

How Costly is Ethnic Discrimination? Evidence from the Late Imperial Russia

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Abstract

How ethnic discrimination affects the efficiency of resource allocation in the economy? In this paper, I exploit the discontinuity caused by the Pale of Settlement in the late Russian Empire to answer this question. This allows to rule out the explanations based on the differences between various provinces of the Russian Empire. The paper shows that firms inside the Pale of Settlement benefited from easier access to capital and had higher power per worker. The evidence of the effect on the power per worker, however, remains ambiguous.

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1 Introduction

Russia systematically lagged behind the developed countries from the point of view of the economic development of the country. The GDP per capita in the Russian Empire around 1900 was just 1237 USD 1990 dollars (Maddison (1995)). To put it into context, this amount is only 43% of the GDP per capita in Germany of that time and is actually close to the world average. The potential explanations include the inefficient institution of the communal property and mutual guarantee in the rural areas (Markevich and Zhuravskaya (2018)), excessive monopolization of the markets supported by the government (Cheremukhin et al. (2017)), underdevelopment of the banking system (Grigoriadis and Suesse (2021)), distorted incentives of the elite resulting in underfinancing of primary education (Chaudhary et al. (2012)).

The argument connecting underdevelopment of institutions with slow industrialization and economic development recently flourished in the economic literature (e. g. Gregg (2020), Grigoriadis and Suesse (2021)). Gregg (2020) notes that the late Russian Empire economy was characterized by higher interest rates than in Western Europe (6-7 percent in comparison to about 1.8 % in England and France and 3.1 % in Germany). The underdevelopment of the financial sector, which represented only 26.9 % of national assets (vs. 39-43 % in the US, France, Germany), impeded the firm's access to capital and, arguably, the development of the Russian Empire. The impetus to obtain easier financing and cheaper access to capital were so high that they incentivized over 4000 Russian firms to incorporate despite the costly and time-consuming nature of this process in the late Russian Empire. The key result of the incorporation was a significant increase in the capital and the productivity of labor. These results suggest that access to capital would be beneficial and important for the firms because of the severe problems with the financial sector.

As the evidence suggests, Jewish presence in the Pale of Settlement may play a great role in determining of the usage of capital. According to Grosfeld et al. (2013), Jews were largely engaged in activities such as financial intermediation and trading. In their paper, the authors argue that the presence of Jews inside the Pale contributed to the development of long-standing anti-market culture in the regions where Jews and the non-Jewish population had to interact. However, Grosfeld et al. (2013) do not shed light on the reasons for the emergence of the anti-Semitic hatred among the non-Jewish population mentioning only that "Jews were dominant in several important economic niches that the non-Jewish population aspired to control". Our investigation may be seen as an argument for an alternative mechanism of the formation of anti-market culture inside the Pale. While entrepreneurs benefited from the factories being more labor productive,

certain categories of workers may actually suffer because of the fact that easier access to capital, as Gregg (2020) points out, “allowed firms to buy newer or better machines and substitute capital for labor while increasing output”. Though we do not directly separate these effects, we document the increase in capital usage for firms inside the Pale.

The connection between the role of Jews as financial intermediaries and their perception by the non-Jewish population was studied in Grosfeld et al. (2020). The authors argue that one of the main drivers of anti-Jewish violence (*pogroms*) in the Russian Empire was their role as providers of insurance, and violence was likely to happen only after the combination of political and economic shocks, which could ruin the implicit insurance contracts. This evidence emphasizes an important role of Jews moneylenders as substitutes of banks and makes us expect a difference between the access to the capital and performance indicators for the firms inside and outside of the Pale.

In this paper I primarily use the “List of Plants and Factories in the Russian Empire”, which gives the performance indicators (revenue, power, workers) for firms in the Russian Empire for 1908 as well as the firm’s location and industry. I start with the OLS specifications and document that the effect of the Pale on the power per worker holds unless we control for the industry of the firm. These specifications, however, don’t allow to include fixed controls, which is why I switch to the discontinuity analysis.

In the discontinuity part of the paper I exploit the fact that the exact border of the Pale of Settlement were fairly random and orthogonal to any relevant covariates. I show that there is a significant jump in the capital usage for the firms, which coincides with the Pale border. To do so, I use the distance to the Pale as a running variable. After that, I investigate the effect of the distance to the Pale on firm’s performance while controlling for the province fixed effects. The results suggest that moving 100 kilometers to the Pale leads on average to 26.8 % increase in its power per worker and 32.3 % increase in the revenue per worker. The latter result, however, is not especially robust and should be treated cautiously.

The rest of the paper proceeds as follows: Section 2 presents the data, Section 3 discusses the identification strategy, Section 4 presents the results. Section 5 discusses the future extensions of the paper because the results are still preliminary. Section 6 concludes.

2 Data

The key data source for this paper is the “List of Plants and Factories in the Russian Empire”. This list contains the results of the Imperial Russian survey of manufacturers, which was conducted in 1908 by the Ministry of Trade and Industry Division of Industry.

This data has recently been investigated by Gregg (2020) and Grigoriadis and Suesse (2021) in the context of Russia’s catch-up industrialization.

To be included in the survey, the factory needed to have either factory devices or a minimum of 15 workers (Gregg (2020)). Thus, the small enterprises are inevitably excluded from our analysis.

