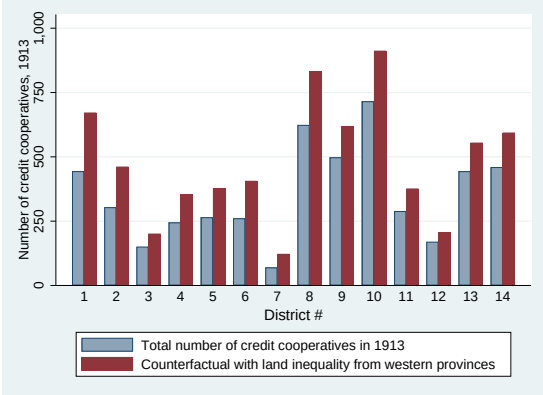
Given the relatively limited variation in inequality in the sample, we need to consider a "radical" policy experiment to see the effect of changes in this variable. In graph 5b, we set land inequality to the level prevailing in the western provinces of Prussia, which is on average 2 standard deviations lower than our sample mean. This leads to a non-trivial counterfactual change in the number of credit cooperatives. In particular the most unequal districts (comprising the province of Posen, see table D.1) would have seen a 50% increase in the number of micro credit institutions.

We have shown asset size to be both statistically and economically highly significant. However, the direction of the economic effects is hump-shaped. We illustrate this using a "moderate" and a "radical" policy experiment. Both experiments rely on the distribution of assets within the county (inequality) remaining unchanged, while the mean is allowed to change. In the moderate experiment (graph 5c) we increase average farm size by 10 % in all counties. The result is a modest counterfactual increase in the number of cooperatives in all districts, suggesting that most counties were below the hump. In the radical experi-

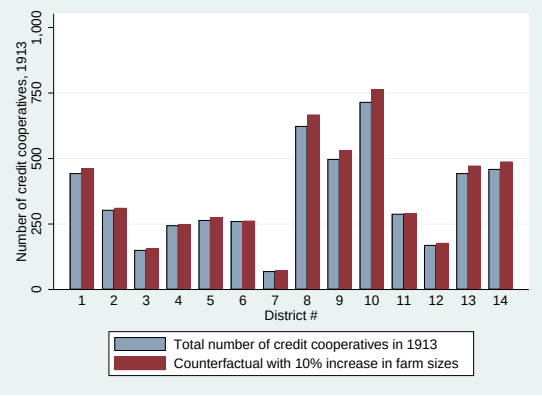
[56] District numbers correspond to those defined in table D.1.



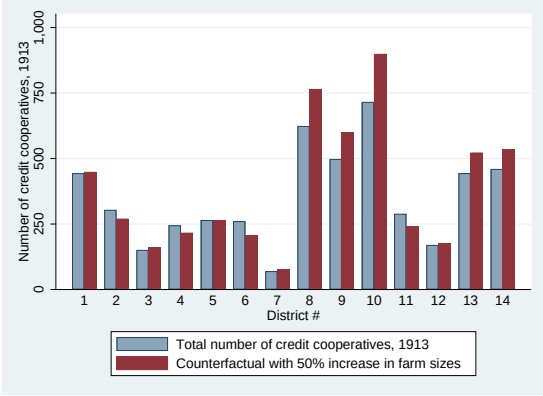
(a) Counterfactual without district fixed effects



(b) Counterfactual with western Prussian land inequality



(c) Counterfactual with 10% farm size increase



(d) Counterfactual 50% farm size increase

Figure 5: Data outcomes and counterfactual scenarios: final number of cooperatives in 1913 at the district level.

ment (graph 5d), we increase farm sizes by 50 %. In this case, the negative impact of the quadratic term on farm size dominates in some regions. While districts marked by small farms gain a lot, others see a counterfactual decrease in cooperative activity. As in theory, large increases in assets causes potential borrowers to substitute bank for small-scale cooperative credit.

5 Conclusion

Starting from a simple theoretical framework, we have derived a number of factors that explain the development of rural micro credit both across time and space. We provided empirical evidence on the development of micro finance in a free market benchmark case without public ownership, subsidization and under a minimal regulatory environment: the

six eastern provinces of Prussia between 1852 and 1913. Our results show that asset sizes, asset inequality, interest rates, and relative prices of agricultural staples explain a large share of the variation in credit cooperatives. We argued that these price movements can be seen as one driver of structural transformation, and that micro credit can potentially play a part in rural adaption to this transformation.

We briefly point to two extensions and one implication of our findings.

Firstly, our approach has explained the development of micro credit institutions as partly depending on complementary financial infrastructure from banks. However, we have not accounted for informal village money lenders, partly because such data is lacking for our period. A recent literature studies the impact of competition between MFIs and money lenders on market outcomes, including interest rates (Mookherjee and Motta, 2016; Demont, 2016). It would be interesting to extend our results in this dimension and examine how the entry decisions of MFIs depends on existing informal money lending.

Secondly, although we have considered economic inequality and ethnic heterogeneity, we have abstracted from many other individual characteristics of potential borrowers. As Ghatak (1999) has classically shown, information about individual-level riskiness can influence group formation through assortative matching. Future research could investigate to what extent regional differences in information dissemination, network structures and group cohesion impact the dispersion of micro credit institutions.

Lastly, we discuss the implications of our focus on long-run structural transformation for understanding the impact of micro credit. We have presented a scenario with two production sectors available to farmers, with sector profitability trending in opposite directions. It follows, firstly, that micro credit uptake will only occur in a limited time frame, namely when sector profits are close enough for switching to be feasible. Secondly, in such a setting there is likely to be a market demand for medium term loans rather than short term financing. Thirdly, if microcredit allows farmers to exit a declining sector, a comparison between their pre- and post credit incomes will not necessarily reveal an "impact" of microfinance on incomes. A more relevant outcome metric would be changes in the sector of economic activity. In this sense, microfinance may be better understood as aiding adaption to a changing environment (Goodspeed, 2016) or as broadening choices (Banerjee et al., 2015), rather than as a tool allowing rural populations to escape poverty.

Appendix to 'Rural transformation, Inequality, and the Origins of Microfinance'

A Mathematical proofs

We now allow the number of cooperatives C to exceed one. In effect, producers can now minimize the cost of capital by founding optimal clubs, subject to the constraints imposed by the region's population distribution. Given two ethnic groups, what is the optimal number of clubs C, and their optimal composition in terms of N_c, H_c? Employing the following two Lemmas is convenient:

LEMMA 1

Segregation ($H_c = 0$) is always optimal if $C = 2$.

PROOF:
The claim is that the cost of capital is smaller under segregation $(H_{c,s}, N_A;\ H_{c,s}, N_B)$ than under any alternative allocation $(H_{c,1}, N_{c,1};\ H_{c,2}, N_{c,2})$ if $C = 2$:

$$\left(r_b + \frac{1}{\delta q N_A} + H_{c,s}\right) N_A + \left(r_b + \frac{1}{\delta q N_A} + H_{c,s}\right) N_B < \left(r_b + \frac{1}{\delta q N_{c,1}} + H_{c,1}\right) N_{c,1} + \left(r_b + \frac{1}{\delta q N_{c,2}} + H_{c,1}\right) N_{c,2}$$

Exploiting the fact that $H_{c,s} = 0$ under segregation, multiplying out the brackets yields:

$$r_b N_A + \frac{1}{\delta q} + r_b N_A + \frac{1}{\delta q} < r_b N_{c,1} + \frac{1}{\delta q} + H_{c,1} N_{c,1} + r_b N_{c,2} + \frac{1}{\delta q} + H_{c,2} N_{c,2}$$

Simplifying and eliminating yields:

$$r_b(N_A + N_B) < r_b(N_{c,1} + N_{c,2}) + H_{c,1} N_{c,1} + H_{c,2} N_{c,2}$$

Using the fact that $N_A + N_B = N$ and $N_{c,1} + N_{c,2} = N$ and eliminating surplus terms:

$$0 < H_{c,1} N_{c,1} + H_{c,2} N_{c,2}$$

which is true unless $(H_{c,1}, H_{c,2}) = (0, 0)$, that is unless both alternative clubs are perfectly segregated too. □

The intuition behind Lemma 1 is as follows: Consider the case of a very small linguistic minority, consisting of two producers, setting up their own club, thus facing very high

capital costs. But shifting one member of this minority into the larger club will incur both a substantial size penalty on the remaining member as well as a heterogeneity penalty on the larger club that cannot be compensated by the small size benefit gained by the large club.

LEMMA 2

For two ethno-linguistic groups the optimal number of clubs is $C \leq 2$.

PROOF:
The claim is that $C > 2$ can never be optimal in the presence of two ethnic groups.

We know from Lemma 1 that segregation is optimal for $C = 2$. The proof is therefore a simple extension from the previous proof. For $C = 3$ we would have:

$$\left(r_b + \frac{1}{\delta q N_A} + H_{c,s}\right) N_A + \left(r_b + \frac{1}{\delta q N_A} + H_{c,s}\right) N_B$$
$$< \left(r_b + \frac{1}{\delta q N_{c,1}} + H_{c,1}\right) N_{c,1} + \left(r_b + \frac{1}{\delta q N_{c,2}} + H_{c,1}\right) N_{c,2} + \left(r_b + \frac{1}{\delta q N_{c,3}} + H_{c,3}\right) N_{c,3}$$

It is clear that adding any additional club to the right-hand side cannot negate the inequality. □

The relevant decision for Proposition 2 is now between one mixed club ($C = 1$) and the segregated option with $C = 2$.

PROPOSITION 2

Founding two cooperatives rather one cooperative will minimize r_c if:

$$qH_N N > \frac{1}{\delta}$$

PROOF:
We want to find the conditions under which $C = 2$ will minimize capital costs.

First note that if individual collateral $q \geq q_T$, $C = 0$, i.e. an individual solution with bank loans, is always optimal compared to any cooperative by construction.

We also know from Lemma 2 that $C > 2$ can be excluded.

$C = 1$, in turn, will offer higher costs than $C = 2$ if:

$$\left(r_b + \frac{1}{\delta q N} + H_N\right) N > \left(r_b + \frac{1}{\delta q N_A}\right) N_A + \left(r_b + \frac{1}{\delta q N_B}\right) N_B$$

Where we have made use of the result from Lemma 1 that under $C = 2$, $H_c = 0$. Multiplying out:

$$r_b + \frac{1}{\delta q N} + H_N > r_b \frac{N_A}{N} + \frac{1}{\delta q N} + r_b \frac{N_B}{N} + \frac{1}{\delta q N}$$

Eliminating and multiplying by N:

$$r_b N + H_N N > r_b (N_A + N_B) + \frac{1}{\delta q}$$

Using $N_A + N_B = N$, eliminating and rearranging:

$$q H_N N > \frac{1}{\delta}$$

which is the inequality proposed. □

B Summary Statistics

Table B.1: Summary statistics: Dependent variables

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
credit cooperatives	Total number of credit cooperatives	14632	5.241	8.574	0	63
Δ credit cooperatives	Total number of credit cooperatives, change	14632	0.338	1.038	0	21
Production cooperatives	Total number of production cooperatives	14632	0.828	2.014	0	21
Δ production cooperatives	Total number of production cooperatives, change	14632	0.061	0.298	0	6
Other cooperatives	Total number of non-credit cooperatives	14632	1.168	3.139	0	64
Δ other cooperatives	Total number of non-credit cooperatives, change	14632	0.137	0.85	0	36
Δ unlimited cooperatives	Number of cooperatives under unlimited liability, change	14632	0.288	0.975	0	21
Δ poor cooperatives	Number of cooperatives with deposit size $<$100 Mark, change	14632	0.158	0.752	0	21
Δ rich cooperatives	Number of cooperatives with deposit size $\geq$100 Mark, change	14632	0.13	0.653	0	17
Δ dairy cattle	county-level change in dairy cow headcount 1868-1906	236	3651.6	3373.4	-12744	21275
Δ beef cattle	county-level change in beef cattle headcount 1868-1906	236	8781.9	7160.4	-23837	47929
Δ pigs	county-level change in pigs headcount 1868-1906	236	21451.7	12855.7	-12962	71982

