# The Limits of Lending? Banks and Technology Adoption across Russia

**Çağatay Bircan**
EBRD

**Ralph De Haas**
EBRD, CEPR, and Tilburg University



We exploit historically determined variation in local credit markets to identify the impact of bank lending on innovation across Russian firms. We find that deeper credit markets increase firms' use of bank credit, their adoption of new products and technologies, and their productivity growth. This relationship is more pronounced in industries farther from the technological frontier, more exposed to import competition, and that export more. These impacts are also stronger for firms near historical R&D centers or railways and in regions with supportive institutions. Consistent with these results, credit markets contribute to economic growth in such regions. (*JEL* D22, F63, G21, O12, O31)

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Firm innovation is an important driver of factor productivity and long-term economic growth (Romer 1990; Aghion and Howitt 1992). In countries close to the technological frontier, innovation typically entails research and

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development (R&D) and the inventi on of new products and technologies. In less-advanced economies, innovation often involves imitation as firms adopt existing products and processes and adapt them to local circumstances (Grossman and Helpman 1991; Acemoglu, Aghion, and Zilibotti 2006). Such innovation helps countries to catch up to the technological frontier but does not push that frontier itself.

As firms adopt products and processes that were developed elsewhere, technologies spread across and within countries. The speed with which technologies diffuse varies greatly from country to country and explains up to a quarter of total variation in national income levels (Comin and Hobijn 2010). Despite this central role of technological diffusion in determining wealth, the mechanisms that underpin the spread of products and production processes remain poorly understood. This paper focuses on one such mechanism: the impact of credit constraints on technological adoption.

Funding constraints can limit technological adoption because external inventions, which are typically context specific and involve tacit know-how, are costly to integrate into a firm's production structure. Estimates for the U.S. manufacturing sector suggest that imitation can cost up to two-thirds of the costs of the original invention (Mansfield, Schwartz, and Wagner 1981). Firms may therefore need external resources to adapt technologies to local circumstances. If external financing is unavailable, they may not be able to adopt state-of-the-art production technologies, thus limiting the diffusion of these technologies from rich to poor countries as well as within poor countries.

Exactly how and under which conditions external finance helps firms to innovate, be it through in-house R&D or through the adoption of existing products and technologies, remains a matter of debate. A key empirical problem hampering this discussion is the dearth of firm-level information on both types of innovation. This problem is compounded by the absence of convincing identification strategies to mitigate endogeneity concerns. To shed more light on this issue, we bring new firm-level evidence to bear from Russia. Russia is a particularly interesting setting to explore this question, given that—like in other large emerging markets, such as India and China—many firms remain plagued by credit constraints.

For our analysis, we employ rich data on a regionally and sectorally representative sample of 4,220 Russian firms. We know the geographical location of these firms and have detailed survey-based information on their innovation activities, including their R&D activity and adoption of products and technologies that are new to them. By matching this information with panel data on these firms' performance, we can also relate local credit availability and innovative activity to various productivity metrics.

Our identification rests on combining our firm-level data with three data sets on geographical variation in Russian credit markets. First, we use newly collected information on the location of over 45,000 bank branches. This gives us a near complete picture of Russia's banking landscape at present. Second, we digitize historical data from archives in London, Kiev, and St. Petersburg to reconstruct a detailed spatial footprint, at the locality level, of all Gosbank (state bank) branches during Soviet times. Third, we employ data on historical variation in the regional presence of so-called “spetsbanks.” This variation reflects bureaucratic power struggles just before the collapse of the Soviet Union and is unrelated to past economic conditions. We exploit this historical and contemporary variation in the spatial distribution of banks to explain differences in firms’ use of credit and their propensity to innovate.

We further merge these data with information on Soviet-era R&D centers, railway networks, and institutional quality across Russia’s regions. The geographical and institutional breadth of the country allows us to assess under which conditions the availability of bank credit allows firms to adopt new products and technologies. Based on recent insights from Schumpeterian growth theory, we also exploit various important dimensions of sector heterogeneity. This further demarcates the margins along which access to credit facilitates technological diffusion and helps firms to move closer to the technological frontier.

To preview our results, we find that firms are more likely to use (long-term) bank credit in local markets where for historical (and exogenous) reasons the number of bank branches is higher. We then show that better access to credit promotes technological upgrading as it helps firms to produce new products, implement new production processes, and conduct more R&D. This increased innovation in deeper credit markets occurs through cooperation with foreign clients and suppliers (in the context of product innovation) as well as the licensing of new technologies and hiring of business consultants (in the context of process innovation). We document that firms that engage in such innovation activity experience higher total factor productivity (TFP) and labor productivity growth than firms that are unable to innovate due to financial constraints.

We uncover substantial heterogeneity in these impacts across industries, firms, and regions. First, the link between bank lending and innovation is more pronounced in industries that are farther from the technological frontier; are more exposed to import competition; and export a larger share of their production. Second, we find that firms that are located closer to R&D centers established during the Soviet period, and firms with easier access to foreign markets, as proxied by distance to railway networks, are more likely to adopt new products and technologies due to deeper credit markets. Third, these firm impacts are stronger in regions with better institutions. Consistent with these firm-level results, we show that deeper credit markets contribute to economic growth at the locality level (as measured by night-time luminosity) but only where institutions are of sufficient quality.

We subject these findings to a battery of tests and conclude that our inferences are robust. First, we show that the depth of local credit markets during Soviet times is orthogonal to many observable local characteristics following Russia’s transition to capitalism. Second, unobservables could explain part of the correlation between local banking and firm innovation. We quantify the importance of omitted variable bias by assessing the stability of our parameters when adding covariates. This shows that unobserved heterogeneity is unlikely to explain the impact we document. If anything, we somewhat underestimate the true causal effect. Third, an important assumption underlying our analysis is that the historical location of bank branches only influences present-day outcomes through their effect on bank branch density today. We analyze the sensitivity of our results to relaxing this strict exogeneity assumption and continue to find a strong and precisely estimated impact of local credit markets on technological adoption.

Our findings contribute to the literature in several ways. First, a number of papers use state-level bank deregulation in the United States to link credit-supply shifts to firm innovation. The main outcome variable in these papers is patenting, which is an appropriate innovation proxy for an advanced economy where many firms operate near or at the technological frontier.[1] While we also exploit geographical variation in the supply of credit (reflecting historical rather than regulatory drivers), we instead focus on an emerging market where innovation is often adoptive in nature. This allows us to test whether financial constraints impede firm-level absorption of foreign technologies, which is the main prediction of the Schumpeterian growth model by Aghion, Howitt, and Mayer-Foulkes (2005).

In studying how financial constraints impede technology adoption, we take advantage of the Russian setting to uncover two novel mechanisms. We first show that there are important complementarities between local banking development and place-based innovation policies. R&D clusters have persistent effects on firm innovation, especially innovations based on firms' own ideas, including frontier innovation, if firms have relatively easy access to local bank credit. Second, firms with better access to larger markets, as measured by proximity to the nearest railways, tend to use bank credit to upgrade their products and production processes to a standard that will allow them to serve foreign markets.

Second, the corporate finance literature stresses the uncertain nature of R&D and frontier innovation (Brown, Martinsson, and Petersen 2012). Assets associated with innovation are often intangible, firm-specific and linked to human capital (Hall and Lerner 2010) and hence difficult to redeploy and to collateralize (Carpenter and Petersen 2002). Banks may therefore be unwilling or unable to fund innovative firms. Other contributions offer a more optimistic

[1] Amore, M. D., C. Schneider, and A. Žaldokas (2013) and Chava et al. (2013) find that interstate banking deregulation in the United States during the 1970s and 1980s boosted patenting, especially among private firms dependent on local bank funding (Cornaggia et al. 2015). In contrast, Chava et al. (2013) and Hombert and Matray (2017) find that patenting by young, private firms decreased following *intra*state deregulation, as more intense bank competition damaged lending relationships between banks and these firms. Going further back in time, Nanda and Nicholas (2014) show that the severity of local banking distress during the Great Depression was negatively associated with the quantity and quality of patenting by U.S. firms.

perspective. Chava, Nanda, and Xiao (2018) show that banks are willing to lend to innovative firms if patents are general (and thus easier to sell in case of liquidation) and creditor rights are strong. Banks' ability to build long-term relationships with borrowers can also overcome information asymmetries related to innovation (De la Fuente and Marin 1996).[2]

While we also assess the ability of bank lending to facilitate innovation, we investigate both frontier and adoptive innovation. Only few other papers have explored the link between bank lending and adoptive innovation and these studies have left cross-sectoral heterogeneity largely unexplored. Herrera and Minetti (2007) and Benfratello, Schiantarelli, and Sembenelli (2008) assess the impact of bank credit on imitative innovation in a developed country (Italy). While both contributions find a positive relationship, the former finds stronger effects for product innovation and the latter for process innovation. Benfratello, Schiantarelli, and Sembenelli (2008) also provide some sector analysis and find stronger effects for industries that are more dependent on external finance. This suggests that industry heterogeneity is important for the link between bank credit and firm innovation. Our rich data allow us to push this line of inquiry further by analyzing several other sector dimensions that influence if and when bank credit helps firms to move closer to the technological frontier.

Third, we break new ground by matching our firm-level innovation data with financial data from Orbis. This allows us to assess whether the impact of bank credit on adoptive innovation also affects firm performance. Our results indicate that branch density is associated with higher TFP and labor productivity growth and that the cross-sectoral heterogeneity in these performance metrics mirrors that of the innovation results. These findings speak to recent papers that calibrate models of how financial frictions in emerging markets distort technology-adoption decisions and hamper productivity growth (Midrigan and Xu 2014; Cole, Greenwood, and Sanchez 2016). We provide direct micro-evidence from Russia in support of such models.

Fourth, our results shed light on the mechanisms that underpin those of Berkowitz, Hoekstra, and Schoors (2014). The authors show that while historical variation in the regional distribution of spetsbanks helps explain modern-day patterns in bank lending and employment across Russia, this variation does not explain average investment and economic growth at the regional level. By hand-collecting data on the exact location of Soviet-era Gosbank branches in 1979, we move our analysis from the regional to the local level. With these fine-grained data in hand, we show that the effect of branch density on technological adoption and TFP growth is stronger in industries and regions where the returns to innovation are high enough, in line with the Schumpeterian notion that financial constraints interact with market incentives to determine long-run growth. This helps explain why the regional analysis by

[2] Atkin et al. (2017) finds, however, that firms that rely more on (relatively flexible) arm's-length financing, such as public debt, innovate more than do firms borrowing from relationship lenders.

Berkowitz, Hoekstra, and Schoors (2014) finds no *average* growth effects at that aggregation level.

Fifth, our within-country analysis allows us to complement cross-country studies on banking development and firm innovation. These papers either focus on frontier innovation, as measured by R&D and patenting (e.g., Brown, Martinsson, and Petersen 2012 and Hsu, Tian, and Xu 2014) or address the potentially endogenous relationship between credit and innovation by using country-level instruments (Ayyagari, Demirgüç-Kunt, and Maksimovic 2011) or self-reported cash-flow shocks as firm-level instruments (Gorodnichenko and Schnitzer 2013).[3] Instead, we use spatial heterogeneity in branch density induced by the top-down Soviet approach to economic planning as a source of exogenous variation in the local supply of credit. An advantage of exploiting within-country variation is that unobserved heterogeneity in economic policies at the country level does not cloud the relationship between bank credit and innovation.

## 1. A Short History of Russian Banking

The first Russian banks were established, often with the help of foreign financiers, during the Imperial era (1721–1917). In 1860, an Imperial State Bank was created to promote trade and stabilize the currency. Its establishment coincided with the abolition of serfdom and ushered in a period of economic progress.

This prosperous period ended with the 1917 October Revolution. Perhaps somewhat surprisingly, socialist leaders initially attached great importance to the presence of bank branches across the vast Russian territory. Lenin wrote in the lead-up to the Revolution:

> "*Without big banks socialism would be impossible*. The big banks *are* the 'state apparatus' which we *need* to bring about socialism. A single State Bank, the biggest of the big, with branches in every rural district [...] will constitute as much as nine-tenths of the socialist apparatus [Italics in original, Lenin (1972)]."

During the civil war following the Revolution, War Communism (1918–1921) abolished private ownership and nationalized and merged all banks into one State Bank. This bank, in turn, was formally abolished in January 1920 as it contradicted the idea of a moneyless economy.

In 1921, a New Economic Policy was implemented in response to the detrimental economic impact of War Communism. Several specialized banks were set up as well as a new State Bank, which was renamed State Bank of the USSR (Gosudarstvennyi Bank, Gosbank) in 1923 (Garvy 1977). It was used

[3] Recent cross-country evidence also indicates that sufficiently deep banking markets help speed up the diffusion of newly invented and capital-intensive technologies (Comin and Nanda 2019).

to impose centralized control on industry and to monitor compliance with the Five-Year Plans. The State Bank did not have a profit motive.

As of 1927, all short-term lending was assigned to Gosbank, whereas the specialized banks focused on longer-term credit (Arnold 1937). The specialized banks operated a branch network of their own and in places where they did not have branches, their work was carried out by the vast network of Gosbank branches. The specialized banks were merged into a single Investment Bank in 1959, after which Soviet banking, including the number and location of Gosbank branches, remained largely unchanged until the 1980s. Our identification strategy will exploit that the geographical distribution of Gosbank branches at that point in time was largely orthogonal to the economic forces that would shape Russia's economic transformation following the collapse of the Soviet Union a decade later.

Just before this collapse, Soviet bureaucrats reorganized the banking network that spans Russia.[4] As part of Gorbachev's perestroika program, the Gosbank remained as the central bank while five new specialized banks ("spetsbanks") were set up for specific segments of the economy: a savings bank (Sberbank), a foreign-trade bank (Vneshtorgbank), a bank for agricultural enterprises (Agroprombank), a bank for projects in housing and social development (Zhilsotsbank), and a bank for general industry (Promstroibank).

Starting in September 1990, these spetsbanks were spontaneously privatized as branch managers were offered the opportunity to turn their branch into an independent joint-stock bank. The newly established Central Bank of Russia transferred all assets and liabilities of the large spetsbanks to their former branches, which turned into hundreds of small independent spetsbanks (Abanrbanell and Meyendorff 1997). The sudden and erratic privatization only took a few months and was completed by the end of 1990. The Soviet Union ceased to exist on Christmas Day 1991, and the Russian Federation was established the next day.

For our purposes, two features of this rapid and unexpected decentralization process are particularly salient. First, the process was not carried out according to a predefined set of rules. Central authorities exercised little control and there was no market-oriented legal framework to guide the process. Berkowitz, Hoekstra, and Schoors (2014) describe how the process, which was conducted by Soviet administrators based on their own preferences, was divorced from the forces shaping the organizations within the market economy.

Second, the sudden privatization of spetsbanks *before* the collapse of the Soviet Union also shaped the entry and location of *new* commercial banks soon *after* the Union ceased to exist. Johnson (2000) describes how spetsbank managers transferred state funding to newly established commercial banks. It

[4] The remainder of this section draws on Johnson (2000), Schoors (2003), and Schoors and Yudaeva (2013).

was attractive for managers to set up new banks near existing spetsbanks to facilitate this move of state resources into private hands.

The rapid banking decentralization just before the collapse of the Soviet Union directly *and* indirectly imprinted historically determined branching patterns on Russia's new commercial banking system. The direct channel refers to the fact that at present about 20% of all lending to the Russian private sector is still conducted by spetsbank successors. More indirectly, historical spetsbank variation influenced the local entry of new commercial banks which established themselves near spetsbanks. This further cemented historical Soviet branching patterns in Russia's modern banking landscape. The persistent exogenous variation in branch density is a crucial feature that we exploit in our empirical analysis.

Once a banking landscape was established in the early 1990s, high inflation led Russian banks, both (former) spetsbanks and new commercial banks, to mainly invest in short-term government bonds rather than lend to firms. This phase ended in 1998 when the government defaulted and the rouble devalued. Banks increasingly started to operate as financial intermediaries after the 1998 financial crisis, when the state reduced its funding needs. Firms expanded their borrowing against the background of an improving macroeconomic environment, higher incomes and institutional reforms. Today, the Russian financial system, like in many other emerging markets, remains bank dominated. The supply of alternative funding sources for firm innovation, such as venture capital and private equity, is limited.[5]

## 2. Data

Our identification strategy, outlined in Section 4, requires a detailed picture of the historical and contemporaneous banking landscape around individual firms as well as information about these firms' use of bank credit and their innovation activities and performance. To this end, we merge various micro data sets. Appendix Table A.1 defines all variables.

### 2.1 Firm-level data

Our main firm-level data come from the 5$^{th}$ round of the Business Environment and Enterprise Performance Survey (BEEPS V) conducted by the European Bank for Reconstruction and Development (EBRD) and the World Bank between August 2011 and October 2012. Face-to-face interviews were held with the owners or main managers of 4,220 firms across Russia to collect data on how particular aspects of the business environment influence these firms' performance. An important improvement over earlier rounds is the

5 For instance, in 2013 the stock of private equity investments stood at just 0.01% of gross domestic product (GDP), compared with slightly over 1% in the United States and 0.45% in Western Europe (source: Emerging Markets Private Equity Association).

comprehensive regional coverage of BEEPS V across all Russian federal districts.[6]

We merge the BEEPS data with panel data on firms' balance sheets and financial statements from Bureau van Dijk's Orbis database. Orbis was used as the sampling frame for BEEPS and this ensures a near-perfect match between the survey and the financial data. This merge allows us to measure firm leverage, track firm-level growth in assets, revenues and employees, and estimate TFP and labor productivity. Table A.2 presents summary statistics on these firm-level variables.

**2.1.1 Firm leverage.** A quarter of the firms in our sample have a bank loan. The average net debt on a firm's balance sheet (short-term plus long-term loans minus cash) is 6% of total assets. Variation across firms is substantial, however, with some firms using no bank credit at all (so that their net debt is negative in case of significant cash holdings). In addition, many firms rely on trade credit as well. On average, a firm's outstanding debt to creditors amounts to 7% of their balance sheet.

**2.1.2 Firm innovation and real outcomes.** The BEEPS V survey for the first time included an *Innovation Module* to elicit detailed information about firm innovation. This module covers both the adoption of existing technologies and in-house R&D and patenting. Appendix 1 contains more details about our innovation data. We use these data to construct various firm-level innovation measures, which are defined and summarized in Appendix Tables A.1 and A.2.

About 25% (24%) of all firms report a *Product (Process) innovation* over the past 3 years. Moreover, 11% of Russian firms undertook some form of R&D, whereas 6% applied for a patent or a trademark. Our data show substantial variation across as well as within Russian regions in the incidence of these innovation activities. This holds similarly for real outcomes. There is substantial variation in our firm population in terms of growth dynamics over the period 2006–2013. Average employment growth over this period (of permanent, full-time workers) is 9% per year, but ranges between −19% and 40%. TFP growth and labor productivity growth over this period average -4% and -6% per year, respectively, while annual growth of operating revenues is about -3%.[7]

## 2.2 Geographical data on bank branches

Despite technological progress, small-business banking remains a local affair as banks tend to lend to nearby enterprises to keep transportation and agency

[6] Russia comprises nine federal districts ("federalnyye okruga"). This is the highest level of administrative aggregation, followed by eighty-nine regions (federal subjects, or "subyekty Rossiyskoy Federatsii") and then localities. Appendix Table A.3 lists all districts, regions, and localities in our data set. The BEEPS V sample frame encompasses nonagricultural firms with at least five employees (fully state-owned firms are excluded). Random sampling with three levels of stratification ensures representativeness across industry, firm size, and region.

[7] We calculate TFP as the residual from a Cobb-Douglas production function estimated by industry.

costs in check.[8] Local variation in credit markets can therefore explain why small firms in certain areas are more credit-constrained than similar firms elsewhere. This local nature of small-business lending plays a central role in our identification. To assess the impact of local banking markets on firms' innovation behavior, we create a contemporaneous measure and two historical measures of spatial variation in branch presence. As we explain in Section 4, we use the latter two measures to instrument the former.

For our contemporaneous measure *Branches*, we use the second Banking Environment and Performance Survey (BEPS), conducted by the EBRD in 2012. As part of this survey, a team of Russian-speaking consultants collected the geographic coordinates of 45,728 branches of 853 Russian banks. Using this detailed and nearly complete picture of the branch footprint of Russia's banking sector, *Branches* measures the number of bank branches in the locality (town or city) of each firm. There are 159 such localities (cf. Table A.3), and the average number of local bank branches is 123 (Table 1, panel B). Throughout our analysis we control for locality-level population (in thousands of inhabitants) so that *Branches* captures the effect of the size of the local banking market conditional on local population size.

Our first historical measure of the size of credit markets is based on regional data from Berkowitz, Hoekstra, and Schoors (2014). As discussed in Section 2, and similar to the historical branching variation exploited by Guiso, Sapienza, and Zingales (2004) for Italy, Berkowitz, Hoekstra, and Schoors (2014) provide evidence that the geographical concentration of spetsbanks in 1995 was unrelated to initial economic growth and instead reflected persistent historical. We define *Spetsbanks 1995* as the number of spetsbanks in 1995 in each region. The average region has 3.3 spetsbanks (Table 1, panel A; Figure 1) and the measure varies between 0 and 22.

Our *Spetsbanks 1995* variable is measured at the regional level and the earliest data are from 1995. This means that spetsbank location might to some extent reflect growth and innovation opportunities during the earliest transition years (1991–1994).[9] Moreover, there is an imperfect match between this regional instrument and our locality-level endogenous regressor (*Branches*) in terms of spatial granularity. For both reasons, we construct a second historical instrument, *Gosbank branches 1979*, by hand-collecting and digitizing historical branch data from libraries in London, Kiev, and St. Petersburg.[10] This instrument measures for each locality the number of

[8] See Petersen and Rajan (2002), Guiso, Sapienza, and Zingales (2004), and Degryse and Ongena (2005).

[9] While the 1995 data were collected a few years after the creation of the spetsbank successors, this was before the Central Bank of Russia started to enforce new regulation that led to the demise of various small spetsbank successors in 1996–1997 (Schoors 2003). Our data thus predate this (potentially endogenous) exit of spetsbank successor banks during the second half of the 1990s.

[10] Appendix B describes the collection and digital processing of these historical Gosbank branch data.