The firm’s data is self-reported, which raises questions about its quality. The truth reporting of the firm’s performance was enforced by the audit from the Division of Industry (Varzar (1912)). Moreover, as Gregg (2020) notes, the results of the census were not aimed to be used for the tax collection, which means that firms had no direct incentive to lie. That said, the data used is subject to the usual measurement errors associated with the self-reported data.

In this paper I use the data on 15 provinces surrounding the Pale of Settlement.¹ The descriptive statistics for all the firms in these provinces is presented in Table 1. In Table 2 I compare firms from the different sides of the Pale. Doing so, I note that firms inside the Pale are smaller in terms of power and the number of workers, though they are more capital-intensive and have higher revenue per worker. Another noticeable thing is that firms inside the Pale are less likely to incorporate which could decrease their financial opportunities. In principle, one could use the whole data set of the firms, but the strong regional differences across the Russian Empire would make this comparison irrelevant, though I provide some analysis for these firms in Appendix A.

The key variables that are given at the factory level and utilized in the paper are the number of workers, power, revenue², and the address of the firm. In OLS specifications I also exploit whether the firm was a corporation, taking this data from Gregg (2020). In the discontinuity design part of the paper, I also use the population of the town or village where the firm is located. This data is taken from the 1897 population census, and there is no data for localities with less than 500 citizens. 76.9 % of the firms that used in the discontinuity part of the paper do, however, have the data on the number of inhabitants.

In 1908 there were 2647 firms that participated in the census in 15 provinces bordering the Pale. For the discontinuity part of the analysis, I take a subsample of firms. This restriction stems from the limited availability of the data. Namely, I study the firms that belong to one of 3 industries: Foods, Wood, or Minerals.³ Foods and Wood industries are

¹There are 7 nearby provinces inside the Pale (Kovenskaya, Vilenskaya, Vitebskaya, Mogilyovskaya, Chernigovskaya, Poltavskaya, and Ekaterinoslavskaya) and 8 provinces outside of the Pale (Kurlyandskaya, Lifyandskaya, Pskovskaya, Smolenskaya, Orlovskaya, Kurskaya, Kharkvovskaya provinces and Don-skaya oblast).

²In the census there are two types of revenue: the first is called “order revenue” whereas the second is called just “revenue”. Power is measured in the horse powers (HP) and includes horses. The main difference between them is that the latter doesn’t include raw materials cost (Varzar (1912)) and is available for very few firms. Thus, in the later analysis, I primarily rely on the “revenue”.

³In the future versions of the paper firms from other industries will be included in the analysis.

Table 1: Descriptive statistics for the firms in the provinces near the Pale (1908)

	Mean	SD	Min	Max	N
Corporation	0.06	0.24	0.00	1.00	2,647
Revenue	204.60	728.67	0.02	21,106.08	2,400
Workers	84.50	278.19	1.00	6,041.00	2,642
Power (HP)	73.23	295.95	0.00	5,865.00	2,647
Revenue per worker	3,272.31	6,277.84	5.00	81,694.75	2,399
Power per worker	1.27	2.31	0.00	28.75	2,642
Revenue per worker (log)	7.22	1.22	1.61	11.31	2,399
Power per worker (log)	-0.26	1.32	-5.39	3.36	1,971
Revenue (log)	10.70	1.68	3.00	16.87	2,400
Workers (log)	3.40	1.25	0.00	8.71	2,642
Power (log)	3.29	1.46	0.00	8.68	1,973
Pale dummy	0.45	0.50	0.00	1.00	2,647
<i>Industry composition:</i>					
Silk	0.00	0.03	0.00	1.00	2,647
Flax	0.05	0.21	0.00	1.00	2,647
Animal	0.09	0.28	0.00	1.00	2,647
Wool	0.02	0.13	0.00	1.00	2,647
Cotton	0.01	0.07	0.00	1.00	2,647
Mixed materials	0.01	0.11	0.00	1.00	2,647
Wood	0.16	0.36	0.00	1.00	2,647
Paper	0.12	0.32	0.00	1.00	2,647
Metals and machines	0.14	0.35	0.00	1.00	2,647
Foods	0.24	0.43	0.00	1.00	2,647
Chemical	0.04	0.19	0.00	1.00	2,647
Mineral product	0.14	0.35	0.00	1.00	2,647

Notes: Corporation is a dummy variable which equals 1 when the firm is a corporation. Revenue is measured in thousands of rubles. Power is measured in horsepower and includes horses. Revenue per worker is measured in rubles. Pale dummy equals 1 if the firm is located inside the Pale of Settlement. After that the industry composition of the market is shown: each if the industry variables is a dummy which equals 1 if the firm belongs to that industry.

Table 2: The difference between the firms inside and outside of the Pale of Settlement for firms in the provinces near the Pale

	Outside the Pale	Inside the Pale	Difference	N
Corporation	0.08	0.04	0.04*** (0.01)	2647
Revenue	246.03	152.49	93.54*** (27.72)	2400
Workers	99.25	66.57	32.68*** (10.41)	2642
Power (HP)	83.78	60.39	23.40** (11.22)	2647
Revenue per worker	2948.20	3679.66	-731.45*** (262.01)	2399
Power per worker	1.15	1.42	-0.27*** (0.09)	2642
Revenue per worker (log)	7.19	7.25	-0.06 (0.05)	2399
Power per worker (log)	-0.40	-0.06	-0.34*** (0.06)	1971
Revenue (log)	10.87	10.48	0.39*** (0.07)	2400
Workers (log)	3.61	3.15	0.45*** (0.05)	2642
Power (log)	3.29	3.28	0.02 (0.07)	1973

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. The p-values are taken from the t-test with unequal variances. Corporation is a dummy variable which equals 1 when the firm is a corporation. Revenue is measured in thousands of rubles. Power is measured in horsepower and includes horses. Revenue per worker is measured in rubles.

the most capital-intensive industries, as Table 3 suggests. The Minerals Industry is one of the least capital-intensive industries, so this industry would serve as a control group in our analysis. We do not expect to observe any significant differences caused by the Pale here because the proposed mechanism driving the difference is the small-scale lending.