Table B.2: Summary statistics: Independent variables

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
	Prices					
grain prices	Weighted rye & wheat prices / CPI	14632	0.259	0.099	0.015	0.719
Δ grain prices	Weighted rye & wheat prices / CPI, change	14632	-0.003	0.034	-0.18	0.136
grain prices, US	Weighted rye & wheat prices / CPI, USA	14632	0.305	0.148	0.013	1.046
Δ grain prices, US	Weighted rye & wheat prices / CPI, USA, change	14632	-0.008	0.056	-0.232	0.226
grain prices, butter	Weighted rye & wheat prices, butter deflator	14632	0.232	0.094	0.015	0.716
Δ grain prices, butter	Weighted rye & wheat prices, butter deflator, change	14632	-0.002	0.037	-0.229	0.138
Grain price volatility	5-year moving average standard deviation of Δ grain prices	14632	0.032	0.026	0.001	0.199
	Other time varying variables					
limited liability	Co-ops eligible for limited liability (1889)	14632	0.403	0.491	0	1
central bank	Central bank for credit co-ops founded (1895)	14632	0.306	0.461	0	1
incorporation	Co-ops granted status as legal person (1867)	14632	0.758	0.428	0	1
population, varying	Time varying county population, '000	14632	55.283	42.463	14.312	1130.819
linguistic frac., varying	Time varying population heterogeneity, index	14632	0.188	0.198	0	0.648
Δ banks	5-year moving average of bank foundations	12508	0.164	0.418	0	6
GDP growth	Annual German GDP growth, %	14632	1.578	2.503	-3.798	7.842
GDP growth, UK	Annual UK GDP growth, %	14632	1.014	2.502	-5.156	8.39
interest rate	Annual mean commercial interest rate, %	8968	3.17	0.793	1.74	5.12
interest rate, UK	Annual mean Bank of England discount rate, %	14632	3.644	1.125	2	7.333
	Time invariant variables: demographics					
population	County population in 1890, '000	14632	56.388	32.742	18.737	335.186
population growth	County population growth, 1858-1910, %	14632	0.508	1.094	-0.467	11.641
Polish share	Share of Polish speakers in 1890	14632	0.226	0.311	0	0.926
Protestant share	Share of Protestants in 1890	14632	0.656	0.347	0.026	0.996
linguistic fractionalization	Linguistic population heterogeneity in 1890, index	14632	0.183	0.199	0.001	0.633
religious fractionalization	Religious population heterogeneity in 1890, index	14632	0.22	0.177	0.008	0.53
linguistic polarization	Linguistic population heterogeneity in 1890, index	14632	0.349	0.375	0.002	0.995
population density	Population density in 1900	14632	5.194	29.407	0.287	413.338
migration	Net immigration, 1895-1905, %	14632	-4.319	5.474	-11.9	28.55
urbanization	Share of population in urban settlements, 1868	14632	0.261	0.211	0	1
suburban	County surrounding a town	14632	0.085	0.279	0	1
illiteracy	Share of illiterates in the population, 1871	14632	0.162	0.115	0.017	0.597
	Time invariant variables: land					
farm size	Mean farm size, 1882, hectares	14632	12.697	4.809	1.742	31.956
land inequality	Share of total arable land in top size category, 1882	14632	0.451	0.172	0	0.821
land inequality (top 2)	Share of total arable land in top 2 size categories, 1882	14632	0.529	0.169	0	0.903
Gini	Gini index of farm size inequality, 1882	14632	0.799	0.079	0.424	0.952
rye share	Share of total land used for rye, 1878	14632	0.144	0.04	0.014	0.236
wheat share	Share of total land used for wheat, 1878	14632	0.03	0.03	0	0.158
rye share 1852	Share of total land used for rye, 1852	14632	0.143	0.039	0.015	0.227
wheat share 1852	Share of total land used for wheat, 1852	14632	0.026	0.027	0	0.145
soil quality	Excellent share of agricultural land	14632	0.196	0.248	0	0.997
religious inequality	Occupational inequality between confessions, 1882	14632	0.098	0.066	0.001	0.331
	Time invariant variables: economic controls					
banks, 1852	Total number of banks, 1852	14632	0.589	0.734	0	3
industrial employment	Share of employment in manufacturing, 1882	14632	0.135	0.063	0.014	0.5
wages	Mean daily wages, 1892, Mark	14632	1.287	0.244	0.85	2.5
income growth	Growth in labor incomes per capita, 1880-1905	14632	89.026	16.473	36.452	145.794
public spending	Share of public spending in total education spending, 1886	14632	0.59	0.276	0.02	1
pupil-teacher ratio	Pupil-teacher ratio in schools, 1886	14632	78.233	13.389	49.153	120.214
	Time invariant variables: geography					
market potential	Weighted distance to markets, 1868	14632	0.818	0.267	0.424	2.796
Berlin distance	Great circle distance to Berlin, 100 km	14632	2.955	1.527	0.048	6.5
Raiffeisen distance	Great circle distance to Neuwied, 100 km	14632	7.215	1.697	4.058	11.239
military settlers, mean	Mean distance to medieval military settlements, 100 km	14632	3.284	1.341	1.058	5.784
military settlers, min.	Min. distance to medieval military settlements, 100 km	14632	1.931	1.215	0.004	4.388
latitude	Geographical latitude, decimal coordinates	14632	52.579	1.392	49.52	55.72
longitude	Geographical longitude, decimal coordinates	14632	17.059	2.408	11.87	22.57

C Additional figures

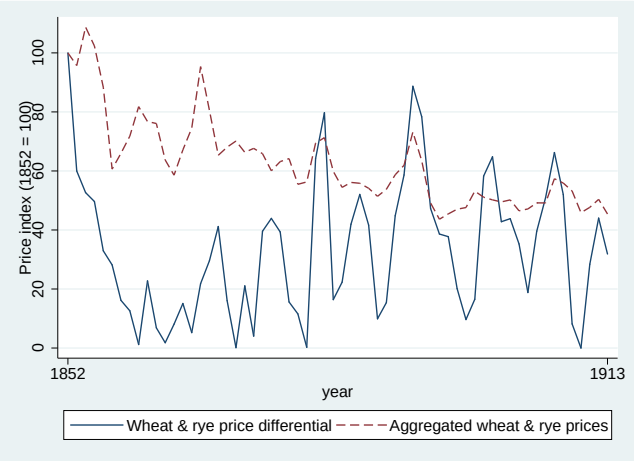


Figure C.1: Rye and wheat price differential and aggregated grain prices, deflated by consumer prices, index

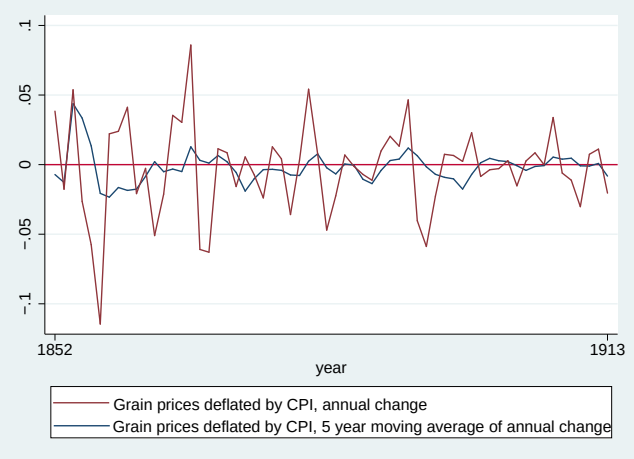


Figure C.2: Grain prices deflated by consumer prices, first differences

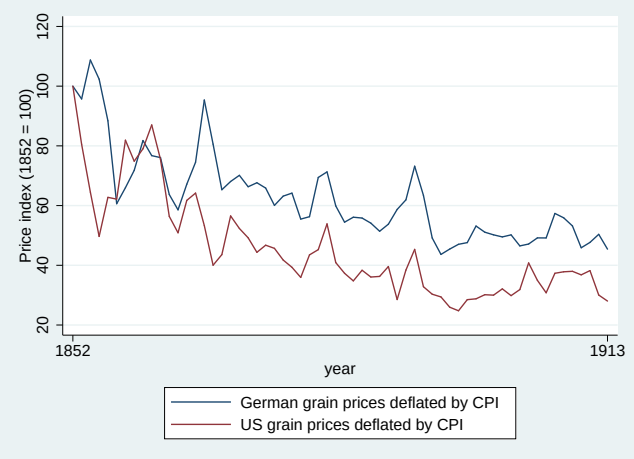


Figure C.3: Grain prices deflated by consumer prices, German and US prices

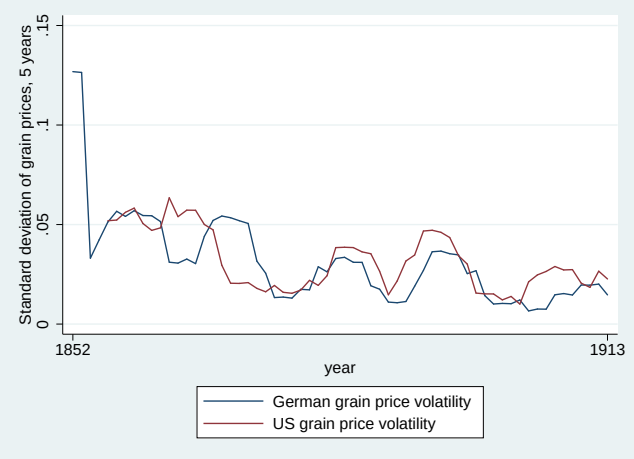


Figure C.4: German and US volatility of grain prices over time, deflated by consumer prices

