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ABSTRACT

Does access to credit improve productivity? Evidence from Bulgarian firms*

Although it is widely accepted that financial development is associated with higher growth, the evidence on the channels through which credit affects growth at the microeconomic level is scant. Using data from a cross section of Bulgarian firms, we estimate the impact of access to credit, as proxied by indicators of whether firms have access to a credit line or overdraft facility on productivity. To overcome potential omitted variable bias of OLS estimates, we use information on firms' past growth to instrument for access to credit. We find credit to be positively and strongly associated with TFP. These results are robust to a wide range of robustness checks.

JEL Classification: D24, G21 and G32
Keywords: access to credit, productivity and transition

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1. Introduction

The link between finance and growth has become one of the stylized facts in development literature. For example, recent evidence from transition economies supports this widely accepted view (see Koivu (2002), Coricelli and Masten (2004) and Beck and Laeven, (2004)). However, the precise channels through which finance operates are still unclear. For example, Levine (2005) suggests that finance may influence long-run growth through its impact on savings rates, investment decisions, and technological innovation. However, in the same article the author states that "We are far from definite answers to these questions: Does finance cause growth, and if it does, how?" In this paper we provide evidence to answer the second question.

One possible channel through which finance affects growth is via improvement in productivity. Several models provide theoretical justifications to the proposition that credit affects growth through its impact on productivity. In these models the financial sector provides real services by alleviating information and transaction costs, in particular making the longer-gestation, higher-return projects more attractive (see, for example, Levine (1991) and Bencivenga et al. (1995)) and facilitating long-run, productivity-enhancing investment, increasing growth and reducing volatility (see Aghion et al. (2005)). In turn, Easterly and Levine (2001) provide macroeconomic evidence that total factor productivity (TFP) accounts for most of the variation in the cross-country differences in economic development and growth. They go as far as to claim that factor accumulation is not important for future growth while productivity is.[1] Levine and Zervos (1998) argue that "the major channel through which growth is

[1] A recent paper by Bond et al. (2004) questions that view and shows that capital accumulation is important for growth.

linked to stock markets and banks is through productivity growth." However, rapid credit growth might also have a reverse, negative, impact on productivity. For example, Ghani and Suri (1999) argue that the rapid growth of bank credit was associated with negative productivity growth in Malaysia because of inefficient credit allocation.

We use information from a cross section of Bulgarian firms to estimate whether access to credit is associated with higher productivity. First, we estimate a measure of total factor productivity using several estimation techniques aimed at correcting for the bias stemming from endogenous input choices. Second, we test directly for the importance of credit for productivity by using indicators of access to credit (whether a firm has access to a credit line or overdraft). Third, as OLS estimates of access to credit on productivity potentially suffer from omitted variable bias, we subject our results to a number of robustness checks. We first enrich our specification with controls for a large list of observables, including type of ownership, education of the workforce, bribe payments, and industry dummies. We then use alternative measures of credit constraints, including subjective indicators of the extent to which access to and cost of credit represent important obstacles to doing business, and individual measures of credit and overdraft line. We also reproduce our main result using all of the alternative estimates of TFP as well as other measures of firms' performance. We find that access to credit has a significant and positive effect on estimated productivity under all of the specifications.

In a cross sectional setup such as ours, however, OLS estimates may suffer from endogeneity bias. In particular the positive coefficient on credit may reflect the fact

that more productive firms find it easier to obtain credit rather than vice-versa. Alternatively, the coefficient could underestimate the true relationship between access to credit and productivity if more productive firms have access to sources of financing other than bank credit lines (such as retained earnings or equity finance). To address this issue, we use information on past growth to instrument for credit access. We expect banks to be more likely to extend credit to successful firms and we indeed find that lagged growth indicators are good predictors of credit access in a first stage regression. To limit the possibility that lagged growth affects productivity through channels other than credit, for example if it captures a common, slow moving component of growth and productivity, we control for contemporaneous growth. We find that the effect of credit on productivity is strong and significant in the two-stage estimation.

Assessing the role of credit in determining productivity is also particularly relevant from a policy point of view in the context of Bulgaria. In the late 1990s irresponsible quasi-fiscal policies brought about a deep financial crisis in Bulgaria (1996-97) that resulted in hyperinflation reaching peaks of 1000% and in a dramatic drop in private investment. Following the crisis, the government adopted a strong commitment to fiscal responsibility by introducing a currency board exchange rate regime and a broad range of market oriented reforms. Because of the collapse of the financial sector, virtually no credit was available to the private sector at the time. However, starting in 2001, credit to the private sector grew at progressively faster rates. For example, bank claims on the non-government sector rose by nearly 8 percentage points of GDP in 2003 (IMF, Article IV consultations) without any sign of deterioration in banks' prudential indicators. Such rapid credit growth and the related

widening of the current account deficit generated concerns of overheating in the economy and induced the authorities to implement restrictive measures in October 2004 to curb it and the question of whether further expansion of credit is beneficial in Bulgaria is still open.

The paper is organized as follows. Section 2 reviews related literature and section 3 described the data. Section 4 discusses alternative TFP estimates and methodology. Section 5 presents the results of the two-stage estimation and the robustness checks. Section 6 concludes.

