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Abstract This paper studies the effect of government-backed partial credit guarantees on firms' performance in Colombia. These guarantees are automatically granted by the National Guarantee Fund (NGF) to firms without enough collateral to lift their credit constraints. We put together a panel of firms covering the period 1997–2007 that allows us to control for observed and unobserved firm characteristics potentially affecting both the selection of firms into the program and firms' performance. We find that firms that gain access to credit backed by the NGF were able to grow in terms of both output and employment. However, we do not find any effect on productivity, wages, or investment.

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1 Introduction

Although there is evidence that banks perceive the small and medium enterprises (SMEs) segment as attractive for its high, risk-adjusted profitability, SMEs still report having difficulty accessing credit.[1] The banking sector faces barriers to involvement with the SME segment related to macroeconomic instability and the regulatory and contractual environment where banks operate, especially in developing countries.[2]

The regulatory and contractual environment is integral to the functioning of credit markets. Given

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[1] This is valid not only for small and niche banks that engage in relationship lending but also for large and foreign banks that use arms-length lending technologies (de la Torre et al. 2010).

[2] The literature points to institutional development as a robust predictor for explaining variations in firms' access to external finance. La Porta et al. (1997,1998) show that countries where legal rules are weak and the quality of law enforcement is low have less access to external finance; Beck et al. (2006) find that institutional development is the most important country characteristic explaining cross-country variation in firms' financing obstacles; and Demirgüç-Kunt and Maksimovic (1998) find that financing constraints are lower in countries with more efficient legal systems.

that debt contracts entail the exchange of cash today for the promise of payment in the future, the functioning of credit markets depends crucially on the markets' ability to make accurate credit decisions and to promptly and inexpensively enforce debt contracts when payment does not occur voluntarily.[3] Credit markets can enforce payment through the use of collateral: by requiring the borrower to pledge a specific asset as guarantee for the loan, the creditor increases the cost of defaulting for the borrower, thus reducing moral hazard. While in an unsecured loan the loss is limited only by the borrower's equity, in a secured loan the loss also includes the asset pledged as collateral. By reallocating part of the loss from the creditor to the borrower, the creditor reduces the borrower's incentive to take excessive risk.[4]

For the creditor to have incentives to enter into debt contracts, the regulatory and contractual environment must support enforcement. Specifically, the legal system needs to be efficient, ensuring that, in the event of a default, any guarantee or collateral pledged is settled quickly and at a low cost. Hindering access to credit are problems associated with procedures for the liquidation of assets used as collateral, limitations in the type of assets that can be used as collateral, inefficiencies in property registries and the judicial system, and uncertainty about property rights (see Beck and Levine 2005 for a review of this literature).[5]

Thus, the differences in exposure by the banking system to the SME segment, its lending practices and business models in developed and developing countries, are driven mainly by the systemic barriers exposed above (Beck et al. 2009).[6] Other barriers are SME-specific, like lack of quality information (opacity), lack of adequate guarantees, low quality of financial statements, problems related to evaluating SME risk, informality, and weakness of family management (de la Torre et al. 2009).[7] For instance, according to data from the World Bank's Enterprise Survey standardized dataset, 2.9 % of large firms did not apply for a line of credit or loan due to unattainable collateral requirements, while 14.1 % of medium firms and 83.1 % of small firms did not apply because of this requirement.[8]

Government-backed partial credit guarantees address at least two of these obstacles faced by SMEs: (1) lack of adequate collateral; and (2) the regulatory and contractual environment where banks operate. Banks provide access to credit to firms that otherwise would have been rejected because the partial credit guarantee relaxes the amount of collateral that a borrower needs to pledge, partially substituting the risk of the borrower by that of the government. In the event of a default, the government guarantees repayment to the bank, reducing the average amount of time a bank needs to wait to recoup the collateral, somewhat artificially improving the collection process. That is one of the reasons why government-

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[3] Credit markets rely ex-ante on information shared via credit bureaus and credit registries to make those credit decisions and rely ex-post on the legal system to enforce debt contracts in the event of a default. IADB (2004) reports that, on average, 90 % of banks in Latin America consult private credit registries frequently for their lending decisions. Beck et al. (2008b) report that 87 % of banks in developing countries require collateral from small-sized enterprises in business lending, and 93 % of banks require collateral from medium-sized enterprises in business lending.

[4] Lenders also use collateral as a screening mechanism to address adverse selection: only low-risk borrowers would be willing to pledge a sufficient amount of collateral as a guarantee for the loan. However, as a consequence, many desirable, low-risk borrowers may be constrained by the assets they can pledge (Bester 1985).

[5] Beck et al. (2008a) show that, although small firms in countries with poor institutions use less external finance—especially bank finance—than medium or large firms, small firms benefit the most from the removal of systemic barriers and institutional reforms that strengthen property rights and financial intermediation mainly due to bank finance.

[6] Contrary to banks in developing countries, banks in developed countries identify competition in the segment as the main obstacle impeding SME finance.

[7] Banks have developed coping mechanisms to deal with some of these difficulties by hedging risk (short-term loans, innovative screening tools, collaterals, etc.) but intrinsic factors make SMEs particularly vulnerable to lack of access to credit because: (1) SMEs are less likely to survive since the probability of firm survival increases with firm size and firm age (Evans 1987), which makes SMEs inherently riskier investments; (2) SMEs face proportionally greater scrutiny and proportionally larger appraisal and monitoring costs for each dollar borrowed; and (3) SMEs are also proportionally more expensive to deal with in the event of a default since the expenses associated with a liquidation procedure—for instance, court and attorney's fees—are independent of the amount borrowed.