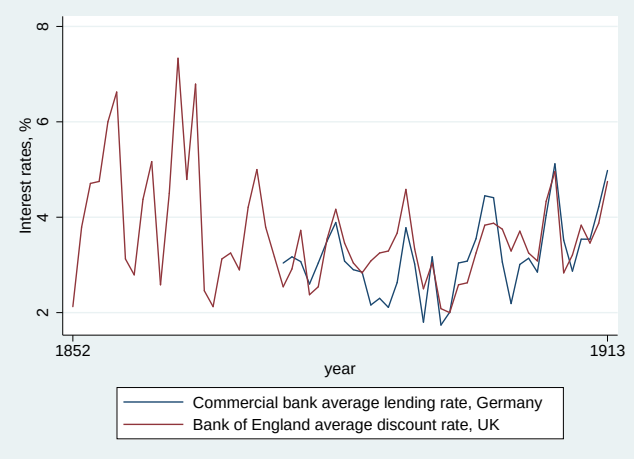


Figure C.5: German commercial and Bank of England lending rates

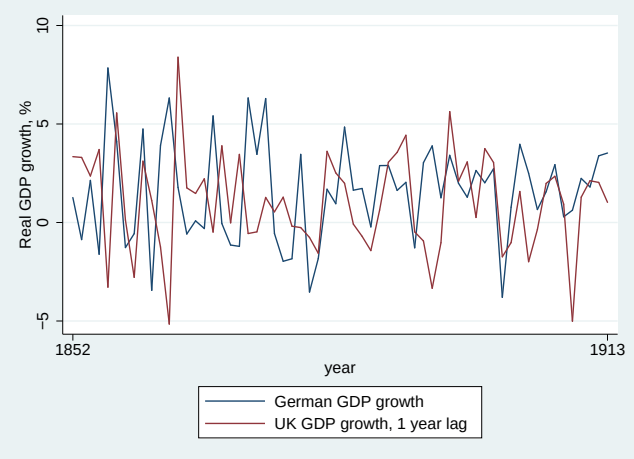


Figure C.6: German and United Kingdom real GDP growth rates

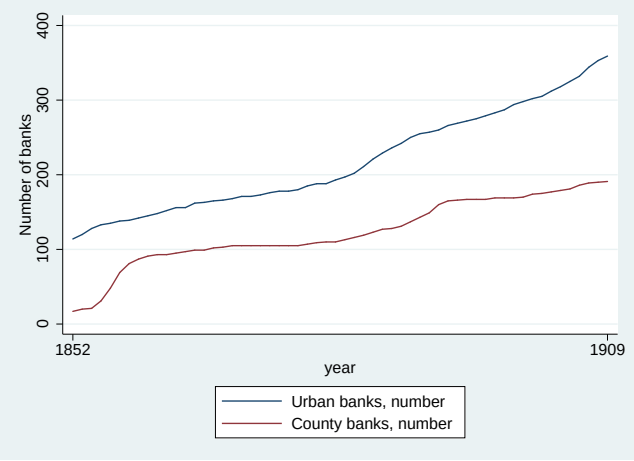


Figure C.7: Urban and county savings banks in the six provinces

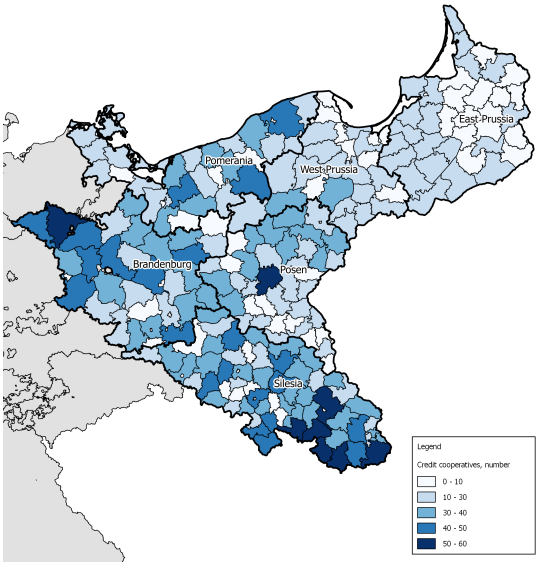
D Administrative divisions

Table D.1: Administrative divisions: the eastern six provinces of Prussia

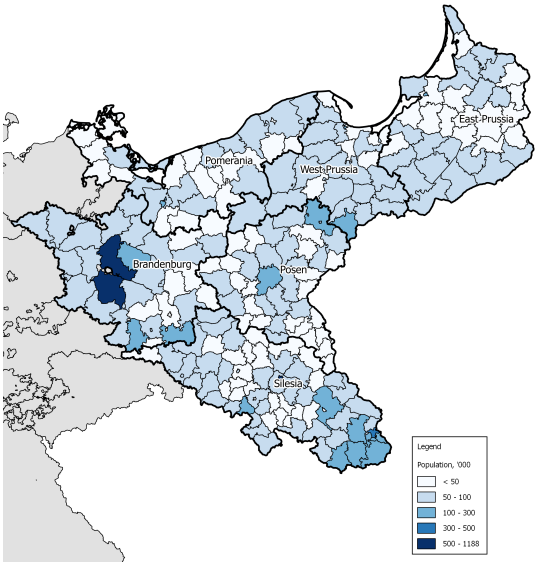
Prov. #	Province	District #	District	Counties per district
1	Posen	1	Posen	26
		2	Bromberg	14
2	West Prussia	3	Danzig	12
		4	Marienwerder	15
3	Pomerania	5	Stettin	13
		6	Köslin	13
		7	Stralsund	5
4	Silesia	8	Breslau	25
		9	Liegnitz	21
		10	Oppeln	20
5	East Prussia	11	Königsberg	20
		12	Gumbinnen	16
6	Brandenburg	13	Potsdam	16
		14	Frankfurt (Oder)	20
	Total			**236**

Administrative divisions are as used in the empirical analysis, and reflect status of 1900. Small independent towns and their surrounding county are grouped together. Berlin and counties becoming part of Berlin before 1914 are excluded.

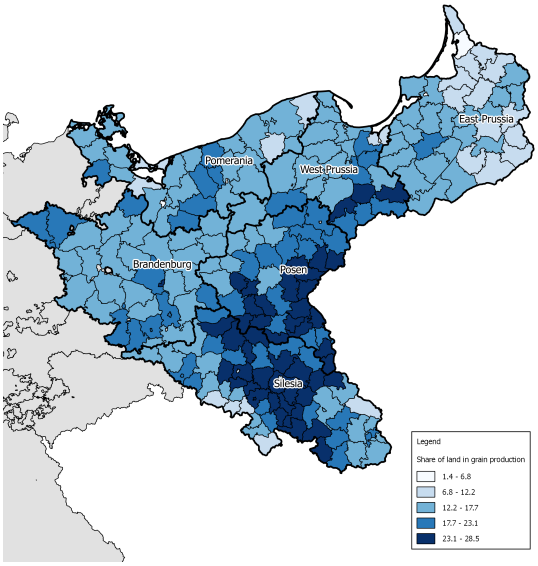
E Maps



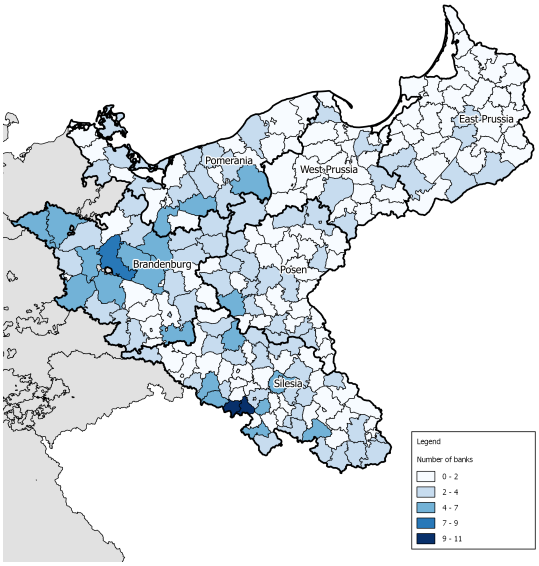
(a) Number of credit cooperatives



(b) Population, '000

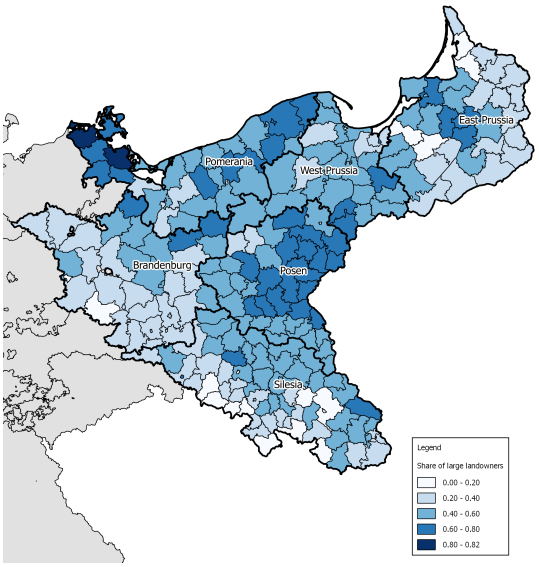


(c) Rye and wheat cultivation, % of total land

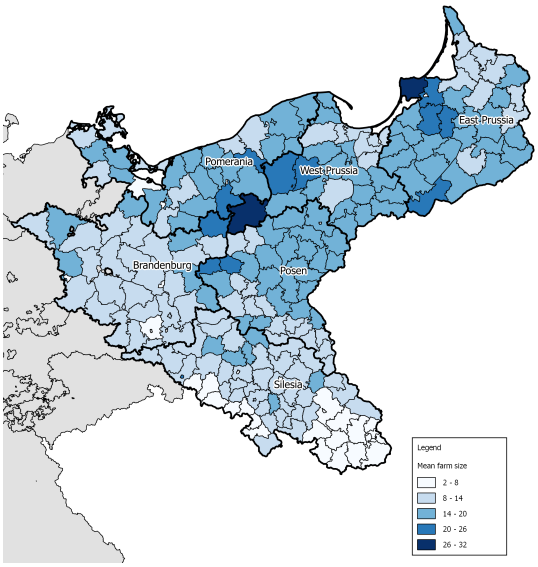


(d) Number of banks

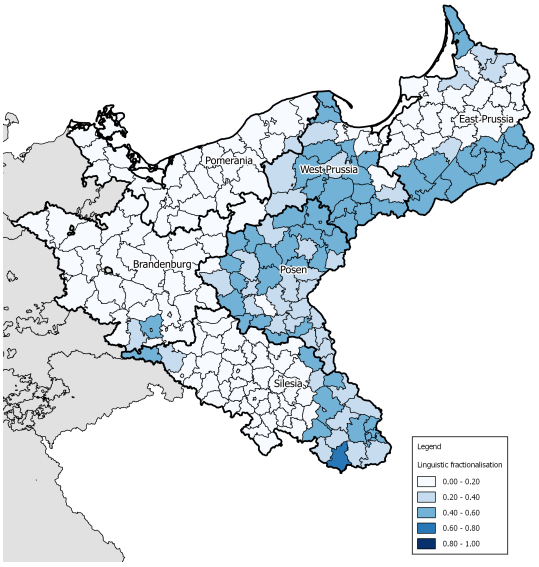
Figure E.1: Count of credit cooperatives and selected independent variables, 1913



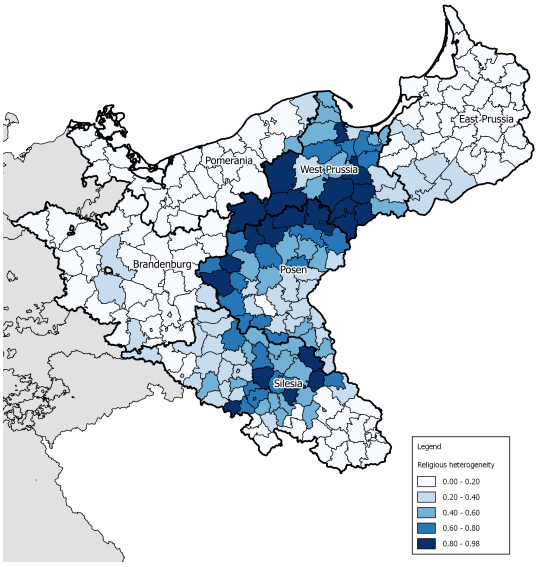
(a) Inequality: share of land under large landowners



(b) Mean farm size, hectares



(c) Linguistic fractionalization, index



(d) Religious polarization

Figure E.2: Selected independent variables, 1913

F Additional results

Table F.1: Determinants of credit cooperative growth, county level, Prussia: **Controls**

	(1) Wages & income growth	(2) migration & illiteracy	(3) population density & growth	(4) Latitude & Longitude	(5) Time varying population & heterogeneity	(6) Population & heterogeneity fixed in 1852
	Dependent Variable: Number of new credit cooperatives per county					
Δ grain prices	-38.2366***	-38.4741***	-38.6381***	-38.5431***	-38.6481***	-38.1804***
	(3.0214)	(3.0209)	(3.0286)	(3.0648)	(3.0413)	(3.0046)
limited liability	1.5916***	1.5923***	1.5929***	1.5926***	1.5868***	1.5911***
	(0.1539)	(0.1537)	(0.1537)	(0.1539)	(0.1539)	(0.1538)
central bank	1.3891***	1.3887***	1.3883***	1.3882***	1.3683***	1.3898***
	(0.1410)	(0.1410)	(0.1409)	(0.1411)	(0.1411)	(0.1410)
incorporation	0.0660	0.0670	0.0678	0.0675	0.0598	0.0656
	(0.1312)	(0.1313)	(0.1313)	(0.1313)	(0.1313)	(0.1312)
population	0.0086***	0.0082***	0.0090***	0.0069***		
	(0.0013)	(0.0014)	(0.0017)	(0.0013)		
ling. fractionalisation	0.1226	0.1475	0.2414+	0.1216		
	(0.1427)	(0.1476)	(0.1280)	(0.1537)		
farm size	0.0777*	0.1228***	0.1015**	0.1384***	0.1020**	0.0721**
	(0.0357)	(0.0326)	(0.0322)	(0.0342)	(0.0339)	(0.0264)
farm size squared	-0.0021+	-0.0035**	-0.0026*	-0.0038**	-0.0029*	-0.0019*
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0009)
land inequality	-0.6882***	-0.7622***	-0.8057***	-0.8866***	-0.7871***	-0.6137**
	(0.1935)	(0.2118)	(0.2053)	(0.2109)	(0.2158)	(0.1870)
wages	-1.0554***					
	(0.2281)					
income growth	-0.0016					
	(0.0013)					
Protestant share	0.0127					
	(0.1586)					
urbanisation	-1.0980***	-1.3080***	-1.4033***	-1.3868***	-1.2479***	-1.0874***
	(0.2509)	(0.2684)	(0.2790)	(0.2718)	(0.3008)	(0.2653)
suburbs	-0.0753	-0.0340	-0.0305	-0.1292	-0.0373	0.0857
	(0.1228)	(0.0949)	(0.0931)	(0.1151)	(0.1381)	(0.1163)
migration		-0.0283***				
		(0.0061)				
illiteracy		-0.5723				
		(0.4059)				
Berlin distance			0.0295			
			(0.0458)			
population density			-0.0010			
			(0.0021)			
population growth			-0.1194***			
			(0.0266)			
latitude				0.1020+		
				(0.0581)		
longitude				-0.0287		
				(0.0348)		
population, varying					0.0015*	
					(0.0006)	
ling. frac., varying					0.1845	
					(0.1871)	
population, 1852						0.0000**
						(0.0000)
ling. frac., 1852						0.1730
						(0.1412)
District F.E.	✓	✓	✓	✓	✓	✓
Urbanization controls	✓	✓	✓	✓	✓	✓
Observations	14632	14632	14632	14632	14632	14632