2. Related Literature

In this section we review previous studies of the effect of access to credit on productivity, giving a special focus to papers on transition economies and especially Bulgaria. The literature on the relationship between firm productivity and access to finance is relatively small and analysis in the context of former centrally planned economies is limited.

Using data from US manufacturing companies, Bernstein and Nadiri (1993) estimate the effect of financial structure on productivity growth. Their focus is on estimating the impact of agency cost of debt and the signaling benefits of dividends on productivity growth. Nickell and Nicholitsas (1999) find that financial pressure (defined as the ratio of interest payments to cash flow) has a positive effect on productivity. They deal with endogeneity of financial pressure by using instruments of lagged debt burden and yield on treasury bonds. Schiantarelli and Sembenelli (1999)

show that firms with a larger proportion of long-term debt in their capital structure have improved subsequent performance measured as profitability, sales growth and total factor productivity in samples of UK and Italian firms. Similar patterns are found in Schiantarelli and Jaramillo (1999) for Ecuador and in Schiantarelli and Srivastava (1999) for India. However, due to data limitations, all the previous studies focused on the effect of leverage on productivity.[2] In our paper we are able to use more direct measures of access to credit, such as presence or absence of overdrafts and lines of credit.

Several recent papers estimated TFP in transitional economies. Ganev (2005) estimates TFP for Bulgaria using aggregate data from National Accounts and argues that TFP growth is the main determinant of economic growth in Bulgaria. Hoekman and Djankov (1999) estimate the effects of trade liberalization and access to global markets on TFP growth in Bulgaria. They argue that firms that increase their imports of intermediate and capital goods have higher productivity growth.[3] Access to capital to finance these imports could be an important driving force for these productivity improvements, which is the focus of our paper. A related paper by Maurel (2001) estimated TFP for a panel of Hungarian firms but is focused mainly on the effect of investment on TFP and not on the relationship between access to credit and TFP, which we investigate here.

Bratkowski et al. (2000) argue that imperfections in capital markets in Central European economies do not seem to actually inhibit the growth of new private firms.

[2] A related strand of literature focuses on the relationship between productivity and leverage in firms that have undergone a leveraged buyout (see Lichtenberg and Siegel (1990), and Ravencraft and Scherer (1987)).

[3] Interestingly, Hoekman and Djankov (1999) find that the percent of output exported has no significant effect on total factor productivity.

They approach the issue from a different angle and find that loss-making *de novo* firms have a lower probability of getting credit than profitable ones.

Most previous related studies of Bulgaria were written using the data from early transition years. A significant number of papers address issues of privatization and soft budget constraints, which are not directly relevant for our paper and, therefore, are not included in this review. Using data from an earlier period in Bulgaria (1993-1995) Budina et al. (2000) find that internal funds are significantly related to firm's investment, which suggests that Bulgarian firms are liquidity constrained. However, Konings et al. (2003) use the same methodology and find that Bulgarian firms are less financially constrained than firms in Poland and the Czech Republic (and explain this finding with the presence of soft budget constraints rather than better market efficiency). A related paper by Rizov (2004) estimates the effect of credit rationing on profitability of Bulgarian firms during the three years following the 1996 financial crisis, when credit was especially low. He finds that bank loans have a significantly larger effect on profitability for a sample of credit-constrained firms (selected using an endogenous switching regression framework) than in a sample of unconstrained firms. Instead of selecting firms into credit-constrained vs. unconstrained firms, we study the average effect of access to credit on productivity in our sample.

3. Data description

We use data from a recent survey of Bulgarian enterprises which was conducted by the International Financial Corporation (IFC)/World Bank in March-April 2004. The survey contains information on 548 Bulgarian firms sampled according to a number of criteria: (i) size, so as to be representative of SMEs and to include a minimum of

20% of large firms; (ii) sectors, so as to mirror the distributions of Bulgarian firms across manufacturing, mining, and services; and (iii) location, so as to include firms in large cities (200 observations), small towns (100 observations), and the capital, Sofia. The survey reports detailed information on administrative and bureaucratic constraints to business and a limited amount of balance sheet-type data.[4] Table 1, Panel A reports distribution of firms in our sample by industry and size.

About 60% of the surveyed firms operate in manufacturing and 30% is engaged in service activities. Access to selling markets is fairly dichotomous: 63% of the firms sell only domestically – these are mostly micro and small enterprises.[5] Exporters sell on average more than 60% of their output to foreigners, indicating that there might be important costs to set up production for export. About 75% of the exporters sell to EU markets (to Germany, Italy, and Greece). Half of these sell also to Eastern Europe and Central Asia markets, in particular to Macedonia, Russia, and Turkey.

Foreign ownership is highly concentrated. In the sample for which TFP can be estimated, 10% of firms are foreign owned and, among these, 75% of firm capital is in foreign hands.

Firms report, amongst others, the value of total sales and fixed assets as well as information on employees, wages, and costs as a percentage of total sales. We use this information to obtain estimates of TFP. Firms were also asked whether they have a credit line or an overdraft facility. As our main indicator of access to credit, we use a variable (LINE) taking value of one if the firm has either overdraft or a credit line and

[4] See "Investment Climate and Regulatory Cost Survey," IFC-FIAS, for more details on the survey.
[5] Firm size is defined as follows: micro enterprises (up to 10 employees); small (between 11 and 50 employees); medium (between 51 and 100 employees); large (more than 100 employees).

zero otherwise. We combine information on overdrafts and credit lines as both instruments represent easy access to immediate liquidity and both have short-term maturity. About 18% of firms have an overdraft facility and about 20% have a line of credit. Overall, about 30% of firms in our sample have either an overdraft or a credit line. Credit availability increases linearly with firm size: only 10% of micro enterprises, between 20% and 30% of small and medium enterprises, and about 40% of large enterprises have a credit line or overdraft. Table 1, Panel B reports distribution of firms with and without access to credit, by size.