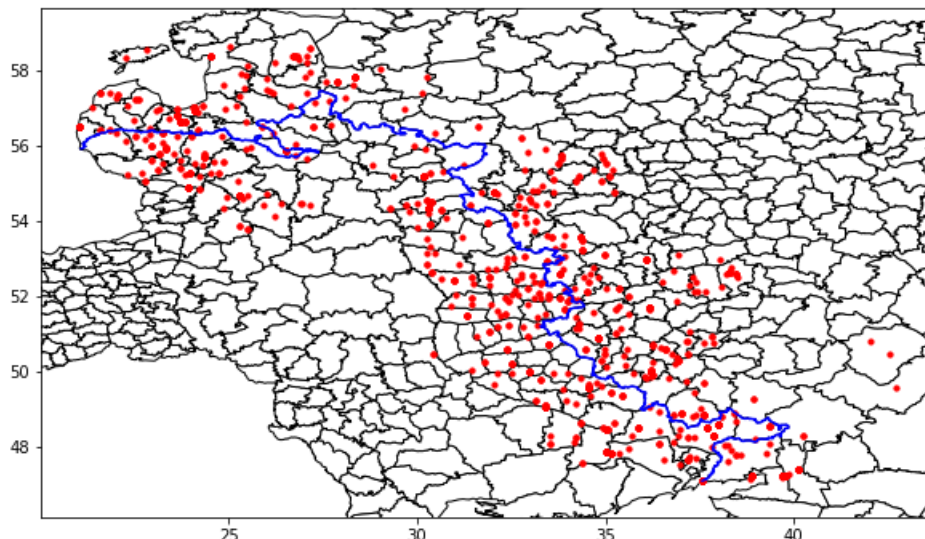
Table 3: Comparison of the industries by power per worker

	Power per worker (log)			Power per worker			Share of firms using power
	N	Mean	SD	N	Mean	SD	
Animal	458	-1.29	1.20	981	0.24	0.50	46.7%
Chemicals	386	-0.76	1.21	460	0.81	1.65	83.9%
Cotton	518	-0.46	0.93	782	0.62	1.17	66.2%
Flax	133	-0.89	0.93	274	0.29	0.49	48.5%
Foods	2,485	0.64	1.23	2,698	3.21	4.63	92.1%
Metals	1,768	-1.02	0.89	2,035	0.47	0.61	86.9%
Mineral products	666	-1.19	1.24	1,473	0.28	0.70	45.2%
Mixed materials	252	-1.33	0.96	379	0.28	0.62	66.5%
Paper	988	-1.11	1.22	1,296	0.67	1.76	76.2%
Silk	145	-1.76	0.82	267	0.13	0.19	54.3%
Wood	1,671	0.06	0.83	1,854	1.29	1.23	90.1%
Wool	622	-0.50	1.01	1,014	0.59	1.09	61.3%
Total	10,092	-0.41	1.30	13,513	1.13	2.52	74.7%

Notes: Power per worker is measured in horse powers and includes horses. The column for each of the indicators show the number of firms, mean and the standard deviation. The last row shows the data on firms in all the industries.

For the discontinuity part of the paper, I exploit the data on 1224 successfully geocoded firms. The geocoding matches the firm to the center of the town for the firms located in the urban region and to the center of the municipal area (“volost”) for the firms located in the rural areas. Thus, the measurement error for the urban firms is very small: we ignore only the street level information. For the rural areas, there may be a measurement error that we should admit, but it is unlikely to matter a lot. As Grigoriadis and Suesse (2021) note, the Russian Empire consisted of more than 13000 municipal areas. In order to avoid the effect to be driven by the outliers, I also exclude 61 factories that are located further than 200 kilometers from the Pale, which means the high precision of the geolocating.

The map of the firms near the Pale can be seen in Figure 1. The Pale of the Settlement is depicted as a blue line whereas black lines show the borders of different districts (“uezds”) of the Russian Empire. To the left from the Pale Jews were allowed to live whereas to the right of it there were very few exceptions. Red dots show the geocoded



Notes: The blue line depicts the Pale of Settlement. Each of the red dots stands for a firm in the province nearby the Pale. Black lines show the borders between the districts of the Russian Empire.

Figure 1: The Map of the Pale of Settlement

factories. Some of the plants are located in the same town, so some dots designate several firms. To calculate the distance between the factories and the Pale, I project them in the local coordinate system. While this may cause some measurement errors caused by the fact that we don't have many reliable data on the roads in the Russian Empire, these measurement errors are unlikely to be correlated with any of the characteristics, which could bias our estimate.⁴

The descriptive statistics for the firms used in the discontinuity part of the paper is presented in Table 4. If we compare the numbers in the table with the statistics for all firms in these provinces from Table 1 we'll notice that the firms in our sample have higher capital per worker, which is driven by our deliberate choice, though poses important questions. When we include other industries, the necessity of this choice will, however, disappear.