**Table 1**
**Summary statistics and balance tests**

| | Obs. | Mean | Median | SD | Above - below median *Spetsbanks 1995* | $t$-stat of difference in (5) | Above - below median *Gosbank Branches 1979* | $t$-stat of difference in (7) |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *A. Regional variables* | | | | | | | | |
| Spetsbanks 1995 | 37 | 3.30 | 2.00 | 3.74 | 4.65 | 4.15*** | — | — |
| Gosbank branches 1922 | 37 | 3.51 | 1.00 | 5.70 | 3.72 | 1.89* | — | — |
| Industrial production index 1950–1989 | 37 | 1.32 | 1.02 | 0.78 | 0.07 | 0.26 | — | — |
| GRP per capita 1995 (USD) | 37 | 2,179 | 2,045 | 732 | 224 | 0.97 | — | — |
| Unemployment rate 1995 (%) | 37 | 8.73 | 8.40 | 1.75 | −0.09 | −0.17 | — | — |
| Inflation rate 1995 (%) | 37 | 132.43 | 130.00 | 12.78 | −2.08 | −0.48 | — | — |
| Firms per 1,000 capita 1995 | 37 | 12.61 | 11.93 | 7.20 | 2.01 | 0.77 | — | — |
| R&D costs / GRP 1995 (%) | 37 | 0.83 | 5.52 | 0.85 | 0.38 | 1.26 | — | — |
| Urbanization rate 1995 | 37 | 73.63 | 73.60 | 11.02 | 5.95 | 1.59 | — | — |
| Index of price regulation 1995 | 37 | 23.03 | 17.00 | 21.01 | −5.11 | −0.70 | — | — |
| Share of asphalted roads 1995 | 37 | 72.83 | 74.60 | 23.99 | −3.76 | −0.47 | — | — |
| Share of privatization completed 1995 | 37 | 76.91 | 84.30 | 19.04 | 0.98 | 0.15 | — | — |
| Democracy index 1991–2001 | 37 | 18.05 | 18.00 | 3.95 | 2.33 | 1.76* | — | — |
| *B. Locality-level variables* | | | | | | | | |
| Gosbank branches 1979 | 157 | 2.59 | 1.00 | 5.73 | 1.39 | 1.39 | 5.80 | 4.12*** |
| Branches | 157 | 1.23 | 0.69 | 3.74 | 1.15 | 1.75* | 2.85 | 2.91*** |
| Current local population (1,000) | 157 | 352 | 112 | 1,002 | 293 | 1.67*** | 775 | 2.97*** |
| Defense plants 1990 per 1,000 capita | 157 | 0.06 | 0.06 | 0.07 | 0.02 | 1.32 | 0.01 | 1.44 |
| Share of large firms | 157 | 0.16 | 0.07 | 0.25 | 0.06 | 1.46 | −0.03 | −0.63 |
| Avg. firm age | 157 | 12.47 | 10.92 | 7.97 | 1.50 | 1.29 | −1.78 | −1.44 |
| Avg. distance to 1979 R&D center (log) | 157 | 2.64 | 2.35 | 1.34 | −0.36 | −1.59 | −0.12 | −0.39 |
| Avg. distance to 1989 railway network (log) | 157 | 7.25 | 7.22 | 1.33 | −0.04 | −0.20 | −0.40 | −1.86* |
| Share of firms expecting higher sales | 157 | 0.49 | 0.50 | 0.32 | −0.01 | −0.13 | −0.01 | −0.14 |
| Share of previously state-owned firms | 157 | 0.12 | 0.03 | 0.22 | 0.03 | 1.09 | −0.06 | −1.80* |

This table reports summary statistics and balance tests for various regional and locality-level variables. The differences in Columns 5 and 7 are based on regressions of each variable on a dummy equal to 1 if an observation is above the sample median Spetsbank or Gosbank presence, respectively (using robust standard errors). Observations are at the regional level in panel A and at the locality level in panel B. Panel B includes district fixed effects. Table A.1 in the appendix defines all variables. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$.

Gosbank branches in 1979. The average number of Gosbank branches is 2.59 (Table 1, panel B) and varies between 0 and 61.

The advantage of this second instrument is that it is measured at the exact same spatial level as our present-day *Branches* variable. Moreover, because we use 1979 data, it is not affected by endogenous survival of branches post-Communism. It is also unlikely that these branch locations reflect commercial considerations correlated with market forces that were only unleashed about a decade later.[11] This increases our confidence in the exclusion restriction.

Figure 2 shows the distribution of the Gosbank branches in 1979, and Figure 3 zooms in on several western regions to illustrate the fine-grained nature of the related instrumental variable, *Gosbank branches 1979*. Each geographical unit is a locality and darker colors indicate a higher number of Gosbank branches. The map shows the substantial variation in the presence of Gosbank branches across localities within the same region.

## 3. Identification Strategy

We analyze how variation in the density of local banking markets today, as instrumented by the historical presence of spetsbanks and Gosbank branches, affects firm indebtedness, innovation, and productivity growth. Consider the empirical model:

$$\begin{aligned} Firm_{ijkrd} &= \alpha_1 Branch_{krd} + \mathbf{z}_{1,ijkrd}\delta_1 + \mathbf{z}_{2,krd}\delta_2 \\ &\quad + \mathbf{z}_{3,rd}\delta_3 + \eta_j + \theta_d + u_{ijkrd} \qquad (1) \\ Branch_{krd} &= \beta_1 Spets_{rd} + \beta_2 Gos_{krd} + \mathbf{z}_{1,ijkrd}\delta_1 + \mathbf{z}_{2,krd}\delta_2 \\ &\quad + \mathbf{z}_{3,rd}\delta_3 + \eta_j + \theta_d + v_{ijkrd} \qquad (2) \end{aligned}$$

for firm $i$ operating in industry $j$ in locality $k$ in region $r$ in district $d$. $Firm_{ijkrd}$ is one of our firm-level outcomes; $Branch_{krd}$ measures the number of bank branches in the locality; $Spets_{rd}$ is the number of spetsbanks in the region in 1995, and $Gos_{krd}$ is the number of Gosbank branches in the locality in 1979.

This 2SLS regression framework contains both a locality-level (*Gosbank branches 1979*) and a region-level (*Spetsbanks 1995*) instrument. The endogenous explanatory variable (*Branches*) is at the locality level. To be conservative, we therefore cluster standard errors at the higher (regional) level of aggregation (Moulton 1986). We also present ordinary least squares (OLS) versions of Equation (1). Here, our main explanatory variable is at the locality level, so we cluster at that level. If instead we cluster at the region level in the OLS as well, the results are virtually unchanged and highly consistent with the IV results.

[11] We also collect similar data on the location of Gosbank branches in 1922, at the start of the Soviet Union, and show in Table A.7 that our results are robust to using this alternative measure.

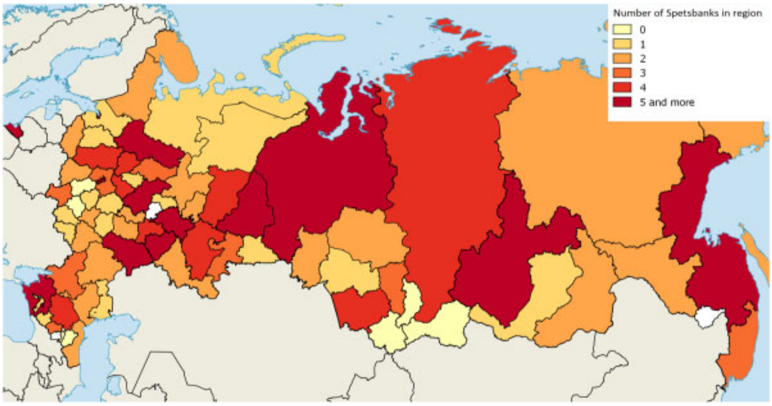


**Figure 1**
**Presence of Spetsbanks across Russia in 1995**
Source: Berkowitz, Hoekstra, and Schoors (2014).

**Figure 2**
**Presence of Gosbank branches across Russia in 1979**
Source: See appendix.

We are interested in $\alpha_1$, the effect of local branch density on firms' use of bank debt and propensity to innovate. The identifying assumption is that the historical presence of spetsbanks and Gosbank branches is orthogonal to the error term in Equation (1): they only affect firm innovation today because of their lasting impact on local branch density. While plausible, this exclusion restriction could be violated if the historical location of spetsbanks and Gosbank branches is related to local factors that correlate with firm innovation at present.

To mitigate such concerns, Table 1 provides balance tests for our region-level instrument (*Spetsbanks 1995*) and locality-level instrument

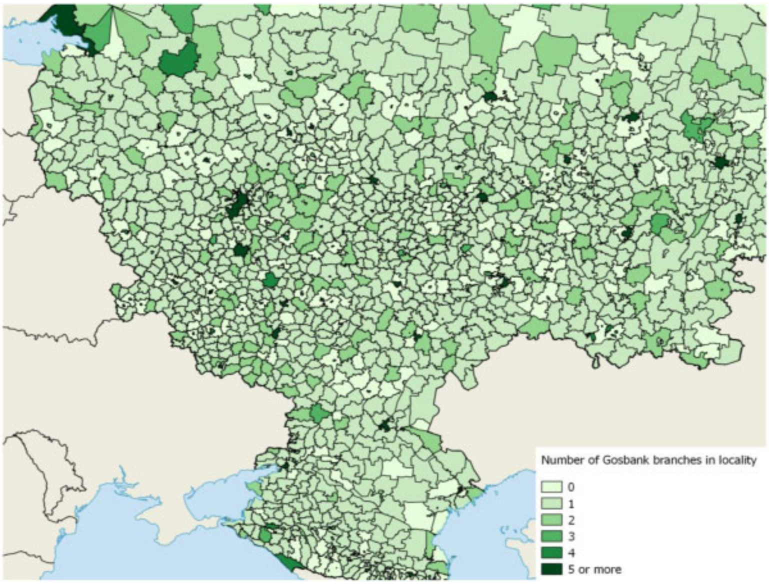


**Figure 3**
**Presence of Gosbank branches across Russia in 1979 (focus on South-Western Russia)**
Source: See appendix.

(*Gosbank branches 1979*).[12] We test for significant differences between regions (localities) with an above-median versus below-median historical presence of spetsbanks (Gosbank branches) along dimensions that may correlate with future industrialization and economic growth. These include, among others, industrial production growth during Soviet times and macroeconomic indicators such as GRP per capita, unemployment, and registered businesses per capita in early transition years at the regional level. Areas with higher historical branch penetration turn out be very similar to those with fewer branches along these dimensions. This reflects that Soviet planning distributed economic activity fairly randomly or at least in ways detached from current (market-based) economic activity (Markevich and Mikhailova 2013).

To be conservative, we nevertheless control for three important proxies for economic opportunities throughout our analysis, one of which is measured at the firm level (and hence part of $\mathbf{z}_{1,ijkrd}$), one at the locality level ($\mathbf{z}_{2,krd}$), and one at the regional level ($\mathbf{z}_{3,rd}$). The assumption needed for the identification of a causal effect of branch presence on firm innovation is therefore that the spatial distribution of spetsbanks and Gosbank branches was random conditional on these covariates.

12 Section 6 shows that our estimates are robust to a gradual relaxation of the exclusion restriction.

At the firm level, we control for the distance (in log km) to the nearest railway in 1989. Railroads have traditionally served as the primary means of transport in Russia and are of crucial economic importance (Pittman 2013). Transportation infrastructure can affect regional technological development by enhancing the circulation of people, goods, and knowledge flows (Agrawal, Galasso, and Oettl 2017). We therefore use distance to the nearest railroad as a proxy for market access (in the vein of Donaldson and Hornbeck 2016).[13] As expected, the distance between a firm and the nearest railway is somewhat shorter in localities with more historical bank branches (Table 1, panel B). This correlation is significant at the 10% level, and we therefore control for this variable throughout our analysis.

At the locality level, $\mathbf{z}_{2,krd}$ controls for population size and the number of defense plants per 1,000 population in 1990.[14] Soviet-era R&D spending was geared toward military purposes and most of the country's high-tech industry was defense related. We find that presence of defense plants was somewhat correlated with spetsbank and Gosbank locations although the correlation is small and statistically insignificant (Table 1).

Lastly, at the regional level, we control for average industrial production growth between 1950 and 1989 (taken from Markevich and Mikhailova 2013). Regional growth patterns during the Communist period may have affected the location of some spetsbank and Gosbank branches and may still correlate with innovative firms' location decisions today.

We include a further set of observable firm covariates in $\mathbf{z}_{1,ijkrd}$. *Firm size* measures full-time employees. Larger companies may benefit more from innovation due to economies of scale. We also account for firm *Age* as older firms may be less flexible because they experience higher adjustment costs when innovating (Hall and Khan 2003). Many firms innovate to expand production or increase efficiency in response to investment opportunities. Although industry fixed effects partly capture this, we also control more directly for such opportunities by including dummies for whether the firm expects sales to increase over the next year (*Expect higher sales*). Lastly, we control for whether a firm was previously state owned and for the distance to the nearest railroad in 1989 (see below).[15]

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13 We manually construct the historical Russian railway network using shapefiles that describe the railroads of the former Soviet Union and that were available from the Vernadsky State Geological Museum (Moscow) and the U.S. Geological Survey 20010600 (2001).

14 We use the data set *The Factories, Research and Design Establishments of the Soviet Defence Industry: A Guide* (version 18) of Dexter and Rodionov (2017). It contains all Soviet defense plants constructed between 1917 and 1991 and gives us data on 7,625 defense plants in the radio-electronic, atomic, aerospace, munitions, shipbuilding, armament, and armored vehicles industries. Using the addresses included in the database, we geocode active defense plants in 1990 and assign them to the correct locality. We then count the number of plants per 1,000 inhabitants.

15 In unreported robustness tests, we experimented with additional covariates. These include dummy variables for whether the establishment is part of a larger firm; is foreign owned; is an exporter; and is located in the main business city of a region. We also included the share of temporary workers. None of the related coefficients was

We saturate the model with $\eta_j$, a vector of industry fixed effects at the ISIC Rev 3.1 2-digit level. These ensure that our estimates are not confounded by attributes common to firms in the same industry. They also absorb sector-specific innovation opportunities via intra-industry knowledge and technology spillovers. Lastly, we include $\theta_d$, a vector of district fixed effects to account for unobservable effects across the main parts of the country.

## 4. Results

### 4.1 Branch density and firms' use of credit

In Table 2 we begin our formal analysis of the relation between local banking markets, access to credit and firm innovation. A logical first step is to assess whether deeper credit markets increase firms' use of bank debt. Panel A presents OLS regressions where we regress firm-level borrowing outcomes on the local presence of bank branches (controlling for population size and all other controls described in Section 4). Because present-day branch presence may be endogenous to contemporaneous economic conditions, panel B presents 2SLS regressions in line with the framework of Section 4. The first stage (Column 7) uses our historical instruments *Spetsbanks 1995* and *Gosbank branches 1979*. The F-statistic is comfortably above the rule-of-thumb of 10, indicating that the instruments are sufficiently strong.

We find that a higher number of local bank branches increases the probability that a firm has a loan outstanding as captured by the BEEPS data (Columns 1 and 8). The coefficient is larger and more precisely estimated in panel B where we instrument present-day branch presence with our historical branch variables. Next, we turn to our matched Orbis data to assess whether branch density also increases credit on the intensive margin. Columns 2–5 and 9–12 show that is the case: firms have more net debt outstanding in localities with more bank branches. This effect is entirely driven by long-term debt. It is reassuring that the results using survey data and balance-sheet data are consistent.

Keeping all else equal, a 1-standard-deviation higher branch presence is associated with an additional USD 52,734 in net debt (Column 9). This corresponds to a 2.4-percentage-point increase in the average firm's net debt-to-assets ratio (Column 10). Alternatively, we can calculate the long-term effect of a higher historical bank presence on firms' credit use at present. A 1-standard-deviation increase in *Spetsbanks 1995* and in *Gosbank branches 1979* is associated with an additional USD 62,000 in bank debt (Column 9) or a 2.8-percentage-point increase in the average firm's net debt-to-assets ratio (Column 10). This is a considerable effect as the typical Russian firm with positive net debt in our sample has USD 390,000 in net debt and a net debt-to-assets ratio of 36%.

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precisely estimated, while our main results were unaffected. In Section 6, we show that omitted variables are unlikely to have a sizeable impact on our estimates.

**Table 2**
**Bank branch presence and firms' borrowing**

**A**

| Dependent variable: | Have a loan | Net debt | Net debt/ assets | Short-term debt/assets | Long-term debt/assets | Creditors /assets |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Branches | 0.0015 | 0.0137** | 0.0067*** | −0.0032 | 0.0025* | −0.0028*** |
| | (0.0018) | (0.0053) | (0.0025) | (0.0033) | (0.0015) | (0.0009) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| $R$-squared | .09 | .16 | .02 | .01 | .04 | .14 |
| Observations | 4,211 | 3,951 | 3,948 | 3,962 | 3,962 | 3,802 |

**B**

| | *First stage* | | | | | | |
|---|---|---|---|---|---|---|---|
| Dependent variable: | Branches | Have a loan | Net debt | Net debt assets | Short-term debt/assets | Long-term debt/assets | Creditors /assets |
| | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Branches | | 0.0035** | 0.0141** | 0.0064** | −0.0045 | 0.0030** | −0.0030*** |
| | | (0.0017) | (0.0055) | (0.0028) | (0.0037) | (0.0015) | (0.0009) |
| Spetsbanks 1995 | 0.5006*** | | | | | | |
| | (0.0507) | | | | | | |
| Gosbank branches 1979 | 0.4406*** | | | | | | |
| | (0.0321) | | | | | | |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IV | 98.42 | 98.42 | 89.75 | 89.76 | 89.39 | 89.39 | 90.43 |
| $R$-squared | | .09 | .16 | .02 | .01 | .04 | .14 |
| Observations | 4,211 | 4,211 | 3,951 | 3,948 | 3,962 | 3,962 | 3,802 |

This table reports results from OLS (panel A) and IV (panel B) regressions to estimate the impact of local bank branch presence on access to debt. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979* in panel B. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the locality level in panel A and region level in panel B and given in parentheses. $^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 in the appendix defines all variables.

Lastly, in Columns 6 and 13, we explore the impact of local bank branch density on firms' use of trade credit. We find that this impact is negative: a higher availability of bank credit is associated with a clear decline in the use of trade credit. This confirms prior work showing (at a more aggregate level) that firms access relatively expensive trade credit typically as a last resort (Petersen and Rajan 1997, Fisman and Love 2003). When formal financial markets are poorly developed, trade credit may provide an alternative, albeit expensive, source of funds. In contrast, when and where formal credit markets are deeper, firms substitute trade for regular credit.

Our IV estimates are in almost all cases slightly larger than the OLS ones. This may be the case for three reasons. First, bank branch density today may be a noisy measure of the treatment of interest and this may bias the OLS estimates downward. We think such attenuation bias is unlikely as our contemporary branch data are of high quality. Second, as we discuss in Section 6, observable controls are on average negatively correlated with our outcomes so that we get stronger coefficient estimates than in regressions without controls. This suggests a downward bias for our OLS estimates due to unobservables. Removing this bias yields slightly larger effects. Third, while the OLS estimates represent the average effect of present-day branch density on firm innovation, the IV estimate is the effect only for firms in localities where branch density was affected by the instrument, that is the complier localities. This is the local average treatment effect (LATE). In shallow banking markets, the effect of an additional bank branch is likely to be higher than average, whereas the impact of additional branches may decrease as local banking markets grow. The fact that our IV results slightly exceed the OLS ones may thus also reflect that our instrument mainly affects firm innovation through influencing branch density in relatively shallow banking markets. Next, we assess whether improved access to credit also allows firms to innovate more.

### 4.2 Branch density and firm innovation

Table 3 assesses the effect of greater local branch presence—instrumented by historical Gosbank and spetsbank presence—on innovation outcomes at the firm level. We again saturate each specification with a battery of covariates at the firm and regional level as well as district and industry fixed effects. The unreported coefficients for the covariates have the right sign and are in most cases precisely estimated.

We find that firms are more likely to innovate in localities where for historical reasons bank credit is more widely available.[16] The IV results in Columns 4–6 show that, all else equal, a 1-standard-deviation increase in *Spetsbank 1995*

[16] As a robustness test, we reestimate all baseline regressions with a limited information maximum likelihood (LIML) estimator (Appendix Table A.5). The LIML estimates and the associated standard errors are virtually identical to the baseline estimates. We are therefore comfortable that our first stage does not introduce any distortion to the causal effect we aim to identify.

**Table 3**
**Bank branch presence and firm innovation**

| Dependent variable: | Product innovation | Process innovation | R&D | Product innovation | Process innovation | R&D |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Branches | 0.0028** | 0.0001 | 0.0042*** | 0.0042*** | 0.0025* | 0.0055*** |
| | (0.0013) | (0.0017) | (0.0009) | (0.0015) | (0.0013) | (0.0010) |
| | | | | | *First stage* | |
| Spetsbanks 1995 | | | | | 0.5006*** | |
| | | | | | (0.0507) | |
| Gosbank branches 1979 | | | | | 0.4406*** | |
| | | | | | (0.0321) | |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | | | | 98.42 | 98.42 | 98.42 |
| *R*-squared | .12 | .10 | .12 | .12 | .10 | .12 |
| Observations | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 |

This table reports results of OLS (Columns 1–3) and IV (Columns 4–6) regressions to estimate the impact of local bank branch presence on firm-level innovation. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979* in Columns 4–6. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the locality level in Columns 1–3 and region level in Columns 4–6 and given in parentheses. $^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 in the appendix defines all variables.

**Table 4**
**Bank branch presence and the diffusion of new products and processes**

| **A** | *Diffusion of new products* | | | | |
|---|---|---|---|---|---|
| Dependent variable: | New to both firm and market | Developed with clients | Developed with foreigners | Developed with suppliers | Applied for a patent or trademark |
| | (1) | (2) | (3) | (4) | (5) |
| Branches | 0.0033** | 0.0011*** | 0.0016*** | 0.0009* | 0.0041*** |
| | (0.0015) | (0.0003) | (0.0004) | (0.0005) | (0.0008) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 98.42 | 98.42 | 98.42 | 98.42 | 98.42 |
| *R*-squared | .10 | .03 | .02 | .03 | .09 |
| Observations | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 |

| **B** | *Diffusion of new production processes* | | | | | |
|---|---|---|---|---|---|---|
| Dependent variable: | New to both firm and market | Developed with clients | Developed with foreigners | Developed with suppliers | Hired local consultant | Licensed technology |
| | (6) | (7) | (8) | (9) | (10) | (11) |
| Branches | 0.0007 | −0.0000 | 0.0004* | 0.0003 | 0.0029*** | 0.0033*** |
| | (0.0012) | (0.0003) | (0.0003) | (0.0006) | (0.0010) | (0.0007) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 98.42 | 98.42 | 98.42 | 98.42 | 98.42 | 98.42 |
| *R*-squared | .07 | .02 | .02 | .02 | .04 | .05 |
| Observations | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on the nature of firm-level innovation. Panel A (B) presents results on the diffusion of new products (production processes). *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 in the appendix defines all variables.

and *Gosbank branches 1979* is associated with an incre ase of 1.8, 1.1, and 2.4 percentage points in the probability of product innovation, process innovation, and R&D, respectively. The impact on process innovation is smaller and less precisely estimated than for product innovation, and this holds for both the OLS (Columns 1 and 2) and IV (Columns 4 and 5) regressions.