The survey also asks firms to rank a number of different obstacles to doing business, including "access to credit (e.g. collateral)" and "cost of financing (e.g. interest rates)" in a five-point scale ranging from "no obstacle" (0) to "major obstacle" (4). Among a set of 25 possible constraints to firm activities, access to credit is listed as one of the major obstacles. Interestingly, the correlation between the extent to which firms rank credit access and cost to be an obstacle, and actual presence of credit lines is significant, but weak. While the reported presence of a credit line is an objective measures of access to credit, obstacle rankings are subjective measures that reflect, at least in part, managers' pessimism or optimism. To correct for this source of systematic bias, we subtract from reported rankings the average score of the answers to the other twenty four questions on obstacles to business ranging from the role of macroeconomic instability to the functioning of customs. The correlation between the resulting measures (COST_ADJ and ACCESS_ADJ) and LINE improves

substantially, indicating that the adjusted indicators track more closely the actual importance of credit constraints.[6]

Table 2 reports descriptive statistics for the main variables.

4. Estimating productivity

Firm productivity is an unobservable firm characteristic. Estimates of productivity can be recovered as the difference between actual output and output estimated by a production function using actual output and input quantities. Productivity estimates can be obtained from a regression of the type:

$$\ln Y_i = \alpha + \beta_k \ln K_i + \beta_l \ln L_i + \varepsilon_i \qquad (1)$$

where Y_i is firm's output, K_i and L_i are capital and labor, β_k and β_l are capital and labor shares, and ε_i is the error. In this model, TFP, the estimated residual, is obtained as the difference between actual and predicted output, or $\hat{\varepsilon}_i = \ln Y_i - \ln \hat{Y}_i$.

The simplest model can be estimated by OLS. However, econometric issues arise because firm productivity can affect input choices. We start by using OLS and later we use an alternative approach that addresses the simultaneity problem.

We then use several estimates of TFP to check for robustness and minimize possible biases. We first estimate value-added TFP from a pooled OLS regression where value

[6] The correlation between LINE and unadjusted access obstacle is -0.11 and with unadjusted cost it is -0.10, both significant at 5%. The correlation between LINE and adjusted access and cost obstacles is -0.16 and -0.15, respectively, and it is significant at 1% in both cases..

added (sales less expenditure on materials) is regressed on capital and labor. In the pooled regression coefficients on capital and labor are the same across manufacturing, construction and services, but intercepts are allowed to differ. Data on capital, labor and sales are available for a total of 190 firms. However, expenditure on materials is available for only 130 firms. To increase the sample on which we compute value-added TFP, we impute material expenditure as percent of sales using industry-size averages. We use the resulting TFP estimate (TFP_VA) as our main measure of productivity. Results are reported in Table 3, column 1. To ensure that imputing missing observations on materials does not drive our results, we also estimate TFP using the restricted sample of actual observations (TFP_VA_RS, Table 3, column 2) and use it as an alternative dependent variable in our robustness checks.

In addition, we run separate TFP regressions for all three sectors, thus allowing for sector-specific capital and labor shares (TFP_VA_S, table 3, columns 3-5). As we have few observations for the construction sector, we do not rely on this as our primary measure of TFP but use it as dependent variable in robustness checks.

The various TFP estimates are highly correlated (correlation of 0.93). In the pooled regression, labor and capital shares are estimated to be around 0.6 and 0.4 respectively, which seems in line with conventional wisdom. The regression is estimated with precision, with an R-squared of about 0.7.

While our OLS estimates appear reasonable, they are likely to be biased because of potential correlation between input choices and the unobserved productivity shock as firms may alter their mix of inputs in response to a productivity shock. This implies

that the error and the regressors in (1) might be correlated and that coefficient estimates obtained with OLS might be biased. A number of solutions have been proposed in the literature to overcome this problem. These include using firm-level fixed effects, which would deal with time-invariant individual effects, and instrumental variable strategies for input choices.

Recent contributions by Olley and Pakes (1996) and Levinsohn and Petrin (2003) argue that using information on intermediate input choices such as demand for raw materials or electricity allows controlling for productivity shocks to obtain consistent and unbiased estimates of β_k and β_l. In their model, labor and materials are freely variable inputs, but capital is treated as a state variable that is affected by the distribution of the productivity shock. The main insight is that other observable firm decisions will also be a function of the productivity shock. This function is then inverted to control for unobservable productivity shock with observable variables.

In the original work by Olley and Pakes (1996), investment was used to proxy for this unobservable shock. However, because of indivisibility, investment is often zero, which presents practical difficulties with inverting the function. The main contribution of Levinsohn and Petrin (2003) is to use different observable variables, such as intermediate inputs, to proxy for unobservable productivity shock (see also discussion in Hallward-Driemeier et al., 2002).