3 Identification Strategy

The paper starts with the OLS estimations of the effect of the Pale of Settlement on the power per worker and revenue per worker. My baseline OLS specifications are shown

⁴For projection, I use the EPSG:3576 system. This system may be used for the Northern hemisphere to the north of the 45th parallel north.

Table 4: Descriptive statistics for the firms used in the discontinuity analysis

	Mean	SD	Min	Max	N
Town (village) population	68.77	87.65	0.49	282.23	894
Revenue	174.59	458.07	0.60	8,054.80	1,030
Workers	52.82	139.13	1.00	2,794.00	1,163
Power (HP)	60.63	446.92	0.00	15,000.00	1,163
Revenue per worker	4,895.20	8,221.01	26.90	70,666.66	1,030
Power per worker	1.87	4.19	0.00	115.38	1,163
Revenue per worker (log)	7.47	1.43	3.29	11.17	1,030
Power per worker (log)	0.06	1.39	-5.39	4.75	1,971
Workers (log)	3.24	1.08	0.00	7.94	1,163
Power (log)	3.31	1.30	0.00	9.62	968
Pale dummy	0.50	0.50	0.00	1.00	1,163

Notes: Town (village) population is given in thousands of people and is available only for the locations with more than 500 inhabitants. Revenue is measured in thousands of rubles. Power is measured in horsepower and includes horses. Revenue per worker is measured in rubles. Pale dummy equals 1 if the firm is located inside the Pale of Settlement.

in the equations (1) and (2):

$$\log(\text{Power}/\text{Worker})_{ij} = \gamma_1 \text{Pale}_{ij} + \phi_1 X_{ij} + \varepsilon_{ij} \quad (1)$$

$$\log(\text{Rev}/\text{Worker})_{ij} = \gamma_2 \text{Pale}_{ij} + \phi_2 X_{ij} + \zeta_{ij} \quad (2)$$

In these equations, for factory i in sector j $\log(\text{Power}/\text{Worker})_{ij}$ denotes its log power per worker (measured in horsepower), $\log(\text{Rev}/\text{Worker})_{ij}$ denotes the firm's log revenue per worker (measured in rubles), Pale_{ij} stands for the dummy that equals 1 for the firms inside the Pale of Settlement (i.e. where the Jews were allowed to live), X_{ij} stands for the firm-level controls. In some of the specifications, I change the dependent variables to the levels instead of logarithms. This difference in the specification may be important for the case of power per worker for which 25.5 % of the firms in the sample used have zero value (i. e. they rely exclusively on craft production).

These specifications allow us to include industry fixed effects μ_j and dummy on whether the firm is a corporation as control variables in X_{ij} , though these specifications leave us no space for province fixed effects. That means that our estimation will be biased and the bias will be caused by the intrinsic differences between different provinces of the Russian Empire. To get rid of this bias, we primarily rely on the discontinuity design.

The main source of the exogeneity in this paper is the fact that the exact borders of the Pale of Settlement were arbitrarily drawn in the 1790s without taking into account any characteristics of the territories (Grosfeld et al. (2013)). Grosfeld et al. (2013) emphasize the fact that Catherine the Great, who established the Pale, was unaware of the specifics of the territories which would later become the provinces near the Pale. For instance, before the Pale was introduced, Jews lived in the northern provinces outside of the Pale, though there were hardly present in the southern provinces inside the Pale. This suggests that the Pale of Settlement can be used as a way to capture exogenous change in the share of Jews in the locality where the firm is situated.

In the discontinuity part of the paper, I start with the following estimations:

$$\log(\text{Power}/\text{Worker})_{ij} = \beta_1 \text{Distance}_{ij} + \vartheta_1 X_{ij} + \varepsilon_{ij} \quad (3)$$

$$\log(\text{Rev}/\text{Worker})_{ij} = \beta_2 \text{Distance}_{ij} + \vartheta_1 X_{ij} + \zeta_{ij} \quad (4)$$

In these equations, for factory i in province j $\log(\text{Power}/\text{Worker})_{ij}$ denotes its log power per worker (measured in horsepower), $\log(\text{Rev}/\text{Worker})_{ij}$ denotes the firm's log revenue per worker (measured in rubles), Distance_{ij} stands for the distance to the Pale of Settlement. The distance is positive for the firms located inside the Pale (i.e. where the Jews were allowed to live) and negative for the firms outside the Pale. X_{ij} stands for the firm-level controls. As before, I tried the levels instead of logarithms in a few specifications. Regressions (3) and (4) allow me to include the province fixed effects so as to exclude the effect of the differences between different provinces of the Russian Empire.

In addition to these specifications, I estimate the linear regressions (3) and (4) separately for the firms inside and outside of the Pale of Settlement to ensure that there is a change at the power per worker, which can be explained by the Pale border.

4 Results

4.1 OLS estimation

In this section I present results of the OLS estimation for the specification equations (1) and (2). Though these results look promising, they should be interpreted cautiously due to the inability of inclusion of the province fixed effects.