The impact on product innovation equals 7.2% of the unconditional mean for this outcome. An example can shed further light on the magnitude of this effect. Consider Samara (current population: 1.2 million) and Omsk (current population: 1.1 million). These two cities differ in the historical presence of bank branches. Back in 1979, Samara had six Gosbank branches compared with only one in Omsk. The spetsbanks reforms also affected the cities differently. In 1995, Samara had seven spetsbanks that survived the reforms of 1988–1990, whereas Omsk had three. Our estimates from Table 3 imply that, all else equal, the difference of five additional Gosbank branches in 1979 has a positive impact of 0.9 percentage points (5*0.4406*0.0042=0.0093) on the probability of firms in Samara engaging in product innovation when compared with firms in Omsk. Similarly, the additional four spetsbanks in 1995, after controlling for the 1979 Gosbank presence, have a positive impact of 0.8 percentage point (4*0.5006*0.0042=0.0084) on the probability of firms in Samara engaging in product innovation compared with firms in Omsk. The combined effect translates into a 1.7-percentage-point higher probability of product innovation, which accounts for 7% of the unconditional mean for this outcome.

The stronger results for product innovation may reflect that firms consider secrecy more important to preserve their technical lead when undertaking process as compared with product innovations (Horstmann, MacDonald, and Slivinski 1985, Herrera and Minetti 2007). Property rights over process innovations are relatively difficult to define and enforce and this limits the effectiveness of patents. Secrecy is also less attractive for product innovations because firms have an incentive to publicize new or improved features of their products (Cohen and Klepper 1996). The tighter secrecy of process innovations is likely to render them more informationally opaque to outside financiers relative to product innovations. Hence, when undertaking a process innovation, a firm could more easily be held up by its bank (Rajan 1992). This will erode the incentive to innovate.

Next, Table 4 exploits the detailed nature of our innovation data by analyzing the impact of local branch presence on more specific innovation outcomes. This yields a richer picture of the channels through which bank lending affects firms' ability to innovate. Like in Table 3, we instrument present-day branch presence by the historical presence of Gosbank branches and spetsbanks. Panels A and B focus on the diffusion of new products and new production processes, respectively. In line with Table 3, we find that the effect of local bank presence is considerably stronger for product than for process innovation.

Column 1 shows that better access to bank loans allows firms to introduce products that are not only new to them (i.e., that they themselves had not been producing before) but also new to the main market in which they operate. Columns 2–4 show that the impact of bank funding on innovation is driven by firms advancing technologically through cooperation with other organizations, in particular (foreign) clients (Columns 2 and 3) and suppliers (Column 4). This tallies with the idea that trade facilitates technology diffusion (Keller 2004) and that banks can facilitate relationship-specific investments between buyers and suppliers of intermediate goods (Strieborny and Kukenova 2016).[17] Moreover, Column 5 shows that better access to bank funding is also associated with an increased propensity of firms to apply for a patent or trademark. This indicates that bank funding not only supports the cross-border diffusion of existing technological know-how but also benefits frontier innovation in emerging markets. This is also in line with the positive effect on R&D we find in Column 6 in Table 3. In contrast, Columns 6–9 in panel B show that access to bank credit appears not to be an important precondition for process innovation through cooperation with clients and suppliers. Instead, better access to bank funding allows firms to upgrade their production technologies by either hiring local consultants (Column 10) or by simply licensing foreign technologies (Column 11).

### 4.3 Branch density and firm innovation: Sectoral heterogeneity

Tables 3 and 4 provide evidence for a strong impact of local bank presence, as instrumented by historical branch variation, on firm innovation. Recent advances in Schumpeterian growth theory suggest that the relationship between access to finance and technological adoption may be stronger in—or even be limited to—particular industries and settings. Our data allow us to test a number of these Schumpeterian predictions in one and the same setting. To do so, Table 5 provides sample-split regressions to explore the preconditions for bank credit to help firms move closer to the technological frontier. Panel C at the bottom of the table (and all following tables with sample-split regressions) provides *p*-values for a Wald test for the equality of coefficients in Panels A and B.

**4.3.1 Distance to the global TFP frontier.** First, in Columns 1 and 2 of Table 5, we split the sample into industries that are relatively far from the global TFP frontier (panel A) and those that are closer to the frontier (panel B). We use the 2013 release of the World Input-Output Database (available at www.wiod.org; described in Timmer et al. 2015) to measure distance to the technological frontier in 1995. We estimate a production function at the sector

[17] One may worry that bank branch density is correlated with the presence of multinationals who may give local subsidiaries access to export markets and hence provide them with an incentive to engage in more product and process innovation (Guadalupe, Kuzmina, and Thomas 2012). However, when we control for the regional flow or stock of FDI—using Rosstat data on regional FDI for the period 2004–2010 as provided by Mirkina (2014)—our results remain (available on request). Section 5.6.2 analyzes in more detail the relationship between access to foreign export markets, as proxied by distance to the nearest railway, the local availability of bank credit, and firm innovation.

level and calculate TFP. We do this using a value-added approach, in which we pool all years (1995–2011) and regress (log) value added on (log) capital stock and (log) labor compensation. We run this regression for each industry so that the coefficients on capital and labor in the production function (in other words, the estimated share of factors in total production) vary across industries.

Armed with the coefficient estimates on capital and labor for each industry, we then calculate the residual for each country and year to arrive at TFP. We assume that the United States represents the technological frontier in 1995, corresponding to the highest TFP level in each industry. We double-check that this is the case. We then calculate the ratio of the Russian TFP level to that in the United States in 1995 for each industry. For example, the level of productivity in ISIC industry 27 (basic metals) in Russia was 54% of the United States level in 1995. We match these estimates with BEEPS and classify industries that are above the median TFP ratio (0.55) as close to the technological frontier, and those that are below as distant from the frontier.[18]

Schumpeterian theory suggests that firms far from the technological frontier are more likely to match with high-productivity firms from whom they can learn. These laggard firms are therefore more likely to choose imitative types of innovation (König, Lorenz, and Zilibotti 2016). In line with this, we find that the link between branch presence and adoptive innovation is much stronger for firms in Russian industries that are farther from the global technological frontier (panel A). Among these firms the estimated coefficients are about 2 (process innovation) to 5 (product innovation) times as large (and more precisely estimated) than among firms in industries closer to the global technological frontier (panel B). Panel C shows that this difference is statistically significant at the 10% level for product innovation, but not for process innovation.

**4.3.2 Exposure to import competition.** Recent theoretical work yields opposing predictions about the effect of import competition on firms' propensity to innovate. On the one hand, trade liberalization can lower mark-ups (Melitz and Ottaviano 2008) so that innovation becomes less attractive or more difficult to finance. Import competition from foreign brands may also lower the residual demand for each domestic brand, thus inducing firms to reduce product innovation (Dhingra 2013). On the other hand, increased import competition may stimulate firms to innovate more to try to escape foreign competition (Aghion et al. 2005).

We measure import competition as the ratio of total imports to total final consumption in Russia. For this calculation, we need imports that are intended for consumer use only. The WIOD differentiates between imports of (and consumption of) intermediate goods in production and final goods. For each industry, we add all imports of goods for final consumption that enter Russia

[18] Column 2 of Appendix Table A.4 provides the industry classification.

**Table 5**
**Bank branch presence and firm innovation: Schumpeterian mechanisms**

| A | *Far from TFP frontier* | | *High import competition* | | *High export share* | | *Younger managers* | | *High EFD* | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | Product innovation | Process innovation | Product innovation | Process innovation | Product innovation | Process innovation | Product innovation | Process innovation |
| | (1a) | (2a) | (3a) | (4a) | (5a) | (6a) | (7a) | (8a) | (9a) | (10a) |
| Branches | 0.0063** | 0.0033* | 0.0060*** | 0.0026 | 0.0056*** | 0.0034* | 0.0057** | 0.0040* | 0.0049*** | 0.0019 |
| | (0.0025) | (0.0019) | (0.0023) | (0.0020) | (0.0019) | (0.0019) | (0.0024) | (0.0020) | (0.0018) | (0.0019) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 114.43 | 114.43 | 167.63 | 167.63 | 101.40 | 101.40 | 43.78 | 43.78 | 170.06 | 170.06 |
| $R$-squared | .12 | .08 | .12 | .09 | .12 | .12 | .11 | .11 | .12 | .12 |
| Observations | 2,100 | 2,100 | 1,961 | 1,961 | 2,056 | 2,056 | 2,083 | 2,083 | 2,275 | 2,275 |
| **B** | *Close to TFP frontier* | | *Low import competition* | | *Low export share* | | *Older managers* | | *Low EFD* | |
| Dependent variable: | Product innovation | Process innovation | Product innovation | Process innovation | Product innovation | Process innovation | Product innovation | Process innovation | Product innovation | Process innovation |
| | (1b) | (2b) | (3b) | (4b) | (5b) | (6b) | (7b) | (8b) | (9b) | (10b) |
| Branches | 0.0012 | 0.0018 | 0.0017 | 0.0018 | 0.0029 | 0.0016 | 0.0029** | 0.0013 | 0.0030 | 0.0025 |
| | (0.0020) | (0.0016) | (0.0019) | (0.0017) | (0.0019) | (0.0015) | (0.0015) | (0.0017) | (0.0028) | (0.0021) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 84.66 | 84.66 | 64.87 | 64.87 | 137.43 | 137.43 | 304.28 | 304.28 | 61.12 | 61.12 |
| $R$-squared | .06 | .07 | .05 | .06 | .13 | .09 | .15 | .12 | .14 | .09 |
| Observations | 2,111 | 2,111 | 2,250 | 2,250 | 2,155 | 2,155 | 2,128 | 2,128 | 1,936 | 1,936 |
| **C** | *Wald test for equality of coefficients* | | | | | | | | | |
| Panel A $\geq$ panel B ($p-$value) | .07 | .23 | .08 | .38 | .11 | .20 | .14 | .15 | .28 | .38 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation in different subsamples. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. Panel A reports estimates for firms that are relatively far away from the technological frontier (Columns 1a–2a), experience high import competition (Columns 3a–4a), export a large share of their production (Columns 5a–6a), for firms that are run by younger managers (Columns 7a–8a) and for firms in industries that are highly reliant on external finance (Columns 9a–10a). Panel B reports estimates on below-median subsamples for the same dimensions. Panel C reports $p$-values for a Wald test for the equality of coefficients in panels A and B. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 in the appendix defines all variables.

in 1995 and divide this sum by total final consumption to arrive at a measure of import substitution. We again split our sample into industries with a relatively high versus low exposure to import competition.[19]

The results in Columns 3a and 3b of Table 5 show that the link between the local presence of bank branches and adoptive product innovation is stronger for firms in industries that face more import competition (the *p*-value of the related Wald test is .08). This may reflect that internal funding is less readily available in industries where mark-ups are under pressure so that external funding becomes more important for firms wanting to escape import competition by upgrading their product offer. While the coefficient for process innovation is larger as well in the sample of firms that face high import competition (Column 4a), it is again not precisely estimated.

**4.3.3 Export orientation.** An industry's export orientation can influence firms' propensity to innovate as well as their need for external finance to do so. First, firms that export tend to serve a larger market. This increases innovation rents and hence induces greater investment in innovative activities (Aghion et al. 2018).[20] Firms may exploit economies of scale in process innovation in particular (Dhingra 2013) unless an industry is highly differentiated so that production processes vary a lot (Flach and Irlacher 2018).

Second, especially in developing countries, exporters can work with sophisticated foreign buyers that have access to skills and techniques they are not familiar with. Doing so may allow them to upgrade their product range and production processes and increase productivity.[21] In line with this, Table 4 already showed that access to credit allows Russian firms to introduce new products by cooperating with clients and foreigners.

We test whether our effects are stronger in industries that are more focused on foreign markets. For each industry we again use the WIOD to calculate the ratio between total Russian exports to the rest of the world and total Russian production. We then split the sample in industries with above and below median export orientation.[22] We find that the link between local bank branch presence and adoptive innovation is considerably tighter for firms in industries that export a larger share of value added. This holds for product (Column 5) and process innovations (Column 6) with *p*-values of formal Wald tests being close to standard levels of significance. These results thus suggest that local access

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[19] Column 3 of Appendix Table A.4 provides the industry classification.

[20] Bustos (2011) and Lileeva and Trefler (2010) provide evidence for this positive relationship between export scale and technological upgrading among Argentinian and Canadian firms, respectively. Teshima (2008) finds positive effects on process R&D from lower output tariffs for Mexican firms.

[21] Atkin et al. (2017) provide experimental evidence for such a learning-through-exporting mechanism for a set of Egyptian rug manufacturers.

[22] Column 4 of Appendix Table A.4 provides the industry classification.

to bank lending may be an important precondition for technological adoption especially in industries where firms serve a large and often more sophisticated export market.

**4.3.4 Age of the firm's manager.** A recent literature has found that firms with younger managers are more open to disruption and hence more likely to engage in innovation, especially more radical and creative innovations (Barker, and Mueller 2002, Acemoglu, Akcigit, and Celik 2017). This may be either because younger managers are themselves more open to disruption or because firms with a more open corporate culture allow younger managers to rise up to the top of the corporate hierarchy. A related recent literature stresses that overconfident CEOs are more likely to innovate (Galasso and Simcoe 2011, Hirshleifer, Low, and Teoh 2012). Such overconfident managers may be overrepresented among younger managers.

In Columns 7 and 8 of Table 5, we split our sample into firms with younger (below median) versus older top managers, as proxied by the number of years of experience they have in the firm's sector (the median being 12). A comparison of panels A and B suggests that the link between local branch presence and firm innovation may indeed be stronger for younger managers, even when controlling for firm industry and firm age. However, the differences between both samples are not statistically significant at standard levels.

**4.3.5 External finance dependence.** Lastly, we distinguish between industries with relatively high (Columns 9a–10a) versus relatively low (Columns 9b–10b) reliance on external finance (Rajan and Zingales 1998). If financial constraints impede firm-level absorption of foreign technologies, as predicted by the Schumpeterian growth model of Aghion, Howitt, and Mayer-Foulkes (2005), then our results should be stronger for industries that rely more on external finance. We use BEEPS data to calculate for each firm the share of funding that is not from internal funds or retained earnings. We then calculate the average for each industry and split the sample in industries with above and below median external finance dependency.

Columns 9 and 10 of Table 5 show that the link between bank lending and product innovation indeed appears stronger for industries that rely more on external funding. In these sectors, firms that have access to deeper local credit markets may find it easier to introduce new products. However, we note that Wald tests cannot reject the null that the coefficients in both subsamples are the same.

Table 2 showed that a higher local branch presence is associated with firms borrowing more from banks but less from trading partners. This suggests that firms reduce trade credit when bank credit becomes more readily available. In Appendix Table A.6, we distinguish between industries in which firms rely a lot

(Column 1) or little (Column 2) on trade credit.[23] We find that the impact of local banking depth is concentrated in sectors that do not routinely use trade credit.[24] Combined with the results in Table 2, this indicates that trade credit is not an adequate substitute for bank credit when it comes to facilitating innovative activities. Note that we also find strong effects of bank branch presence on *process* innovation in the subsample of firms that rely less on trade credit.

## 4.4 Branch density and firms' productivity

Next, we assess whether better access to credit and the resultant higher incidence of adoptive product and process innovation affect firms' productivity and growth. In Table 6, we consider growth in TFP (Columns 1 and 5), labor productivity (Columns 2 and 6, measured as growth in business turnover per employee), employment (Columns 3 and 7), and operating revenues (Columns 4 and 8). We first show OLS regressions (Columns 1–4) and then equivalent IV regressions (Columns 5–8). We construct these variables by matching our BEEPS data to panel data from Orbis and then calculating average annual growth over the period 2006–2013 for each firm outcome.

Both the OLS and the IV regressions show that a higher local bank branch presence is associated with higher TFP growth and labor productivity growth. The OLS coefficient in Column 1 and the IV coefficient in Column 5 indicate that a 1-standard-deviation increase in the number of bank branches in a locality is associated with an additional 0.3% annual TFP growth over the period 2006-2013. Historical branching presence plays an important role in driving the present-day increase in firm efficiency. According to our estimates in Columns 5 and 6, a 1-standard-deviation increase in *Spetsbanks 1995* and in *Gosbank branches 1979* is associated with an additional 0.4% (0.35%) annual growth in TFP (labor productivity) through its impact on banking presence today. In contrast, there is no relation between the local availability of bank credit and either growth in firms' employment or operating revenues. These results suggest that an important channel through which the local availability of bank loans affects growth is through boosting adoptive innovation and firm-level productivity, and not so much—at least not in the short run—through speeding up firm-level growth. They also indicate that the efficiency improvements we identify are likely driven by the innovative activity undertaken by firms, and not simply a a result of scaling up as firms move down their average cost curve.

If a higher local presence of bank branches influences firm productivity via increased innovation activity, then these productivity impacts should be stronger for sectors and firms where the innovation impacts are concentrated. To see whether this is the case, we use the sample splits from Table 5 to assess the

[23] We use BEEPS data on each firm's share of funding from purchases on credit from suppliers and advances from customers. We then calculate the average for each industry and split industries by the median use of trade credit.

[24] Wald tests show that the coefficients in panel A and B are statistically significantly different (*p*-values are .01 and .03, respectively).

relation between local bank presence and productivity growth. Table 7 shows that the between-industry heterogeneity in firms' performance metrics closely mirrors that of the innovation results, although most between-sample coefficient differences are not significantly different at standard levels. Nevertheless, Table 7 clearly suggests that access to credit leads to productivity growth when firms use local banking markets to undertake adoptive innovation. Next, we explore the nexus between local branch density, firm borrowing, innovation, and productivity growth in more detail.

### 4.5 Impacts are concentrated on which firms?

So far, our identification strategy has produced local average treatment effects indicating that a higher bank branch density (as instrumented by historical branch presence) leads to more firm borrowing (Table 2) and, separately, to more firm innovation and higher firm productivity (Tables 3 and 6, respectively). We have not yet demonstrated that the set of borrowing firms and the set of innovating firms typically overlap. One indication that this is likely, is that the innovation and productivity results appear somewhat stronger in industries that depend more on external finance (Tables 5 and 7). This is at least suggestive of a causal chain—from borrowing via innovation to firm productivity—that occurs among the same set of firms.

We now discuss four additional pieces of evidence on this issue. First, Table 8 provides basic descriptive statistics. In panel A we compare the share of innovators among firms that stated during the BEEPS survey that they did not have a need for credit (*No loan demand*) and those that needed credit (*Loan demand*). Among the latter, we then further distinguish between those that did not gain access to credit (*Nonborrowing*) and those that did (*Borrowing*). This cut of our data shows that both imitative innovation (process and product innovation) and frontier innovation (R&D) are higher among borrowing firms (i.e., firms with a strictly positive amount of bank debt) as compared to nonborrowing firms. This difference is large: 7 percentage points or one-third of the innovation incidence among nonborrowers (conditional on loan demand).

Alternatively, we can compare firms that indicated during the BEEPS survey that they are credit constrained (i.e., they were rejected when they applied for credit or were discouraged from applying in the first place) with firms that are not credit constrained. This comparison gives a very similar picture. Among firms that had a demand for credit and were able to satisfy that demand, the propensity to innovate is between 13 percentage points (process innovation) and 5 percentage points (R&D) higher than among credit-constrained firms. Lastly, Columns 4 and 5 of Table 8 also show sharp differences between borrowers and nonborrowers in terms of average TFP growth and labor productivity growth. Indeed, while productivity growth among borrowing firms and firms that are not credit constrained was on average positive during our sample period, it was on average negative among nonborrowing and credit-constrained firms.

**Table 6**
**Bank branch presence and firm-level real outcomes**

| Dependent variable: | Total factor productivity growth | Labor productivity growth | Employment growth | Operating revenue growth | Total factor productivity growth | Labor productivity growth | Employment growth | Operating revenue growth |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Branches | 0.0009** | 0.0007** | −0.0002 | 0.0005 | 0.0009** | 0.0008** | −0.0004 | 0.0010 |
| | (0.0004) | (0.0003) | (0.0003) | (0.0006) | (0.0004) | (0.0004) | (0.0003) | (0.0008) |
| | | | | | | *First stage* | | |
| Spetsbanks 1995 | | | | | | 0.5019*** | | |
| | | | | | | (0.0514) | | |
| Gosbank branches 1979 | | | | | | 0.4399*** | | |
| | | | | | | (0.0324) | | |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | | | | | 99.30 | 99.30 | 99.30 | 99.30 |
| $R$-squared | .04 | .05 | .15 | .05 | .04 | .05 | .15 | .05 |
| Observations | 4,128 | 4,128 | 4,128 | 4,128 | 4,128 | 4,128 | 4,128 | 4,128 |

This table reports results of OLS (Columns 1–4) and IV (Columns 5–8) regressions to estimate the impact of local bank branch density on firm-level growth. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979* in Columns 5–8. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the locality level in Columns 1–4 and region level in Columns 5–8 and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 in the appendix defines all variables.

**Table 7**
**Bank branch presence and firm-level real outcomes: Schumpeterian mechanisms**

| A | *Far from TFP frontier* | | *High import competition* | | *High export share* | | *Younger managers* | | *High EFD* | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth |
| | (1a) | (2a) | (3a) | (4a) | (5a) | (6a) | (7a) | (8a) | (9a) | (10a) |
| Branches | 0.0011* | 0.0015** | 0.0013*** | 0.0015** | 0.0013** | 0.0012*** | 0.0014* | 0.0014** | 0.0010** | 0.0009** |
| | (0.0006) | (0.0006) | (0.0005) | (0.0006) | (0.0005) | (0.0004) | (0.0008) | (0.0006) | (0.0005) | (0.0004) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 114.55 | 114.55 | 168.41 | 168.41 | 103.55 | 103.55 | 42.96 | 42.96 | 174.10 | 174.10 |
| $R$-squared | .06 | .06 | .06 | .06 | .03 | .03 | .05 | .05 | .04 | .04 |
| Observations | 2,063 | 2,063 | 1,922 | 1,922 | 2,017 | 2,017 | 2,037 | 2,037 | 2,233 | 2,233 |
| **B** | *Close to TFP frontier* | | *Low import competition* | | *Low export share* | | *Older managers* | | *Low EFD* | |
| Dependent variable: | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth |
| | (1b) | (2b) | (3b) | (4b) | (5b) | (6b) | (7b) | (8b) | (9b) | (10b) |
| Branches | 0.0005 | 0.0004 | 0.0005 | 0.0005 | 0.0001 | 0.0007 | 0.0008 | 0.0007* | 0.0003 | 0.0008 |
| | (0.0005) | (0.0004) | (0.0005) | (0.0005) | (0.0007) | (0.0008) | (0.0006) | (0.0004) | (0.0006) | (0.0009) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 86.17 | 86.17 | 65.95 | 65.95 | 137.43 | 137.43 | 311.17 | 311.17 | 60.68 | 60.68 |
| $R$-squared | .02 | .04 | .05 | .04 | .03 | .04 | .04 | .03 | .03 | .03 |
| Observations | 2,065 | 2,065 | 2,206 | 2,206 | 2,111 | 2,111 | 2,091 | 2,091 | 1,895 | 1,895 |
| **C** | *Wald test for equality of coefficients* | | | | | | | | | |
| Panel A $\geq$ panel B ($p-$value) | .22 | .15 | .08 | .07 | .08 | .19 | .28 | .26 | .24 | .47 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level real outcomes in different sub-samples. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. Panel A reports estimates for firms that are relatively far away from the technological frontier (Columns 1a–2a), experience high import competition (Columns 3a–4a), export a large share of their production (Columns 5a–6a), for firms that are run by younger managers (Columns 7a–8a) and for firms in industries that are highly reliant on external finance (Columns 9a–10a). Panel B reports estimates on below-median subsamples for the same dimensions. Panel C reports $p-$values for a Wald test for the equality of coefficients in panels A and B. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 in the appendix defines all variables.