[8] The survey defines large firms as firms with 100 employees or more, medium firms as firms with 20 employees or more but less than 100 employees, and small firms as firms with 5 employees or more but less than 20 employees.

backed partial credit guarantees, one of the mechanisms devised to increase access to credit for SMEs, are rated by banks from developed and developing countries as the most important government program influencing SME financing—above directed credit, interest rates subsidies, and regulatory subsidies (Beck et al. 2008b).

The argument most commonly used to justify credit guarantee programs is that their guarantees act as substitutes for collateral when the market for collateral operates inefficiently (de la Torre et al. 2007). These inefficiencies occur because of limitations in the types of assets that can be used as collateral, problems associated with the liquidation of assets, inefficiencies in property registries and the judicial system, and uncertainty about property rights, which lead to uncertainty about the value that the repossessed asset will have and consequently to excessive collateral requirements. Another argument to justify credit guarantee programs is that the guarantees act as subsidies to cover the cost of financial intermediaries learning to provide loans to a new group of borrowers. However, Vogel and Adams (1997) point out that there is no evidence this is the case.

Consistent with the most common justification for credit guarantee programs, by acting as guarantor of a fraction of the loan, the government is able to lift the credit constraint of SMEs that otherwise would have been unable to access the formal credit market because they were constrained by the assets they could pledge as collateral. Further, by outsourcing the origination and servicing of loans to for-profit intermediaries, the government increases the efficiency of the operation; and by guaranteeing the loan only partially, it assures that the lender retains some risk and has an incentive to conduct an accurate credit appraisal (see Honohan 2010).[9]

SMEs as a group represent a very large percentage of firms, generate most of the jobs and a large percentage of the private sector payroll, and are disproportionally affected by market failures. Given that access to finance is identified as one of the greatest obstacles for the operation and growth of businesses, especially for SMEs, policies directed at efficiently lifting credit constraints for this group would have, as a result, a direct impact on their growth and on the growth of the economy as a whole.[10,11] Indeed, government-backed partial credit guarantees, which offer advantages over direct government lending, have been widely used by OECD countries after the 2008 credit crunch (see OECD 2009).

In this paper, we use firm-level data to evaluate the impact of the Colombian government's partial credit guarantee program on the performance of beneficiary firms—that is, the impact of relaxing the amount of collateral a borrower needs to pledge to gain access to credit in the formal market. We take advantage of the panel structure of our dataset to control for observable and unobservable factors that can affect participation in the program and the performance of the firms. Applying a combination of propensity score matching and fixed-effects, we find that credit facilitation through the National Guarantee Fund (NGF) has a positive impact on firms' growth—measured by output and employment. We do not find an impact on investment, productivity, or wages. Our results suggest that firms use the new funds as working capital to grow their businesses rather than as a source for investment in new durable goods that increase their capital stock.

The main contribution of the paper is in providing evidence on the effectiveness of the NGF as a mechanism to relax restrictions on growth for SMEs due to lack of access to credit in the formal market. Evidence regarding these types of programs is scarce and mixed. On the one hand, Boocock and Shariff (2005) and Kang and Heshmati (2008) find no evidence in favor of credit guarantee programs in Malaysia and Korea. On the other hand, Lelarge et al.

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[9] Whether the guarantor does any credit appraisal, the proportion of the credit that is guaranteed—if the scheme guarantees individual loans rather than portfolios—and the categories of eligible borrowers are design dimensions that, together with the pricing, affect the operation of the scheme and its effectiveness in increasing the availability of credit.

[10] See World Bank's Enterprise Surveys

[11] King and Levine (1993), Rajan and Zingales (1998), Demirgüç-Kunt and Maksimovic (1998), and Jayaratne and Strahan (1996) find that the level of financial intermediation development has a large causal impact on real per capita GDP growth. Beck et al. (1999) find "an economically large and statistically significant relationship between financial intermediation development and both real per capita GDP growth and total factor productivity growth." Although the link between access to finance and growth seems to be a settled matter in the economic literature, the channel through which access to finance leads to growth is still the subject of debate.

(2010) find that the French credit guarantee program SOFARIS significantly impacted the growth of newly created firms. In fact, they find that firms targeted by the program raised systematically more external finance, paid lower interest expenses, and enjoyed higher growth rates than other similar firms. Oh et al. (2009) and Chandler (2012) also find that credit guarantees increased firms' size in terms of employment and revenues in Korea and Canada. With results similar to ours, Oh et al. (2009) do not find any impact on research and development, investment, or productivity.

The rest of the paper is organized as follows: Sect. 2 describes the NGF, the government agency in charge of implementing the partial credit guarantee program; Sect. 3 describes the dataset and presents the model used for the estimation; Sect. 4 presents our results; and Sect. 5 concludes.