Table 5 suggests that we should expect the effect of the Pale of Settlement on the power per worker (log), and this effect is not driven by outliers. The results from Table 6 show that this initial result is robust to the change in the scale measurement of the capital intensity. That said, Tables 5 and 6 do not show a significant effect of the Pale on the

Table 5: OLS Estimation of the Effect of the Pale on Power per worker (log) and Revenue per worker (log) for provinces near the Pale of Settlement.

	<i>Dependent variables:</i>					
	Power per worker (log)			Revenue per worker (log)		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	−0.399*** (0.050)	−0.413*** (0.052)	−1.362*** (0.278)	7.195*** (0.081)	7.130*** (0.084)	7.435*** (0.152)
Pale dummy	0.336** (0.139)	0.342** (0.139)	0.131 (0.108)	0.055 (0.186)	0.087 (0.180)	−0.042 (0.162)
Corporation		0.137 (0.147)	0.316** (0.125)		0.762*** (0.144)	0.685*** (0.071)
Chemicals			0.595* (0.301)			0.094 (0.231)
Cotton			0.844** (0.295)			−0.049 (0.476)
Flax			0.799*** (0.244)			−0.782*** (0.171)
Foods			2.025*** (0.288)			1.111*** (0.172)
Metals			0.354 (0.261)			−0.646*** (0.117)
Mineral products			0.054 (0.235)			−1.159*** (0.125)
Mixed materials			0.163 (0.177)			−0.463 (0.281)
Paper			0.309 (0.332)			−0.752*** (0.121)
Silk			−0.510* (0.278)			−0.286 (0.366)
Wood			1.402*** (0.288)			−0.568*** (0.151)
Wool			1.128*** (0.297)			−0.575** (0.205)
N	1971	1971	1971	2399	2399	2399
R^2	0.016	0.017	0.355	0.001	0.025	0.452
R^2 Adj.	0.015	0.016	0.350	0.000	0.024	0.449
Clustered by:	Province	Province	Province	Province	Province	Province

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors are clustered by province. Corporation is a dummy variable which equals 1 when the firm is a corporation. Power per worker is measured in horsepowers per worker and includes horses. Revenue per worker is measured in rubles.

Table 6: OLS Estimation of the Effect of the Pale on Power per worker and Revenue per worker for provinces near the Pale of Settlement.

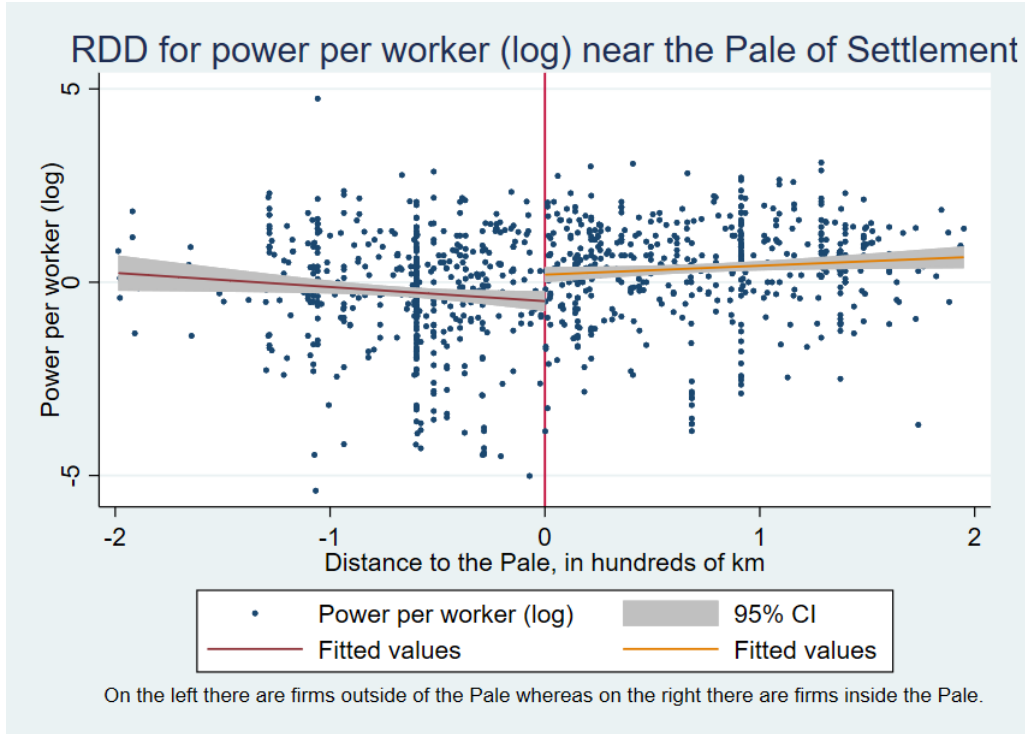
	<i>Dependent variables:</i>					
	Power per worker			Revenue per worker		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1.147*** (0.084)	1.113*** (0.087)	0.124 (0.117)	2948.201*** (504.591)	2767.183*** (505.997)	2467.393*** (503.058)
Pale dummy	0.270 (0.202)	0.286 (0.203)	0.137 (0.138)	731.454 (1100.238)	818.676 (1096.059)	229.626 (799.493)
Corporation		0.417** (0.175)	0.459*** (0.152)		2121.408** (816.870)	1947.465*** (579.816)
Chemicals			0.744*** (0.230)			504.721 (551.776)
Cotton			0.432** (0.179)			114.916 (1294.296)
Flax			−0.032 (0.087)			−1622.268*** (328.006)
Foods			2.828*** (0.250)			6964.870*** (1406.902)
Metals			0.320*** (0.067)			−1544.050*** (285.199)
Mineral products			0.086 (0.055)			−1953.377*** (294.162)
Mixed materials			0.254*** (0.078)			−1215.147*** (358.801)
Paper			0.628** (0.246)			−1632.987*** (300.126)
Silk			−0.164** (0.067)			−1069.938 (627.443)
Wood			1.254*** (0.134)			−1258.703*** (357.538)
Wool			0.958*** (0.272)			−1455.314** (514.978)
N	2642	2642	2642	2399	2399	2399
R^2	0.003	0.005	0.222	0.003	0.010	0.320
R^2 Adj.	0.003	0.005	0.218	0.003	0.010	0.316
Clustered by:	Province	Province	Province	Province	Province	Province