**Table 8**
**Share of innovative firms by loan demand and access to credit**

| | Product innovation | Process innovation | R&D | TFP growth (%) | Labor productivity growth (%) | Obs. |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ***A. Share of innovative firms*** | | | | | | |
| No loan demand | .21 | .19 | .08 | −0.08 | −0.94 | 1,758 |
| Loan demand | .27 | .27 | .14 | 0.26 | −0.66 | 2,462 |
| Non-borrowing | .24 | .23 | .12 | −1.29 | −2.42 | 1,167 |
| Borrowing | .31 | .30 | .16 | 1.63 | 0.85 | 1,295 |
| Credit constrained | .25 | .21 | .12 | −0.11 | −1.54 | 1,459 |
| Unconstrained | .31 | .34 | .17 | 0.79 | 0.51 | 1,003 |
| Total | .25 | .24 | .11 | 0.12 | −0.78 | 4,220 |
| ***B. Two-sample*t*-test(*p*-value)*** | | | | | | |
| No loan demand vs. loan demand | 4.55 (.00) | 5.65 (.00) | 6.63 (.00) | 0.81 (.42) | 0.65 (.51) | |
| Borrowing vs. nonborrowing | 3.69 (.00) | 4.28 (.00) | 2.65 (.01) | 5.35 (.00) | 6.22 (.00) | |
| Constrained vs. unconstrained | 3.31 (.00) | 6.86 (.00) | 3.83 (.00) | 1.60 (.11) | 3.89 (.00) | |

This table reports the incidence of firm-level innovation by loan demand and by access to credit. *Loan demand* equals 1 if a firm answered in the BEEPS survey that it would like to take out a bank loan or increase its existing borrowing, and 0 otherwise. *Borrowing* equals 1 if a firm has a positive amount of bank debt on its balance sheet over the sample period (*source*: Orbis). *Credit constrained* equals 1 if the firm either had a loan application rejected or was discouraged from applying (see Table A.1 for discouragement reasons). Two-sample $t$-tests assume unequal variances in the two groups being compared.

Second, in Table 9 we present sample-split versions of our baseline IV regressions. In the first three columns, we distinguish between firms with above average (panel A) and below average (panel B) borrowing (net debt-to-assets) during 2006–2013 within each locality. In Columns 4 to 6, we do the same while adjusting for selection into credit demand by including an inverse Mill's ratio. We derive this ratio from a first-stage Heckman selection equation in which, following Popov and Udell (2012), we use a dummy that indicates whether the firm applied for a state subsidy as a credit-demand shifter. The rationale for using this variable as an instrument is that applying for a state subsidy signals a need for external finance. In both cases we find that the impact of higher branch density on innovation is concentrated (or at least substantially larger) among firms that borrow more from banks. In most cases the differences between both subsamples are statistically significant, as indicated by the formal Wald tests in panel C.

Third, we assess to what extent higher firm productivity in localities with a higher bank branch density is indeed concentrated among those firms that actually borrow and innovate. Columns 4 and 5 in Table 8 already indicated that TFP growth and labor productivity growth are considerably higher among borrowing firms and firms that are not credit constrained. These are also the firms where the incidence of innovation is significantly higher (Columns 1–3). To investigate this further, we first ran (unreported) OLS regressions in which we directly link TFP growth and labor productivity growth to firm-level innovation or, alternatively, to interaction terms between innovation and both a *Borrowing dummy* and a *Nonborrowing dummy.* The benchmark group in

**Table 9**
**Bank branch presence and firms' innovation: Heterogeneity by access to credit**

| **A** | *High borrowing* | | | *High borrowing conditional on loan demand* | | |
|---|---|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | Product R&D | Process innovation | innovation | R&D |
| | (1a) | (2a) | (3a) | (4a) | (5a) | (6a) |
| Branches | 0.0050** | 0.0051** | 0.0120*** | 0.0089*** | 0.0039 | 0.0109*** |
| | (0.0020) | (0.0023) | (0.0026) | (0.0029) | (0.0027) | (0.0024) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 30.85 | 30.85 | 30.85 | 177.08 | 177.08 | 177.08 |
| $R$-squared | .15 | .14 | .16 | .18 | .16 | .18 |
| Observations | 1,322 | 1,322 | 1,322 | 1,277 | 1,277 | 1,277 |
| **B** | *Low borrowing* | | | *Low borrowing conditional on loan demand* | | |
| Dependent variable: | Product innovation | Process innovation | Product R&D | Process innovation | innovation | R&D |
| | (1b) | (2b) | (3b) | (4b) | (5b) | (6b) |
| Branches | 0.0025 | −0.0006 | 0.0035*** | 0.0010 | 0.0042 | 0.0026 |
| | (0.0019) | (0.0017) | (0.0010) | (0.0044) | (0.0043) | (0.0038) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 132.23 | 132.23 | 132.23 | 91.03 | 91.03 | 91.03 |
| $R$-squared | .12 | .09 | .10 | .14 | .10 | .13 |
| Observations | 2,626 | 2,626 | 2,626 | 1,180 | 1,180 | 1,180 |
| **C** | *Wald test for equality of coefficients* | | | | | |
| Panel A $\geq$ panel B ($p$-value) | .18 | .02 | .00 | .07 | .52 | .03 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation for firms with relatively high levels of bank debt (panel A, Columns 1a–3a) versus those with lower levels of bank debt (panel B, Columns 1b–3b). Columns 4–6 show the same conditional on loan demand. Panel C reports $p-$values for a Wald test for the equality of coefficients in panels A and B. *High (low) borrowing* are firms with above (below) mean net debt-to-assets ratio during 2006-2013 within each locality. Columns 4–6 include an inverse Mill's ratio calculated from a first-stage probit model of loan demand. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $*p<.1$; $**p<.05$; $***p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

these regressions thus consists of noninnovating firms. Innovation takes the form of a dummy equal to 1 if the firm engaged in product innovation, process innovation, and/or R&D and 0 otherwise. All these regressions also include locality and sector fixed effects as well as our standard firm-level controls. We find that, within the same locality, it is the innovating firms that display significantly higher productivity growth. Moreover, this effect is fully driven by innovating firms that borrow from banks. In contrast, there is no statistical difference between, on the one hand, innovators that financed their innovation from internal funding and, on the other hand, noninnovators. These results, which are available on request, provide further evidence that our IV results

**Table 10**
**Bank branch presence and firm-level real outcomes: Heterogeneity by innovation status**

| **A** | ***Innovating firms*** | | | | | |
|---|---|---|---|---|---|---|
| **Type of innovation:** | **Product** | | **Process** | | **R&D** | |
| Dependent variable: | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth |
| | (1a) | (2a) | (3a) | (4a) | (5a) | (6a) |
| Branches | 0.0019** | 0.0014* | 0.0017** | −0.0003 | 0.0018** | 0.0035** |
| | (0.0007) | (0.0008) | (0.0008) | (0.0008) | (0.0009) | (0.0018) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 170.49 | 170.49 | 106.80 | 106.80 | 522.03 | 522.03 |
| $R$-squared | .07 | .07 | .05 | .09 | .07 | .10 |
| Observations | 1,026 | 1,026 | 975 | 975 | 469 | 469 |
| **B** | ***Non-innovating firms*** | | | | | |
| Dependent variable: | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth | Total factor productivity growth | Labor productivity growth |
| | (1b) | (2b) | (3b) | (4b) | (5b) | (6b) |
| Branches | 0.0001 | 0.0006 | 0.0007 | 0.0009 | 0.0007 | 0.0010 |
| | (0.0006) | (0.0006) | (0.0005) | (0.0006) | (0.0005) | (0.0007) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 78.75 | 78.75 | 164.91 | 164.91 | 91.22 | 91.22 |
| $R$-squared | .03 | .05 | .03 | .05 | .03 | .04 |
| Observations | 3,103 | 3,103 | 3,153 | 3,153 | 3,659 | 3,659 |
| **C** | ***Wald test for equality of coefficients*** | | | | | |
| Panel A $\geq$ panel B ($p$-value) | .03 | .21 | .14 | .88 | .14 | .09 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level real outcomes for innovating firms (panel A) versus noninnovating firms (panel B). Panel C reports $p$-values for a Wald test for the equality of coefficients in panels A and B. Innovating (noninnovating) firms are those that report having engaged in a particular type of innovation. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^*p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

are indeed driven by borrowing, innovating and productivity growth within the same group of firms.

Fourth, in Table 10 we focus on the effect of (instrumented) locality-level branch density on firm-level productivity growth in separate samples consisting of innovating firms (panel A) and noninnovating firms (panel B). The results show that the positive impact of higher branch density on firm-level productivity growth is fully concentrated among innovating firms. This is our final piece of evidence indicating that increased innovation is a key channel through which deeper local credit markets help firms to become more productive.

**Table 11**
**Bank branch presence, distance to historical R&D centers, and firm innovation**

| | | | | *Diffusion of new products* | | | | *Diffusion of new production processes* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | R&D | New to both firm and market | Developed with own ideas | Developed with clients | Developed with foreigners | New to both firm and market | Developed with own ideas | Developed with clients | Developed with foreigners |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Branches | 0.0048*** | 0.0030** | 0.0059*** | 0.0041*** | 0.0035*** | 0.0009*** | 0.0013*** | 0.0019* | 0.0015* | −0.0001 | 0.0002 |
| | (0.0015) | (0.0013) | (0.0008) | (0.0014) | (0.0013) | (0.0003) | (0.0003) | (0.0011) | (0.0008) | (0.0002) | (0.0002) |
| Branches * Distance to historical R&D | −0.0006*** | −0.0006* | −0.0004** | −0.0009*** | −0.0009*** | 0.0002*** | 0.0002** | −0.0012*** | −0.0002 | 0.0001 | 0.0003*** |
| | (0.0002) | (0.0003) | (0.0002) | (0.0003) | (0.0003) | (0.0001) | (0.0001) | (0.0002) | (0.0002) | (0.0001) | (0.0001) |
| Distance to historical R&D | −0.0028 | −0.0038 | 0.0006 | −0.0050 | −0.0018 | 0.0000 | −0.0005 | −0.0001 | 0.0034 | −0.0016 | −0.0025 |
| | (0.0075) | (0.0098) | (0.0053) | (0.0073) | (0.0062) | (0.0016) | (0.0015) | (0.0051) | (0.0046) | (0.0017) | (0.0019) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 | 45.02 |
| $R$-squared | .12 | .10 | .12 | .10 | .11 | .03 | .02 | .07 | .06 | .02 | .02 |
| Observations | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation in relation to firms' proximity to historical R&D centers. *Distance to historical R&D* is measured as of 1979. *Branches* and *Branches***Distance to historical R&D* are the endogenous variables, instrumented by *Gosbank branches 1979; Spetsbanks 1995; Gosbank branches 1979***Distance to historical R&D;* and *Spetsbanks 1995***Distance to historical R&D*. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. Table A.1 defines all variables.

### 4.6 Mechanisms and heterogeneous impacts across Russia

So far, our analysis has shown that across Russia, deeper local banking markets are associated with more firm-level innovation and higher productivity growth. We also uncovered important cross-sectoral heterogeneity in this relationship and interpreted this variation using recent advances in Schumpeterian theory. The vastness of the territory of the Russian Federation, combined with its history of central planning during Soviet times, provides for a unique opportunity to explore the role of regional rather than sectoral heterogeneity. This allows us to analyze which preconditions need to be in place in order for local bank branch density to stimulate firm-level innovation. In this subsection, we focus on three such mechanisms: the persistent role of historical R&D centers, the impact of proximity to railways and the related ability to export to foreign markets, and the role of regional institutional quality.

**4.6.1 Proximity to historical R&D centers.** We first use the fact that the Soviet Union was one of the first countries to invest heavily in place-based innovation strategies, including by channeling large amounts of financial and human resources into localized R&D clusters. While many countries nowadays use such place-based policies to stimulate firm innovation, we still know little about their long-term effectiveness.[25] Russia provides an interesting setting to learn about the potential long-term impact of spatial R&D policies. This is especially so because the locations of R&D facilities were chosen by Soviet leaders without much regard for market-based considerations (such as the potential for local economic development) but instead reflected political and military considerations (Aguirrechu 2009).[26]

Against this background, Table 11 provides IV regressions in which we interact our endogenous variable *Branches* with *Distance to historical R&D*.[27] The latter variable measures the distance in kilometers between the firm and the nearest Soviet era (1979) state center for research and development. Figure 4 depicts the data from Dexter and Rodionov (2017). Table 11 first confirms our earlier finding that exogenous variation in local branch density affects firms' propensity to innovate, either imitatively or at the frontier. Second, we do not find a strong independent effect of distance to historical R&D centers on firm innovation. Importantly, however, the interaction terms in the first three columns show that firms that are closer to historical R&D centers are still more likely

[25] Neumark and Simpson (2015) survey the empirical research on place-based policies. Most contributions use Western data, although a few papers focus on China (for instance, Wang (2013); Fan and Zou 2018).

[26] Schweiger, Stepanov, and Zacchia (2018) describe how these historically determined R&D clusters, although no longer having preferential access to resources today, remain characterized by a relatively well-educated population and a large number of workers in R&D and ICT.

[27] These regressions include the following instruments: *Gosbank branches 1979*; *Spetsbanks 1995*; *Gosbank branches 1979*Distance to historical R&D*; and *Spetsbanks 1995*Distance to historical R&D*. Note that interactions of instruments with exogenous variables are valid instruments for endogenous variables interacted with exogenous variables (Wooldridge 2002, p. 122).

**Figure 4**
**Presence of R&D centers across Russia in 1979 (focus on South-Western Russia)**
Source: Dexter and Rodionov (2017).

to innovate today if they are also in localities with a relatively high branch density. This is indicative of important complementarities between place-based innovation policies and banking development. R&D clusters only appear to have persistent effects on innovation if firms also have access to external funding in the form of bank debt.[28]

Similarly, the impact of branch density on innovation tends to wear off when firms are further removed from historical R&D clusters. The left-hand side of Figure 6 visualizes this. The figure shows the average marginal effect of *Branches* on innovation based on the distance between a firm and the nearest R&D center. For instance, panel A indicates that, all else equal, a 1-standard-deviation increase in historical branch presence (*Spetsbanks 1995* and *Gosbank branches 1979*) is associated with an increase of 1.9 percentage points in the probability of product innovation for a firm located 2 km away from an R&D center versus a 1.2-percentage-point increase for a firm located 20 km away.

Columns 4–11 of Table 11 shed additional light on the mechanisms through which distance to historical R&D clusters interacts with the availability of bank credit. In particular, Columns 4–5 and 8–9 indicate that better credit access

28 At the locality level, the correlation between, on the one hand, the change in branch density over the period 1979–2011 and, on the other hand, the average distance of local firms to the nearest R&D center is low (−0.10). This suggests that the stronger effect of branch density on innovation for firms close to historical R&D centers is not a reflection of differential survival probabilities of historical bank branches in such localities.

**Figure 5**
**Railway network across Russia in 1989 (focus on South-Western Russia)**
Source: Vernadsky State Geological Museum (Moscow) and U.S. Geological Survey (2001).

helps firms closer to R&D centers to introduce products or processes that are not only new to the firm but also new to their main market (Columns 4 and 8). Being in the vicinity of historical R&D clusters also helps firms to develop new products by themselves and based on their own ideas (Column 5). Interestingly, and in sharp contrast, the interaction coefficients in Columns 6–7 and 10–11 are positive. This indicates that proximity to R&D centers makes it less likely that firms use bank credit to develop new products and processes with the help of (foreign) clients and other foreign partners, such as suppliers. Taken together, these contrasting results, visualized in Figure 7, suggest that deeper local credit markets help firms to innovate but that the channel differs depending on other locality characteristics. Firms closer to historical R&D centers are more likely to innovate based on internally generated ideas whereas firms farther away from such centers are more inclined to team up with foreign clients and suppliers.

**4.6.2 Proximity to railways.** In a similar vein, Table 12 explores how local bank density interacts with proximity to railways. We use this proximity as a proxy for access to foreign markets (Donaldson and Hornbeck 2016) and expect it to strengthen the impact of branch density on innovation, in particular (imitative) product and process innovation. For firms that can easily access foreign markets, it will be more attractive to borrow, innovate and expand production as compared with firms that are constrained to a local market of

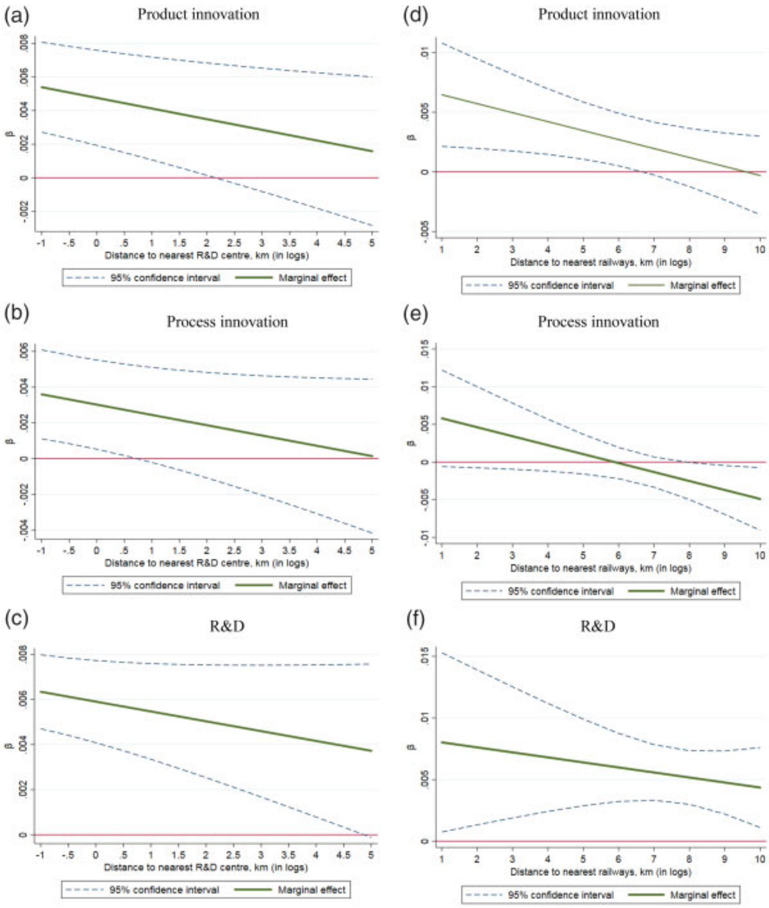



**Figure 6**
**Impact of banking density on innovation by distance to historical R&D centers and railways**
This figure shows average marginal effects of local bank branch density on innovation by distance to the nearest historical R&D center and by distance to the nearest railway.

more or less fixed size. Figure 5 depicts our data on historical (1989) railway networks across Russia.[29]

The results in the first three columns of Table 12 show that the effect of branch density on innovation increases the closer a firm is located to a railway. This only holds for imitative forms of innovation (product and process innovation) and not for R&D (Column 3). Figure 6 visualizes this in the right-hand side.

29 Since the collapse of the Soviet Union, virtually no new railways have been built in Russia. Policy makers have instead focused on restructuring the ownership structure of the existing railways, the reform of tariffs, and attempts to create rail competition (Pittman 2013). This means that the 1989 historical network of Russian railways is very similar to the network that firms have access to at present.

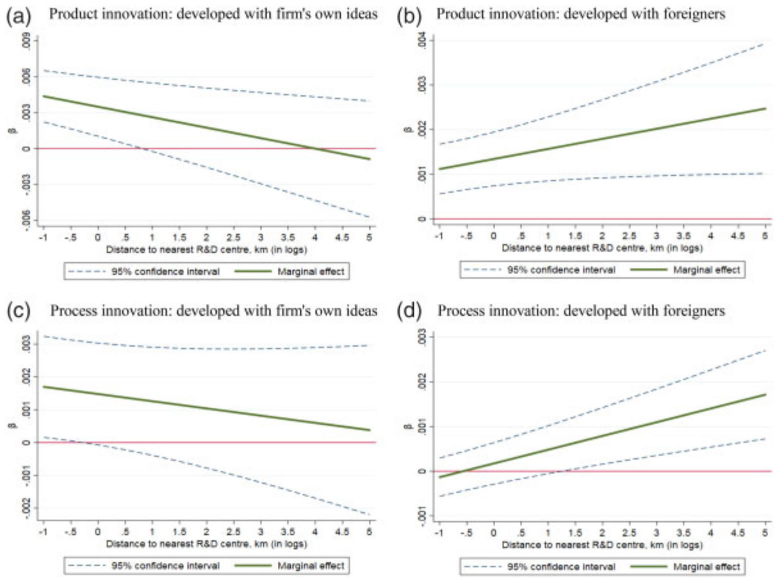



**Figure 7**
**Bank branch presence and firm innovation by distance to historical R&D centers**
This figure shows average marginal effects of local bank branch density on innovation by distance to the nearest historical R&D center.

The figure shows the average marginal effect of *Branches* on innovation based on a firm's distance to railways. While the estimated effect of branch density on product (panel D) and process (panel E) innovation tends toward zero with a firm's distance to railways, the estimated effect on R&D (panel F) remains positive and statistically significant.[30]

These interactions reflect that firms closer to railways are more likely to use locally available credit to work with foreign clients and suppliers to upgrade their products and production processes to a standard that will allow them to serve foreign markets (using the nearby railway). The results in columns 4 to 11 show exactly that. In particular, while being close to a railway has no significant impact on the propensity of firms to use local credit to develop innovative ideas of their own (Columns 5 and 9), such proximity does stimulate firms to use local bank credit to work with foreign clients and other partners to upgrade

[30] At the firm level, the correlation between (log) distance to railway and (log) distance to R&D centers is positive but low at .09. One might worry that this correlation is stronger for innovative firms, possibly violating the exclusion restriction. Reassuringly, we find that for the subset of firms that introduce a new product and/or process this correlation is in fact slightly lower at .06 (compared with .10 for noninnovators). Similar to what we did for distance to R&D centers, we here also measure at the locality level the correlation between, on the one hand, the change in bank branch intensity over 1979–2011 and, on the other hand, the average distance of local firms to the nearest railways. We find that this locality-level correlation is low as well (.09).

their products and processes (Columns 6–7 and 10–11).[31] This is in line with railways being particularly important for firms that aim to produce for (large) foreign markets and that, conditional on having access to local debt funding, innovate jointly with their foreign partners in order to produce better products destined for (more demanding) foreign markets. Our results thus complement recent work showing how exposure to international export markets incentivizes firms to conduct more product and process innovation (Guadalupe, Kuzmina, and Thomas 2012; Peters, Roberts, and Vuong 2018). We show how access to local credit may be an important precondition for this effect to materialize.