2 Description of the National Guarantee Fund

The main objective of the National Guarantee Fund (NGF) is to facilitate access to credit for micro-, small-, and medium enterprises (MSMEs) through the use of guarantees. Although the NGF was created in 1981, the number of beneficiaries and the amount of the guarantees did not become significant until the 2000s. The number of beneficiaries went from 8,394 in 1999 to 23,131 in 2000, to 50,849 in 2003, and to 113,375 in 2008, and the amount of credit facilitated by the NGF grew from US\$591 million in 2003 to US\$2,578 million in 2008, at an annual average rate of 34 % over this 5-year period.[12] Growth in the portfolio coincided with recognition of the guarantees by the Superintendence of Banks in 1999 and with strong financial support given to the fund in 2000, which more than tripled its capital. With the recognition of the Superintendence, banks were no longer required to make provisions for the whole loans guaranteed by the fund, freeing resources for intermediation.[13] For banks, the fund's additionality lies in providing access to credit itself: the mechanism helps provide credit to entrepreneurs that without the fund guarantee would have been unable to obtain the loan for lack of collateral (Llisterri et al. 2006).

Guarantees offered by the fund back credit to Colombian MSMEs for working capital, investment, research and development, and business creation. These loans are guaranteed individually and mostly automatically.[14] All sectors of the economy are eligible except the agricultural sector, which is served by another institution. More than 95 % of the guarantees are approved automatically and do not require any appraisal from the part of the fund;[15] however, the partial coverage of the guarantees—on average 48 % in 2008—generates incentives for the banks to conduct accurate credit appraisals. In fact, once the NGF adopted the practice of outsourcing origination and servicing of loans to banks in 1995, the default rates decreased from nearly 20 % in 1996 to 4.2 % in 2008. The average maturity of the loans is 34 months, as shown in Table 1.

The fund does not set limits on the number of times an entrepreneur can use the guarantees; however, it does not allow creditors to have additional guarantees from other institutions. Moreover, one debtor may have several NGF guarantees simultaneously provided that the total debt does not exceed the debt limit set by the NGF.

In the event of default, the bank must bring an action for recovery before a court within 180 days. After filing the complaint, the bank may file a claim before the NGF for payment of the guarantee and the NGF must pay the bank within 30 days of filing the claim, accelerating the recovery process. Once the fraction of the loan that is guaranteed is paid to the bank, the NGF subrogates against the borrower during the legal process for loan recovery. All costs and recoveries from this process are shared between the bank and the NGF. However, if the estimated cost of the recovery process exceeds the expected value of the collateral collected, the NGF abandons the subrogation process. Although Colombia has one of the most efficient debt enforcement proceedings in Latin America, a lender still recovers only 52.8 cents on

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[12] Values in 2008 pesos converted to dollars at the average 2008 exchange rate of 1,966.26 pesos per dollar.

[13] The provision required depends on the credit rating and the number of days in arrears.

[14] The fund also guarantees the portfolio of microfinance institutions. The rest of the guarantees go to credit for social housing and student loans.

[15] The NGF automatically grants partial 50 % coverage for loans of up to US\$264,462. It grants partial 70 % coverage for special Bancóldex credit lines of up to US\$300,000.

Table 1 NGF activity in the period 2003–2008

Year	Beneficiaries	Credit facilitated (in US$ million)	Average loan size (in US$)	Average coverage (%)	Average repayment period (months)
2003	50,849	591	11,623	53.0	29.7
2004	82,383	1,014	12,308	54.5	30.1
2005	103,935	1,373	13,210	52.4	35.3
2006	117,968	1,841	15,606	49.9	39.6
2007	122,284	2,104	17,206	49.8	36.1
2008	113,375	2,578	22,739	48.2	33.6

Source NGF and authors' calculations

the dollar for a defaulted loan, according to World Bank estimates. This reflects the cost of enforcing contracts, such as court fees and fees paid to insolvency practitioners, independent assessors, lawyers, and accountants, and the loss in value due to the time spent on the enforcement proceedings, which in Colombia totals about 3 years.[16]

Data from the Superintendence of Banks and the NGF indicate that commercial credit and microcredit guaranteed by the fund increased from 1.4 % of the total commercial and microcredit portfolio in December 2001 to 6.1 % in December 2008.[17] Table 1 summarizes the activity of the NGF between 2003 and 2008, the period for which firm-level data are available.

3 Empirical strategy

3.1 Data

We use three sources of information. Our primary source is the Annual Manufacturing Survey of Colombia (Encuesta Anual Manufacturera, henceforth EAM) collected by the Departamento Administrativo Nacional de Estadísticas (DANE). EAM is a census of all manufacturing plants with ten or more employees and output exceeding 500 minimum wages, and is

available from 1997 to 2007. It contains information on plant characteristics like location, sector of activity, legal organization form, and size, as well as information on plant performance like output, employment, capital stock, and expenditures. The second source is the customs authority, Dirección de Impuestos y Aduanas Nacionales (DIAN), which provided detailed firm-level information on foreign trade. DIAN's data can be merged with EAM's data using firm identifiers to follow firms' exports and imports over time. These data are available for the same 1997–2007 period. The third source is the NGF, which provided us with firm-level records from 2003 onward containing information about the moment when the NGF granted the guarantee, the amount of credit facilitated by the guarantee, and the guarantees' coverage. This database can also be merged with EAM using firm identifiers.

Merging these three sources of data entailed an important consolidation work. We drop all observations for plants that *exited* before 2003—i.e., before the date when we can identify treatment for the first time in our NGF dataset—or that entered after 2002—our baseline year. We also drop observations for plants appearing in only 1 year in the dataset and for firms that own multiple plants—in EAM only 3 % of plants belong to multi-plant firms, and treated multi-plant firms account for only 0.6 % of the manufacturing firms treated, so the data loss is negligible. By doing this, we obtain a firm-level dataset.