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors are clustered by province. Corporation is a dummy variable which equals 1 when the firm is a corporation. Power per worker is measured in horsepowers per worker and includes horses. Revenue per worker is measured in rubles.

revenue per worker. Standard errors in all the specifications are clustered at the province level. The results don't significantly change if we switch to the heteroskedasticity robust errors, as it's shown in Appendix B.

4.2 Discontinuity analysis

We start the discontinuity estimation with showing that we do observe a spike at the power per worker (log) near the border of the Pale. Figure 1 shows that the spike near the Pale in fact exists. We estimate the first order polynomials on the both sides of the Pale and find that their 95% confidence intervals do not intersect. Thus, we observe that RDD design allows us to conclude that the Pale causes a sudden increase in the access to capital, and the firms benefit from it in terms of capital intensity.



Notes: The linear regression on the both sides of the Pale are estimated. 95% Confidence intervals are presented.

Figure 2: Regression discontinuity for power per worker (log)

I proceed with the estimations of the regressions (3) and (4). The results of the estimation are presented in the Tables 7 and 8. It should be noted that adding uezd (district) fixed effects, though may sound reasonable, actually leaves almost no variation due to the large number of districts. That said, I also demonstrate the result from the regressions with an inclusion of the uezd (district) fixed effect.

The results from Tables 7 and 8 can be used to obtain our estimates. Column (2) is useful for obtaining the effect of the Pale for all the firms in the surrounding provinces

Table 7: Discontinuity analysis for power per worker (log)

	<i>Dependent variable:</i>				
	Power per worker (log)				
	(1)	(2)	(3)	(4)	(5)
Intercept	0.050 (0.118)	−0.305** (0.138)	−0.125 (0.173)	0.413 (0.338)	0.452 (0.563)
Distance (100 km)	0.311** (0.130)	0.268** (0.099)	0.400*** (0.114)	0.605** (0.253)	0.575 (0.421)
Town population			−0.002* (0.001)		0.001 (0.002)
Province FE	No	Yes	Yes	No	No
Uezd FE	No	No	No	Yes	Yes
N	968	968	726	968	726
R^2	0.036	0.150	0.137	0.328	0.305
R^2 Adj.	0.035	0.137	0.118	0.230	0.184
Clustered by:	Province	Province	Province	Province	Province

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors are clustered by province. Power per worker is measured in horsepower per worker and includes horses. Town (village) population is given in thousands of people and is available only for the locations with more than 500 inhabitants.

Table 8: Discontinuity analysis for revenue per worker (log)

	<i>Dependent variable:</i>				
	Revenue per worker (log)				
	(1)	(2)	(3)	(4)	(5)
Intercept	7.467*** (0.132)	6.725*** (0.172)	6.684*** (0.200)	6.764*** (0.636)	6.133*** (0.968)
Distance (100 km)	0.179 (0.164)	0.324** (0.124)	0.379** (0.134)	0.792 (0.491)	1.272 (0.752)
Town population			0.000 (0.002)		0.003 (0.004)
Province FE	No	Yes	Yes	No	No
Uezd FE	No	No	No	Yes	Yes
N	1030	1030	791	1030	791
R^2	0.012	0.123	0.099	0.251	0.228
R^2 Adj.	0.011	0.110	0.080	0.150	0.114
Clustered by:	Province	Province	Province	Province	Province

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors are clustered by province. Revenue per worker is measured in rubles. Town (village) population is given in thousands of people and is available only for the locations with more than 500 inhabitants.

whereas column (3) specifies the effect for the relatively large localities. Thus, using Table 7, we demonstrate that for the firm moving 100 kilometers to the Pale leads on average to 26.8 % increase in its power per worker and this estimate increases up to 40 % when we take into account only firms situated in places where the population exceeds 500 inhabitants.

In a very similar way, we can look at Table 8 to get our estimates for the revenue per worker. For the firm moving 100 kilometers to the Pale leads on average to 32.3 % increase in its revenue per worker and this estimate becomes as high as 37.9 % when we take into account only firms from the relatively large localities. However, we should admit that the effect for revenue per worker is not really robust to the alternative specifications, so we should treat it cautiously and for now, we consider this estimate to be ambiguous.

Section C of the Appendix provides estimates for power per worker and revenue per worker. Here we don't observe the effect for power per worker, which seems to happen because of the outliers spoiling the validity of the OLS estimate. The effects for the revenue per worker, however, exhibit a very similar dynamic as in Table 8.