**4.6.3 Regional institutions.** An earlier cross-country literature has shown that the positive impact of financial intermediation on economic growth is conditional on the adequate protection of property rights (La Porta et al 1997). More specifically, Beck, Levine, and Loayza (2000) show that banks backed by strong legal institutions foster economic growth by boosting TFP. Relatedly, recent Schumpeterian work highlights how well-functioning democratic institutions encourage innovation by reducing the scope for the expropriation of successful innovators (Aghion, Akcigit, and Howitt 2013).

We use our firm-level data to ask whether the beneficial role of bank lending for innovation is limited to Russian regions with relatively high-quality institutions. To shed light on this question, we need regional variation in institutional quality that is both salient from a business perspective and, as much as possible, exogenous to economic development during the period we study. We construct two regional measures of institutional quality that satisfy these conditions.

First, we use regional institutional data from the Carnegie Moscow Center that date back to 1991 and are thus unlikely to be influenced by regional developments after the fall of Communism.[32] We create a regional index that summarizes six indicators of political and economic institutional quality (related to openness, elections, pluralism, political structure, economic liberalization, and corruption).[33] We use this index to perform a sample-split IV regression, the results of which we report in Columns 1 to 5 of Table 13. Our results—both in terms of innovation and in terms of productivity growth—are concentrated in regions with relatively good institutions.

[31] Note that the results in Column (4) suggest that while such adoptive innovation involves products that are new to the firm they are not necessarily new to the broader Russian market. This contrasts with the frontier-style innovation by financially unconstrained firms that are close to historical R&D centers (Table 11, Column 4). R&D-based innovation tends to be not only new to the firm itself but also new to the broader market.

[32] While Russia experimented with market-preserving federalism (Weingast 1995), in which regions were supposed to compete for (mobile) investments by developing good policies and institutions, this decentralized institutional reform failed. A detailed analysis of Russia after 1998 indicates that “institutional quality did not follow economic growth in Russia” (Polishchuk 2013, p. 201). Schulze and Zakharov (2018) show that corruption across Russia is both heterogeneous and persistent over time.

[33] More details on these indicators can be found in the Web appendix of Bruno, Bytchkova, and Estrin (2013).

**Table 12**
**Bank branch presence, distance to historical railways, and firm innovation**

| | | | | *Diffusion of new products* | | | | *Diffusion of new production processes* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | R&D | New to both firm and market | Developed with own ideas | Developed with clients | Developed with foreigners | New to both firm and market | Developed with own ideas | Developed with clients | Developed with foreigners |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Branches | 0.0071*** | 0.0070* | 0.0084** | −0.0011 | 0.0053** | 0.0038*** | 0.0037*** | 0.0020 | 0.0043 | 0.0010* | 0.0030*** |
| | (0.0025) | (0.0038) | (0.0042) | (0.0022) | (0.0022) | (0.0013) | (0.0011) | (0.0026) | (0.0028) | (0.0006) | (0.0007) |
| Branches * Distance to railways | −0.0008** | −0.0012** | −0.0004 | 0.0006** | −0.0004 | −0.0004** | −0.0003* | −0.0002 | −0.0004 | −0.0001** | −0.0004*** |
| | (0.0003) | (0.0006) | (0.0005) | (0.0003) | (0.0004) | (0.0002) | (0.0002) | (0.0003) | (0.0004) | (0.0001) | (0.0001) |
| Distance to railways | 0.0048 | 0.0069 | 0.0061 | −0.0007 | −0.0021 | 0.0010 | 0.0020* | −0.0005 | −0.0001 | 0.0017** | 0.0012 |
| | (0.0040) | (0.0064) | (0.0047) | (0.0034) | (0.0036) | (0.0012) | (0.0011) | (0.0050) | (0.0040) | (0.0008) | (0.0007) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 | 87.91 |
| $R$-squared | .12 | .10 | .12 | .10 | .11 | .03 | .02 | .07 | .06 | .02 | .02 |
| Observations | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes for firms in relation to their proximity to historical railway routes. *Distance to railways* is measured as of 1989. *Branches* and *Branches * Distance to railways* are the endogenous variables, instrumented by *Gosbank branches 1979; Spetsbanks 1995; Gosbank branches 1979 * Distance to railways*; and *Spetsbanks 1995 * Distance to railways.* All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. Table A.1 defines all variables.

**Table 13**
**Bank branch presence, firms' innovation, and real outcomes: The role of local institutional quality**

| **A** | *Better institutions: Carnegie index* | | | | | *Lower corruption: Mironov and Zhuravskaya (2016)* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | R&D | Total factor productivity growth | Labor productivity growth | Product innovation | Process innovation | R&D | Total factor productivity growth | Labor productivity growth |
| | (1a) | (2a) | (3a) | (4a) | (5a) | (6a) | (7a) | (8a) | (9a) | (10a) |
| Branches | 0.0040** | 0.0033* | 0.0040*** | 0.0010*** | 0.0008** | 0.0122** | 0.0034 | 0.0115*** | 0.0028* | 0.0025** |
| | (0.0020) | (0.0018) | (0.0009) | (0.0003) | (0.0003) | (0.0062) | (0.0032) | (0.0027) | (0.0016) | (0.0012) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 498.22 | 498.22 | 498.22 | 498.47 | 505.90 | 31.50 | 31.50 | 31.50 | 32.01 | 32.01 |
| $R$-squared | .13 | .12 | .11 | .04 | .05 | .13 | .14 | .10 | .06 | .06 |
| Observations | 2,196 | 2,196 | 2,196 | 2,163 | 2,157 | 1,991 | 1,991 | 1,991 | 1,953 | 1,953 |
| **B** | *Worse institutions: Carnegie index* | | | | | *Higher corruption: Mironov and Zhuravskaya (2016)* | | | | |
| Dependent variable: | Product innovation | Process innovation | R&D | Total factor productivity growth | Labor productivity growth | Product innovation | Process innovation | R&D | Total factor productivity growth | Labor productivity growth |
| | (1b) | (2b) | (3b) | (4b) | (5b) | (6b) | (7b) | (8b) | (9b) | (10b) |
| Branches | 0.0023 | 0.0004 | 0.0003 | −0.0001 | 0.0018 | 0.0008 | −0.0010 | 0.0022** | 0.0006 | 0.0003 |
| | (0.0046) | (0.0028) | (0.0009) | (0.0013) | (0.0011) | (0.0031) | (0.0025) | (0.0010) | (0.0004) | (0.0005) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 46.32 | 46.32 | 46.32 | 31.11 | 30.86 | 307.18 | 307.18 | 307.18 | 295.78 | 295.78 |
| $R$-squared | .14 | .12 | .08 | .04 | .06 | .14 | .12 | .11 | .06 | .06 |
| Observations | 2,015 | 2,015 | 2,015 | 1,965 | 1,970 | 2,220 | 2,220 | 2,220 | 2,175 | 2,175 |
| **C** | *Wald test for equality of coefficients* | | | | | | | | | |
| Panel A ≥ panel B | .34 | .24 | .00 | .13 | .81 | .04 | .32 | .00 | .21 | .02 |
| ($p$-value) | .34 | .24 | .00 | .13 | .81 | .04 | .32 | .00 | .21 | .02 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation in regional samples with high versus low levels of institutional quality. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. Panel A (B) is estimated on a sample of regions with relatively better (worse) institutions according to the Carnegie Institute index (Columns 1–5) or following Mironov and Zhuravskaya (2016) (Columns 6–10). Panel C reports $p$-values for a Wald test for the equality of coefficients in panels A and B. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instrument is insignificant. Table A.1 defines all variables.

Second, we use financial transactions data from Mironov (2013) for the near-population of large firms in Russia to analyze the correlation between tunneling around elections (i.e., illegal transfers of cash out of firms) and the probability that a firm obtains a public procurement contract.[34] The strength of this correlation varies across regions and, following Mironov and Zhuravskaya (2016), we use it as a proxy for the extent of corruption (and hence an inverse measure of institutional quality). While this approach comes at the cost of using more contemporaneous data (for the period 1999–2004), it has the advantage that the data measure a specific aspect of institutional quality directly related to firm performance.

Following Mironov and Zhuravskaya (2016), we first run a firm-level regression where we estimate the relationship between the probability of a firm obtaining a procurement contract in the year following a regional election on the tunneling activity of that firm during the preceding elections (controlling for tunneling outside this narrow election window). We let the coefficient on tunneling vary across regions by including a set of interactions between regional dummies and (election and nonelection) tunneling. We also include the full set of region dummies to control for unobserved variation across regions. We then take the $t$-statistics of the (positive) coefficients for these interaction terms as a continuous measure of the strength of regional corruption.

Using this institutional measure, we again split the regions into above and below median quality and perform a sample-split regression (Table 13, Columns 6–10). The results line up well with those in the previous four columns. The $p$-values of the Wald tests (panel C) indicate that the differences between regions with relatively good versus bad institutions are measured most precisely when using the Mironov and Zhuravskaya (2016) institutional measure. Overall, we confirm that institutional context matters: only in regions with stronger property rights and less corruption do we find positive effects of local branch density on firm innovation and productivity. Only in these regions are firms confident that they can reap the benefits of innovative investments.[35]

### 4.7 Local growth effects of banking development

Next, we assess whether historical variation in bank branch presence not only led to higher firm-level innovation and productivity growth but also to measurable economic impacts at the locality level. Because of a lack of Russian statistics on city-level economic growth, we proxy local economic activity by

[34] Tunneling is measured as the average weekly transfer (in USD) by a firm to so-called "fly-by-night firms" within a specific time window around the election date in the region where a firm is located. Mironov (2013) defines fly-by-night firms as firms that pay no taxes despite having transactions that require the payment of taxes according to Russian law. Such firms typically exist to tunnel cash for legitimate firms.

[35] We also experimented with two alternative regional proxies for institutional quality: one based on the 2011 Index of Support data from the Eurasia Competitiveness Institute, as previously used by Kuzmina, Volchkova, and Zueva (2014), and one based on the proportion of round-trip FDI (like in Ledyaeva, Karhunen, and Whalley 2013). When using these alternative measures our results remain qualitatively very similar.

night-time light intensity as captured by satellite imagery. Night-time light is increasingly used to measure economic activity at detailed geographical levels (Henderson, Storeygard, and Weil 2011). This indicator ranges between 0 and 63, with a greater value indicating stronger light intensity.[36]

We expect that the historical branch variation only started to impact local economic outcomes once commercial banking took off after the 1998 Russian crisis. We use a difference-in-differences framework to provide evidence in support of this idea:

$$EconomicActivity_{krdt} = \alpha + \beta_1 \theta_{krd} + \beta_2 f_t + \beta_3 Gos_{krd} \times Post98_t + \theta_{krd} \times t + \varepsilon_{krdt} \quad (3)$$

where $\theta_{krd}$ indicate locality fixed effects for locality $k$ in region $r$ in district $d$; $f_t$ indicate year fixed effects, $Post98_t$ is an indicator variable equal to 1 for 1999–2013 and 0 for years up to and including 1998, and, as before, $Gos_{krd}$ is the number of Gosbank branches in locality $k$ in 1979. This is a reduced form difference-in-differences specification with a continuous treatment in which we directly relate our main instrument (*Gosbank branches 1979*) to locality-level growth (proxied by night-time light) during different time windows.

We are interested in $\beta_3$, the differential effect of historical variation in Gosbank branches on local economic outcomes after 1998 net of the general change post-1998 and net of permanent differences across localities. In other words, we difference away time-invariant characteristics (such as initial levels of economic development and institutional quality) between localities with different Gosbank exposures, and we also difference away common trends affecting these localities (such as shocks to oil prices or aggregate demand).

If there are unobserved locality characteristics that correlate with historical Gosbank branch presence and that also set localities on different paths of banking and economic development, then our estimator may be inconsistent. We address this by saturating the model with locality-specific linear trends, $\theta_{krd} \times t$, which absorb local secular trends. Under the assumption that trends are linear, this corrects for the case where the parallel trends assumption is not fully satisfied (Angrist and Pischke 2009). To account for potential serial correlation within localities, we cluster the standard errors by locality.

Column 1 in Table 14 shows no statistically significant difference in post-1998 growth paths of localities with higher versus lower levels of historical Gosbank presence. Column 2 shows that both types of localities were on parallel growth paths before 1998 as well. Since Table 13 showed that the link between local banking development and firm innovation is limited to regions with better institutions, we perform a similar sample split here between regions with better

[36] A potential problem of night-time light data is the top censoring of values. We only encounter this problem for Moscow, where light intensity has been top coded at 63 since 1995. Excluding Moscow from the analysis does not impact our results.

**Table 14**
**Historical bank presence, institutions, and night-time light intensity**

| | Night-time light intensity | | | | | |
|---|---|---|---|---|---|---|
| | Full sample | | Better institutions | | Worse institutions | |
| Dependent variable: | (1) | (2) | (3) | (4) | (5) | (6) |
| Gosbank branches 1979 × post-1998 | 0.0352 | | 0.0706** | | −0.0069 | |
| | (0.0263) | | (0.0300) | | (0.0219) | |
| Gosbank branches 1979 × 1996-1998 | | −0.0313 | | −0.0482 | | −0.0015 |
| | | (0.0245) | | (0.0736) | | (0.0418) |
| Locality fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Locality trends | Yes | Yes | Yes | Yes | Yes | Yes |
| $R$-squared | .64 | .34 | .57 | .35 | .76 | .38 |
| Observations | 3,498 | 1,113 | 1,826 | 581 | 1,672 | 532 |

This table reports difference-in-differences regressions to estimate the impact of historical bank branching across different localities in Russia on the change in night-time light intensity in these localities between 1992 and 2013. Columns 3 and 4 report estimates from a sample of regions with better institutions, and Columns 5 and 6 report estimates from a sample of regions with worse institutions, according to the Carnegie Institute index. All regressions include locality and year fixed effects and linear time trends for each locality. Standard errors are clustered at the locality level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. Table A.1 in the appendix defines all variables.

(Columns 3 and 4) versus worse (Columns 5 and 6) institutions. We use the same Carnegie Institute index, which is used in the first four columns of Table 13.

In line with Table 13, we find that after 1998 localities with a high Gosbank branch presence grew faster as compared with localities with fewer Gosbank branches in regions with high-quality institutions (Column 3).[37] The size of this effect is nonnegligible: a 1-standard-deviation higher historical Gosbank presence is associated with an additional 0.41 increase in night-time light intensity during 1999–2013 compared with the earlier period. The average luminosity in Russian localities in 1998 was 25, so the estimated effect corresponds to an additional increase of 1.6% of the luminosity level before the Russian banking system took off. Moreover, the average increase in luminosity during 1999–2013 was 9.3 so that historical variation in Gosbank presence can explain 4.4% of this increase. Lastly, we note that before 1998 there is no difference in growth performance depending on Gosbank presence in either regions with high-quality (Column 4) or with low-quality (Column 6) institutions. The differential growth pattern in regions with good institutions only emerges at the end of the 1990s when commercial banking takes off in Russia.

These results also shed light on those of Berkowitz, Hoekstra, and Schoors (2014), who find that spetsbanks successors (measured at the regional level) are associated with more lending to Russian firms but on average not with more investment or economic growth. They do find positive growth impacts, however,

37 We do not find an effect in regions with less accommodating institutions (Column 5). If anything, the estimated coefficient here is negative.

in spetsbanks-dense regions where property rights are well protected. Our data on the location of Soviet-era Gosbank branches allow us to move the analysis from the regional to the locality level and circumvent potential identification issues that may arise due to the nonrandom survival of spetsbanks in the early years of transition. At this local level, we find that deeper credit markets foster economic growth by stimulating firm innovation and productivity but this channel is conditional on institutional quality. We thus uncover a locality-level mechanism that underpins the regional findings of Berkowitz, Hoekstra, and Schoors (2014).

## 5. Robustness and extensions

### 5.1 Robustness tests

Our IV regressions contain two historical branch instruments, one at the regional level (*Spetsbank 1995*) and one at the locality level (*Gosbank branches 1979*). Table A.7 presents robustness tests where we either use *Gosbank branches 1979* as the only instrument (Columns 1--5) or use *Gosbank branches 1922* (Columns 6–10). The latter instrument measures the presence of Gosbank branches about half a century earlier, at the start of the Soviet Union, and is therefore unlikely to be affected by how the Soviet economy developed over the following decades (see Appendix B for more details).

While most results go through in both cases, the first-stage F-statistic is about 7.8 in case of the 1922 instrument.[38] We prefer the 1979 Gosbank instrument over the 1922 one for three reasons. First, many new branches were created in 1931 because of a reorganization of the agricultural credit system. Second, during the late 1930s and early 1940s there were major changes in the administrative division of the USSR. So, regions in 1979 are much closer to the current regions than those in 1922. Third, the 1922 data exclude the Kaliningrad region as this area was only annexed from Germany in 1945. It is, however, part of our BEEPS data on modern Russia. These issues may weaken the first stage based on the 1922 instrument.

Appendix Table A.8 subjects our baseline specifications of Tables 3 and 6 to several robustness checks. In panel A, we exclude firms that are 5 years old or younger. This reduces the probability that recently established firms have sorted into localities with banking structures conducive to firm innovation. In panel B, we exclude the 30 most innovative localities (those with the highest number of innovating firms) to make sure that our results are not driven by a few innovation clusters. For the same reason we exclude the three most innovative regions (Moscow, Perm Territory and Samara) in panel C, while in panel D we exclude Russia's two main oil-producing regions (Western Siberia and the Volga region). In each case, our first stage remains strong and we continue

[38] However, the *Branches* coefficients are no longer statistically significant for process innovation (columns 2 and 7), suggesting that regional variation in *Spetsbanks 1995* is driving our weaker results for this outcome in the baseline IV regressions that include both instruments.

to find an economically and statistically significant positive impact of local branch presence on product innovation and productivity growth. Our results for process innovation are again less precisely estimated.

Lastly, in panel E we cluster the standard errors at the locality rather than the regional level. As expected, we continue to find precisely estimated effects of local branch presence on our innovation and firm productivity outcomes. Unreported regressions show that the same holds when we bootstrap the standard errors following Chiburis, Das, and Lokshin (2012).

### 5.2 Alternative mechanisms

In this subsection we investigate two alternative mechanisms that might (partially) underpin the positive relationship between local bank branch presence and firm innovation. A first concern may be that innovative firms tend to cluster and that this endogenous placement of firms partly explains our results. If this mechanism were of empirical importance, then firm clustering should be especially prevalent in industries that have a natural tendency to agglomerate. Our results should then be stronger for (or limited to) firms in such industries.

To see whether this is born out by our data, we perform a sector-split analysis based on Ellison and Glaeser (1997, henceforth EG). In the EG model, the location choice of firms in a particular industry depends on physical and intellectual spillovers as well as natural advantages. The EG index is zero if employment is concentrated as much as when firms in an industry would have chosen their locations randomly and without regard for natural advantages or industry-specific spillovers. The index is higher if firms in an industry cluster more. We apply the EG method to Russia using 2012 data from Orbis. We collect total employment data by region and industry, calculate the EG index, and then split industries into those with a high (above median) versus a low (below median) tendency to agglomerate.[39] Appendix Table A.9 shows that our results are stronger in industries that agglomerate *less*, suggesting that clustering of innovative firms is unlikely to drive our results.

Appendix Table A.10 investigates a possible mechanism. Bank density could increase the availability of consumer credit and this might boost the local demand for sophisticated consumer products. That, in turn, could incentivize firms to engage more in product innovation. In this alternative channel, an increase in firm credit does not play an important role. To investigate, we follow Antràs et al. (2012) and create an industry measure of upstreamness. A long distance to final demand means that a firm is upstream in the process, such as a producer of raw materials. A short distance, conversely, means that a firm is close to final demand, such as retail services. We construct this measure using the 2002 US input-output tables at the level of 426 industries, which we match with the BEEPS data using existing concordance keys.

[39] Our EG industry ranking is very similar to the one reported by Markevich and Mikhailova (2013) based on 1988 Russian data for manufacturing sectors only. When we replicate our analysis using their index (with about 600 observations in each subsample), we obtain very similar results.

Table A.10 indicates that our results are stronger in upstream industries. It is therefore unlikely that they mainly reflect that branch density leads to firm innovation through an expansion of consumer credit. This conclusion is also supported by Table 2, which already revealed a clear positive relationship between branch density and *firms*' use of bank credit.

### 5.3 Exclusion restrictions

Causal identification requires that the historical location of Gosbank branches and spetsbanks only influences present-day outcomes through their effect on bank branch density today. We analyze the sensitivity of our results to a gradual relaxation of this strict exogeneity assumption.

We implement the local-to-zero approximation method of Conley, Hansen, and Rossi (2012) and allow for a direct effect of our instruments on firm innovation. Since our analysis includes two instruments, we first compute their first principal component (linear combinations of valid instruments remain valid instruments; see Bai and Ng 2010). We first confirm that the regressions with the principal component as instrument yield very similar results as those with two instruments. We then assume that the (potential) direct effect of historical bank presence on firm-level innovation and real outcomes is weakly positive and uniformly distributed in an interval $[0,\delta]$ with $\delta>0$. By varying $\delta$, we identify the threshold at which the second-stage coefficient on (instrumented) bank branch density becomes insignificant at the 10% level.

Figure 8 shows results for our main specifications. We plot the 90% confidence interval derived from the local-to-zero approximation method for various values of $\delta$. $\delta=0$ corresponds to the strict exogeneity case, with our point estimates reflecting the impact of bank branches on innovation as instrumented by the first principal component. As we relax the exclusion restriction with higher values of $\delta$, our point estimate continues to be statistically significant at the 10% level. Only at very high values is the coefficient less precisely estimated. These $\delta$ thresholds are around 0.007 for product innovation, 0.004 for process innovation, and 0.0013 for both TFP growth and labor productivity growth.