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Limited liability, central bank and incorporation are time variant policy dummies. Population and fractionalization in (5) are time varying. Other variables are time invariant. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. See tables B.1 and B.2 definitions. All regressions are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin. Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.2: Determinants of credit cooperative growth, county level, Prussia: **Farm size and farm value**

	(1) Interaction with soil quality	(2) Interaction with market potential	(3) Interaction with industrialization	(4) Interaction with migration	(5) Interaction with decadal trends
	Dependent Variable: Number of new credit cooperatives per county				
Δ grain prices	-38.4552***	-38.3691***	-38.3399***	-38.4820***	-30.0960***
	(3.0559)	(3.0575)	(3.0549)	(3.0161)	(2.9856)
population	0.0068***	0.0083***	0.0065***	0.0084***	0.0067***
	(0.0013)	(0.0016)	(0.0013)	(0.0014)	(0.0013)
ling. fractionalisation	0.1450	0.1058	0.1187	0.0663	0.1510
	(0.1537)	(0.1433)	(0.1513)	(0.1437)	(0.1527)
farm size	0.1502***	0.1000*	0.1310*	0.1279***	
	(0.0367)	(0.0456)	(0.0535)	(0.0339)	
farm size squared	-0.0041**	-0.0040**	-0.0036*	-0.0035**	-0.0041***
	(0.0013)	(0.0014)	(0.0015)	(0.0013)	(0.0013)
land inequality	-0.7587***	-0.8022***	-0.8889***	-0.8466***	-0.8489***
	(0.1981)	(0.1949)	(0.2073)	(0.1981)	(0.2024)
soil quality	0.4634				
	(0.4356)				
farm size × soil quality	-0.0383				
	(0.0408)				
market potential		-0.9178*			
		(0.4094)			
farm size × market potential		0.0532			
		(0.0414)			
industrial employment			-0.6753		
			(1.2159)		
farm size × industrial employment			-0.0043		
			(0.1266)		
migration				-0.0330*	
				(0.0140)	
farm size × migration				0.0004	
				(0.0014)	
-1854 × farm size					-0.1862
					(0.1236)
1855-1864 × farm size					0.1630***
					(0.0364)
1865-1874 × farm size					0.1997***
					(0.0350)
1875-1884 × farm size					0.1287***
					(0.0352)
1885-1894 × farm size					0.1750***
					(0.0398)
1895-1904 × farm size					0.1550***
					(0.0350)
1905-1913 × farm size					0.1218***
					(0.0356)
District F.E.	✓	✓	✓	✓	✓
Urbanization controls	✓	✓	✓	✓	✓
Policy dummies	✓	✓	✓	✓	✓
Observations	14632	14632	14632	14632	14632

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Limited liability, central bank and incorporation are time variant policy dummies. Other variables are time invariant. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. See tables B.1 and B.2 definitions. All regressions are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.3: Determinants of credit cooperative growth, county level, Prussia: **Prices robustness**

	(1) Full fixed effects	(2) Land use fixed at sample start	(3) Instrument with US prices	(4) Instrument, controlling for price volatility	(5) Instrument land use with soil quality	(6) Deflating by butter prices
	Dependent Variable: Number of new credit cooperatives per county					
Δ grain prices	-38.3070**				-39.6746***	
	(13.5937)				(3.1124)	
Δ grain prices, 1852 land		-39.2433***	-36.0025***	-26.3261***		
		(3.1138)	(5.0490)	(5.4315)		
Δ grain prices, butter deflator						-37.9594***
						(3.1462)
Price volatility, 1852 land				11.1721***		
				(1.9258)		
limited liability		1.5920***	1.5714***	1.4701***	1.6004***	1.6056***
		(0.1539)	(0.1542)	(0.1514)	(0.1536)	(0.1546)
central bank		1.3869***	1.4028***	1.7156***	1.3824***	1.3872***
		(0.1412)	(0.1435)	(0.1514)	(0.1407)	(0.1415)
incorporation		0.0672	-0.1375	0.2308	0.0763	0.1766
		(0.1313)	(0.1421)	(0.1530)	(0.1310)	(0.1337)
population		0.0067***	0.0067***	0.0069***	0.0068***	0.0067***
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
ling. fractionalisation		0.1448	0.1460	0.1076	0.1477	0.1470
		(0.1525)	(0.1524)	(0.1532)	(0.1519)	(0.1528)
farm size		0.1408***	0.1419***	0.1162**	0.1403***	0.1427***
		(0.0349)	(0.0347)	(0.0359)	(0.0347)	(0.0348)
farm size sq		-0.0039**	-0.0039**	-0.0032*	-0.0039**	-0.0039**
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
land inequality		-0.8460***	-0.8444***	-0.8461***	-0.8492***	-0.8445***
		(0.2019)	(0.2018)	(0.2015)	(0.2014)	(0.2023)
Year F.E.	✓					
County F.E.	✓					
District F.E.		✓	✓	✓	✓	✓
Urbanization controls		✓	✓	✓	✓	✓
Observations	14632	14632	13688	13688	14632	14632

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. "Grain prices, 1852 land use" weighs rye and wheat prices using 1852 land use. "Grain prices, butter deflator", deflates rye and wheat prices using butter prices. Price volatility is the five year standard deviation of the change in deflated rye and week prices, weighed by 1852 land use. Specification (3) and (4) instrument grain prices with US grain prices (available from 1856), using the 1852 land use weighting. (5) instruments wheat and rye land shares with county-level soil suitability. Limited liability, central bank and incorporation are time varying policy dummies. Other variables are time invariant. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. See tables B.1 and B.2 for further definitions. Regressions (1), (2) and (6) are Poisson, (3) (4) and (5) are GMM. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.
Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.4: Determinants of credit cooperative growth, county level, Prussia: **Reduced forms**

	(1) Grain prices with soil quality interaction	(2) US grain prices	(3) US grain prices with US price volatility	(4) UK GDP growth	(5) Bank of England interest rates	(6) Mean distance to medieval military settlements	(7) Min. distance to medieval military settlements
	Dependent Variable: Number of new credit cooperatives per county						
Δ grain prices				-34.2597***	-28.2212***	-38.2809***	-38.2810***
				(2.9776)	(2.8426)	(3.0493)	(3.0473)
Δ grain prices, soil qual.	-7.0706***						
	(0.5827)						
Δ US grain prices		-20.1711***	-11.4757***				
		(2.3631)	(2.3619)				
US price volatility			22.2255***				
			(2.9418)				
GDP growth, UK				0.0489***			
				(0.0109)			
interest rate, UK					-0.2335***		
					(0.0324)		
limited liability	1.5930***	1.4479***	1.1797***	1.5819***	1.4840***	1.5912***	1.5912***
	(0.1535)	(0.1515)	(0.1473)	(0.1537)	(0.1479)	(0.1541)	(0.1541)
central bank	1.3914***	1.5616***	1.8991***	1.3594***	1.5126***	1.3896***	1.3896***
	(0.1409)	(0.1372)	(0.1414)	(0.1408)	(0.1391)	(0.1412)	(0.1412)
incorporation	0.0623	-0.2083	0.3141*	0.0913	-0.2355+	0.0662	0.0662
	(0.1310)	(0.1327)	(0.1421)	(0.1321)	(0.1379)	(0.1312)	(0.1312)
population	0.0065***	0.0066***				0.0056***	0.0054***
	(0.0013)	(0.0014)				(0.0016)	(0.0016)
ling. fractionalisation	0.1145	0.1427				0.3504*	0.3516*
	(0.1567)	(0.1555)				(0.1571)	(0.1543)
farm size	0.1481***	0.1496***				0.1727***	0.1754***
	(0.0342)	(0.0342)				(0.0377)	(0.0380)
farm size sq	-0.0041***	-0.0041***				-0.0056***	-0.0056***
	(0.0012)	(0.0012)				(0.0015)	(0.0015)
land inequality	-0.8070***	-0.7665***					
	(0.2065)	(0.2059)					
military settlers, mean						0.1604*	
						(0.0782)	
military settlers, min							0.1701*
							(0.0853)
District F.E.	✓	✓				✓	✓
County F.E.			✓	✓	✓		
Urbanization controls	✓	✓					✓
Observations	14508	13806	14508	14508	14632	14632	

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. "Grain prices, soil quality" interacts German grain prices with county-level soil quality. "US grain prices" carries out same procedure using US rye and wheat prices. US Price volatility is the five year standard deviation of the change in deflated US rye and wheat prices (available from 1856). Limited liability, central bank and incorporation are time varying policy dummies. UK GDP growth is lagged by one year. BoE interest rate refers to the discount rate. Other variables are time invariant. Distance to medieval military settlements measures mean or shortest parth geodesic distance between a county capital and medieval crusader settlements. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. See tables B.1 and B.2 for further definitions. All regressions are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin. Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.5: Determinants of cooperative growth, county level, Prussia: **Credit cooperative categories**

	(1) Excluding urbanized counties	(2) only unlimited liability cooperatives	(3) Cooperatives with capital contribution $<$ 100 RM	(4) Cooperatives with capital contribution $\geq$ 100 RM
	Dependent Variable: Number of new credit cooperatives per county			
Δ grain prices	-41.5987***	-41.9636***	-49.5009***	-33.9088***
	(4.4561)	(3.4360)	(5.2061)	(5.2181)
limited liability	1.8194***	1.7190***	2.9012***	0.2819
	(0.1949)	(0.1721)	(0.2847)	(0.1863)
central bank	1.2295***	1.2928***	0.8847***	2.2024***
	(0.1966)	(0.1496)	(0.1724)	(0.2088)
incorporation	0.2545	0.5508***	1.3502***	0.3297*
	(0.1711)	(0.1546)	(0.3784)	(0.1580)
population	0.0100***	0.0060***	0.0062**	0.0068**
	(0.0019)	(0.0017)	(0.0020)	(0.0022)
ling. fractionalisation	0.1004	0.1314	0.1059	0.2260
	(0.1466)	(0.1746)	(0.2806)	(0.3657)
farm size	0.1487***	0.1659***	0.1282+	0.2731***
	(0.0365)	(0.0423)	(0.0661)	(0.0744)
farm size sq	-0.0044***	-0.0044**	-0.0035	-0.0076**
	(0.0012)	(0.0016)	(0.0024)	(0.0024)
land inequality	-0.5799*	-1.0469***	-0.6540+	-1.6755***
	(0.2647)	(0.2391)	(0.3553)	(0.4470)
District F.E.	✓	✓	✓	✓
Urbanization controls	✓	✓	✓	✓
Observations	7316	14632	14632	14632
No. of cooperatives	2617	4212	2307	1905

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var.: year-on-year change in number of credit cooperatives (of various characteristics) per county; grain prices refers to the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Limited liability, central bank and incorporation are time varying policy dummies. Other variables are time invariant. Urbanization controls include the share of the population resident in urban areas and a dummy for suburban counties. Regression (1) excludes all counties with urbanisation above the median. See tables B.1 and B.2 in the appendix for further definitions. All specifications are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.6: Determinants of credit cooperative growth, county level, Prussia: **Sample robustness over time**

	(1) Only years after 1860	(2) Excluding spike 1895 & 1896	(3) Only years before 1895 spike	(4) Only years after 1895 spike	(5) US prices, only years before 1879 tariffs	(6) US prices, only years after 1879 tariffs
	Dependent Variable: Number of new credit cooperatives per county					
Δ grain prices	-39.8564***	-11.3822***	-30.3729***	-40.5544***		
	(3.2412)	(3.0372)	(5.0569)	(3.4742)		
Δ grain prices, US					-7.6074**	-26.8687***
					(2.9069)	(3.3405)
limited liability	1.6017***	1.0806***	1.5379***			1.7719***
	(0.1544)	(0.1602)	(0.1591)			(0.2563)
central bank	1.3814***	1.6791***				1.5631***
	(0.1414)	(0.1720)				(0.1372)
incorporation	-0.5972***	-0.0889	0.0080		-0.1410	
	(0.1327)	(0.1303)	(0.1381)		(0.1112)	
population	0.0067***	0.0075***	0.0041**	0.0071***	0.0051***	0.0068***
	(0.0013)	(0.0013)	(0.0015)	(0.0014)	(0.0012)	(0.0014)
ling. fractionalisation	0.1502	0.0083	0.4655	0.0995	-0.2168	0.1933
	(0.1531)	(0.2051)	(0.4240)	(0.1990)	(0.3364)	(0.1646)
farm size	0.1420***	0.1644***	0.2399**	0.1160***	0.2174***	0.1497***
	(0.0352)	(0.0298)	(0.0802)	(0.0340)	(0.0564)	(0.0372)
farm size squared	-0.0039**	-0.0050***	-0.0060*	-0.0033**	-0.0080***	-0.0040**
	(0.0013)	(0.0009)	(0.0029)	(0.0011)	(0.0020)	(0.0014)
land inequality	-0.8531***	-0.7109**	-2.3437***	-0.5151*	-0.8100*	-0.8116***
	(0.2032)	(0.2273)	(0.3911)	(0.2429)	(0.3957)	(0.2184)
District F.E.	✓	✓	✓	✓	✓	✓
Urbanization controls	✓	✓	✓	✓	✓	✓
Observations	12744	13688	10148	4484	5428	8496