5 Future Extensions

The results presented in the paper remain preliminary. In the future versions of the paper, I'm going to further investigate what drives the difference between firms inside the Pale and outside of it.

One of the possible explanations may be the bonding social capital among the Jews. To analyze this, I'm going to explore the heterogeneity of the effects among the firms with Jewish and non-Jewish owner. Though there is no exact information on the ethnicity of the factory owner, I'm planning to proxy it using the name and family name of the firm owner.

Another thing that I'm going to explore is a possible concern of self-selection of the firms inside the Pale into the industries which more heavily rely on the small-scale lending. To address this issue, I'd like to instrument the industry in which the firms operates. The natural instrument for minerals would be a proximity to the coal deposits. This approach would be helpful in separating excluding the self-selection effect.

6 Conclusion

Despite being preliminary, our results suggest that it was beneficial for the firm to be inside the Pale in terms of the access to capital. Therefore, the firms inside the Pale had

higher power per workers than firms outside of it. The evidence on the effect of the Pale on the revenue per worker is not consistent.

The obtained results show another possible reason for the underdevelopment of the Russian Empire, which is a misallocation of the resources (namely, capital) brought about by the ethnic discrimination.

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Appendices

A Analysis for all the firms participating in the 1908 census

Table 9: Descriptive statistics for all the firms which participated in the 1908 census.

	Mean	SD	Min	Max	N
Corporation	0.08	0.27	0.00	1.00	13,561
Revenue	260.56	1,056.47	0.00	38,953.00	11,766
Workers	121.00	462.12	1.00	13,498.00	13,513
Power (HP)	86.09	405.69	0.00	12,772.00	13,561
Revenue per worker	2,647.66	8,775.04	1.02	777,777.75	11,755
Power per worker	1.13	2.52	0.00	150.00	13,513
Revenue per worker (log)	7.12	1.14	0.02	13.56	11,755
Power per worker (log)	-0.41	1.30	-6.53	5.01	10,092
Revenue (log)	10.76	1.72	1.10	17.48	11,766
Workers (log)	3.54	1.33	0.00	9.51	13,513
Power (log)	3.25	1.51	-1.39	9.46	10,112
Pale dummy	0.41	0.49	0.00	1.00	13,561
<i>Industry composition:</i>					
Silk	0.02	0.14	0.00	1.00	13,561
Flax	0.02	0.14	0.00	1.00	13,561
Animal	0.07	0.26	0.00	1.00	13,561
Wool	0.07	0.26	0.00	1.00	13,561
Cotton	0.06	0.23	0.00	1.00	13,561
Mixed materials	0.03	0.17	0.00	1.00	13,561
Wood	0.14	0.34	0.00	1.00	13,561
Paper	0.10	0.29	0.00	1.00	13,561
Metals and machines	0.15	0.36	0.00	1.00	13,561
Foods	0.20	0.40	0.00	1.00	13,561
Chemical	0.03	0.18	0.00	1.00	13,561
Mineral product	0.11	0.31	0.00	1.00	13,561

Notes: Corporation is a dummy variable which equals 1 when the firm is a corporation. Revenue is measured in thousands of rubles. Power is measured in horsepower and includes horses. Revenue per worker is measured in rubles. Pale dummy equals 1 if the firm is located inside the Pale of Settlement. After that the industry composition of the market is shown: each if the industry variables is a dummy which equals 1 if the firm belongs to that industry.

Table 10: The difference between the firms inside and outside of the Pale of Settlement for all firms

	Outside the Pale	Inside the Pale	Difference	N
Corporation	0.10	0.05	0.05*** (0.004)	13561
Revenue	316.27	171.11	145.16*** (17.49)	11766
Workers	156.30	70.56	85.74*** (7.17)	13513
Power (HP)	105.07	59.01	46.06*** (6.51)	13561
Revenue per worker	2510.70	2867.59	-356.89*** (146.74)	11755
Power per worker	0.95	1.38	-0.43*** (0.04)	13513
Revenue per worker (log)	7.07	7.20	-0.13*** (0.02)	11755
Power per worker (log)	-0.58	-0.16	-0.42*** (0.03)	10092
Revenue (log)	10.90	10.53	0.37*** (0.03)	11766
Workers (log)	3.77	3.21	0.56*** (0.02)	13513
Power (log)	3.32	3.15	0.17*** (0.03)	10112

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. The p-values are taken from the t-test with unequal variances. Corporation is a dummy variable which equals 1 when the firm is a corporation. Revenue is measured in thousands of rubles. Power is measured in horsepower and includes horses. Revenue per worker is measured in rubles.

B OLS estimation with robust standard errors

Table 11: OLS Estimation of the Effect of the Pale on Power per worker (log) and Revenue per worker (log) for provinces near the Pale of Settlement.