This panel of firms allows us to identify beneficiaries several years before and after they receive the guarantee and to compare them to non-beneficiaries during the same time period. Moreover, EAM provides us with rich firm-level information useful for identifying non-beneficiary firms with similar

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[16] These estimations, reported annually by the World Bank's publication Doing Business, are based on fictitious standardized cases solved by local practitioners and verified through a study of laws and regulations as well as public information on bankruptcy systems.

[17] Since the NGF only guarantees credit aimed at MSME, these percentages grossly underestimate the importance of the credit guaranteed by the fund.

Table 2 Manufacturing firms with NGF guarantees

Year	Manufacturing firms in EAM	Manufacturing firms used in the analysis	Manufacturing firms with NGF guarantees	Percentage
2003	7,039	5,434	678	12.5
2004	7,008	5,179	659	12.7
2005	7,231	4,998	640	12.8
2006	7,001	4,694	605	12.9
2007	6,818	4,439	581	13.1

Source NGF and authors' calculations

characteristics to beneficiary firms. The main limitation of this dataset is that it restricts analysis to firms in the manufacturing sector with ten or more employees, even though the NGF offers guarantees for microenterprises as well as SMEs across almost all sectors of the economy. Table 2 provides information on the number of firms in EAM and the number of manufacturing firms that received partial credit guarantees from the NGF.

3.2 Identification strategy

We are interested in measuring the impact of NGF credit facilitation on firm performance as reflected in output, employment, wages, productivity, capital stock per worker, and exports (average impact of treatment on the treated, ATT). The causal effect of the program is the difference between the value of the outcome variable in two different scenarios: one in which the firm participates in the program and one in which it does not. The main challenge for the estimation of this causal effect is that firms cannot simultaneously participate and not participate in the program and therefore it is necessary to construct a counterfactual.

When the treatment is assigned randomly, the counterfactual is easily estimated by averaging the value of the outcome variable for the non-treated. But when the treatment is not randomly assigned, as in our case, participants and non-participants may differ in their characteristics—both observable and unobservable. Therefore, the simple comparison of averages between participants and non-participants does not provide an unbiased estimate for the causal effect. Moreover, it may be precisely the difference in those characteristics that explains why some firms decide to participate in the program and others do not. Therefore, to identify the causal effect of the program, it is necessary to consider the effect of observable and

unobservable characteristics on both the participation decision and the outcome variables.

Given that we have panel data and we do observe participants and non-participants before and after they participate in the program, we can use the fixed-effect estimator. An important advantage of this method is that it allows us to avoid biases caused by both observed and unobserved firm characteristics that do not vary over time. It also allows us to control for observables and non-observables that vary in time and affect all firms in the same way (for example, inflation, business cycle, exchange rate, or any shock that affects the economy as a whole). When more than two periods of information are available, the fixed-effect estimator is a generalization of the difference-in-difference (DID) estimator. The DID method estimates the effect of the program by considering first the difference in the value of the outcome variables for each group of firms before and after the program is applied and then measuring the difference between beneficiaries and non-beneficiaries.

As Heckman et al. (1999) point out, even the estimation by DID might result in biased estimates if the firms in the control group differ significantly from the participants. To avoid this bias, Heckman et al. (1999) recommend using the DID estimators on a group of firms with similar characteristics. To define the group of firms with similar characteristics, they propose matching on the ex-ante participation probability—i.e., propensity score matching (PSM).

There are several alternatives to match beneficiaries and non-beneficiaries and, in general, results depend on the matching algorithm and the variables included to estimate the propensity score. We match observations using the nearest neighbor with one neighbor because this choice is the most conservative algorithm in terms of bias reduction (see Caliendo

and Kopening [2008]; Heinrich et al. [2010]). In order to estimate the propensity score, we estimate a participation model using a logit model and data from 1997 to 2002, the period before the beneficiaries received support.[18]

After identifying the firms for the control group—i.e., non-beneficiaries with the same probability of participation as beneficiaries—it is necessary to check that the characteristics of the control group are equal to the characteristics of those firms that participated in the program (see Rosenbaum and Rubin [1983]). We test this by: (1) a difference in mean test before and after the matching; (2) a joint test that all the characteristics in the control group are equal in mean to those in the treatment group; and (3) a test of the equality of the distribution of the propensity scores between participants and firms in the control group.

We estimate the impact of the program by estimating the parameters δ in the following equation:[19]

$$Y_{it} = \delta_0 P_{i,t} + \delta_1 P_{i,t-1} + \delta_2 P_{i,t-2} + \mu_t + c_i + v_{it},$$
$$i \in C, \quad t = 1, 2, \ldots, T \tag{1}$$

where Y_{it} is the value of the outcome variable Y for firm i in period t, and $P_{i,t}$ is a variable that takes value 1 if firm i participates in the program in period t. Therefore, δ_0, δ_1, and δ_2 reflect the impact of the program the year the firm receives the loan, 1 year after the firm receives the loan, and 2 years after the firm receives the loan, respectively. μ_t is a set of year dummies that capture the effect of all the non-observable factors that affect the performance of all the firms in the same way, c_i are firm-level fixed effects controlling for unobserved characteristics of firm i that do not vary over time, and v_{it} can be interpreted as random shocks to the outcome variable that are not correlated with participation in the program. Finally, C is the set of firms in the matched sample defined using PSM.

4 Results

4.1 Participation model

As mentioned above, we estimate the effect of the program using fixed-effects. An important assumption of this method is that in the absence of the program, the trend in outcome variables is equal for beneficiary and non-beneficiary firms. Although this counterfactual cannot be tested, it is more likely to hold if we compare firms that have similar trends before the program is applied.