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. (5) and (6) use US instead of German grain prices. Limited liability, central bank and incorporation are time variant policy dummies. Other variables are time invariant. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. See tables B.1 and B.2 for further definitions. All regressions are Poisson. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.7: Determinants of credit cooperative growth, county level, Prussia: **Sample robustness over space**

	(1) Dropping Posen	(2) Dropping West Prussia	(3) Dropping Pomerania	(4) Dropping Silesia	(5) Dropping East Prussia	(6) Dropping Brandenburg
	Dependent Variable: Number of new credit cooperatives per county					
Δ grain prices	-37.9784***	-38.4256***	-39.8508***	-35.7485***	-36.9494***	-41.0139***
	(3.5237)	(3.2005)	(3.2762)	(3.6413)	(3.1946)	(3.2604)
limited liability	1.7872***	1.6812***	1.6151***	1.1105***	1.6281***	1.6138***
	(0.1727)	(0.1630)	(0.1573)	(0.1710)	(0.1762)	(0.1640)
central bank	1.3203***	1.3527***	1.2604***	1.6141***	1.5814***	1.2956***
	(0.1528)	(0.1478)	(0.1426)	(0.1700)	(0.1634)	(0.1503)
incorporation	-0.1259	0.0175	0.2155	0.1854	-0.0936	0.1949
	(0.1529)	(0.1438)	(0.1358)	(0.1528)	(0.1266)	(0.1486)
population	0.0059***	0.0066***	0.0068***	0.0078***	0.0073***	0.0070***
	(0.0012)	(0.0013)	(0.0014)	(0.0019)	(0.0013)	(0.0017)
ling. fractionalisation	-0.0766	0.1663	0.1705	0.1764	0.3251+	0.2128
	(0.1576)	(0.1670)	(0.1542)	(0.2084)	(0.1751)	(0.1598)
farm size	0.1093**	0.1438***	0.1366***	0.1827***	0.1679***	0.1389***
	(0.0360)	(0.0399)	(0.0351)	(0.0528)	(0.0333)	(0.0344)
farm size squared	-0.0032*	-0.0039*	-0.0035**	-0.0049**	-0.0051***	-0.0037**
	(0.0014)	(0.0016)	(0.0013)	(0.0018)	(0.0011)	(0.0013)
land inequality	-0.7652***	-0.8443***	-0.8449***	-0.6801**	-0.8827***	-1.0717***
	(0.2073)	(0.2182)	(0.2104)	(0.2526)	(0.2286)	(0.2075)
District F.E.	✓	✓	✓	✓	✓	✓
Urbanization controls	✓	✓	✓	✓	✓	✓
Observations	12152	12958	12710	10540	12400	12400

Sample: Six eastern provinces of Prussia 1852-1913, dropping one province per regression. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Limited liability, central bank and incorporation are time variant policy dummies. Other variables are time invariant. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. See tables B.1 and B.2 for further definitions. Regressions (2), (3), and (4) are county fixed effect Poisson regressions (234 counties), (1), (5) and (6) are Poisson with fixed effects at the level of 14 districts. Standard errors clustered at county level (236 counties). All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table F.8: Determinants of credit cooperative growth, county level, Prussia: **Specification**

	(1) Poisson, zero-inflated	(2) Poisson, zero-inflated with controls	(3) Negative Binomial	(4) Negative Binomial zero-inflated	(5) Ordinary Least Squares	(6) Ordinary Least Squares, logarithmic
	Dependent Variable: Number of new credit cooperatives per county					ln(new coops + 0.01)
Δ grain prices	-33.2849***	-32.9996***	-36.9780***	-36.0901***	-2.1215***	-2.0859***
	(2.8135)	(2.8094)	(2.8135)	(2.8073)	(0.1714)	(0.6300)
limited liability	1.5785***	1.5721***	1.5374***	1.5365***	0.0842***	
	(0.1607)	(0.1596)	(0.1459)	(0.1465)	(0.0114)	
central bank	1.3582***	1.3623***	1.4393***	1.4318***	0.3396***	
	(0.1506)	(0.1482)	(0.1274)	(0.1294)	(0.0195)	
incorporation	0.0260	0.0258	0.0287	0.0257	-0.0063	
	(0.1321)	(0.1319)	(0.1308)	(0.1309)	(0.0039)	
population	0.0028*	0.0023+	0.0079***	0.0057***		
	(0.0012)	(0.0012)	(0.0016)	(0.0014)		
ling. fractionalisation	0.2519	0.2393	0.1157	0.1407		
	(0.1678)	(0.2146)	(0.1552)	(0.1399)		
farm size	0.1414***	0.1402***	0.1688***	0.1655***		
	(0.0343)	(0.0337)	(0.0400)	(0.0357)		
farm size squared	-0.0038**	-0.0039**	-0.0045**	-0.0044**		
	(0.0013)	(0.0013)	(0.0015)	(0.0013)		
land inequality	-1.0152***	-1.2902***	-1.0984***	-1.1044***		
	(0.1929)	(0.2342)	(0.2220)	(0.1959)		
ln(population)					0.1308***	0.1308***
					(0.0150)	(0.0150)
ln(ling. fractionalisation)					0.0025	0.0025
					(0.0025)	(0.0025)
ln(farm size)					0.2742***	0.2742***
					(0.0521)	(0.0522)
ln(farm size squared)					-0.0450***	-0.0451***
					(0.0124)	(0.0125)
ln(land inequality)					-0.0146**	-0.0146**
					(0.0045)	(0.0045)
District F.E.	✓	✓	✓	✓	✓	✓
Year F.E.						✓
Urbanization controls	✓	✓	✓	✓	✓	✓
Observations	14632	14632	14632	14632	14632	14632

Sample: Six eastern provinces of Prussia, 1852-1913. Dep. Var. year-on-year change in number of credit cooperatives per county; grain prices are the year-on-year change of the moving average of weighted rye and wheat prices lagged over the past five years, deflated by the consumer price index. Limited liability, central bank and incorporation are time variant policy dummies. Other variables are time invariant. Urbanization controls include the share of the population in urban areas and a dummy for suburban counties. Regression (1) is a zero-inflated Poisson with population in the logit predicting zero occurrences. Regression (2) is a zero-inflated Poisson with population, ethnic fractionalization, farm size and land inequality in the logit predicting zero occurrences. (3) is a Negative Binomial specification, and (4) is a zero-inflated Negative Binomial with population in the logit predicting zero occurrences. (5) Ordinary Least Squares (6) Ordinary Least Squares on the natural logarithm of new credit cooperatives and a small constant. See tables B.1 and B.2 for further definitions. Standard errors clustered at county level (236 counties). Fixed effects at the level of 14 districts. All regressions exclude Berlin.

Standard errors in parentheses: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

G Historical and institutional background

G.1 The six eastern provinces of Prussia

The focus of our study is on the eastern regions of Prussia from the second half of the 19th century until the First World War. Compared to the rest of Prussia, the regions east of the river Elbe had low levels of urbanization and stayed predominantly agricultural until 1914. Accordingly, they lagged behind other parts of Prussia in terms of income, and exhibited high land inequality. Tables G.1 and G.2 provide a comparison of the eastern regions in our sample with the remainder of Prussia at the district level.

As we see, there was also substantial heterogeneity within the eastern provinces. The city of Berlin, located in Brandenburg, was growing rapidly since the end of the 1850s to become one of Europe's largest financial and industrial centers. In addition, Upper Silesia in the southeast of Prussia was industrializing around booming coal mines and iron ore production (Kiesewetter, 2004, pp. 181 ff.) . However, most parts of the eastern provinces were characterized by agriculture, dominated by grain production.

G.2 Rural transformation

From the 1850s onwards, this rural economy faced growing pressure to change and adjust from several sides. First, the modernization of the Prussian and later German state led to a rising tax burden, which in turn required peasants to produce a larger marketable surplus (Wygodzinski (1911, p. 128), Ullmann (2005, p. 81)). Second, the growth of industry in centers like Berlin, Saxony, Silesia or the Ruhr attracted agricultural labor and thus increased the opportunity costs of work in agriculture (Grant, 2006, pp. 97ff). Peasants and agricultural workers had now the option to leave and find work in a factory, and many did. Related to this, income growth in cities and industrial regions contributed to a strong increase in the demand for products of animal origin such as meat and dairy products. This created new opportunities for agriculture, but it also made old types of agricultural production less attractive. The third and arguably most powerful driver for rural transformation was the decline of grain prices, both in relative and in absolute terms due to international market integration. The average prices for wheat and rye in Prussia declined

Table G.1: Eastern and western districts of Prussia, part 1: Population Statistics

District	Population		Population Density		Urban share		Income p.c.	
	1867	*1900*	*1867*	*1900*	*1875*	*1900*	*1880*	*1905*
Prussia east of the river Elbe								
Königsberg	1,063,340	1,204,386	0.50	0.57	27.70	34.11	260.05	474.76
Gumbinnen	744,778	792,240	0.47	0.50	12.73	18.44	213.86	417.02
Danzig	515,222	665,992	0.65	0.84	32.05	37.79	289.37	499.89
Marienwerder	767,620	897,666	0.44	0.51	21.56	25.73	218.50	436.42
Potsdam	550,895	1,929,304	0.27	0.94	36.89	47.98	394.87	805.61
Frankfurt	702,041	1,179,250	0.37	0.61	34.65	40.50	274.99	520.26
Stettin	993,428	830,709	0.82	0.69	37.57	48.55	330.46	610.67
Köslin	1,020,157	587,783	0.73	0.42	23.98	28.95	239.05	456.03
Stralsund	675,596	216,340	1.68	0.54	40.42	44.18	330.24	583.30
Posen	554,464	1,198,252	0.32	0.68	28.35	32.12	221.14	396.85
Bromberg	215,575	689,023	0.19	0.60	26.41	33.35	255.77	477.48
Breslau	1,364,632	1,697,719	1.01	1.26	31.83	41.93	259.14	472.15
Liegnitz	1,241,320	1,102,992	0.91	0.81	26.60	34.66	268.55	491.34
Oppeln	979,800	1,868,146	0.74	1.41	18.97	24.76	220.72	425.42
Prussia west of the river Elbe								
Magdeburg	832,141	1,176,372	0.72	1.02	42.52	50.21	406.46	714.04
Merseburg	864,853	1,189,825	0.85	1.17	37.39	44.01	353.40	639.29
Erfurt	370,072	466,419	1.05	1.32	41.52	47.99	334.73	619.54
Schleswig	439,213	1,387,968	0.23	0.73	34.15	43.25	450.63	894.71
Hannover	477,122	647,908	0.84	1.13	32.02	55.55	391.94	724.23
Hildesheim	791,361	526,758	1.48	0.98	31.33	39.05	337.59	612.99
Lüneburg	596,493	472,598	0.53	0.42	20.12	29.05	368.59	756.56
Stade	1,243,902	375,017	1.83	0.55	7.75	23.47	423.04	791.16
Osnabrück	555,882	328,600	0.90	0.53	21.47	28.77	296.97	597.65
Aurich	578,889	240,058	1.86	0.77	22.59	29.35	362.66	633.90
Münster	480,192	699,583	0.66	0.96	25.68	31.98	347.02	666.21
Minden	981,718	636,875	1.87	1.21	26.37	33.47	319.08	660.39
Arnsberg	385,957	1,851,319	0.50	2.41	34.28	40.36	439.72	832.71
Kassel	410,210	890,142	0.41	0.88	29.71	34.83	336.80	642.07
Wiesbaden	381,712	1,007,839	0.68	1.79	38.08	52.67	473.78	956.30
Koblenz	301,407	682,454	0.49	1.10	22.21	23.66	383.95	704.81
Düsseldorf	264,475	2,599,806	0.48	4.75	58.57	62.33	452.94	852.72
Köln	193,876	1,021,878	0.49	2.57	38.14	55.07	408.86	793.90
Trier	770,569	840,696	1.07	1.17	16.21	19.09	379.05	710.72
Aachen	609,176	614,964	1.47	1.48	34.42	39.47	404.32	729.22
Sigmaringen	64,632	66,780	0.57	0.59	18.36	12.79	318.47	654.57
Berlin								
Berlin	986,443	1,888,848	155.71	298.16	100.00	100.00	876.98	1,447.18

Population is headcount according to Prussian census, urban share is the share of population residing in urban areas. Income per capita refers to annual labour income in Marks per worker. See table B.2 and text for further definitions. Our sample includes counties in all districts (*Regierungsbezirke*) entirely east of the river Elbe, and excludes Berlin. See table D.1 for more information on the administrative division of Prussia.