We follow the Levinsohn and Petrin (2003) procedure to obtain alternative estimates of TFP using raw material inputs as an intermediate input variable. [7] To estimate the model we need to have a panel with at least 2 years of data. While our survey data is technically a cross-section, there is enough information in the survey to construct estimates of the previous year values for our key variables – sales, labor, capital and materials – and create a "pseudo-panel."

Specifically, to estimate sales for 2002, we use sales for 2003 and the reported sales growth rate (from 2002 to 2003). To estimate employment in 2002, we take number of employees in 2003, add to it the number of employees hired in 2003 and subtract the number of employees who left the company in 2003. To estimate fixed assets in 2002 we use fixed assets in 2003 and the reported growth rate of fixed assets.[8] Finally, to estimate the material expenditure in 2002 we use data on proportion of material expenditure as percent of sales and estimated sales in 2002. We implicitly assume that the proportion of material expenditure as percent of sales does not change from 2002 to 2003.[9]

Using this pseudo-panel, we obtain the estimates of TFP with the Levinsohn-Petrin method. We refer to this measure as TFP_LP. The estimates are reported in Table 4, column 6. The estimate on capital is fairly similar relative to the OLS estimate.

[7] The estimation is performed with a two-step procedure. The first stage can be estimated by OLS with the polynomial expansion of the function capturing unobservable shock, or by a non-parametric method. The second stage is estimated by the method of moments and is used to extract the coefficients on capital and materials. The errors are bootstrapped. The procedure is implemented in Stata, as "levpet" command, which is described in Petrin et al. (2004).

[8] For firms that are missing fixed assets growth rate, we use data on the rate of investment (expressed as percent of sales) and recover past capital as current capital minus current investment, assuming a 10% depreciation rate. This helps to fill in 53 observations and to increase our sample size considerably. Results are similar if we use the fixed assets measure constructed with data on growth rate.

[9] For observations that are missing data on material expenditures as percent of sales we impute them using industry-size averages.

However, the estimate on labor share is significantly different: OLS produces an estimate in the range of 0.6, while the LP method returns an estimate of about 0.3. Nevertheless, the correlation between TFP_VA and TFP_LP estimates is high (correlation of 0.90).

Because TFP_LP is constructed with estimated data, we use TFP_VA, which is estimated in one step with OLS, as our main measure, and employ TFP_LP in robustness checks instead. We should also note that some recent research has highlighted that OLS and 2SLS TFP estimates do not differ substantially (see Eslava et al, 2004). This is in line with our findings, as our results are robust to using different TFP measures.

5. Access to credit and productivity

We first present basic OLS estimates of main correlates of firm TFP and assess the impact, if any, of access to credit as proxied by the presence of a credit line or overdraft facility. We then discuss various robustness checks as well as the econometric problems associated with OLS estimation in this context. Finally, we discuss our two-stage estimation strategy.

5.1 OLS estimates

We first regress our main TFP estimate on the credit measure (LINE) together with a number of basic correlates such as firm size, an indicator of previous government

ownership, firm age, and sectoral dummies. Results are reported in Table 4. We find that LINE is positively and significantly associated with productivity.

It is important to note that access to credit could proxy for a number of other firm characteristics. In particular, one might argue that exporting or foreign owned firms both have higher know how (and thus are more productive) and, at the same time, have privileged access to credit. However, when we include a dummy for whether the firm is an exporter, or foreign ownership measures (either a dummy indicating foreign ownership above 10% of firm capital or the percentage of foreign ownership) the coefficient on LINE is unchanged. Similarly, publicly owned firms might be both less productive and systematically favored by banks. Nonetheless, including in the regression the percent of capital that is state owned leaves our results unchanged. One might also argue that paying bribes to obtain public services and licenses might both lower firms' productivity and also affect the extent to which firms can get access to credit. To control for this potential issue, we include the percentage of sales that firms report to be paying as bribes to public officials. Bribing is negatively associated with productivity but the coefficient on LINE is unaffected by the inclusion of this additional regressor. Moreover, the ability of managers (and of the workforce in general) might be positively correlated with both access to credit and productivity. To proxy for this possible source of bias, we use a measure of overall workforce education (as proxied by the share of employees with more than 12 years of education). We find that while this workforce education is significantly and positively related to TFP, our access indicator remains significant. The overall predicted power of our regression is also improved, as the R^2 increases from 0.12 to

0.20. Finally, the coefficient of interest is also robust to including 15 industry dummies.

According to the specifications reported in Table 4, a change from no credit to access to a credit line or overdraft is associated with increases in productivity in the range of 30% to 43% of a standard deviation in TFP.

5.2 Robustness checks

Next, we assess whether our results are robust to using alternative measures of access to credit (Table 5). We first use the individual indicators for availability of credit line only or availability of overdraft facility (note that our main indicator LINE equals to one if the firm has either one of the two). CREDIT_LINE is significant by itself at 1%, but OVERDRAFT is only significant marginally (at about 12%). This suggests that while both facilities are important for improving access, credit line access plays a more prominent role than overdraft. This is not surprising, as overdraft is thought to be more of a back-up source of "emergency" finance, while credit line is a source of longer term finance.