In order to verify this, we first estimate a participation model using a logistic regression with data from 1997 to 2002 and construct a control group of non-beneficiaries with similar characteristics to beneficiaries. The explanatory variables we include in this model are firm size dummies (defined by the number of employees), dummies denoting organization types, ISIC 2-digit sector, and location dummies.[20,21] Unfortunately, we do not have access to information on the firms' level of indebtedness, which would have allowed for a more robust participation model; however, we compensate for this shortcoming by using a measurement of the firms' credit constraint. We also include other firm characteristics such as the value of output, labor productivity, capital per worker, and the value of fixed assets—which presumably affect the firm's ability to access collateralized debt. Given that EAM does not include information on the firms' level of indebtedness, we use the information on interest paid to infer which firms hold debt. We are unable, however, to identify the source of that debt—financial sector, ONGs, cooperatives, informal sources, family and friends, credit card finance, or other sources.[22]

These variables are known to affect access to finance and are therefore good candidates for explaining the participation of firms in the program. Compared to large firms, small and medium firms use less bank finance and

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[18] We use 2002 as our baseline because firm-level records from the NGF are available from 2003 onwards.

[19] The same approach was used in Arráiz et al. ([2013]), who estimated the impact of a supplier development program on firm performance in Chile, and Castillo et al. ([2013]), who estimated the impact of an innovation program on employment and wages in Argentina.

[20] We defined three size categories as follows: from 10 to 50 employees, from 50 to 200 employees, and 200 employees and more.

[21] Location is defined as the metropolitan area in which the firm is located.

[22] According to the Enterprise Survey dataset, private commercial banks finance 13.6 % of investment in Colombia, family and friends finance 6.7 %, and informal sources finance 2.4 %. The percentages for working capital are 31.5, 18.9, and 0.05 %, respectively.

finance a lower proportion of their investment externally. Firms in the manufacturing sector use more bank finance than firms in the service sector, presumably because they are more capital intensive and consequently are more likely to satisfy banks' collateral requirements. The same holds for firms with a higher proportion of fixed assets. Firms' growth potential—in our case approximated by firms' output, employment, and productivity growth in the period 1997–2002—is also used by financial intermediaries as a proxy for firms' ability to pay. The literature finds that these proxies are good candidates for explaining access to finance—see Beck et al. (2008a) for an analysis of financing patterns of small firms around the world.

As mentioned before, we also include a variable designed to measure the extent of a firm's credit constraints. Following Hsieh and Parker (2007), we calculate the correlation between firm cash flow and investment for each firm between 1997 and 2002. This correlation provides us with a credit constraint variable because credit constrained firms rely heavily on internal funds to finance operations and are unable to invest if cash flow drops substantially. Therefore, firms with a high correlation between cash flow and investment are more likely to be credit constrained than firms with a low correlation. Investment decisions by firms with access to financial markets are independent of their cash flow. The exact measure is constructed as the correlation coefficient between the ratio of operational profits to capital and the ratio of net investment to capital— assuming a 5 % depreciation rate. Hsieh and Parker's methodology is based on a broad literature surveyed by Bernanke et al. (1996). The seminal paper by Fazzari et al. (1988) finds that investment is quite sensitive to cash flow for the firms thought most likely a priori to be credit constrained and is not very sensitive to cash flow for firms that are not expected to be constrained. Gilchrist and Himmelberg (1995) find that, even after accounting for the predictive power of cash flow for future profitability, the cash flow's role in alleviating credit constraints remains in firms with limited access to capital markets, and in these cases investment is still "excessively" sensitive to fluctuations in cash flow.

We use the estimated probability from the participation model—the propensity score—to identify the non-participating firm with the closest propensity score to each participating firm; i.e., we apply propensity score matching with the nearest neighbor algorithm, considering only one neighbor.
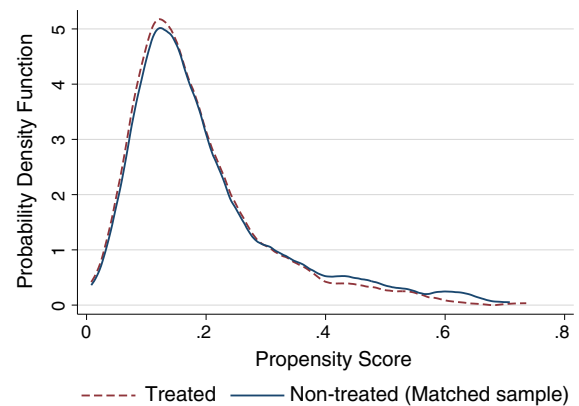

Fig. 1 Distribution of the propensity score, matched sample

Figure 1 presents the distribution of the propensity score for beneficiaries and non-beneficiaries in the matched sample. The Kolmogorov–Smirnov tests of the equality of distributions of the propensity scores for the matched sample cannot reject the null hypothesis that the distributions are equal for treated and control firms—the p value is 0.64. Table 3 shows the balance in the observable characteristics before and after the matching. After the matching, the equality of means in the treated and non-treated groups cannot be rejected for any of the variables. Moreover, the pseudo R^2 from a probit of treatment status on all the variables decreases from 0.114 to 0.012, and the corresponding p value of the likelihood-ratio test of the joint insignificance of all the regressors increases from 0 to 0.983, indicating that after the match our regressors are not able to determine which firms get credit guaranteed by the NGF and which do not.[23] Therefore, treated and untreated firms in the matched sample are indistinguishable from each other across the variables included in the participation model.