Table G.2: Eastern and western districts of Prussia, part 2: Agricultural Statistics

District	Agricultural share		Land inequality	Cows	Pigs
	1880	*1905*	*1883*	*1906*	*1906*
Prussia east of the river Elbe					
Königsberg	0.57	0.47	0.45	318,997	713,134
Gumbinnen	0.71	0.61	0.33	228,964	610,484
Danzig	0.49	0.41	0.42	133,607	301,306
Marienwerder	0.65	0.58	0.52	241,382	644,141
Potsdam	0.39	0.21	0.38	247,371	659,594
Frankfurt	0.51	0.44	0.41	229,033	619,385
Stettin	0.46	0.39	0.53	177,362	543,426
Köslin	0.63	0.60	0.63	197,859	544,614
Stralsund	0.45	0.44	0.77	65,137	138,283
Posen	0.65	0.57	0.58	293,478	667,547
Bromberg	0.63	0.56	0.59	170,222	440,417
Breslau	0.42	0.33	0.44	312,827	457,330
Liegnitz	0.47	0.40	0.35	275,352	319,403
Oppeln	0.52	0.35	0.38	277,595	453,744
Prussia west of the river Elbe					
Magdeburg	0.40	0.35	0.32	166,127	718,053
Merseburg	0.40	0.34	0.27	192,784	644,531
Erfurt	0.35	0.31	0.16	62,713	202,874
Schleswig	0.42	0.32	0.17	469,940	1,079,253
Hannover	0.40	0.31	0.07	112,533	568,145
Hildesheim	0.39	0.35	0.18	90,192	331,969
Lüneburg	0.58	0.48	0.07	143,717	622,087
Stade	0.55	0.46	0.03	113,726	399,412
Osnabrück	0.63	0.55	0.01	115,031	371,418
Aurich	0.50	0.50	0.03	93,323	132,985
Münster	0.51	0.33	0.03	159,177	459,133
Minden	0.51	0.37	0.09	128,769	503,438
Arnsberg	0.21	0.12	0.09	137,275	350,307
Kassel	0.47	0.40	0.11	185,470	648,640
Wiesbaden	0.35	0.25	0.02	140,661	206,801
Koblenz	0.50	0.45	0.02	134,903	168,331
Düsseldorf	0.19	0.10	0.03	179,870	463,620
Köln	0.32	0.19	0.05	100,084	99,753
Trier	0.50	0.39	0.03	161,117	264,028
Aachen	0.35	0.27	0.02	104,699	123,988
Sigmaringen	0.63	0.64	0.03	24,892	30,352
Berlin					
Berlin	0.01	0.00	0.18	12,046	9,980

Agricultural share refers to share of working population employed in agriculture. Cows and pigs are headcounts. See table B.2 and text for further definitions. Our sample includes counties in all districts (*Regierungsbezirke*) entirely east of the river Elbe, and excludes Berlin. See table D.1 for more information on the administrative division of Prussia.

in absolute terms from the mid-1850s, partly due to international competition from grain producers from North America (O'Rourke, 1997). In consequence, relative to consumer prices and to prices for meat and dairy products, grain prices continued to decline strongly until the First World War (see figure 1, also (Federico, 2005, p. 28)).

With this, old extensive forms of agricultural production as well as subsistence farming became unsustainable. Farmers faced a choice between giving up (for example, migrating and looking for employment in industry) and investing into the modernization of their business. The latter could mean an intensification of production, a switch towards higher yielding products, such as meat or dairy, or a combination thereof. The costs involved in such a production switch were substantial. As table G.3 shows, evaluated at the average rural wage rate, the price of one head of beef cattle was equivalent to between 120 and 170 days of work. The purchase of a pig would cost the equivalent of at least 1 month's wage. The implication was a strong increase in the demand for capital (Wygodzinski, 1911, p.129). Rural credit cooperatives developed in response to this pressure in Germany from the 1850s onwards as an altogether new type of credit institution.

Table G.3: Cattle prices at the province level: **Value per head of cattle**

	(1) Price of Beef cattle (Marks per head)	(2) Price of pigs (Marks per head)	(3) Rural unskilled wage (Marks per day)	(4) Value of Beef cattle (days of labour)	(5) Value of Pigs (Days of labour)
East Prussia	145	34	1.21	119.5	28.0
West Prussia	184	43	1.28	144.3	33.9
Brandenburg	203	61	1.34	151.7	45.4
Pomerania	242	68	1.43	169.3	47.6
Posen	172	55	1.22	141.3	44.9
Silesia	173	57	1.06	162.7	54.1
Mean (unweighted)	187	53	1.26	148.5	42.2

Cattle prices calculated from aggregate value of cattle (in Mark) and cattle headcount at the province level in 1883. Source: Statistical Yearbook for the German Empire (Statistisches Amt, 1886, pp. 25-26) Daily wages for 1892 are aggregated from the county level, see table B.2. Column (4) = (1)/(3), Column (5) = (2)/(3).

G.3 Sources of rural credit

Why could the demand for credit not be met by the existing sources of capital? To start with, most peasants had little savings of their own (Kersting, F., Wolf, N.,

Wohnsiedler, I., 2019). Next, peasants were unattractive debtors for several reasons. Most importantly, many farmers had only limited assets, which could serve as collateral. Furthermore, accounting practices were hardly known in these regions around 1850, and the valuation of assets was often difficult, for example regarding the value of non-marketable livestock such as young horses, pigs or cows. Moreover, peasants would often require small sums, but over comparatively long periods, due to harvest cycles and the time to grow animals. This also implied that farmers were liquidity constrained over much of the year. Taken together, the lack of (documented) collateral, the small size of loans requested, and the need for relatively long-term credit added to the risk of lending to farmers and prevented them from accessing private banks. The remaining sources for credit were individual moneylenders, often wholesale traders, and saving banks (Wygodzinski (1911, pp. 132f.), Faust (1965a, pp. 328ff.)).

Rural moneylenders had a bad reputation at the time and were regularly accused of usury. Interest rates of 30 percent or more were not uncommon (Verein für Socialpolitik (1887), also Guinnane (2001, p. 368)). We note that such accusations may have reflected anti-Semitic sentiment, as many moneylenders were Jewish. Saving banks did spread and prosper in the Eastern Provinces after 1850, but they were often reluctant to extend credit to farmers. The problem was not that they shied away from risky maturity transformation implied by their often short-term deposits and the demanded long-term loans from farmers. As reported by Wygodzinski (1911, p. 134), in 1907 savings banks in Prussia had only 3.53% of their capital invested in personal credit and the remainder in securities (23.83%) and mortgages (60.49%). More likely, savings banks considered lending to small farmers as unprofitable business.

Credit cooperatives emerged as an institutional innovation to this situation (on the following see Guinnane (2001)), pioneered by Hermann Schulze-Delitzsch (1808-1883) and Wilhelm Raiffeisen (1818-1888). They shared a number of important organizational features, which likely contributed to their long-run success and survival. While Schulze-Delitzsch focused on urban craftsmen, and Raiffeisen on rural populations, both emphasized the principle of joint-liability lending (Faust, 1965a). Moreover, most rural credit cooperatives following Raiffeisen retained unlimited liability, even though limited liability became a legal option in 1889. Rural credit cooperatives restricted their operations to a small geographic area and a small num-

ber of people, similar to the "Regionalprinzip" of German savings banks. Finally, most credit cooperatives served a double function of credit banks and savings. As discussed in Banerjee et al. (1994), it was the combination of these characteristics that helped to reduce the considerable risk of lending to farmers, because they provided monitoring incentives and simple yet efficient monitoring mechanisms - if heterogeneity within their area of operation was limited.

The rural cooperative movement grew quickly in the decades before 1914, particularly in the 1880s and 1890s, probably helped by the cooperative law (1889) and the foundation of the Preussenkasse, a central bank for cooperatives(1895). In 1913 there were around 19,000 credit cooperatives with a share of nearly 7% in total assets of all financial institutions in Germany (Kluge (1991, p. 89), Tilly (1992)).

G.4 Operation of cooperatives: loan and collateral

A typical rural credit cooperative combined lending (*Aktivgeschäft*) and deposit business (*Passivgeschäft*). Consider the aggregated balance sheets of all credit cooperatives organized into the "Verband der polnischen Erwerbs- und Wirtschaftsgenossenschaften in der Provinz Posen und Westpreussen" in table G.4.[57] This is a rare instance of consolidated microdata being available at the co-op level. The table shows the development of loans, savings deposits and third party bank credit together with the overall size of the balance sheet, 1873-1907. The number of cooperatives increased from 43 (1873) to 225 (1907).

Several findings stand out. First, we see a very substantial increase in the total volume of credit issued by member cooperatives of this association, in particular from the 1890s onwards. Most part of the *Aktivgeschäft* of these credit cooperatives consists of providing loans to their individual members (loans to non-members were ruled out by law since 1889). In this region, it was common practice by both German and Polish credit cooperatives to secure loans by financial bills (Wechsel) and cosigners (Swart (1911, p. 139), Seidel (1897, p. 451)). The exact extent to which such loans were collateralized is rarely known, but it is likely that collateralization became more important in the Eastern Provinces over time. For example, the management committee of the Association decided in September 1907 to provide loans

[57] This roughly translates as "Association of Polish Economic Cooperatives in the Provinces of Posen and West Prussia".

Table G.4: Aggregated Balance Sheets of Credit Cooperatives organized in "Association of Polish Cooperatives in Posen and West Prussia"

Year	Total Balance Sheet	Loans *(Wechsel)*	Share loans in Activa	Saving Deposits	Banks (external funding)	Share Saving deposits in Passiva	Share Banks in Passiva	Ratio Savings to Loans
1873	3,739,303	3,321,408	0.89	2,600,870	377,411	0.696	0.101	0.783
1874	4,493,258	4,206,771	0.94	3,345,649	191,888	0.745	0.043	0.795
1875	4,664,843	4,522,160	0.97	3,414,437	289,877	0.732	0.062	0.755
1876	5,833,799	5,299,917	0.91	4,113,766	363,468	0.705	0.062	0.776
1877	6,333,792	6,046,207	0.96	4,533,591	355,089	0.716	0.056	0.750
1878	6,935,886	6,639,366	0.96	4,852,238	456,586	0.700	0.066	0.731
1879	6,894,557	6,393,654	0.93	4,860,377	296,676	0.705	0.043	0.760
1880	7,218,109	6,781,756	0.94	5,219,266	229,032	0.723	0.032	0.770
1881	8,827,849	8,245,228	0.93	6,489,611	229,243	0.735	0.026	0.787
1882	9,223,512	8,315,469	0.90	6,844,717	152,654	0.742	0.017	0.823
1883	10,718,589	10,109,503	0.94	7,937,405	240,720	0.741	0.022	0.785
1884	11,518,278	10,982,232	0.95	8,432,204	259,199	0.732	0.023	0.768
1885	11,890,343	11,334,393	0.95	8,676,014	245,629	0.730	0.021	0.765
1886	12,249,617	11,618,529	0.95	8,908,417	245,248	0.727	0.020	0.767
1887	13,343,992	12,559,960	0.94	9,652,998	259,028	0.723	0.019	0.769
1888	14,472,320	13,331,869	0.92	10,507,893	243,167	0.726	0.017	0.788
1889	15,265,872	13,783,108	0.90	11,121,626	332,281	0.729	0.022	0.807
1890	16,980,742	15,320,179	0.90	12,523,183	302,190	0.737	0.018	0.817
1891	18,942,662	16,650,523	0.88	12,661,911	970,879	0.668	0.051	0.760
1892	15,454,997	14,439,906	0.93	10,782,235	687,405	0.698	0.044	0.747
1893	19,162,825	16,671,612	0.87	13,106,546	593,848	0.684	0.031	0.786
1894	21,401,901	18,197,042	0.85	14,970,083	399,968	0.699	0.019	0.823
1895	24,379,510	20,379,160	0.84	16,774,448	779,923	0.688	0.032	0.823
1896	27,009,274	23,539,093	0.87	19,078,036	441,660	0.706	0.016	0.810
1897	32,825,358	27,923,547	0.85	22,325,160	1,444,052	0.680	0.044	0.800
1898	40,546,919	30,866,931	0.76	26,749,760	1,085,849	0.660	0.027	0.867
1899	46,647,161	38,390,725	0.82	32,462,061	2,104,363	0.696	0.045	0.846
1900	53,559,698	42,266,620	0.79	37,787,516	2,088,746	0.706	0.039	0.894
1901	60,347,493	48,151,082	0.80	42,248,506	3,024,011	0.700	0.050	0.877
1902	68,594,954	54,610,381	0.80	49,282,288	3,191,201	0.718	0.047	0.902
1903	80,771,179	52,278,119	0.65	58,908,668	1,726,624	0.729	0.021	1.127
1904	98,339,437	75,292,663	0.77	70,616,513	2,212,735	0.718	0.023	0.938
1905	117,623,657	87,685,799	0.75	87,421,051	2,986,025	0.743	0.025	0.997
1906	143,541,423	105,214,815	0.73	107,062,057	3,765,857	0.746	0.026	1.018
1907	164,441,955	127,232,979	0.77	123,004,213	5,060,369	0.748	0.031	0.967