These results indicate that there are economically significant impacts of bank branch density on firm innovation and real outcomes even after allowing for a reasonably large direct effect of our historical instruments. To gauge magnitudes, we follow Satyanath, Voigtländer, and Voth (2017) and compare the $\delta$ thresholds to the overall effect of the principal component instrument on product innovation. We calculate this effect by running a reduced-form regression of product innovation on the principal component (including our baseline controls and fixed effects). This yields a point estimate of 0.021. The $\delta$ threshold of 0.007 therefore suggests that the direct effect of the principal component on product innovation today should be larger than 1/3 (=0.007/0.021) of the overall effect to render our results insignificant. In

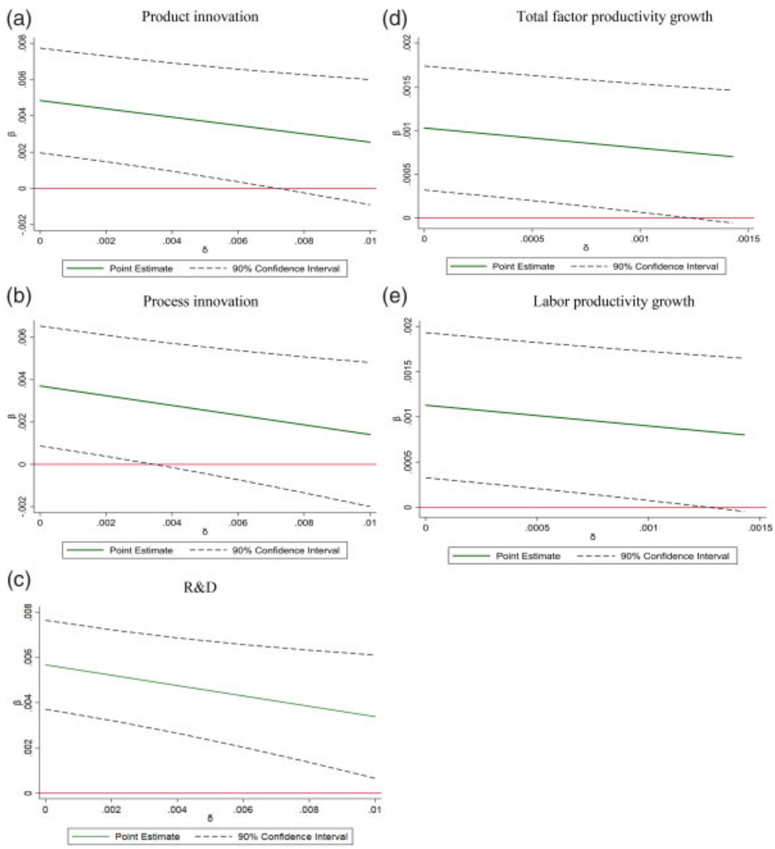



**Figure 8**
**Coefficient stability under plausible exogeneity**
This figure shows the point estimate and 90% confidence interval for the impact of bank branch presence on firm-level innovation and real outcomes when the IV exclusion restriction is gradually relaxed. We follow the local-to-zero approach of Conley, Hansen, and Rossi (2012) using the prior that the direct effect of historical bank presence on firm-level innovation and real outcomes is weakly positive. $\delta =$ zero corresponds to the strict exogeneity case, whereas higher values of $\delta$ indicate a gradual weakening of the exogeneity assumption.

sum, we find that our estimated effects are qualitatively robust to reasonable violations of the exclusion restriction.[40]

## 5.4 The exogeneity of local banking markets

One may worry that branch location is related to unobserved local factors that correlate with firm innovation. Such concerns should be eased by the

[40] This relaxation has a limited impact for two reasons. First, that local unobservable variation appears to play a minor role (see Section 6.4) mitigates concerns about our instrument being correlated with such unobservables. Second, first-stage F-statistics indicate that our instruments are strong. With strong instruments, some violation of the exclusion restriction has less of an effect on the precision of estimates (Bound, Jaeger, and Baker 1995).

strong *prima facie* historical evidence, discussed in Section 2, indicating that the geographical dispersion of Gosbank branches in 1979 and spetsbanks in 1995 was determined by bureaucratic rather than economic considerations. This is backed up by statistical evidence, summarized in Table 1, indicating that historical branch variation is largely orthogonal to economic fundamentals. This subsection provides two pieces of further evidence to mitigate endogeneity concerns.

First, one may be concerned that banks opened (more) branches in regions that at present tend to be more conducive to innovation. We therefore collect time-series data from the Russian central bank on regional banking and correlate the regional change in the number of credit institutions between 2002 and 2011 with innovation activity in 2012. We measure regional innovation as the percentage of firms that were involved in product or process innovation. For both innovation types there is a positive but statistically insignificant correlation with the establishment of new banks in the preceding decade ($p$-values of .24 and .60, respectively).

Second, while we control for many firm-level, locality-level, and regional-level observable characteristics, remaining *unobservables* may generate a direct effect of local banking on firms' propensity to innovate. Appendix Table A.11 therefore follows Altonji, Elder, and Taber (2005) and Bellows and Miguel (2009) to analyze how the coefficient for *Branches* changes when we include a rich set of firm- and locality-level covariates. If this change is substantial, then it is more likely that including additional (currently unobservable) covariates would reduce the estimated impact. In contrast, if the coefficient is stable when adding controls, then we can more confidently interpret our results in a causal sense.

The odd-numbered columns in Table A.11 replicate our baseline regressions (from Tables 3 and 6), and the even-numbered columns also include the following locality-level controls: average distance of bank branches to their HQs; average equity-to-assets ratio of banks (weighted by the number of branches of each bank); share of firms with a high-speed internet connection; share of firms that experienced a power cut in the past year; and four variables that measure the locality-level average of firms' perceptions of the following business constraints: business licensing, political instability, courts, and workforce education. The ratios in the odd-numbered columns compare our baseline specification (shown in these columns) to an unreported specification without firm-level or regional controls. The ratios in the even-numbered columns compare a specification with firm-level, regional, and locality-level controls with an unreported specification without controls.

We measure coefficient stability as the ratio between the coefficient in the regression including controls (numerator) and the difference between this coefficient and the one derived from a regression without covariates (denominator). This shows how strong the covariance between the unobserved factors explaining firm innovation and bank branch density needs to be, relative to the covariance between observable factors and branch density, to explain away our entire effect. We find that the Altonji ratios are in fact consistently negative, ranging between -0.96 and -8.40, indicating that observable controls are on average negatively correlated with firm innovation and real outcomes. The coefficient for *Branches* slightly increases when we add firm or locality covariates, suggesting that our estimates somewhat underestimate the true causal effect. The magnitude of the absolute coefficients indicates that selection on unobservables would have to be substantially stronger than selection on observables for the true effect to deviate substantially from our reported estimates. We conclude from this that the presence of unobservable characteristics (leading to selection of firms into certain localities) is unlikely to drive the results.

## 6. Conclusions

Given the importance of technological diffusion for economic growth, it is crucial to understand what keeps firms in emerging markets from introducing new products or upgrading their production technologies. To further this understanding, we exploit historical and contemporaneous variation in bank branch density to identify the impact of bank lending on firm innovation in a large emerging market, Russia. Our motivation is the stylized fact that many emerging markets continue to display low levels of technological adoption and hence fail to realize their "advantage of backwardness" (Gerschenkron 1962). Aghion, Howitt, and Mayer-Foulkes (2005) put forward the idea that credit constraints can prevent firms in these countries from exploiting the global pool of available technologies. We use firm-level data to put this idea to the test and, moreover, to assess under which conditions relieving credit constraints enables technological adoption by firms.

Our results show that where local banking markets are deeper, firm are better able to catch up to the technological frontier by expanding their product offer, adopting production technologies from elsewhere, and carrying out more R&D. Firms introduce these new products and technologies either with the help of foreign clients and suppliers or by simply acquiring external know-how. Denser branch networks are also associated with increased patenting activity. This shows that even in emerging markets, better access to credit can help some firms to push the technological frontier by developing new products and production processes from scratch. Lastly, we find that a greater local supply of bank credit and the resultant technological upgrading also translate into higher firm-level and locality-level growth.

Taken together, our findings indicate that better access to bank credit can facilitate the diffusion of new products and production methods within emerging markets. Without access to credit, firms may remain stuck in a pattern of low productivity and weak growth, even after other businesses in the same country have managed to upgrade their operations.

Importantly, our data also allow us to demarcate more precisely when bank credit can help firms move closer to the technological frontier and when it cannot: the limits of lending. Indeed, we find that the relationship between bank credit and adoptive innovation is neither automatic nor universal. Instead, and in line with recent Schumpeterian models, financial constraints interact with market incentives to determine technological adoption and growth. We show that the relation between banking markets and innovation is most pronounced in industries that are farther away from the global TFP frontier, that are faced with more import competition and have a stronger export orientation, and in firms with relatively young managers. Moreover, credit only facilitates innovation and economic growth in regions where the institutional environment is sufficiently supportive. Financial and institutional development therefore are complementary drivers of firm innovation and local growth.

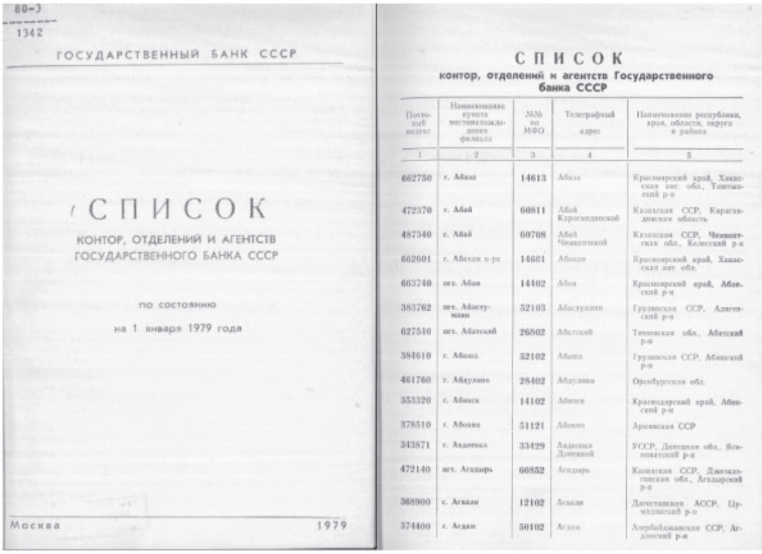
Lastly, we show that while local access to "uninformed finance" in the form of bank loans helps firms to innovate, the exact mechanisms depend on other local characteristics. Firms closer to historical R&D centers are more likely to use local bank funding to innovate based on internally generated ideas. In contrast, firms farther away from such R&D clusters, and especially those close to railways, are more inclined to team up with foreign clients and suppliers to upgrade their products and production processes to a standard that will allow them to serve foreign markets.

## Appendix

### Appendix A. The BEEPS V Innovation Module

All questions on innovation in the BEEPS V Innovation Module comply with the OECD guidelines for collecting technological innovation data as laid down in the 3rd edition of the so-called "Oslo Manual." The survey also incorporates suggestions by Mairesse and Mohnen (2010) for best practices in innovation survey design.

Firm managers were asked whether during the past 3 years they introduced new products or services (product innovation); production methods (process innovation); organizational practices or structures (organization innovation); marketing methods (marketing innovation); or conducted R&D. The Oslo Manual defines these types of innovation, a classification that dates back to Schumpeter (1934), in more detail. A product innovation involves the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, or other functional characteristics. A process innovation is the implementation of a new or significantly improved production or delivery method. Here, one can think of significant changes in production techniques, equipment, software, or logistical methods. Lastly, R&D comprises creative work undertaken on a



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ГОСУДАРСТВЕННЫЙ БАНК СССР

СПИСОК

КОНТОР, ОТДЕЛЕНИЙ И АГЕНТСТВ ГОСУДАРСТВЕННОГО БАНКА СССР

по состоянию на 1 января 1979 года

Москва 1979

СПИСОК
контор, отделений и агентств Государственного банка СССР

| Почтовый индекс | Наименование пункта местонахождения филиала | №№ по МФО | Телеграфный адрес | Наименование республики, края, области, округа и района |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 662750 | г. Абаза | 14613 | Абаза | Красноярский край, Хакасская авт. обл., Таштыпский р-н |
| 472370 | г. Абай | 60811 | Абай Карагандинской | Казахская ССР, Карагандинская область |
| 487340 | с. Абай | 60708 | Абай Чимкентской | Казахская ССР, Чимкентская обл., Келесский р-н |
| 662601 | г. Абакан к-ра | 14601 | Абакан | Красноярский край, Хакасская авт. обл. |
| 663740 | пгт. Абан | 14402 | Абан | Красноярский край, Абанский р-н |
| 383762 | пгт. Абастумани | 52103 | Абастумани | Грузинская ССР, Адигенский р-н |
| 627540 | пгт. Абатский | 26802 | Абатский | Тюменская обл., Абатский р-н |
| 384610 | г. Абаша | 52102 | Абаша | Грузинская ССР, Абашский р-н |
| 461760 | г. Абдулино | 28402 | Абдулино | Оренбургская обл. |
| 353320 | г. Абинск | 14102 | Абинск | Краснодарский край, Абинский р-н |
| 378510 | г. Абовян | 51121 | Абовян | Армянская ССР |
| 343871 | г. Авдеевка | 33429 | Авдеевка Донецкой | УССР, Донецкая обл., Ясиноватский р-н |
| 472140 | пгт. Агадырь | 60852 | Агадырь | Казахская ССР, Джезказганская обл., Агадырский р-н |
| 368900 | с. Агвали | 12102 | Агвали | Дагестанская АССР, Цумадинский р-н |
| 374400 | г. Агдам | 50102 | Агдам | Азербайджанская ССР, Агдамский р-н |

**Figure A.1**
**Excerpt from statistical yearbook published by the State Bank of the USSR, 1979**
*Source*: National Library of Russia (St. Petersburg).

systematic basis to increase the stock of knowledge and to use this stock to devise new applications.

Interviewees were presented with show cards that contained examples of innovations in each of these categories. It was made clear that "new" meant new to the firm, but not necessarily new to the local, national, or international market. Firms that had undertaken at least one form of innovation were asked detailed questions on the nature of this innovation. A verbatim description of the main innovative product or process (if any) was noted down by the interviewer.

## Appendix B. Historical Data on Gosbank Branches

We accessed the archives of Soviet Russia to trace the historical development of Gosbank's branch network over the past century. The Soviet Ministry of Finance (Narkomfin) published annual books called "The list of offices, branches, agencies of the State Bank, and cash desks of the USSR NKF [Ministry of Finance], assigned to the institutions of the State Bank" ("Список контор, отделений, агентств Государственного банка и касс НКФ СССР, приписанных к учреждениям Государственного банка"). In addition, so-called "Trade-Industry Handbooks" were published. We were able to locate some of these books in the National Library of Ukraine in Kiev and the Russian National Library in St. Petersburg. With the help of local librarians, we obtained PDF copies of the original books for the years 1922, 1946, and 1979 (Figure A.1).

The books contain the address of each Gosbank branch. We digitized the addresses by processing the pictures taken from the primary sources using an OCR (optical character recognition) online tool. We needed to ensure that locality names refer to modern-day names. As this requires knowledge of Russian city names, which tend to change over time, we hired research assistants who are Russian speakers and knowledgeable about Russian geography. We then ran a Google maps algorithm to record the latitude and longitude of each branch and then a separate algorithm to assign each branch to the correct modern-day Russian locality (municipality). This second algorithm mapped all the coordinates over a digital map of Russian municipalities and the number of points within each municipality was counted. Non-geocoded addresses were manually rechecked.

We use the 1979 data to construct our second instrument and show robustness tests based on the 1922 data. We prefer the 1979 data over the 1922 ones for three reasons. First, many new branches were created in 1931 due to a reorganization of the agricultural credit system. As part of this reorganization, the assets and liabilities of the agricultural credit co-operative associations were transferred to the State bank. Second, during the late 1930s and early 1940s there were major changes in the administrative division of the USSR. So, regions in 1979 are much closer to the current regions than those in 1922.[41] Third, the 1922 data exclude the Kaliningrad region as this area was only annexed from Germany in 1945. It is, however, part of our BEEPS data on modern Russia.

41 The correlation between the 1946 and 1979 numbers of Gosbank branches in a locality is .89, indicating that branch networks have been relatively stable during the post-WWII period. Using the 1946 instead of the 1979 data to construct the second instrument gives very similar results.

**Table A.1**
**Variable definitions and data sources**

| Variable | Definition | Data source |
|---|---|---|
| *A. Innovation activity* | | |
| Product innovation | Dummy=1 if firm introduced a new or significantly improved product or service in the last 3 years | BEEPS V |
| Process innovation | Dummy=1 if firm introduced a new or significantly improved method for the production or supply of products or services in the last 3 years | BEEPS V |
| R&D | Dummy=1 if firm invested in R&D in the last 3 years | BEEPS V |
| Applied for a patent or trademark | Dummy=1 if firm applied for a patent or trademark in the last 3 years | BEEPS V |
| Licensed technology | Dummy=1 if firm uses any technologies licensed from a foreign-owned company, excluding software | BEEPS V |
| New to both firm and market | Dummy=1 if the firm introduced a new or significantly improved product or service in the last 3 years that was new to the firm's market | BEEPS V |
| Developed with foreigners | Dummy=1 if the firm introduced a new or significantly improved product or service in the last 3 years that was developed in cooperation with a client or supplier located abroad | BEEPS V |
| Developed with clients | Dummy=1 if firm introduced a product (process) innovation in the last 3 years that it developed in cooperation with clients | BEEPS V |
| Developed with suppliers | Dummy=1 if firm introduced a product (process) innovation in the last 3 years that it developed in cooperation with suppliers | BEEPS V |
| Hired local consultant | Dummy=1 if over the last 3 years the firm hired at least once a local consultant (e.g., management consultant, engineer, accountant) | BEEPS V |
| *B. Access to credit* | | |
| Have a loan | Dummy=1 if the firm has an outstanding loan or credit line from a bank | BEEPS V |
| Borrowing | Dummy=1 if the firm has reported a positive amount of bank debt on its balance sheet over 2006-2013 | Orbis |
| Loan demand | Dummy=1 if the firm states it would like to take out a bank loan or increase its borrowing if it already has one | BEEPS V |
| Credit constrained | Dummy=1 if the firm either had a loan application rejected or was discouraged from applying. Discouragement reasons: complex application procedures, unfavorable interest rates, too high collateral requirements, insufficient size of loan or maturity, informal payments necessary, belief that application would be rejected | BEEPS V |
| Net debt | Logarithm of short-term loans plus long-term loans minus cash (million USD), average over 2006-2013 | Orbis |
| Net debt / assets | Short-term loans plus long-term loans minus cash (million USD) as a ratio of total assets (million USD), average over 2006-2013 | Orbis |

(*Continued*)

**Table A.1**
(*Continued.*)

| Variable | Definition | Data source |
|---|---|---|
| Short-term debt / assets | Short-term loans (million USD) as a ratio of total assets (million USD), average over 2006-2013 | Orbis |
| Long-term debt / assets | Long-term loans (million USD) as a ratio of total assets (million USD), average over 2006-2013 | Orbis |
| Creditors / assets | Creditors account (million USD) as a ratio of total assets (million USD), average over 2006-2013 | Orbis |
| *C. Locality and regional characteristics* | | |
| Branches | Present-day number of bank branches (100) in the locality (2011) | BEPS II, Rosstat |
| Spetsbanks 1995 | Number of Spetsbanks operating in 1995 in the region | Schoors et al. 2014 |
| Gosbank branches 1979 | Number of Gosbank branches operating in 1979 in the locality | See appendix |
| Gosbank branches 1922 | Number of Gosbank branches operating in 1922 in the locality | See appendix |
| Current local population | Number of people living in the locality | Rosstat |
| Night-time light intensity | Locality-level intensity of night-time luminosity as measured by satellite imagery | NOAA/NGDC |
| Industrial production index | Region-level index of industrial production over the period 1950-1989 | Markevich and Mikhailova 2013 |
| Defense plants 1990 per 1,000 capita | Number of factories and research and design establishments of the Soviet defense industry in 1990 | Dexter and Rodionov 2017 |
| Democracy index | Region-level index that summarizes six indicators of political and economic institutional quality (openness, elections, pluralism, political structure, economic liberalization, and corruption) on a 5-point scale | Bruno et al 2013 |
| GRP per capita 1995 (USD) | Logarithm of gross regional product per capita in a region in 1995 | Rosstat, EBRD |
| Unemployment rate 1995 | Region-level unemployment rate in 1995 | Regions of Russia, Mirkina 2014 |
| Inflation rate 1995 | Region-level growth in consumer price index in 1995 | Regions of Russia, Mirkina 2014 |
| Firms per 1,000 capita 1995 | Region-level total number of enterprises per 1,000 capita in 1995 | Regions of Russia, Mirkina 2014 |
| R&D costs / GRP 1995 | Region-level total expenditure on research and development as a share of regional gross output | Regions of Russia, Mirkina 2014 |
| Share of privatization completed 1995 | Share of small-scale privatization in the region completed by the end of 1995 | EBRD |
| Index of price regulation 1995 | Index of price liberalization in the region (on a scale of 1-100) in 1995 | EBRD |

**Table A.1**
(*Continued.*)

| Variable | Definition | Data source |
|---|---|---|
| Share of asphalted roads 1995 | Share of asphalted roads in total roads in the region in 1995 | Rosstat, EBRD |
| Urbanization rate 1995 | Share of regional population living in urban areas in 1995 | Rosstat, EBRD |
| Share of large firms | Share of firms classified as large (250+ employees) in locality | BEEPS V |
| Average firm age | Average number of years that a firm has been in operation in a locality | BEEPS V |
| Average distance to 1989 railway network | Locality-level average of the nearest distance in km between a firm and the 1989 railway network | BEEPS V, Vernadsky State Geological Museum Moscow, United States Geological Survey 2001 |
| Share of firms expecting higher sales | Share of firms in a locality that expect higher sales in the next year | BEEPS V |
| Share of previously state-owned firms | Share of firms in a locality that were previously state owned | BEEPS V |
| *D. Firm characteristics* | | |
| Firm size | Logarithm of number of full-time employees of the firm | BEEPS V, Orbis |
| Firm age | Logarithm of number of years since the firm started operations | BEEPS V, Orbis |
| Employment growth | Average annual growth over 2006-2013 in number of permanent, full-time workers | BEEPS V, Orbis |
| Total factor productivity growth | Average annual growth over 2006-2013 in total factor productivity, calculated as the residual from a Cobb-Douglas production function estimated by industry | Orbis |
| Operating revenue growth | Average annual growth over 2006-2013 in business turnover | Orbis |
| Labor productivity growth | Average annual growth over 2006-2013 in business turnover per employee | Orbis |
| State connection (0/1) | Dummy=1 if the firm was previously state owned, is currently partly state owned, or is a subsidiary of a previously state owned enterprise | BEEPS V |
| Expecting higher sales (0/1) | Dummy=1 if the firm expects sales to be higher next year than this year | BEEPS V |
| Large city (0/1) | Dummy=1 if the firm is located in a city with more than 1 million inhabitants | BEEPS V |
| Distance to 1979 R&D center | Distance in kilometers between a firm and the nearest research and design establishment of the Soviet Union in 1979 (in log) | BEEPS V, Dexter and Rodionov 2017 |
| Distance to 1989 railway network | Distance in kilometers between a firm and the 1989 railway network (in logarithm) | BEEPS V, Vernadsky State Geological Museum (Moscow), United States Geological Survey 2001 |