We cannot test the assumption that in the absence of the program both beneficiaries and non-beneficiaries have the same trend in outcome variables. However, we can observe the trends before the beneficiaries participated in the program (1997–2002) and test that these trends are the same for beneficiaries and non-beneficiaries. Table 4 presents these tests for the full sample and for firms in the matched sample. The results show that for the full sample the trends in

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[23] The pstest command in Stata used to carry out these tests estimates probit models instead of the logit we are using as our participation model.

Table 3 Balance in observables: full and matched sample

	Full sample			Matched sample		
	Treated	Non-treated	p value[b]	Treated	Non-treated	p value[b]
Output in 2002 (logs)	14.001	14.552	0.000	14.001	13.954	0.541
Labor productivity in 2002 (logs)	10.846	11.060	0.000	10.846	10.813	0.469
Capital per worker in 2002 (logs)	8.928	9.333	0.000	8.928	8.854	0.281
Proportion of firms with debt in 2002	0.890	0.845	0.007	0.890	0.888	0.920
Fixed assets in 2002 (logs)	12.083	12.826	0.000	12.083	11.995	0.357
Financial constraint correlation (1997–2002)	−0.068	−0.035	0.068	−0.068	−0.051	0.480
Growth in output[a]	0.003	0.001	1.000	0.003	0.003	0.682
Growth in employment[a]	0.006	−0.002	1.000	0.006	0.002	0.906
Growth in capital per worker[a]	0.011	0.014	0.001	0.011	0.012	0.331
Growth in investment rate[a]	−0.198	−0.214	0.723	−0.198	−0.151	0.128
Growth in labor productivity[a]	0.002	0.002	0.748	0.002	0.003	0.252
Growth in total factor productivity[a]	−0.005	−0.011	0.998	−0.005	−0.005	0.530

[a] Average annual growth between 1997 and 2002

[b] p value of t test for difference in means

Table 4 Test for equality of trends in outcome variables from 1997 to 2002, ex-ante

	Full sample			Matched sample		
	Treated	Non-treated	p value[a]	Treated	Non-treated	p value[a]
Output (in logs)	0.0030	0.0012	0.9999	0.0030	0.0027	0.6815
Employment (in logs)	0.0055	−0.0023	0.9997	0.0055	0.0017	0.9055
Labor productivity (in logs)	0.0024	0.0020	0.7476	0.0024	0.0029	0.2524
Total factor productivity (in logs)	−0.0047	−0.0111	0.9982	−0.0047	−0.0050	0.5302
Capital per worker (in logs)	0.0113	0.0141	0.0007	0.0113	0.0118	0.3308
Exports as % of output	0.1374	0.1255	0.5761	0.1374	0.0588	0.8448

[a] p value of t test for difference in means

outcome variables from 1997–2002 were different for beneficiaries and non-beneficiaries in some cases. When only firms in the matched sample are considered, it is not possible to reject the hypothesis that trends in the outcome variables—output, employment, wages, labor productivity, total factor productivity (TFP), capital stock per worker, and exports—are equal for beneficiaries and non-beneficiaries.[24] Figure 2 shows the mean of the different output variables

for beneficiaries and non-beneficiaries before and after 2002, our baseline.

4.2 Impact of the program on firm performance

We estimate the effect of the program using Eq. (1). The treatment variable is an indicator variable equal to one for the firm that obtained a credit guaranteed by the NGF at the moment it received the credit, and otherwise equal to zero. This variable captures firms that were marginally able to gain access to credit in the formal credit market thanks to the guarantee and that otherwise would not have been able to access credit because of insufficient collateral. In addition to this variable, we include two of its lags to assess the impact of the program not only the year the firm is able to