Aggregated balance sheet data of the credit cooperatives belonging to the "Association" as gathered by Prussian authorities (Polizei Präsidium Posen, 1909). All amounts in Mark, unless noted as share of total or ratio.

only on financial bills (Polizei Präsidium Posen, 1909, p.12). As argued by Swart (1911, pp. 139f.), "financial bills" in the balance sheet often reflected mortgage loans, which had been transformed into bills. More generally, some form of collateral was required by Raiffeisen's *Musterstatut* according to §31, which demanded that cosigners of a loan had to own land or property that exceeded the value of the loan by at least 1/3 (see also Kraus (1876, p. 32)).[58]

[58]The *Musterstatut* was a template for cooperative organisation designed by the central Raiffeisen orgranisation that local cooperatives could, but did not have to, adopt.

There is evidence that loans were typically secured by one or two cosigners, and that in order to qualify as a cosigner, a person had to be known in terms of their wealth and liabilities (Guinnane (2001, p.378), Schlütz (2013, p. 307)). Schlütz (2013, pp. 300ff.) provides details on the *Aktivgeschäft* of credit cooperatives in the Rhineprovince, which indicates that collateral, including land became more important over time. Von Altrock (1900) describes the credit operations of rural credit cooperatives in the province of Brandenburg for the years 1897 and 1898 in some detail. He reports for 101 credit cooperatives that were part of the Raiffeisen-system the following: in 1897 they had provided loans over 1.72 Million Marks or 356 Mark per member. About 1.47 Million Mark of loans were provided for a fixed term, where 28.4% for a term of up to 1 year, 48.4% for a term between 1 and 10 years and 23.2% for a term of more than 10 years. A total of 1.48 Million Mark of those loans were secured by either cosigners or land, in particular 64.1% secured by cosigners and 35.9% secured by land (Hypotheken, see Von Altrock (1900, p. 49)).

G.5 Relationship of cooperatives to banks and the state

Most important for the loan operation of credit cooperatives however, was the fact that they combined the function of a credit bank with that of savings banks. Due to their character of joint-liability institutions and the fact that most often the deposits of some members served as capital for the loans to others, the total assets of members served as implicit collateral for their loan operations (Banerjee et al., 1994). Sometimes, credit cooperatives used their total members' collateral to approach third party funding institutions such as banks, but more often regional "central banks" controlled by a larger group of credit cooperatives. This mattered especially for young, small credit cooperatives, which had not yet accumulated sufficient saving deposits of their own. We see from table G.4 that for the first decades, credit cooperatives, which were part of the Association, could serve about 80% of their members' total credit demand using the capital of their savings account. By the turn of the century, the credit cooperatives in this sample had become on balance financially "self-sufficient". Similarly, table G.4, shows that third party funding was important early on, but declined in relative importance. More generally, it was the *Passivgeschäft* with interest bearing saving deposits that enabled credit cooperatives to engage in their *Aktivgeschäft*, providing loans (Schlütz, 2013, p. 352).

The loans provided were typically medium- to long-run, which stood in contrast to loans provided by moneylenders, saving banks or private banks (Wygodzinski, 1911, pp. 139ff.). It seems that most credits were given for more than three months, often up to 20 years with at least yearly installments of repayment (Kluge, 1991, p.191f). Schlütz (2013) shows that for several credit cooperatives in the Rhine Province, loans provided for longer terms and larger amounts were becoming more frequent during the two decades before 1914.

Credit cooperatives proved to be very resilient before 1914, with extremely low failure rates. In particular, rural credit cooperatives failed less often than urban cooperatives (Schlütz, 2013, p. 154). If they did so, this was typically either because they were not part of a larger regional association, which could have helped to refinance their loans, or because they operated under limited liability. As reported in Banerjee et al. (1994, p. 503), in 1909/10 out of 15,000 rural credit cooperatives only three failed (all with limited liability). This resilience is all the more remarkable, given that state intervention remained limited. Rural credit cooperatives were never directly state subsidized, although many of them might have benefited from cheap or free managerial labor, provided by local authorities such as state officials or priests who voluntarily contributed their expertise and time to the cause. However, as argued in Guinnane (2001), this likely mattered only for the early years of cooperatives and can hardly explain their long-run success. However, indirectly, the state supported the credit cooperative movement in two important ways. First, the state provided a legal framework, with the 1867 incorporation law bestowing legal personhood unto cooperatives, and the 1889 law allowing cooperatives to opt for limited liability (Faust, 1965a). Second, the foundation of the Preussenkasse in 1895, which was initially endowed with public resources helped to safeguard the credit operations of cooperatives and their regional central banks as a refinancing institution (Guinnane et. al., 2013, pp. 77ff.). However, as we see from table G.4 above, while this certainly mattered temporarily and for some credit cooperatives, most of them were financially self-sufficient by the turn of century.

References

Ahlin, C. (2015). The role of group size in group lending. *Journal of Development Economics 115*, 140–155.

Ahlin, C., J. Lin, and M. Maio (2011). Where does microfinance flourish? Microfinance institution performance in macroeconomic context. *Journal of Development Economics 95*, 105–120.

Alesina, A. and E. La Ferrara (2000). Participation in heterogeneous communities. *Quarterly Journal of Economics 115*(3), 847–904.

Alesina, A., S. Michalopoulos, and E. Papaioannou (2016). Ethnic inequality. *Journal of Political Economy 124*, 428–488.

Armendariz, B. and J. Morduch (2010). *The Economics of Microfinance*. Cambridge MA: MIT Press.

Banerjee, A., D. Karlan, and J. Zinman (2015). Six randomized evaluations of microcredit: Introduction and further steps. *American Economic Journal: Applied Economics 7*, 1–21.

Banerjee, A. V., T. Besley, and T. W. Guinnane (1994). Thy neighbor's keeper: The design of a credit cooperative with theory and a test. *Quarterly Journal of Economics 109*(2), 491–515.

Barr, A., M. Dekker, and M. Fafchamps (2015). The formation of community-based organizations: An analysis of a quasi-experiment in Zimbabwe. *World Development 66*, 131–153.

Becker, S., F. Cinnirella, E. Hornung, and L. Wößmann (2014). iPEHD - the ifo Prussian Economic History Database. *Historical Methods: A Journal of Quantitative and Interdisciplinary History 47*(2), 57–66.

Becker, S. and L. Wößmann (2009). Was Weber wrong? A human capital theory of Protestant economic history. *Quarterly Journal of Economics 124*, 531–596.

Belzyt, L. (1998). *Sprachliche Minderheiten im preußischen Staat 1815-1914: Die preußische Sprachenstatistik in Bearbeitung und Kommentar [Linguistic minorities in the Prussian state 1815-1914: The Prussian language statistics, edited and annotated]*. Marburg: Herder Institut.

Bertanha, M. and P. Moser (2016). Spatial errors in count data regressions. *Journal of Econometric Methods 5*(1), 49–69.

Born, K. E. (1985). *Wirtschafts- und Sozialgeschichte des Deutschen Kaiserreichs (1867-1914) [An economic and social history of the German Empire]*. Stuttgart: Franz Steiner.

Bundesbank, D. (1976). *Deutsches Geld- und Bankwesen in Zahlen 1876 - 1975 [Money and Banking in Germany 1876-1975]*. Frankfurt am Main: Fritz Knapp.

Burgess, R. and R. Pande (2005). Do rural banks matter? Evidence from the Indian social banking experiment. *American Economic Review 95*, 780–795.

Burhop, C. (2011). *Wirtschaftsgeschichte des Kaiserreichs 1871-1918 [An economic history of the German Empire]*. Göttingen: Vandenhoeck Ruprecht.

Cameron, A. C. and P. Trivedi (2013). *Regression Analysis of Count Data* (2nd ed.). Cambridge: CUP.

Cameron, A. C. and P. K. Trivedi (2015). Count panel data. In B. H. Baltagi (Ed.), *Oxford Handbook of Panel Data*, pp. 233–256. Oxford: OUP.

Cinirella, F. and E. Hornung (2016). Landownership concentration and the expansion of education. *Journal of Development Economics 121*, 135–152.

Cinirella, F. and R. Schueler (2016). The cost of decentralization: Linguistic polarization and the provision of education. *CESifo Working Paper No 5894*.

Colvin, C., S. Hendersen, and J. D. Turner (2018). The origins of the (cooperative) species: Raiffeisen banking in the Netherlands, 1898 - 1909. *QUCEH Working Paper Series 1803*.

Colvin, C. and E. McLaughlin (2014). Raiffeisenism abroad: Why did German cooperative banking fail in Ireland but prosper in the Netherlands? *Economic History Review 67*(2), 492–516.

Cull, R., A. Demirgüç-Kunt, and J. Morduch (2007). Financial performance and outreach: A global analysis of leading microbanks. *Economic Journal 117*, 107–133.

Cull, R., A. Demirgüç-Kunt, and J. Morduch (2014). Banks and microbanks. *Journal of Financial Services Research 46*, 1–53.

de Quidt, J., T. Fetzer, and M. Ghatak (2018). Commercialization and the decline of joint liability microcredit. *Journal of Development Economics 134*, 209–225.

Demont, T. (2016). Microfinance spillovers: A model of competition in informal credit markets with an application to Indian villages. *European Economic Review 89*, 21–41.

Eddie, S. M. (2008). *Landownership in Eastern Germany before the Great War*. Oxford: OUP.

Eichengreen, B. (1987). Conducting the international orchestra: Bank of England leadership under the classical Gold Standard. *Journal of International Money and Finance 6*, 5–29.

Esteban, J., L. Mayoral, and D. Ray (2012). Ethnicity and conflict: An empirical study. *American Economic Review 102*, 1310–1342.

Evert, G. (1911). Die Preußischen Sparkassen einzeln und in ihrer Gesamtheit im Rechnungsjahre 1909 [The Prussian savings banks individually and in aggregate in the financial year 1909]. *Zeitschrift des Königlich Preußischen Statistischen Bureaus 51*.

Fafchamps, M. and F. Gubert (2007). Risk sharing and network formation. *American Economic Review: Papers and Proceedings 97*(2), 75–79.

Faust, H. (1965a). *Geschichte der Genossenschaftsbewegung: Ursprung und Aufbruch der Genossenschaftsbewegung in England, Frankreich und Deutschland sowie ihre weitere Entwicklung im deutschen Sprachraum [History of the cooperative movement: Origins and development of the cooperative movement in England, France and Germany, as well as their further development in the German-speaking region]*. Knapp.

Faust, H. (1965b). *Geschichte der Genossenschaftsbewegung: Ursprung und Weg der Genossenschaften im Deutschen Sprachraum [A History of the cooperative movement: Origins and development of cooperatives in the Germanophone area]*. Frankfurt: Fritz Knapp.