**Table A.2**
**Summary statistics**

| | Obs. (1) | Mean (2) | Median (3) | SD (4) | Min. (5) | Max. (6) |
|---|---|---|---|---|---|---|
| Product innovation | 4,220 | .25 | .00 | .43 | .00 | 1.00 |
| New to both firm and market | 4,220 | .16 | .00 | .37 | .00 | 1.00 |
| Developed with foreigners | 4,220 | .01 | .00 | .11 | .00 | 1.00 |
| Developed with clients | 4,220 | .01 | .00 | .10 | .00 | 1.00 |
| Developed with suppliers | 4,220 | .04 | .00 | .19 | .00 | 1.00 |
| Process innovation | 4,220 | .24 | .00 | .42 | .00 | 1.00 |
| New to both firm and market | 4,220 | .13 | .00 | .33 | .00 | 1.00 |
| Developed with foreigners | 4,220 | .01 | .00 | .09 | .00 | 1.00 |
| Developed with clients | 4,220 | .01 | .00 | .08 | .00 | 1.00 |
| Developed with suppliers | 4,220 | .04 | .00 | .19 | .00 | 1.00 |
| R&D | 4,220 | .11 | .00 | .32 | .00 | 1.00 |
| Applied for a patent or trademark | 4,220 | .06 | .00 | .24 | .00 | 1.00 |
| Licensed technology | 4,220 | .08 | .00 | .26 | .00 | 1.00 |
| Hired local consultant | 4,202 | .14 | .00 | .34 | .00 | 1.00 |
| Have a loan | 4,220 | .23 | .00 | .42 | .00 | 1.00 |
| Borrowing | 4,220 | .49 | .00 | .50 | .00 | 1.00 |
| Loan demand | 4,220 | .58 | 1.00 | .49 | .00 | 1.00 |
| Credit constrained | 2,462 | .59 | 1.00 | .49 | .00 | 1.00 |
| Net debt (US 1 million) | 3,957 | 0.29 | 0.00 | 1.23 | −0.85 | 13.88 |
| Net debt / assets | 3,954 | 0.06 | 0.00 | 0.28 | −0.66 | 1.56 |
| Short-term debt / assets | 3,970 | 0.10 | 0.02 | 0.17 | 0.00 | 1.11 |
| Long-term debt / assets | 3,970 | 0.05 | 0.00 | 0.13 | 0.00 | 1.04 |
| Creditors / assets | 3,809 | 0.07 | 0.07 | 0.02 | 0.00 | 0.70 |
| Firm size (log) | 4,211 | 3.05 | 2.83 | 1.22 | 1.39 | 9.31 |
| Firm age (log) | 4,220 | 2.20 | 2.20 | 0.68 | 0.00 | 5.16 |
| Employment growth | 4,136 | 0.09 | 0.07 | 0.11 | −0.19 | 0.40 |
| Total factor productivity growth | 4,136 | −0.04 | −0.02 | 0.17 | −0.71 | 0.48 |
| Operating revenue growth | 4,136 | −0.03 | −0.01 | 0.30 | −0.91 | 0.98 |
| Labor productivity growth | 4,136 | −0.06 | −0.03 | 0.17 | −0.55 | 0.53 |
| State connection | 4,220 | 0.09 | .00 | .29 | .00 | 1.00 |
| Expecting higher sales | 4,220 | 0.51 | 1.00 | .50 | .00 | 1.00 |
| Large city | 4,220 | 0.26 | .00 | .44 | .00 | 1.00 |
| Distance to 1979 R&D center (log) | 4,220 | 1.84 | 1.87 | 1.04 | −8.58 | 7.12 |
| Distance to 1989 railway network (log) | 4,220 | 7.27 | 7.31 | 1.63 | 0.69 | 13.63 |

This table reports summary statistics for the variables used in the analysis. Table A.1 in the appendix defines all variables.

**Table A.3**
**Distribution of BEEPS firms across Russia**

| *Federal district* | *Region* | *Locality* | *Firms* | *Federal district* | *Region* | *Locality* | *Firms* |
|---|---|---|---|---|---|---|---|
| Central | Belgorod | Belgorod | 118 | Northwestern | Kaliningrad | Baltijsk | 1 |
| Central | Belgorod | Stary Oskol | 2 | Northwestern | Kaliningrad | Kaliningrad | 120 |
| Central | Kaluga | Balabanovo | 2 | Northwestern | Kaliningrad | p.Vasilkovo | 1 |
| Central | Kaluga | Kaluga | 86 | Northwestern | Krasnodar | Novoe Devyatkino | 1 |
| Central | Kaluga | Maloyaroslavets | 5 | Northwestern | Leningrad | Gatchina | 35 |
| Central | Kaluga | Obninsk | 28 | Northwestern | Leningrad | Kipen | 1 |
| Central | Kursk | Kursk | 86 | Northwestern | Leningrad | Luga | 5 |
| Central | Kursk | Pryamitsyno | 1 | Northwestern | Leningrad | Nikolskij | 2 |
| Central | Lipetsk | Gryazi | 3 | Northwestern | Leningrad | Novyj Svet | 1 |
| Central | Lipetsk | Lipetsk | 118 | Northwestern | Leningrad | Sosnovyj bor | 23 |
| Central | Moscow | Balasikha | 7 | Northwestern | Leningrad | Tajtsy | 2 |
| Central | Moscow | Pavlovskaya Sloboda | 1 | Northwestern | Leningrad | Tikhvin | 3 |
| Central | Moscow | Dolgoprudny | 7 | Northwestern | Leningrad | Tosno | 16 |
| Central | Moscow | Domodedovo | 4 | Northwestern | Leningrad | Vojkovitsy | 2 |
| Central | Moscow | Ivanteevka | 2 | Northwestern | Leningrad | Vsevolozhsk | 7 |
| Central | Moscow | Klimovsk | 1 | Northwestern | Leningrad | Vyborg | 14 |
| Central | Moscow | Kolomna | 4 | Northwestern | Murmansk | Kandalaksha | 1 |
| Central | Moscow | Korolev | 29 | Northwestern | Murmansk | Kola | 1 |
| Central | Moscow | Kotelniki | 6 | Northwestern | Murmansk | Kovdor | 2 |
| Central | Moscow | Krasnogorsk | 3 | Northwestern | Murmansk | Monchegorsk | 21 |
| Central | Moscow | Lobnya | 2 | Northwestern | Murmansk | Murmansk | 91 |
| Central | Moscow | Lytkarino | 10 | Northwestern | Murmansk | Olenegorsk | 3 |
| Central | Moscow | Lyubertsy | 3 | Northwestern | Murmansk | Severomorsk | 1 |
| Central | Moscow | Moscow | 124 | Northwestern | St. Petersburg | Russko-Vysoczkoe | 1 |
| Central | Moscow | Mytischi | 9 | Northwestern | St. Petersburg | Saint Petersburg | 127 |
| Central | Moscow | Odintsovo | 3 | Northwestern | St. Petersburg | Sertolovo | 2 |
| Central | Moscow | Podolsk | 17 | Siberian | Irkutsk | Angarsk | 27 |
| Central | Moscow | Schelkovo | 1 | Siberian | Irkutsk | Bajkalsk | 1 |
| Central | Moscow | Serpukhov | 2 | Siberian | Irkutsk | Irkutsk | 95 |
| Central | Moscow | Yubilejny | 1 | Siberian | Irkutsk | Kirensk | 1 |
| Central | Moscow | Zheleznodorozhny | 7 | Siberian | Irkutsk | Meget | 1 |
| Central | Smolensk | s.Pechersk | 1 | Siberian | Irkutsk | Shelekhov | 4 |
| Central | Smolensk | Smolensk | 70 | Siberian | Irkutsk | Usole-Sibirskoe | 2 |
| Central | Tver | Konakovo | 2 | Siberian | Kemerovo | Anzhero-Sudzhensk | 2 |

**Table A.3**
**(Continued)**

| *Federal district* | *Region* | *Locality* | *Firms* | *Federal district* | *Region* | *Locality* | *Firms* |
|---|---|---|---|---|---|---|---|
| Central | Tver | Staricza | 1 | Siberian | Kemerovo | Kemerovo | 113 |
| Central | Tver | Tver | 117 | Siberian | Kemerovo | Krapivinskij | 1 |
| Central | Voronezh | Liski | 1 | Siberian | Kemerovo | Novokuznetsk | 8 |
| Central | Voronezh | Voronezh | 120 | Siberian | Krasnoyarsk | Krasnoyarsk | 89 |
| Central | Yaroslavl | Krasnye Tkachi | 1 | Siberian | Novosibirsk | Berdsk | 6 |
| Central | Yaroslavl | Rostov | 1 | Siberian | Novosibirsk | Cherepanovo | 1 |
| Central | Yaroslavl | Rybinsk | 18 | Siberian | Novosibirsk | Iskitim | 2 |
| Central | Yaroslavl | Tutaev | 3 | Siberian | Novosibirsk | Krasnoobsk | 3 |
| Central | Yaroslavl | Yaroslavl | 97 | Siberian | Novosibirsk | Novosibirsk | 111 |
| Far Eastern | Khabarovsk | Khabarovsk | 113 | Siberian | Omsk | Omsk | 119 |
| Far Eastern | Khabarovsk | Komsomolsk-na-Amure | 9 | Siberian | Omsk | S Druzhinino | 1 |
| Far Eastern | Primorski Territory | Lesozavodsk | 1 | Siberian | Tomsk | Seversk | 2 |
| Far Eastern | Primorski Territory | Vladivostok | 119 | Siberian | Tomsk | Tomsk | 120 |
| Far Eastern | Republic of Sakha | Neryungri | 10 | Southern | Krasnodar Territory | Armavir | 1 |
| Far Eastern | Republic of Sakha | Yakutsk | 82 | Southern | Krasnodar Territory | Krasnodar | 81 |
| N. Caucasian | Karachai-Cherkess | Kislovodsk | 5 | Southern | Krasnodar Territory | Novorossijsk | 1 |
| N. Caucasian | Stavropol Territory | Mikhajlovsk | 5 | Southern | Krasnodar Territory | Sochi | 5 |
| N. Caucasian | Stavropol Territory | Pyatigorsk | 5 | Southern | Rostov | Batajsk | 1 |
| N. Caucasian | Stavropol Territory | Stavropol | 105 | Southern | Rostov | Kamenolomni | 1 |
| Southern | Rostov | Krivyanskaya | 1 | Urals | Sverdlovsk | Patrushi | 1 |
| Southern | Rostov | Novocherkassk | 15 | Urals | Sverdlovsk | Pervouralsk | 8 |
| Southern | Rostov | Rostov-na-Donu | 28 | Urals | Sverdlovsk | Polevskoj | 1 |
| Southern | Rostov | Shakhty | 12 | Urals | Sverdlovsk | Revda | 3 |
| Southern | Rostov | Taganrog | 62 | Urals | Sverdlovsk | Sysert | 1 |
| Southern | Volgograd | Kalach-na-Donu | 1 | Urals | Sverdlovsk | Verkhnyaya Pyshma | 2 |
| Southern | Volgograd | Kamyshin | 1 | Volga | Kirov | Belaya Kholunitsa | 1 |
| Southern | Volgograd | Mikhaylovka | 1 | Volga | Kirov | Kirov | 126 |
| Southern | Volgograd | Volgograd | 102 | Volga | Kirov | Kirovo-Chepetsk | 5 |
| Southern | Volgograd | Volzhsky | 15 | Volga | Kirov | Slobodskoj | 2 |
| Urals | Chelyabinsk | Chelyabinsk | 59 | Volga | Nizhni Novgorod | Dzerzhinsk | 11 |
| Urals | Chelyabinsk | Magnitogorsk | 20 | Volga | Nizhni Novgorod | Kstovo | 2 |
| Urals | Sverdlovsk | Bilimbaj | 1 | Volga | Nizhni Novgorod | Nizhny Novgorod | 69 |
| Urals | Sverdlovsk | Ekaterinburg | 102 | Volga | Perm Territory | Chernoe | 1 |
| Urals | Sverdlovsk | p.Monetny | 1 | Volga | Perm Territory | Krasnokamsk | 6 |

**Table A.3**
**(Continued)**

| *Federal district* | *Region* | *Locality* | *Firms* |
|---|---|---|---|
| Volga | Perm Territory | Overyata | 1 |
| Volga | Perm Territory | P.Sylva | 1 |
| Volga | Perm Territory | Perm | 110 |
| Volga | Perm Territory | Polazna | 1 |
| Volga | Bashkortostan | Ufa | 103 |
| Volga | Bashkortostan | Ufimskij | 3 |
| Volga | Mordovia | Atemar | 2 |
| Volga | Mordovia | r.p.Yalga | 1 |
| Volga | Mordovia | Ruzaevka | 1 |
| Volga | Mordovia | Saransk | 116 |
| Volga | Tatarstan | Almetevsk | 3 |
| Volga | Tatarstan | Apastovo | 1 |
| Volga | Tatarstan | Elabuga | 4 |
| Volga | Tatarstan | Kazan | 69 |
| Volga | Tatarstan | Naberezhnye Chelny | 23 |
| Volga | Tatarstan | Nizhnekamsk | 13 |
| Volga | Tatarstan | Zelenodolsk | 7 |
| Volga | Samara | Novokujbyshevsk | 6 |
| Volga | Samara | Samara | 69 |
| Volga | Samara | Syzran | 2 |
| Volga | Samara | Tollyatti | 43 |
| Volga | Ulyanovsk | Dmitrovgrad | 22 |
| Volga | Ulyanovsk | Ulyanovsk | 98 |
| *Total* | | | 4,220 |

**Table A.4**
**Russian industry characteristics in 1995**

| | ISIC code (Rev. 3) | Distance to frontier | Import competition | Export share |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Food | 15 | 0.47 | 0.26 | 0.02 |
| Tobacco products | 16 | 0.47 | 0.26 | 0.02 |
| Textiles | 17 | 0.23 | 0.64 | 0.08 |
| Garments | 18 | 0.23 | 0.64 | 0.08 |
| Tanning & leather | 19 | 0.17 | 0.84 | 0.08 |
| Wood | 20 | 0.43 | 0.09 | 0.12 |
| Paper & paper products | 21 | 0.55 | 0.32 | 0.28 |
| Publishing, printing, & recorded media | 22 | 0.55 | 0.32 | 0.28 |
| Coke & refined petroleum | 23 | 0.46 | 0.46 | 0.14 |
| Chemicals | 24 | 0.45 | 0.56 | 0.30 |
| Plastics & rubber | 25 | 0.69 | 0.12 | 0.04 |
| Nonmetallic mineral products | 26 | 0.53 | 0.04 | 0.02 |
| Basic metals | 27 | 0.54 | 0.21 | 0.42 |
| Fabricated metal products | 28 | 0.54 | 0.21 | 0.42 |
| Machinery & equipment | 29 | 0.25 | 0.49 | 0.31 |
| Office machinery | 30 | 0.40 | 0.42 | 0.09 |
| Electronics | 31 | 0.40 | 0.42 | 0.09 |
| Communication equipment | 32 | 0.40 | 0.42 | 0.09 |
| Precision instruments | 33 | 0.40 | 0.42 | 0.09 |
| Motor vehicles | 34 | 0.39 | 0.32 | 0.08 |
| Other transport equipment | 35 | 0.39 | 0.32 | 0.08 |
| Furniture | 36 | 0.34 | 0.26 | 0.02 |
| Recycling | 37 | 0.34 | 0.26 | 0.02 |
| Construction | 45 | 0.47 | 0.04 | 0.00 |
| Services of motor vehicles | 50 | 0.39 | 0.02 | 0.10 |
| Wholesale | 51 | 0.66 | 0.03 | 0.21 |
| Retail | 52 | 0.76 | 0.03 | 0.10 |
| Hotels & restaurants | 55 | 0.52 | 0.01 | 0.01 |
| Transport | 60 | 0.50 | 0.03 | 0.37 |
| Supporting transport activities | 63 | 0.67 | 0.01 | 0.08 |
| Post and telecommunications | 64 | 0.42 | 0.05 | 0.04 |
| Information technology | 72 | 0.44 | 0.01 | 0.02 |

This table reports Russian industry measures for the year 1995 calculated with data from the World Input-Output Database. *Distance to frontier* shows the ratio of total factor productivity (TFP) in a Russian industry to TFP in the United States for the same industry. TFP is obtained from a cross-country panel regression of (log) value added on (log) capital stock and (log) labor compensation. *Import competition* is the ratio of total imports to total final consumption for each industry in Russia. *Export share* is the ratio of total exports to total output for each industry in Russia.

**Table A.5**
**Bank branch presence and firm outcomes: LIML estimates**

| | ***LIML estimates*** | | | | |
|---|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | R&D | Total factor productivity growth | Labor productivity growth |
| | (1) | (2) | (3) | (4) | (5) |
| Branches | 0.0042*** | 0.0025* | 0.0055*** | 0.0009** | 0.0008** |
| | (0.0015) | (0.0013) | (0.0010) | (0.0004) | (0.0004) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 98.42 | 98.42 | 98.42 | 99.30 | 99.30 |
| $R$-squared | .12 | .10 | .12 | .04 | .05 |
| Observations | 4,211 | 4,211 | 4,211 | 4,128 | 4,128 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes using a limited information maximum likelihood (LIML) estimator. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

**Table A.6**
**Bank branch presence and firm outcomes: Trade credit intensity**

| **A** | ***Industries intensive in trade credit*** | | | |
|---|---|---|---|---|
| Dependent variable: | Product innovation | Process innovation | Total factor productivity growth | Labor productivity growth |
| | (1a) | (2a) | (3a) | (4a) |
| Branches | −0.0004 | 0.0002 | 0.0012 | 0.0007 |
| | (0.0019) | (0.0017) | (0.0008) | (0.0006) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 71.72 | 71.72 | 73.54 | 73.54 |
| $R$-squared | .04 | .04 | .04 | .04 |
| Observations | 2,217 | 2,217 | 2,167 | 2,167 |
| **B** | ***Industries that are not intensive in trade credit*** | | | |
| Dependent variable: | Product innovation | Process innovation | Total factor productivity growth | Labor productivity growth |
| | (1b) | (2b) | (3b) | (4b) |
| Branches | 0.0077*** | 0.0047** | 0.0014** | 0.0013* |
| | (0.0024) | (0.0019) | (0.0006) | (0.0007) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 128.38 | 128.38 | 127.67 | 127.67 |
| $R$-squared | .14 | .10 | .05 | .06 |
| Observations | 1,994 | 1,994 | 1,961 | 1,961 |
| **C** | ***Wald test for equality of coefficients*** | | | |
| Panel B ≥ panel A ($p$-value) | .01 | .03 | .45 | .17 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes in industries where firms heavily rely on trade credit (panel A) versus industries where firms do not (panel B). Panel C reports $p$-values for a Wald test for the equality of coefficients in panels A and B. We calculate trade credit intensity based on BEEPS. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

**Table A.7**
**Bank branch presence and firm outcomes: Alternative instruments**

| Dependent variable: | Product innovation (1) | Process innovation (2) | R&D (3) | Total factor productivity growth (4) | Labor productivity growth (5) | Product innovation (6) | Process innovation (7) | R&D (8) | Total factor productivity growth (9) | Labor productivity growth (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Branches | 0.0035** | 0.0008 | 0.0053*** | 0.0010** | 0.0009** | 0.0076** | 0.0012 | 0.0020 | 0.0003 | 0.0011** |
| | (0.0017) | (0.0016) | (0.0010) | (0.0005) | (0.0005) | (0.0036) | (0.0038) | (0.0029) | (0.0006) | (0.0005) |
| | | *First stage* | | *First stage* | | | *First stage* | | *First stage* | |
| Gosbank branches 1979 | | 0.5905*** | | 0.5902*** | | | | | | |
| | | (0.0234) | | (0.0236) | | | | | | |
| Gosbank branches 1922 | | | | | | | 2.6652*** | | 2.6795*** | |
| | | | | | | | (0.1187) | | (0.1196) | |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 67.05 | 67.05 | 67.05 | 67.40 | 67.40 | 7.80 | 7.80 | 7.80 | 7.88 | 7.88 |
| *R*-squared | .12 | .10 | .12 | .04 | .05 | .12 | .10 | .12 | .04 | .05 |
| Observations | 4,211 | 4,211 | 4,211 | 4,128 | 4,128 | 4,211 | 4,211 | 4,211 | 4,128 | 4,128 |

This table reports results from IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes. *Branches* is the endogenous variable, instrumented by *Gosbank branches 1979* in Columns 1–5 and by *Gosbank branches 1922* in Columns 6–10. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Standard errors are clustered at the locality level in Columns 1–5 and at the region level in columns 6–10 and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instrument is insignificant. Table A.1 defines all variables.