	<i>Dependent variables:</i>					
	Power per worker (log)			Revenue per worker (log)		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	−0.399*** (0.038)	−0.413*** (0.039)	−1.362*** (0.132)	7.195*** (0.031)	7.130*** (0.032)	7.435*** (0.068)
Pale dummy	0.336*** (0.060)	0.342*** (0.060)	0.131*** (0.049)	0.055 (0.051)	0.087* (0.051)	−0.042 (0.039)
Corporation		0.137 (0.105)	0.316*** (0.111)		0.762*** (0.090)	0.685*** (0.070)
Chemicals			0.595*** (0.182)			0.094 (0.126)
Cotton			0.844*** (0.234)			−0.049 (0.371)
Flax			0.799*** (0.194)			−0.782*** (0.090)
Foods			2.025*** (0.139)			1.111*** (0.083)
Metals			0.354** (0.140)			−0.646*** (0.073)
Mineral products			0.054 (0.157)			−1.159*** (0.071)
Mixed materials			0.163 (0.228)			−0.463** (0.207)
Paper			0.309* (0.161)			−0.752*** (0.077)
Silk			−0.510*** (0.132)			−0.286 (0.368)
Wood			1.402*** (0.137)			−0.568*** (0.079)
Wool			1.128*** (0.195)			−0.575*** (0.209)
N	1971	1971	1971	2399	2399	2399
R^2	0.016	0.017	0.355	0.001	0.025	0.452
R^2 Adj.	0.015	0.016	0.350	0.000	0.024	0.449
Std.Errors	HC1	HC1	HC1	HC1	HC1	HC1

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Heteroskedasticity robust errors are used. Corporation is a dummy variable which equals 1 when the firm is a corporation. Power per worker is measured in horsepowers per worker and includes horses. Revenue per worker is measured in rubles.

Table 12: OLS Estimation of the Effect of the Pale on Power per worker and Revenue per worker for provinces near the Pale of Settlement.

	<i>Dependent variables:</i>					
	Power per worker			Revenue per worker		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1.147*** (0.057)	1.113*** (0.061)	0.124** (0.054)	2948.201*** (159.677)	2767.183*** (169.546)	2467.393*** (230.666)
Pale dummy	0.270*** (0.091)	0.286*** (0.092)	0.137* (0.082)	731.454*** (262.010)	818.676*** (265.545)	229.626 (220.661)
Corporation		0.417* (0.214)	0.459** (0.214)		2121.408*** (571.932)	1947.465*** (459.840)
Chemicals			0.744*** (0.207)			504.721 (481.994)
Cotton			0.432*** (0.165)			114.916 (1080.302)
Flax			−0.032 (0.048)			−1622.268*** (213.075)
Foods			2.828*** (0.143)			6964.870*** (491.418)
Metals			0.320*** (0.052)			−1544.050*** (208.912)
Mineral products			0.086* (0.047)			−1953.377*** (199.659)
Mixed materials			0.254** (0.110)			−1215.147*** (331.669)
Paper			0.628*** (0.125)			−1632.987*** (200.216)
Silk			−0.164* (0.085)			−1069.938 (714.828)
Wood			1.254*** (0.073)			−1258.703*** (209.498)
Wool			0.958*** (0.176)			−1455.314*** (351.103)
N	2642	2642	2642	2399	2399	2399
R^2	0.003	0.005	0.222	0.003	0.010	0.320
R^2 Adj.	0.003	0.005	0.218	0.003	0.010	0.316
Std.Errors	HC1	HC1	HC1	HC1	HC1	HC1

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Heteroskedasticity robust errors are used. Corporation is a dummy variable which equals 1 when the firm is a corporation. Power per worker is measured in horsepowers per worker and includes horses. Revenue per worker is measured in rubles.

C Discontinuity analysis with levels instead of logs for revenue per worker and power per worker

Table 13: Discontinuity analysis for power per worker

	<i>Dependent variable:</i>				
	Power per worker				
	(1)	(2)	(3)	(4)	(5)
Intercept	1.865*** (0.182)	0.727** (0.276)	0.825 (0.486)	3.637*** (0.626)	3.716** (1.636)
Distance (100 km)	0.276 (0.228)	0.276 (0.199)	0.253 (0.293)	0.418 (0.468)	0.348 (1.222)
Town population			0.000 (0.003)		0.007 (0.007)
Province FE	No	Yes	Yes	No	No
Uezd FE	No	No	No	Yes	Yes
N	1163	1163	894	1163	894
R^2	0.003	0.030	0.026	0.079	0.081
R^2 Adj.	0.002	0.017	0.008	−0.032	−0.046
Clustered by:	Province	Province	Province	Province	Province

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors are clustered by province. Power per worker is measured in horsepower per worker and includes horses. Town (village) population is given in thousands of people and is available only for the locations with more than 500 inhabitants.

Table 14: Discontinuity analysis for revenue per worker

	<i>Dependent variable:</i>				
	Revenue per worker				
	(1)	(2)	(3)	(4)	(5)
Intercept	4896.147*** (858.288)	−143.973 (937.706)	−1094.620 (965.570)	−4212.588 (4066.851)	−9875.697 (5822.098)
Distance (100 km)	1023.402 (1044.054)	1517.823** (676.157)	1953.616** (798.136)	5120.437 (3142.598)	9447.384* (4508.569)
Town population			3.617 (8.760)		17.861 (19.930)
Province FE	No	Yes	Yes	No	No
Uezd FE	No	No	No	Yes	Yes
N	1030	1030	791	1030	791
R^2	0.012	0.143	0.129	0.224	0.217
R^2 Adj.	0.011	0.130	0.111	0.119	0.101
Clustered by:	Province	Province	Province	Province	Province

Notes: The p-values are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors are clustered by province. Revenue per worker is measured in rubles. Town (village) population is given in thousands of people and is available only for the locations with more than 500 inhabitants.