We then check robustness using two alternative measures of access – the subjective perceptions of access and cost obstacles, described in the data section. Note that a higher level of the indicator means less access, so we will expect a negative coefficient in the TFP regression. We find that the estimated coefficients on both measures are negative (Table 5, columns 3 and 4). The access obstacle is significant at 1%, while the cost obstacle is significant at 10%.

We also assess whether our results are robust to using the alternative measures of productivity discussed in section 4. Table 6, column (1) reports our baseline estimation with TFP_VA as dependent variable for comparison; column (2) reports estimates for TFP_VA_RS (the TFP estimate on the restricted sample for which we have the firm-reported, rather than imputed, measures of materials)[10]; column (3) reports results with TFP_LP, the TFP estimate obtained with the Levinsohn-Petrin procedure; column (4) reports TFP estimated separately for each sector. Our results are robust to using all of these productivity estimates: LINE is significant at 5% for all four alternative measures, and the coefficients are also robust in magnitude, ranging from about 0.4 to 0.5.

Finally, we use alternative measures of firm's performance – (log) sales per employee and measures of profitability (Table 6, columns 5-8). LINE has the predicted and significant effect on sales to employee ratio. Two additional measures of good performance are available – an indicator of whether the firm is making a positive profit, and an indicator variable for exports. We find that access to credit, as measured by our LINE variable, is positively related to the profitability indicator and export status. Column 6 reports the regression with positive profit dummy with all available observations, while column 7 reproduces the same regression using the smaller sample for which we have value added data. Results are fairly similar, which reassures us that our limited sample with available TFP data is fairly representative of the larger sample of firms in the survey. We also find that firms with access to LINE

[10] See description in section 4.

are more likely to be exporters, although the causality of this relationship is hard to establish without additional data.

5.3 Instruments and 2SLS

Notwithstanding the large battery of robustness checks, the concern remains that the positive association between access to credit and productivity that we estimated by OLS might be biased by endogeneity or omitted unobservables. More productive firms might be better at obtaining credit from banks (which in our context would imply a positive bias to the coefficient on LINE as estimated with OLS). Alternatively, more productive firms could rely less, overall, on bank financing and more on retained earnings and equity finance, which would imply a negative bias to the coefficient on LINE. To address these issues we implement a two-step estimation.

Although the information in the survey is mainly cross sectional, firms were asked to report whether their sales grew that year (2003) and in the past (2001 and 2002). A priori we expect banks to be more likely to extend credit to successful firms, and therefore to find a positive correlation between LINE and indicators of positive growth. Sales growth is often used as an indicator of demand for credit as fast growing firms may have higher demand for external finance. Using past growth rates as an instrument for access to credit helps us to distinguish firms that actually need external financing from those that have no demand for it. A first-stage regression indicates that past growth dummies are good predictors of access and are thus good candidate instruments. However, for the exclusion restriction to hold, the instruments

should not affect productivity through channels other than access to credit. In a two-stage specification such as:

$$TFP_{i,t} = \alpha_0 + \alpha_1 * LINE_{i,t} + \alpha_3 * X_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$LINE_{i,t} = \beta_0 + \beta_1 * GROWTH_{i,t-1} + \beta_3 * GROWTH_{i,t-2} + \beta_4 * X_{i.t} + u_{i,t} \quad (2)$$

where *i* and *t* index firms and time respectively, validity of the instruments would imply that $E(GROWTH_{i,t-k}, \varepsilon_{i,t})=0$. A legitimate concern is that this condition is unlikely to be satisfied if both growth and productivity shocks are correlated or if growth has a slow moving component. Assume that growth follows a process of the type $GROWTH_{i,t} = \gamma_0 + \gamma_1 * GROWTH_{i,t-1} + \mu_{i,t}$ and that TFP and growth are contemporaneously correlated, for example $TFP_{i,t} = g(LINE_{i,t}, GROWTH_{1,t}, X_{i,t})$. If this is the case, $\mathrm{E(GROWTH}_{i,t-1}, \varepsilon_{i,t}) \neq 0$ because contemporaneous growth is effectively an omitted channel - independent from credit - through which lagged growth can affect productivity. However, we are able to account for this potential channel of impact by controlling for contemporaneous growth in the final regression. Thus, contemporaneous growth rate "soaks up" any potential correlation between the residual in the TFP regression and lagged growth rates that might reflect better growth opportunities faced by highly productive firms. As a result, lagged growth indicators would be valid instruments in this context.[11] Thus we estimate the following specification:

[11] This approach is somewhat akin to the idea used in TFP estimation by Olley and Pakes (1996) and Levinsohn and Petrin (2003) who use information on observable variables (in our case this is the current growth rates) to control for unobservable correlation between TFP and access to credit.

$$TFP_{i,t} = \alpha_0 + \alpha_1 * LINE_{i,t} + \alpha_3 * X_{i,t} + \alpha_4 * GROWTH_{i,t} + \varepsilon_{i,t}$$

$$LINE_{i,t} = \beta_0 + \beta_1 * GROWTH_{i,t-1} + \beta_3 * GROWTH_{i,t-2} + \beta_4 * X_{i.t} + u_{i,t}$$

Results are reported in Table 7. We find LINE to be significantly and positively associated with productivity. Coefficients estimated with 2SLS are larger than those obtained with OLS, suggesting that OLS underestimated the actual impact of credit on productivity. This might have occurred because of higher reliance of productive firms on forms of finance other than bank credit and might also reflect the correction of an attenuation bias due to measurement error in LINE. The test of over-identifying restrictions cannot reject the hypothesis of zero correlation between the instruments and the error in the main regression (P-value of 0.67). In columns 3-4 we reproduce this procedure using only growth 2002 as instrument, with similar results.