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[24] We measure TFP using the firm-level residual from a standard production function. We use the estimates of factor elasticities from Eslava et al. (2006), who estimated the production function controlling for the endogeneity of inputs using instrumental variables and EAM data for the 1982–1998 period.
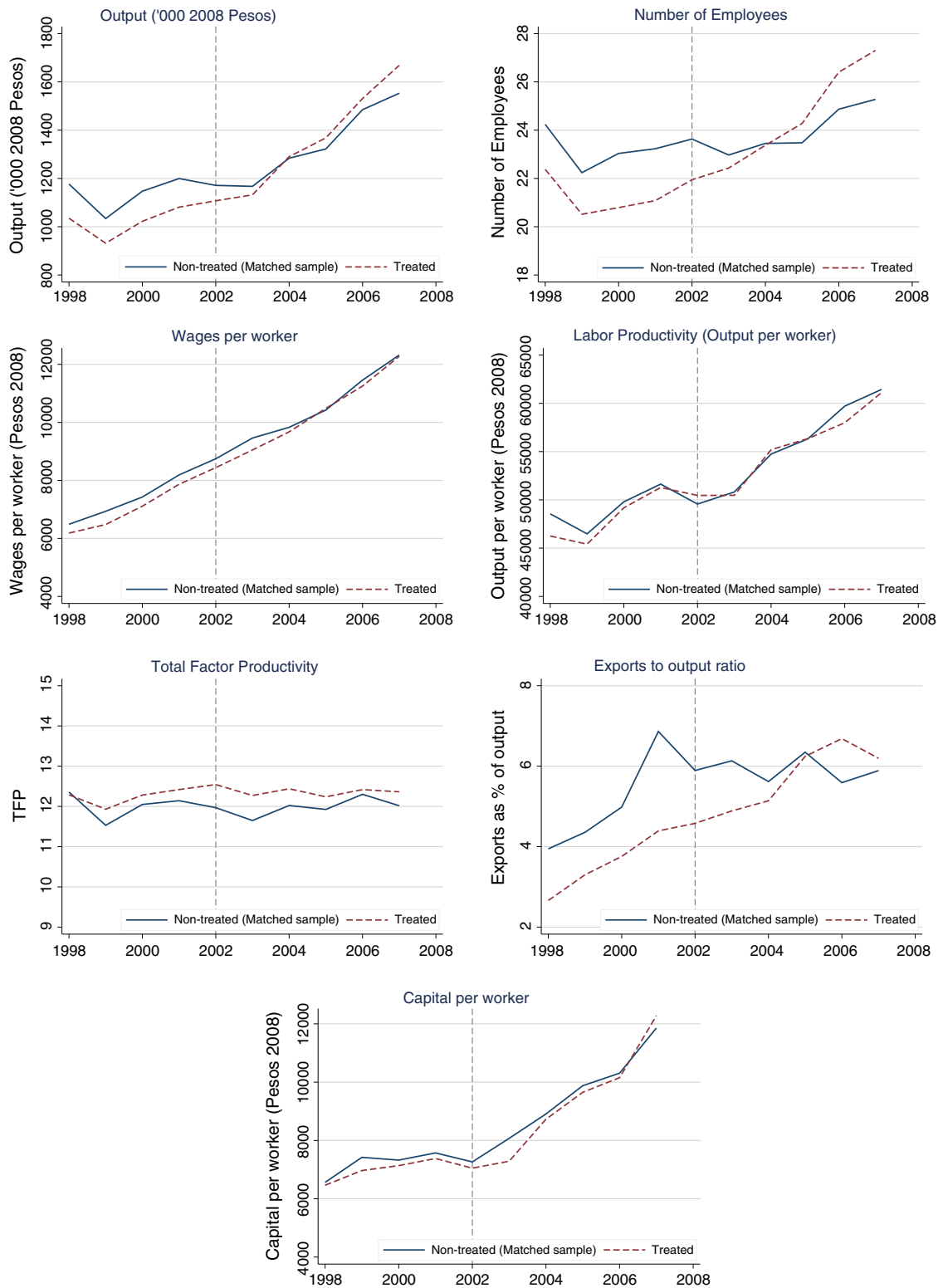
Fig. 2 Evolution of outcome variables

secure a new loan, but also in the years following the granting of the loan, with the average repayment period of the loan being 34 months (see Table 1).

However, we cannot differentiate the effect of additional credit (by itself and independent of the partial guarantee) from the effect of the partial guarantee itself (independent of the additional credit). We interpret the effects as driven by additional credit rather than by the partial guarantee, since it is difficult to imagine that the partial guarantee by itself, which could be transparent for the borrower since the loans are guaranteed automatically via the financial institution, can affect the borrowers' business decisions and consequently the firms' performance. Because the NGF guarantees the loan only partially, it assures that the borrower has an incentive not to take excessive risk. Having access to the firms' level of indebtedness and the source of that debt would have allowed us to partially answer the question.

If access to finance was indeed a binding constraint for growth, and its facilitation through the NGF's partial credit guarantees succeeded in removing the constraint, treated firms should outperform comparable firms that do not benefit from formal credit guaranteed by the government program. To test this hypothesis, we use as outcome variables a set of firm performance measures that include output in levels, employment, productivity measured alternatively as labor productivity and as total factor productivity (TFP), average wages paid by the firms, capital stock per worker, and the ratio of exports to output.

Table 5 shows the estimates of Eq. (1) for the full sample—panel A—and the firms in the matched sample—panel B. We used data from 5,469 firms, 502 treated and 4,967 non-treated (an average of 11 years of observations per firm); the matched sample had a total of 932 firms, 502 treated and 430 non-treated (an average of 12 years of observations per firm).

Our estimations confirm a positive impact of treatment on firm size measured both by output and employment. Firms that benefited from the government program become 6.0 % larger in terms of output and 3.7 % larger in terms of employment than their

Table 5 The impact of the program on firms' performance

Dependent variable	Employment (in logs) (1)	Output (in logs) (2)	Wages (in logs) (3)	Labor prod. (in logs) (4)	TFP (in logs) (5)	Capital stock (in logs) (6)	Exports as % of output (7)
(A) Full sample							
Dummy FNG = 1	0.0758***	0.0938***	0.0309***	0.0180	0.0223	−0.0284	0.0029
	(0.0128)	(0.0190)	(0.0077)	(0.0171)	(0.0146)	(0.0178)	(0.0031)
Dummy FNG = 1 ($t - 1$)	0.0621***	0.0892***	0.0187**	0.0271*	0.0199	−0.0206	0.0066*
	(0.0140)	(0.0183)	(0.0081)	(0.0150)	(0.0125)	(0.0189)	(0.0034)
Dummy FNG = 1 ($t - 2$)	0.0703***	0.0736***	0.0273***	0.0033	0.0063	0.0189	0.0107**
	(0.0163)	(0.0217)	(0.0096)	(0.0172)	(0.0142)	(0.0225)	(0.0044)
Number of observations	60,918	60,918	60,918	60,918	60,918	60,918	60,918
Number of firms	5,469	5,469	5,469	5,469	5,469	5,469	5,469
R^2	0.044	0.043	0.679	0.037	0.050	0.280	0.040
(B) Matched sample							
Dummy FNG = 1	0.0361**	0.0582**	0.0124	0.0221	0.0166	−0.0126	0.0061
	(0.0162)	(0.0226)	(0.0097)	(0.0201)	(0.0165)	(0.0191)	(0.0042)
Dummy FNG = 1 ($t - 1$)	0.0534***	0.0661***	0.0160	0.0127	0.0102	−0.0079	0.0114**
	(0.0182)	(0.0228)	(0.0103)	(0.0189)	(0.0147)	(0.0214)	(0.0047)
Dummy FNG = 1 ($t - 2$)	0.0643***	0.0548**	0.0183	−0.0095	0.0084	−0.0156	0.0175**
	(0.0210)	(0.0276)	(0.0131)	(0.0217)	(0.0171)	(0.0250)	(0.0072)
Number of observations	10,780	10,780	10,780	10,780	10,780	10,780	10,780
Number of firms	932	932	932	932	932	932	932
R^2	0.027	0.061	0.707	0.046	0.027	0.325	0.036