Federico, G. (2005). *Feeding the World. An economic history of agriculture, 1800–2000*. Princeton.

Fernandez, E. (2014). Trust, religion, and cooperation in western agriculture, 1880-1930. *Economic History Review 67*(3), 678–698.

Findlay, R. and K. H. O'Rourke (2009). *Power and Plenty: Trade, War, and the World Economy in the Second Millennium*. Princeton: Princeton University Press.

Ghatak, M. (1999). Group lending, local information and peer selection. *Journal of Development Economics 60*(1), 27–50.

Ghatak, M. and T. W. Guinnane (1999). The economics of lending with joint liability: Theory and practice. *Journal of Development Economics 60*(1), 195–228.

Ghosh, P., D. Mookherjee, and D. Ray (2000). Credit rationing in developing countries: An overview of the theory. In D. Mookherjee and D. Ray (Eds.), *Readings in the Theory of Economic Development*, pp. 283–301. Malden, MA: Blackwel.

Goodspeed, T. (2016). Microcredit and adjustment to environmental shock: Evidence from the Great Famine in Ireland. *Journal of Development Economics 121*, 258–277.

Grant, O. (2006). *Migration and Inequality in Germany 1870–1913*. Oxford: Clarendon.

Guinnane, T. W. (1997). Regional organization in the German cooperative banking system in the late 19th century. *Research in Economics 51*(3), 251–274.

Guinnane, T. W. (2001). Cooperatives as information machines: German rural credit cooperatives, 1883-1914. *Journal of Economic History 61*(2), 366–389.

Guinnane, T. W. (2003). Delegated monitors, large and small: Germany's banking system 1800-1914. *Journal of Economic Literature*, 73–124.

Guinnane, T. W. (2004). Regional banks for micro-credit institutions: "centrals" in the German cooperative system before the First World War. *mimeo, Yale University*.

Guinnane et. al. (2013). *Die Geschichte der DZ Bank [The history of the DZ Bank]*. München: Beck.

Guiso, L., P. Sapienza, and L. Zingales (2004). Does local financial development matter? *Quarterly Journal of Economics 119*, 923–969.

Hansen, G. D. and E. C. Prescott (2002). Malthus to Solow. *American Economic Review 92*(4), 1205–1217.

Hausman, J., B. H. Hall, and Z. Griliches (1984). Econometric models for count data with an application to the patents-R&D relationship. *Econometrica 52*(4), 909–938.

Heblich, S. and A. Trew (2018). Banking and industrialization. *Journal of the European Economic Association*.

Hermes, N., R. Lensink, and A. Meesters (2018). Outreach and efficiency of microfinance institutions. *World Development 39*(6), 938–948.

Herrendorf, B., R. Rogerson, and A. Valentinyi (2014). Growth and structural transformation. In P. Aghion and S. Durlauf (Eds.), *Handbook of Economic Growth Volume 2*, pp. Chapter 6. North Holland: Elsevier.

Herrman, C. (2015). *Burgen im Ordensland Preußen [Castles in the Land of the Teutonic Order in Prussia]*. Petersberg: Michael Imhof Verlag.

Hornung, E. (2014). Immigration and the diffusion of technology: The Huguenot diaspora in Prussia. *American Economic Review 104*, 84–122.

Jacks, D. (2013). From boom to bust: A typology of real commodity prices in the long run. *NBER Working Paper No 18874*.

Jaremski, M. and P. Fishback (2018). Did inequality in farm sizes lead to suppression of banking and credit in the late nineteenth century? *The Journal of Economic History 78*(1), 155–185.

Jensen, P., M. Lampe, P. Sharp, and C. Skovsgaard (2018). Getting to Denmark: The role of elites for development. *CEPR Discussion Paper No. 12679*.

Karlan, D. S. (2007). Social connections and group banking. *Economic Journal 117*, 52–84.

Karlan, D. S. and J. Morduch (2009). Access to finance. In D. Rodrik and M. Rosenzweig (Eds.), *Handbook of Development Economics, V. 5*, pp. Chapter 2. North Holland: Elsevier.

Kersting, F., Wolf, N., Wohnsiedler, I. (2019). Weber Revisited: the Protestant Ethic and the Spirit of Nationalism. *CRC TRR 190 Discussion Paper No. 199*.

Kiesewetter, H. (2004). *Industrielle Revolution in Deutschland [Industrial Revolution in Germany]*. Stuttgart: Franz Steiner.

Kindleberger, C. P. (1951). Group behavior and international trade. *Journal of Political Economy 59*(1), 30–46.

King, R. and R. Levine (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics 108*(3), 717–737.

Kluge, A. (1991). *Geschichte der deutschen Bankgenossenschaften. Zur Entwicklung mitgliederorientierter Unternehmen [History of the German banking cooperatives. On the development of enterprises focused on members]*. Frankfurt am Main: Fritz Knapp.

Kongsamut, P., S. Rebelo, and D. Xie (2001). Beyond Balanced Growth. *Review of Economic Studies 68*, 869–882.

Kopsidis, M. and N. Wolf (2012). Agricultural productivity across Prussia during the Industrial Revolution: A Thünen perspective. *Journal of Economic History 72*(3), 634–670.

Kraus, T. (1876). *Statistik und Beschreibung der Raiffeisenschen Darlehnskassenvereine [Statistics and Description on the Raiffeisen Loan Associations]*. Bonn: Strauss.

Kuczynski, J. (1961). *Die Geschichte der Lage der Arbeiter unter dem Kapitalismus, Teil 1 [The History and Situation of the Workers under Capitalism, Part 1]*. Berlin: Akademie Verlag.

La Ferrara, E. (2002). Inequality and group participation: Theory and evidence from rural Tanzania. *Journal of Public Economics 85*, 253–273.

Lehmann, S. (2010). The German elections in the 1870s: who caused the turn towards protectionism? *Journal of Economic History 70*(1), 146–178.

Lehmannn-Hasemeyer, S. and F. Wahl (2017). Savings banks and the industrial revolution in Prussia: Supporting regional development with public financial institutions. *CEPR Paper 12500*.

Leighton, G. (2016). The Teutonic order and the origins of its state as an example of a crusading landscape in fourteenth-century Prussia. In "9th Quadrennial Conference of the Society for the Study of the Crusades and the Latin East" (Eds.), *After the Crusade - Ending the Fight, Reorganizing Society*. Odense.

Lorenz, T. and U. Müller (2006). National segregation and mass mobilization. Polish cooperatives in Poznania before the First World War. In T. Lorenz (Ed.), *Cooperatives in Ethnic Conflicts: Eastern Europe in the 19th and early 20th Century*, pp. 183–200. Berlin: BWV.

Losch, B., S. Freguin-Gresh, and E. White (2011). *Rural Transformation and Late Developing Countries in a Globalizing World. A Comparative Analysis of rural change*. Washington DC: World Bank.

Meitzen, A. (1869, 1879, 1901). *Der Boden und die landwirthschaftlichen Verhältnisse des Preußischen Staates nach dem Gebietsumfange vor 1866 [Soil and agricultural conditions of the Prussian state in its territory of 1866]*. Berlin.

Mookherjee, D. and Motta (2016). A theory of interactions between MFIs and informal lenders. *Journal of Development Economics 121*, 191–200.

Morduch, J. (1999). The role of subsidies in microfinance: evidence from the Grameen bank. *Journal of Development Economics 60*, 229–248.

O'Rourke, K. (1997). The European Grain Invasions, 1870–1913. *Journal of Economic History 57*(4), 775–801.

O'Rourke, K. H. (2007). Culture, conflict and cooperation: Irish dairying before the Great War. *Economic Journal 117*(523), 1357–1379.

Périlleux, A., A. Vanroose, and B. D'Espallier (2016). Are financial cooperatives crowded out by commercial banks in the process of financial sector development? *Kyklos 69*(1), 108–134.

Piana, M. and C. Carlsson (2014). *Archaeology and Architecture of the Military Orders: New Studies*. Ashgate: Routledge.

Polizei Präsidium Posen (1909). *IV. Sonderausgabe des Gesamtüberblicks über die polnische Tagesliteratur, Heft II: Rechenschaftsberichte [IV. Special Edition of the Review of Polish daily papers, volume II: Accounts]*. Posen: Merzbach'sche Buchdruckerei.

Preußische Central-Genossenschafts-Kasse (1915). *Adreßuch der Erwerbs- und Wirtschaftsgenossenschaften im Deutschen Reiche [Adressbook of Purchasing and Economic Cooperatives in the German Empire]*. Berlin: Carl Henmans Verlag.

Preußisches Statistisches Landesamt (1907). Besondere Beilage: Monats- und Jahrespreise wichtiger Lebens- und Verpflegungsmittel einschließlich lebenden Viehs in Preußen [Special supplement: Monthly and yearly prices of key agricultural products, including livestock, in Prussia]. *Zeitschrift des Königlich Preußischen Statistischen Landesamtes 47*.

Preußisches Statistisches Landesamt (1908). Die endgültigen Ergebnisse der außerordentlichen Viehzählung vom Dezember 1906 [The final results of the extraordinary cattle census of 1906]. *Preußische Statistik 210*.

Rajan, R. G. and R. Ramcharan (2011). Land and credit: A study of the political economy of banking in the United States in the early 20th century. *Journal of Finance 66*, 1895–1931.

Schlütz, F. (2013). *Ländlicher Kredit. Kreditgenossenschaften in der Rheinprovinz (1889–1914) [Rural credit. Credit cooperatives in the Rhine Province (1889–1914)]*. Stuttgart: Franz Steiner.

Seidel, D. (1897). Der Personalkredit des ländlichen Kleingrundbesitzes in Deutschland [The personal credit of rural smallholders in Germany]. *Jahrbücher Für Nationalökonomie Und Statistik / Journal of Economics and Statistics 14*(69), 442–454. no. 3.

Statistisches Amt, K. (1886). Statistisches Jahrbuch für das Deutsche Reich [Statistical Yearbook of the German Empire].

Swart, F. (1911). Das polnische Genossenschaftswesen in der Provinz Posen [The Polish cooperative movement in the Province of Posen]. In W. Mitscherlich (Ed.), *Die Ostmark. Eine Einführung in die Probleme ihrer Wirtschaftsgeschichte*, pp. 132–153. Wiesbaden: Springer.

Teignier, M. (2018). The role of trade in structural transformation. *Journal of Development Economics 130*, 45–65.

Tilly, R. (1992). An overview on the role of the large German banks up to 1914. In Y. Cassis (Ed.), *Finance and Financiers in European History, 1880-1960*, pp. 93–112. Cambridge University Press.

Timmer, C. P. (2007). *A World Without Agriculture. The structural transformation in historical perspective*. Washington DC: AEI Press.

Torbus, T. (1998). *Die Konventsburgen im Deutschordensland Preußen [Monastic castles in the State of the Teutonic Order in Prussia]*. Muenchen: Oldenbourg.

Ullmann, H.-P. (2005). *Der deutsche Steuerstaat: Geschichte der öffentlichen Finanzen vom 18. Jahrhundert bis heute [The German tax state: History of public finances from the 18th century to today]*. CH Beck.

Uy, T., K. M. Yi, and J. Zhang (2013). Structural change in an open economy. *Journal of Monetary Economics 60*(6), 667–682.

v. Finckenstein, H. W. G. F. (1960). *Die Entwicklung der Landwirtschaft in Preußen und Deutschland, 1800-1930 [The Development of Agriculture in Prussia and Germany 1800-1930]*. W urzburg: Holzner.

Vanroose, A. (2016). Which factors drive the regional expansion of microfinance institutions? Evidence from Peru. *Journal of International Development 28*(7), 1104–1120.

Verein für Socialpolitik (1887). Der Wucher auf dem Lande. Berichte und Gutachten [Usury in the countryside. Reports and analyses]. *Schriften des Vereins für Socialpolitik XXXV*.

Von Altrock, W. (1900). *Der ländliche Personalkredit in der Provinz Brandenburg [Rural personal credit in the province of Brandenburg]*. Berlin: Puttkamer und Mühlbrecht.

Weber, M. (1892). *Die Lage der Landarbeiter im Ostelbischen Deutschland [The situation of agricultural laborers in east Elbian Germany]*. Leipzig.

Wygodzinski, W. (1911). *Das Genossenschaftswesen in Deutschland [The cooperative movement in Germany]*. Leipzig und Berlin: Teubner.

Zeissig, H. (1964). *Harms Geschichts- und Kulturatlas [Atlas of History and Culture]*. Muenchen: List Verlag.