While our approach of controlling for contemporaneous growth rates eliminates the concerns due to the contemporaneous correlation between TFP and growth, it does not eliminate all possible concerns with our instruments. For example, if there is an unobservable firm fixed effect in productivity (or another slow-moving process in TFP), past growth rates might be correlated with the current error in TFP regression. Therefore, we offer our instrumental variable estimation as a potential but not definitive improvement over the OLS results. Although all concerns about potential endogeneity cannot be completely dispelled with cross-sectional non experimental data, the numerous robustness checks to the OLS estimation, supplemented by a plausible IV strategy, are suggestive of a robust relationship between access to credit and productivity.

6. Conclusions

Although a vast literature highlights the positive impact of financial development on growth, the evidence on the channels through which credit affects growth on the micro level is still limited. We test whether access to credit has an impact on firm productivity. To do so we first estimate TFP in a cross section of Bulgarian firms and then assess the impact of access to credit on TFP. To overcome the potential omitted variable bias problems with OLS estimates, we use information on past firm growth to instrument for access to credit. We find credit to be strongly and positively associated with productivity across firms. This result is robust to a number of robustness checks, including using alternative estimates of TFP and productivity, different measures of access to credit, and a large set of controls in the specification. Even if we cannot completely rule out the possibility of endogeneity, our results shed light on an important channel through which access to credit affects growth and suggest that at least some of this effect may be operating through enhancing firms' productivity.

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Table 1. Tabulations

Panel A. Firm size and sector

In each cell, the first number is the number of firms, second number is row percent and third number is column percent.

Size	Manufacturing	Construction	Services	Total
Micro	76	6	63	145
	52.41	4.14	43.45	100
	22.62	13.95	40.13	26.8
Small	113	13	52	181
	62.43	7.18	28.73	100
	33.63	30.23	33.12	33.46
Medium	67	12	24	103
	65.05	11.65	23.3	100
	19.94	27.91	15.29	19.04
Large	80	12	18	112
	71.43	10.71	16.07	100
	23.81	27.91	11.46	20.7
Total	336	43	157	541
	62.11	7.95	29.02	100
	100	100	100	100

Panel B. Firm size and access to credit

In each cell, the first number is the number of firms and the second number is the row percent.

Size	Credit line or overdraft?		
	No	Yes	Total
Micro	125	14	139
	89.93	10.07	100
Small	133	42	175
	76	24	100
Medium	63	31	94
	67.02	32.98	100
Large	47	58	105
	44.76	55.24	100
Total	368	145	513
	71.73	28.27	100

Table 2. Summary statistics

Variable	min	25th percentile	50th percentile	75th percentile	max	mean	sd	N
Log Sales	0.00	4.88	6.52	7.82	11.55	6.36	1.99	271
Log Capital	0.00	4.11	5.99	7.24	11.03	5.70	2.29	205
Log Employment	0.69	2.40	3.43	4.54	7.38	3.49	1.34	541
Log Wages	0.69	3.22	4.50	5.56	9.02	4.44	1.61	353
Log sales / employees	-0.22	2.15	2.78	3.34	8.96	2.78	1.10	270
Log Sales/ capital	-3.67	-0.05	0.69	1.61	4.49	0.72	1.37	195
Investment	0.00	0.00	7.00	30.00	101.00	23.30	34.68	496
R&D	0.00	0.00	0.00	0.00	70.00	2.11	7.08	463
TFP	-2.57	-0.60	-0.01	0.50	3.04	0.00	0.91	196
Log Age	0.00	2.08	2.56	3.26	4.82	2.68	0.86	548
Sales sold domestically (%)	0.00	70.00	100.00	100.00	100.00	80.37	33.27	534
Previous government ownership dummy	0.00	0.00	0.00	1.00	1.00	0.39	0.49	546
Foreign ownership dummy	0.00	0.00	0.00	0.00	1.00	0.10	0.29	545
Workforce education	0.00	7.00	20.00	33.00	100.00	25.45	27.11	525
Positive growth in 2001	0.00	0.00	1.00	1.00	1.00	0.52	0.50	338
Positive growth in 2002	0.00	0.00	1.00	1.00	1.00	0.52	0.50	347
Informal payments (% of sales)	0.00	0.00	0.00	0.00	40	1.11	3.82	385

Table 3. Estimating TFP

Dependent variable is Value Added in all regressions. Capital is measured by fixed assets, employment is measured by number of people; Models (1)-(5) are estimated by OLS, Model (6) is estimated by Levinsohn-Petrin (2003) method. Robust t statistics in brackets, *, ** and *** indicate significance at 10%, 5% and 1% respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	All sectors – Restricted sample	All sectors, imputed sample	Manufacturing	Construction	Services	LP estimate, all sectors
Log capital	0.404	0.327	0.301	0.366	0.378	0.405
	[6.04]***	[6.19]***	[4.13]***	[2.03]*	[4.29]***	[1.76]*
Log employment	0.533	0.663	0.678	0.333	0.692	0.306
	[5.35]***	[8.57]***	[6.83]***	[0.64]	[5.03]***	[3.25]***
Construction dummy	0.478	0.417				
	[1.96]*	[2.00]**				
Service dummy	0.4	0.299				
	[1.88]*	[1.79]*				
Constant	1.3	1.267	1.365	2.91	1.223	N/A
	[5.56]***	[6.03]***	[5.30]***	[2.12]**	[4.36]***	N/A
Observations	130	190	126	20	44	284
R-squared	0.73	0.72	0.7	0.54	0.74	N/A