All regressions include year dummies and firm-level fixed effects. Robust standard errors in parentheses

*** Significance at 1 %, ** significance at 5 %, * significance at 10 %

counterparts in the control group. We find no evidence that the use of NGF partial credit guarantees results in higher capital stock, higher productivity, or higher wages. We interpret these results as suggestive of firms using credit to increase their working capital rather than to invest in durable goods and increase their capital stock. This interpretation is consistent with the average maturity of the loans, 34 months, and with the finding of Llisteri et al. (2006) that most of NGF's guarantees are for short-term debt. We also find a positive impact on exports as a share of output, which is consistent with this interpretation: using credit to increase firms' working capital that allows them to grow.

The results on output, employment, and exports are maintained over time. The impact on output, for instance, is 6.0 % the year the firm receives the credit, 6.8 % 1 year after, and 5.6 % 2 years after. The impact on employment is 3.7 % the year the firm receives the credit, 5.5 % 1 year after, and 6.6 % 2 years after. The impact on exports as a share of output is 1.2 % the year after the firm receives the credit and 1.8 % 2 years after that.

Because there is no evidence of changes in the way firms conducted their businesses—since most of the loans were used as working capital instead of as investments in new technologies—we should not expect impacts of the program on productivity. We should not expect an impact on wages either, since increases in productivity are generally considered to be a necessary (but not sufficient) condition for wage increases.

The results are consistent with the fact that before treatment both the treatment and control group were equally financially constrained and that access to credit lifted this binding constraint for growth for the treatment group. The results also show that even though these firms were not eligible for credit in the formal credit market because of insufficient collateral, reforms that ease how collateral markets operate could have a dramatic impact on access to credit for a broad range of firms.

5 Conclusion and policy recommendations

This paper evaluates the impact of partial credit guarantees on manufacturing firms' performance in Colombia. By using partial credit guarantees, the NGF lifts credit constraints faced by firms that do not have enough qualifying assets to pledge as collateral in the formal credit market without affecting the firms' appetite for risk. By outsourcing the origination and servicing of loans to for-profit intermediaries, the NGF does not affect the banks' incentives to conduct an accurate credit appraisal because the banks partially assume the default risk. The NGF, however, affects the banks' time frame for recovery in the event of a default. After bringing an action for recovery before a court, the bank gets payment from the NGF up to 30 days after filing a complaint for the (partial) guarantee, artificially improving the collection process.

We use fixed-effects and propensity score matching to identify the causal relationship between program participation, consequent access to credit in the formal market, and firm performance. We find that the program was effective in easing credit constraints that allowed beneficiary firms to grow both in terms of employment and output. We also find that, through participation in the program, beneficiaries were able to increase their sales in foreign markets. We do not capture an impact on productivity or wages paid to employees. Finally, our results indicate that the program has no impact on capital accumulation, suggesting that firms are using the new funds for working capital rather than for investment in durable goods which would increase their capital stock. This is consistent with the short-term maturity of the loans guaranteed.

However, we cannot differentiate the effect of additional credit from the effect of the partial guarantee itself. Because the NGF only partially guarantees the loans, it assures that the borrowers have an incentive not to take excessive risk; borrowers' business decisions, and consequently the firms' performance, should be affected by additional credit and not by the partial guarantee itself. From a policy point of view, if the effect of the program is due to additional credit independent of the partial guarantee, as we believe, the results argue in favor of countrywide institutional reforms aimed at easing the use of collateral.

Because it is a targeted program, its impact is restricted only to firms that participate in the program instead of the universe of potential firms that could have been reached by countrywide institutional reforms that ease how collateral markets operate. Although the program has grown since its creation, it

represents a small percentage of commercial credit granted by the Colombian financial system. Partial credit guarantees appear to be a second-best solution for easing SMEs' credit constraints as they do not directly affect the lending infrastructure with the largest impact on access to credit: commercial and bankruptcy laws that affect creditor rights and restrict the type of assets that can be used as collateral, slow and expensive processes for enforcement of contracts, ineffective sharing of credit information, etc. From this perspective, partial credit guarantees should be seen as a temporary second-best solution while implementing other policies aimed at solving these structural problems.

Due to data restrictions, the analysis in this paper considers only manufacturing firms with more than ten employees. Therefore, although the partial guarantee program targets other sectors of the economy as well as micro firms, this study cannot determine whether the program is effective for these firms.

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