**Table A.8**
**Robustness**

| Dependent variable: | Product innovation (1) | Process innovation (2) | R&D (3) | Total factor productivity growth (4) | Labor productivity growth (5) |
|---|---|---|---|---|---|
| **A** | ***Excluding young firms ( ≤ 5 years)*** | | | | |
| Branches | 0.0043** | 0.0018 | 0.0052*** | 0.0008* | 0.0012*** |
| | (0.0017) | (0.0014) | (0.0012) | (0.0004) | (0.0004) |
| F-statistic on IVs | 90.84 | 90.84 | 90.84 | 91.09 | 91.09 |
| Observations | 3,560 | 3,560 | 3,560 | 3,499 | 3,499 |
| **B** | ***Excluding top-30 innovative localities*** | | | | |
| Branches | 0.0029** | 0.0012 | 0.0049*** | 0.0009** | 0.0008** |
| | (0.0015) | (0.0015) | (0.0009) | (0.0003) | (0.0004) |
| F-statistic on IVs | 146.46 | 146.46 | 146.46 | 148.45 | 148.45 |
| Observations | 4,055 | 4,055 | 4,055 | 3,976 | 3,976 |
| **C** | ***Excluding Moscow, Perm Territory, and Samara*** | | | | |
| Branches | 0.0031** | 0.0015 | 0.0051*** | 0.0010** | 0.0011** |
| | (0.0014) | (0.0013) | (0.0009) | (0.0004) | (0.0004) |
| F-statistic on IVs | 119.88 | 119.88 | 119.88 | 121.29 | 121.29 |
| Observations | 3,971 | 3,971 | 3,971 | 3,890 | 3,890 |
| **D** | ***Excluding two main oil-producing regions*** | | | | |
| Branches | 0.0038*** | 0.0039** | 0.0052*** | 0.0009** | 0.0007 |
| | (0.0014) | (0.0017) | (0.0012) | (0.0004) | (0.0004) |
| F-statistic on IVs | 218.00 | 218.00 | 218.00 | 220.31 | 220.31 |
| Observations | 2,390 | 2,390 | 2,390 | 2,349 | 2,349 |
| **E** | ***Clustering standard errors at locality level*** | | | | |
| Branches | 0.0042*** | 0.0025* | 0.0055*** | 0.0009** | 0.0010** |
| | (0.0016) | (0.0014) | (0.0010) | (0.0004) | (0.0004) |
| F-statistic on IVs | 98.88 | 98.88 | 98.88 | 99.68 | 99.68 |
| Observations | 4,211 | 4,211 | 4,211 | 4,128 | 4,128 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. Panel A is estimated on a sample excluding firms aged 5 years or younger; panel B on a sample excluding the 30 most innovative localities; panel C on a sample excluding Moscow, Perm Territory, and Samara; panel D on a sample excluding the two most oil producing regions (Western Siberia and Volga). All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level, except for panel E, where they are clustered at the locality level, and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

**Table A.9**
**Bank branch presence and firm outcomes: The role of agglomeration**

| **A** | ***Less agglomeration (EG index)*** | | | |
|---|---|---|---|---|
| Dependent variable: | Product innovation (1a) | Process innovation (2a) | Total factor productivity growth (3a) | Labor productivity growth (4a) |
| Branches | 0.0060*** | 0.0025 | 0.0010** | 0.0016** |
| | (0.0020) | (0.0020) | (0.0005) | (0.0006) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 116.31 | 116.31 | 114.43 | 114.43 |
| $R$-squared | .13 | .08 | .03 | .05 |
| Observations | 2,234 | 2,234 | 2,184 | 2,184 |

| **B** | ***More agglomeration (EG index)*** | | | |
|---|---|---|---|---|
| Dependent variable: | Product innovation (1b) | Process innovation (2b) | Total factor productivity growth (3b) | Labor productivity growth (4b) |
| Branches | 0.0015 | 0.0023 | 0.0006 | 0.0001 |
| | (0.0019) | (0.0017) | (0.0009) | (0.0005) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 88.34 | 88.34 | 86.95 | 86.95 |
| $R$-squared | .10 | .12 | .05 | .03 |
| Observations | 1,977 | 1,977 | 1,944 | 1,944 |

| **C** | ***Wald test for equality of coefficients*** | | | |
|---|---|---|---|---|
| Panel A $\geq$ panel B ($p$-value) | .04 | .48 | .19 | .05 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes in samples split by sector-level agglomeration. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. Panel A (B) is estimated on a sample of industries with a low (high) Ellison-Glaeser agglomeration index. Panel C reports $p$-values for a Wald test for the equality of coefficients in panels A and B. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

**Table A.10**
**Bank branch presence and firm outcomes: Location on the value chain**

| **A** | ***Upstream industries*** | | | |
|---|---|---|---|---|
| Dependent variable: | Product innovation (1a) | Process innovation (2a) | Total factor productivity growth (3a) | Labor productivity growth (4a) |
| Branches | 0.0050*** (0.0016) | 0.0039** (0.0015) | 0.0009* (0.0005) | 0.0010** (0.0005) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 145.95 | 145.95 | 188.22 | 188.22 |
| $R$-squared | .12 | .12 | .04 | .04 |
| Observations | 2,454 | 2,454 | 2,398 | 2,398 |
| **B** | ***Downstream industries*** | | | |
| Dependent variable: | Product innovation (1b) | Process innovation (2b) | Total factor productivity growth (3b) | Labor productivity growth (4b) |
| Branches | 0.0029 (0.0022) | 0.0012 (0.0017) | 0.0009 (0.0006) | 0.0006 (0.0008) |
| District & industry FEs; controls | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 58.69 | 58.69 | 89.82 | 89.82 |
| $R$-squared | .15 | .10 | .05 | .05 |
| Observations | 1,757 | 1,757 | 1,730 | 1,730 |
| **C** | ***Wald test for equality of coefficients*** | | | |
| Panel A ≥ panel B ($p$-value) | .15 | .07 | .50 | .34 |

This table reports results of IV regressions to estimate the impact of local bank branch presence on firm-level innovation and real outcomes in upstream (panel A) and downstream (panel B) industries. *Branches* is the endogenous variable, instrumented by *Spetsbanks 1995* and *Gosbank branches 1979*. Panel A (B) is estimated on a sample of 4-digit industries classified as upstream (downstream) in production following Antràs et al. (2012). Panel C reports $p$-values for a Wald test for the equality of coefficients in panels A and B. All regressions include industry and district fixed effects, region and firm controls, and a constant. Region controls include average industrial production growth between 1950 and 1989, local defense plants per capita in 1990, and local (log) population. Firm controls include (log) employment, (log) age, (log) distance to 1989 railway network, expecting higher sales (0/1), large city (0/1), and previously state owned (0/1). Robust standard errors are clustered at the region level and given in parentheses. $^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

**Table A.11**
**Quantifying omitted variables bias: Altonji et al. ratios**

| Dependent variable: | Product innovation | | Process innovation | | R&D | | Total factor productivity growth | | Labor productivity growth | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Branches | 0.0042*** | 0.0050*** | 0.0025* | 0.0022* | 0.0055*** | 0.0054*** | 0.0009** | 0.0012*** | 0.0008** | 0.0014*** |
| | (0.0015) | (0.0015) | (0.0013) | (0.0013) | (0.0010) | (0.0014) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| *Altonji et al. ratio* | −8.40 | −3.85 | −0.96 | −0.97 | −2.62 | −2.70 | −3.32 | −2.08 | −4.75 | −1.82 |
| Locality-level controls | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| District & industry FEs; controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic on IVs | 98.42 | 125.86 | 98.42 | 125.86 | 98.42 | 125.86 | 99.30 | 127.19 | 99.30 | 127.19 |
| $R$-squared | .12 | .13 | .10 | .12 | .12 | .12 | .04 | .05 | .05 | .05 |
| Observations | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,211 | 4,128 | 4,128 | 4,128 | 4,128 |

The odd-numbered columns in this table replicate our baseline IV regressions (cf. Tables 6 and 6), and the even-numbered also include the following locality-level controls: average distance of bank branches to their HQs; average equity-to-assets ratio of banks (weighted by the number of branches of each bank); share of firms with a high-speed internet connection; share of firms that experienced a power cut in the past year; and four variables that measure the locality-level average of firms' perceptions of the following business constraints: business licensing, political instability, courts, and education. Only second-stage results of the IV estimation are reported. The Altonji et al. ratios are measured following Altonji, Elder, and Taber (2005). The ratios in the odd-numbered columns are based on a comparison of our baseline specification (shown in these columns) to an unreported specification without firm-level or regional controls. The ratios in the even-numbered columns are based on a comparison of a specification with firm-level, regional, and locality-level controls to an unreported specification without controls. The Altonji et al. ratio equals the value of the coefficient in the regression including controls divided by the difference between this coefficient and the one derived from the regression without the controls. All regressions include industry and district fixed effects and a constant. Robust standard errors are clustered at the region level and given in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$. The F-statistic on IVs is for the F-test that the instruments are jointly insignificant. Table A.1 defines all variables.

**References**

Abanrbanell, J. S., and A. Meyendorff. 1997. Bank privatization in post-communist Russia: The case of Zhilsotsbank. *Journal of Comparative Economics* 25:62–96.

Acemoglu, D., P. Aghion, and F. Zilibotti. 2006. Distance to frontier, selection, and economic growth. *Journal of the European Economic Association* 4:37–74.

Acemoglu, D., U. Akcigit, and M. A. Celik. 2017. Young, restless and creative: Openness to disruption and creative innovations. Mimeo.

Aghion, P., U. Akcigit, and P. Howitt. 2013. What do we learn from Schumpeterian growth theory? Working Paper, College de France.

Aghion, P., N. Bloom, R. Blundell, R. Griffith, and P. Howitt. 2005. Competition and innovation: An inverted U-relationship. *Quarterly Journal of Economics* 120:701–28.

Aghion, P., A. Bergeaud, M. Lequien, and M. J. Melitz. 2018. The impact of exports on innovation: Theory and evidence. Working Paper, College de France.

Aghion, P., and P. Howitt. 1992. A model of growth through creative destruction. *Econometrica* 60:323–51.

Aghion, P., P. Howitt, and D. Mayer-Foulkes. 2005. The effect of financial development on convergence: Theory and evidence. *Quarterly Journal of Economics* 120:173–222.

Agrawal, A., A. Galasso, and A. Oettl. 2017. Roads and innovation. *Review of Economics and Statistics* 99:417–34.

Aguirrechu, A. A. 2019. *Russian science cities: History of formation and development (in Russian)*. Moscow: Moscow University Press.

Altonji, J. G., T. E. Elder, and C. R. Taber. 2005. Selection on observed and unobserved variables: Assessing the effectiveness of Catholic schools. *Journal of Political Economy* 113:151–84.

Amore, M. D., C. Schneider, and A. Žaldokas. 2013. Credit supply and corporate innovation. *Journal of Financial Economics* 109:835–55.

Angrist, J. D., and J.-S. Pischke. 2009. *Mostly harmless econometrics: An empiricist's companion*. Princeton, NJ: Princeton University Press.

Antrás, P., D. Chor, T. Fally, and R. Hillberry. 2012. Measuring the upstreamness of production and trade flows. *American Economic Review Papers and Proceedings* 102:412–16.

Arnold, A.Z. 1937. *Banks, credit, and money in Soviet Russia*. New York: Columbia University Press.

Atanassov, J. 2016. Arm's length financing and innovation: Evidence from publicly traded firms. *Management Science* 62:128–55.

Atkin, D., A. Chaudhry, S. Chaudry, A. K. Khandelwal, and E. Verhoogen. 2017. *Quarterly Journal of Economics* 132:1101–164.

Ayyagari, M., A. Demirgüç-Kunt, and V. Maksimovic. 2011. Firm innovation in emerging markets: The role of finance, governance, and competition. *Journal of Financial and Quantitative Analysis* 46:1545–80.

Bai, J., and S. Ng. 2010. Instrumental variable estimation in a data rich environment. *Econometric Theory* 26:1577–606.

Barker, V. L., and G. C. Mueller. 2002. CEO characteristics and firm R&D spending. *Management Science* 48:782–801.

Beck, T., R. Levine, and N. Loayza. 2000. Finance and the sources of growth. *Journal of Financial Economics* 58:261–300.

Bellows, J., and E. Miguel. 2009. War and local collective action in Sierra Leone. *Journal of Public Economics* 93:1144–57.

Benfratello, L., F. Schiantarelli, and A. Sembenelli. 2008. Banks and innovation: Microeconometric evidence on Italian firms. *Journal of Financial Economics* 90:97–217.

Berkowitz, D., M. Hoekstra, and K. Schoors. 2014. Bank privatization, finance, and growth. *Journal of Development Economics* 114:93–106.

Bound, J., D. Jaeger, and R. Baker. 1995. Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American Statistical Association* 90:443–50.

Brown, D., M. Fay, S.V. Lall, H. Wang, and J. Felkner. 2008. Death of distance? Economic implications of infrastructure improvement in Russia. Working Paper, European Investment Bank.

Brown, J., G. Martinsson, and B. Petersen. 2012. Do financing constraints matter for R&D? *European Economic Review* 56:1512–29.

Bruno, R. L., M. Bytchkova, and S. Estrin. 2013. Institutional determinants of new firm entry in Russia: A cross-regional analysis. *Review of Economics and Statistics* 95:1740–49.

Bustos, P. 2011. Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinean firms. *American Economic Review* 101:304–340.

Carpenter, R. E., and B. C. Petersen. 2002. Capital market imperfections, high-tech investment, and new equity financing. *Economic Journal* 112:F54–F72.

Chava, S., A. Oettl, A. Subramanian, and K. V. Subramanian. 2013. Banking deregulation and innovation. *Journal of Financial Economics* 109:759–74.

Chava, S., V. K. Nanda, and S. C. Xiao. 2018. Lending to innovative firms. *Review of Corporate Finance Studies* 6:234–89.

Chiburis, R. C., J. Das, and M. Lokshin. 2012. A practical comparison of the bivariate probit and linear IV estimators. *Economics Letters* 117:762–66.

Cohen, W. M., and S. Klepper. 1996. Firm size and the nature of innovation within industries: The case of process and product R&D. *Review of Economics and Statistics* 78:232–43.

Cole, H. L., J. Greenwood, and J. M. Sanchez. 2016. Why doesn't technology flow from rich to poor countries? *Econometrica* 84:1477–521.

Comin, D., and B. Hobijn. 2010. An exploration of technology diffusion. *American Economic Review* 100:2031–59.

Comin, D., and R. Nanda. 2019. Financial development and technology diffusion. *IMF Economic Review* 67:395–419.

Conley, T. G., C. B. Hansen, and P. E. Rossi. 2012. Plausibly exogenous. *Review of Economics and Statistics* 94:260–72.

Cornaggia, J., Y. Mao, X. Tian, and B. Wolfe. 2015. Does banking competition affect innovation? *Journal of Financial Economics* 115:189–209.

Degryse, H., and S. Ongena. 2005. Distance, lending relationships, and competition. *Journal of Finance* 60:231–66.

De la Fuente, A. and, J. M. Marin. 1996. Innovation, bank monitoring, and endogenous financial development. *Journal of Monetary Economics* 38:269–301.

Demirgüç-Kunt, A., and R. Levine. 2001. *Financial structure and economic growth*. A cross-country comparison of banks, markets, and development. Cambridge: MIT Press.

Dexter, K., and I. Rodionov. 2017. *The factories, research and design establishments of the Soviet defence industry: A guide*", version 18. Report, University of Warwick, Coventry, England.

Dhingra, S. 2013. Trading away wide brands for cheap brands. *American Economic Review* 103: 2554–84.

Donaldson, D., and R. Hornbeck. 2016. Railroads and American economic growth: A "market access" approach. *Quarterly Journal of Economics* 131:799–858.

Ellison, G., and E. L. Glaeser. 1997. Geographic concentration in U.S. manufacturing industries: A dartboard approach. *Journal of Political Economy* 105:889–927.

Fan, J., and B. Zou. 2018. Industrialization from scratch: The 'third front' and local economic development in China's hinterland. Mimeo.

Fisman, R., and Love, I. 2003. Trade credit, financial intermediary development, and industry growth. *Journal of Finance* 58:353–74.

Flach, L., and M. Irlacher. 2018. Product versus process: Innovation strategies of multiproduct firms. *American Economic Journal: Microeconomics* 10:236–77.

Galasso, A., and T. Simcoe. 2011. CEO overconfidence and innovation. *Management Science* 57:1469–84.

Garvy, G. 1977. The origins and evolution of the Soviet banking system: An historical perspective, In *Money, financial flows, and credit in the Soviet Union*, pp. 13–35. Washington, DC: NBER.

Gerschenkron, A. 1962. Economic backwardness in historical perspective. In *The progress of underdeveloped areas*, ed. B. Hoselitz. Chicago: University of Chicago Press.

Gorodnichenko, Y., and M. Schnitzer. 2013. Financial constraints and innovation: Why poor countries don't catch up. *Journal of European Economic Association* 11:1115–52.

Greenwood, J., and B. Jovanovic. 1990. Financial development, growth, and the distribution of income. *Journal of Political Economy* 98:1076–107.

Guadalupe, M., O. Kuzmina, and C. Thomas. 2012. Innovation and foreign ownership. *American Economic Review* 102:3594–627.

Guiso, L., P. Sapienza, and L. Zingales. 2004. Does local financial development matter? *Quarterly Journal of Economics* 119:929–69.

Grossman, G. M., and E. Helpman. 1991. Quality ladders and product cycles. *Quarterly Journal of Economics* 106:557–86.

Hall, B. H., and J. Lerner. 2010. The financing of R&D and innovation. In *Handbook of the economics of innovation*, eds. B.H. Hall and N. Rosenberg. North Holland: Elsevier.

Hall, B. H, and B. Khan. 2003. Adoption of new technology. In *New economy handbook*, ed. D. C. Jones, 230–51. Amsterdam, the Netherlands: Elsevier Science.

Henderson, J. V., A. Storeygard, and D. N. Weil. 2011. A bright idea for measuring economic growth. *American Economic Review* 101:194–99.

Herrera, A. M., and R. Minetti. 2007. Informed finance and technological change: Evidence from credit relationships. *Journal of Financial Economics* 83:223–69.

Hirshleifer, D., A. Low, and S. Teoh. 2012. Are overconfident CEOs' better innovators? *Journal of Finance* 67:1457–98.

Horstmann, I., G. M., MacDonald, and A. Slivinski. 1985. Patents as information transfer mechanisms: To patent or (maybe) not to patent. *Journal of Political Economy* 93:837–58.

Hombert, J., and A. Matray. 2017. The real effects of lending relationships on innovative firms and inventor mobility. *Review of Financial Studies* 30:2413–45.

Hsu, P.-H., X. Tian, and Y. Xu. 2014. Financial development and innovation: Cross-country evidence. *Journal of Financial Economics* 112:116–35.

Johnson, J. 2000. *A fistful of rubles: The rise and fall of the Russian banking system*. Ithaca, NY: Cornell University Press.

Keller, W. 2004. International technology diffusion. *Journal of Economic Literature* 42:752–82.

König, M. D., J. Lorenz, and F. Zilibotti. 2016. Innovation vs. imitation and the evolution of productivity distributions. *Theoretical Economics* 11:1053–102.

Kuzmina, O., N. Volchkova, and T. Zueva. 2014. Foreign direct investment and governance quality in Russia. *Journal of Comparative Economics* 42:874–91.

La Porta, R., F. López-de-Silanes, A. Shleifer, and R. W. Vishny. 1997. Legal determinants of external finance. *Journal of Finance* 52:1131–50.

Ledyaeva, S., P. Karhunen, and J. Whalley. 2013. Offshore jurisdictions (including Cyprus), corruption money laundering and Russian round-trip investment. Working Paper, Aalto University.

Lenin, V. I. 1972. Can the Bolsheviks retain state power? *Lenin's collected works*, 87–136. Moscow: Progress Publishers.

Lileeva, A., and D. Trefler. 2010. Improved access to foreign markets raises plant-level productivity for some plants. *Quarterly Journal of Economics* 125:1051–99.

Mairesse, J., and P. Mohnen. 2010. Using innovation surveys for econometric analysis". In *Handbook of the economics of innovation*, eds. B. H. Hall and N. Rosenberg, 1130–55. Amsterdam, the Netherlands: Elsevier.

Mansfield, E., M. Schwartz, and S. Wagner. 1981. Imitation costs and patents: An empirical study. *Economic Journal* 91:907–18.

Markevich, A., and T. N. Mikhailova. 2013. Economic geography of Russia, In *The Oxford handbook of the Russian economy*, eds. M. Alexeev and S. Weber, chap. 26, 617–42. Oxford, UK: Oxford University Press.

Melitz, M. J., and G. I. Ottaviano. 2008. Market size, trade, and productivity. *Review of Economic Studies* 75:295–316.

Midrigan, V., and D. Y. Xu. 2014. Finance and misallocation: Evidence from plane-level data. *American Economic Review* 104:422–58.

Mirkina, I. 2014. Aggregate data, regions of Russia, 1990-2010. ICPSR35355-v1. Ann Arbor, MI: Inter-University Consortium for Political and Social Research.

Mironov, M. 2013. Taxes, theft, and firm performance. *Journal of Finance* 68:1441–72.

Mironov, M., and E. Zhuravskaya. 2016. Corruption in procurement and the political cycle in tunneling: Evidence from financial transactions data. *American Economic Journal: Economic Policy* 8:287–321.

Nanda, R., and T. Nicholas. 2014. Did bank distress stifle innovation during the Great Depression? *Journal of Financial Economics* 114:273–92.

Neumark, D., and H. Simpson. 2015. Do place-based policies matter? *FRBSF Economic Letter*. March.

Peters, B., M. J. Roberts, and V. A. Vuong. 2018. Firm R&D investment and export market exposure. Working Paper, ZEW.

Petersen, M. A., and R. G. Rajan. 1997. Trade credit: Theories and evidence. *Review of Financial Studies* 10:661 –91.

Petersen and Rajan. 2002. Does distance still matter? The information revolution in small business lending. *Journal of Finance* 57:2533–70.

Pittman, R. 2013. Blame the switchman? Russian railways restructuring after ten years. In *The Oxford handbook of the Russian economy*, eds. M. Alexeev and S. Weber, chap. 21. Oxford, UK: Oxford University Press.

Polishchuk, L. 2013. Institutional performance. In *The Oxford handbook of the Russian economy*, eds. M. Alexeev and S. Weber, chap. 21. Oxford, UK: Oxford University Press.

Popov, A., and G. Udell. 2012. Cross-border banking, credit access, and the financial crisis. *Journal of International Economics* 87:147–61.

Rajan, R. G. 1992. Insiders and outsiders: The choice between relationship and arm's length debt. *Journal of Finance* 47:1367–1400.

Rajan, R. G, and L. Zingales. 1998. Financial dependence and growth. *American Economic Review* 88:559–86.

Romer, P. M. 1990. Endogenous technological change. *Journal of Political Economy* 98:S71–S102.

Satyanath, S., N. Voigtländer, and H.-J. Voth. 2017. Bowling for fascism: Social capital and the rise of the Nazi party. *Journal of Political Economy* 125:478–526.

Schoors, K. 2003. The fate of Russia's former state banks: Chronicle of a restructuring postponed and a crisis foretold. *Europe-Asia Studies* 55:75–100.

Schoors, K., and K. Yudaeva. 2013. Russian banking as an active volcano. In *Oxford handbook of the Russian economy*, eds. M. Alexeev and S. Weber, chap. 21. Oxford, UK: Oxford University Press.

Schulze G. G., and N. Zakharov. 2018. Corruption in Russia: Historic legacy and systemic nature. Working Paper, University of Freiburg.

Schumpeter, J. A. 1934. *The theory of economic development. An inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, MA: Harvard University Press.

Schweiger, H., A. Stepanov, and P. Zacchia. 2018. The long-run effects of R&D place-based policies: Evidence from Russian science cities. Working Paper, European Bank for Reconstruction and Development, London.

Strieborny, M., and M. Kukenova. 2016. Investment in relationship-specific assets: Does finance matter. *Review of Finance* 20:1487–515.

Timmer, M. P., E. Dietzenbacher, B. Los, R. Stehrer, and G. J. de Vries. 2015. An illustrated user guide to the world input-output database: The case of global automotive production. *Review of International Economics* 23:575–605.

Wang, J. 2013. The economic impact of special economic zones: Evidence from Chinese municipalities. *Journal of Development Economics* 101:133–47.

Weingast, B. 1995. The economic role of political institutions: Market-preserving federalism and economic development. *Journal of Law, Economics & Organization* 20:11–31.

Wooldridge, J. M. 2002. *Econometric analysis of cross section and panel data*. Cambridge, MA: MIT Press.