Table 4. Access to credit and firm productivity, OLS estimation

LINE is a dummy variable for firms that have either credit line or an overdraft facility. Workforce education is measured by percent workforce with over 12 years education (university and post-graduate). Robust t statistics in brackets, *, ** and *** indicate significance at 10%, 5% and 1% respectively.

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TFP_VA	TFP_VA	TFP_VA	TFP_VA	TFP_VA	TFP_VA	TFP_VA	TFP_VA
Micro firm dummy	-0.27	-0.336	-0.178	-0.165	-0.237	-0.4	-0.39	-0.194
	[1.29]	[1.53]	[0.82]	[0.74]	[1.13]	[1.94]*	[1.58]	[0.90]
Small firm dummy	0.163	0.103	0.24	0.254	0.195	-0.039	0.239	0.252
	[0.80]	[0.50]	[1.17]	[1.24]	[0.95]	[0.21]	[1.00]	[1.24]
Medium firm dummy	-0.183	-0.273	-0.104	-0.108	-0.122	-0.329	-0.274	-0.074
	[0.85]	[1.29]	[0.47]	[0.50]	[0.57]	[1.69]*	[1.17]	[0.37]
Previous government ownership	-0.269	-0.314	-0.267	-0.269	-0.258	-0.264	-0.319	-0.25
	[1.28]	[1.48]	[1.29]	[1.31]	[1.23]	[1.32]	[1.24]	[1.17]
Log age	-0.07	-0.043	-0.044	-0.029	-0.054	-0.02	-0.079	-0.093
	[0.63]	[0.39]	[0.40]	[0.27]	[0.48]	[0.19]	[0.59]	[0.89]
Construction dummy	0.065	0.02	0.083	0.099	0.055	0.098	-0.073	0.468
	[0.29]	[0.08]	[0.38]	[0.45]	[0.24]	[0.46]	[0.28]	[1.13]
Service dummy	0.086	0.059	0.088	0.095	0.085	0.027	0.011	0.051
	[0.53]	[0.32]	[0.54]	[0.58]	[0.52]	[0.17]	[0.06]	[0.12]
Line	0.425	0.433	0.432	0.43	0.426	0.301	0.387	0.305
	[2.45]**	[2.38]**	[2.50]**	[2.50]**	[2.44]**	[1.88]*	[2.03]**	[1.82]*
Exporter		-0.105						
		[0.60]						
Dummy if foreign ownership >10%			0.395					
			[1.28]					
% Foreign owned				0.006				
				[1.22]				
% State owned					-0.003			
					[0.45]			
Workforce Education						0.013		
						[4.29]***		
Informal Payments							-0.021	
							[1.60]	
Industry Dummies (14)								Yes
Constant	0.224	0.268	0.053	-0.001	0.156	-0.029	0.414	-0.142
	[0.69]	[0.75]	[0.16]	[0.00]	[0.48]	[0.09]	[1.03]	[0.29]
Observations	189	185	187	187	187	184	146	188
R-squared	0.11	0.11	0.12	0.12	0.11	0.2	0.14	0.26

Table 5. Access to credit and TFP: Robustness checks using alternative measures of access to credit (OLS)

Credit line is a dummy variable for firms that have credit line, Overdraft is a dummy variable for firms that have overdraft facility, Access and Cost obstacles are the subjective perception measure of obstacles, adjusted for respondent's pessimism level (discussed in section 3). Robust t statistics in brackets, *, ** and *** indicate significance at 10%, 5% and 1% respectively. In addition, [(a)] indicates significance at 12%.

Dependent Variable	(1)	(2)	(3)	(4)
	TFP_VA	TFP_VA	TFP_VA	TFP_VA
Micro firm dummy	-0.252	-0.442	-0.547	-0.492
	[1.27]	[2.24]**	[2.59]**	[2.36]**
Small firm dummy	0.177	0.021	-0.047	-0.017
	[0.87]	[0.10]	[0.22]	[0.08]
Medium firm dummy	-0.196	-0.302	-0.39	-0.369
	[0.90]	[1.39]	[1.71]*	[1.69]*
Previous government ownership	-0.235	-0.292	-0.547	-0.551
	[1.13]	[1.35]	[2.62]***	[2.59]**
Log age	-0.09	-0.066	0.031	0.046
	[0.81]	[0.57]	[0.28]	[0.42]
Construction dummy	0.09	0.053	0.042	0.006
	[0.41]	[0.23]	[0.19]	[0.02]
Service dummy	0.084	0.108	0.134	0.108
	[0.51]	[0.66]	[0.78]	[0.66]
Credit Line	0.533			
	[2.71]***			
Overdraft		0.298[(a)]		
		[1.58]		
Cost Obstacle			-0.096	
			[1.68]*	
Access Obstacle				-0.141
				[2.62]***
Constant	0.259	0.412	0.536	0.452
	[0.84]	[1.26]	[1.56]	[1.34]
Observations	187	185	177	176
R-squared	0.12	0.08	0.1	0.11

Table 6. Access to credit and productivity: Robustness checks with alternative measures of firm performance (OLS)

TFP_VA is our baseline TFP measure, used in previous tables, TFP_VA_RS is the same measure estimated on restricted sample (without imputing material expense, as described in section 4), TFP_LP is TFP estimated using Levinsohn-Petrin (2003) method and TFP_VA_S is TFP estimated separately for each of the 3 sectors, see Table 3. Positive Profit dummy is a dummy taking value of 1 if firms reported positive profits in 2003. Exporter is a dummy taking value 1 for firms that sell part of their production abroad. Robust t statistics in brackets, *, ** and *** indicate significance at 10%, 5% and 1% respectively.

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TFP_VA	TFP_VA_RS	TFP_LP	TFP_VA_S	Log sales/ employees	Positive Profit Dummy	Positive Profit Dummy	Exporter
Micro firm dummy	-0.27	-0.293	-1.21	-0.237	-0.323	-0.009	0.114	-0.389
	[1.29]	[1.04]	[5.72]***	[1.13]	[1.38]	[0.12]	[0.98]	[5.86]***
Small firm dummy	0.163	0.054	-0.401	0.124	-0.164	-0.033	-0.009	-0.307
	[0.80]	[0.18]	[1.97]*	[0.60]	[0.87]	[0.49]	[0.08]	[5.05]***
Medium firm dummy	-0.183	-0.1	-0.457	-0.212	-0.072	-0.006	-0.007	-0.167
	[0.85]	[0.38]	[2.11]**	[0.98]	[0.38]	[0.08]	[0.06]	[2.68]***
Previous government ownership	-0.269	-0.516	-0.336	-0.248	-0.035	-0.116	-0.101	-0.021
	[1.28]	[1.71]*	[1.62]	[1.17]	[0.16]	[1.93]*	[1.00]	[0.39]
Log age	-0.07	0.008	-0.056	-0.075	0.023	-0.071	-0.115	0.057
	[0.63]	[0.06]	[0.50]	[0.67]	[0.20]	[2.09]**	[2.42]**	[1.91]*
Construction dummy	0.065	0.075	0.489	1.338	0.169	0.087	0.161	-0.491
	[0.29]	[0.29]	[2.15]**	[5.97]***	[0.75]	[1.30]	[1.61]	[9.48]***
Service dummy	0.086	0.105	0.366	0.164	0.088	-0.038	-0.15	-0.2
	[0.53]	[0.52]	[2.32]**	[1.01]	[0.56]	[0.82]	[1.71]*	[4.38]***
Line	0.425	0.492	0.395	0.45	0.489	0.106	0.168	0.111
	[2.45]**	[2.40]**	[2.34]**	[2.61]***	[3.36]***	[2.37]**	[2.38]**	[2.52]**
Constant	0.224	0.112	2.79	-0.215	2.676	0.993	1.039	0.519
	[0.69]	[0.25]	[8.51]***	[0.66]	[8.07]***	[9.08]***	[6.45]***	[5.23]***
Observations	189	130	189	189	265	439	182	493
R-squared	0.11	0.12	0.23	0.22	0.07	0.07	0.15	0.26

Table 7. Access to credit and TFP: Instrumental estimation

"Overid p-value" is a p-value for the test of overidentifying restrictions.

Dependent Variable	(1)	(2)	(3)	(4)
	TFP_VA	LINE	TFP_VA	LINE
Estimation	IV	First Stage	IV	First Stage
Micro firm dummy	0.86	-0.712	0.962	-0.716
	[1.31]	[6.55]***	[1.34]	[6.59]***
Small firm dummy	0.758	-0.5	0.845	-0.521
	[1.49]	[4.49]***	[1.45]	[4.69]***
Medium firm dummy	0.51	-0.349	0.591	-0.364
	[1.24]	[3.00]***	[1.31]	[3.17]***
Previous government ownership	0.108	-0.253	0.13	-0.241
	[0.34]	[2.30]**	[0.38]	[2.20]**
Log age	-0.201	0.079	-0.188	0.065
	[1.33]	[1.19]	[1.24]	[0.98]
Construction dummy	-0.085	0.166	0.066	0.151
	[0.21]	[0.89]	[0.16]	[0.88]
Service dummy	0.497	-0.263	0.547	-0.272
	[1.22]	[1.82]*	[1.24]	[1.91]*
LINE	1.659		1.766	
	[1.91]*		[1.83]*	
Growth 2003	0.4	-0.262	0.365	-0.235
	[1.79]*	[2.45]**	[1.57]	[2.22]**
Growth 2002		0.231		0.295
		[1.66]*		[2.58]**
Growth 2001		0.119		
		[0.94]		
Constant	-0.856	0.553	-0.984	0.619
	[0.98]	[2.47]**	[1.01]	[2.79]***
Observations	129	129	130	130
R-squared		0.32		0.31
Overid., p-value	0.67		N/A	
Instruments	Growth 2002 Growth 2001		Growth 2002	