Short-term Finance, Long-term Effects: Evidence from a Loan Guarantee Program in Morocco *

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Abstract

We study the effect of short-term finance on firm growth. Using a unique firm-level dataset of a credit guarantee program in Morocco, we show that firms with guaranteed short-term loans expand homogeneously in their production scales with both increases in labor and capital inputs, and sharply decrease their cash holdings, especially younger and smaller firms. This is consistent with a heterogeneous-firm model with collateral constraints and working capital constraints, where firms inefficiently allocate resources to cash and away from capital. Importantly, we also find that firms expand their production scale permanently and do not experience any growth reversal (i.e., a growth slowdown relative to non-guaranteed firms in subsequent periods). This indicates that collateral constraints slow down the convergence of firms to their long-run scale, but they also reduce said long-run scale. This is consistent with "erosion" in the firms' profits, due for instance to taxes, expropriation risk, subsistence consumption, etc. Using our micro data, we identify the model parameters and quantify the role of the two frictions (financial constraints and erosion) and their interaction, and conduct counterfactuals to assess the effect of an expansion of the credit guarantee program and other reforms.

Keywords: collateral constraints; financial friction; firm dynamics; SME financing;
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1 Introduction

Financial frictions hinder firms' ability to use inputs efficiently, affect firm growth, and, therefore, lower economic development. An extensive literature has addressed how the scarcity of long-term external finance in underdeveloped countries leads to under-leveraged small and medium enterprises whose production scale is inefficiently constrained.[1] However, little attention is paid to the scarcity of short-term external finance in underdeveloped countries. Relative to this literature, our paper's objective is to understand better the effect of expanding short-term external finance on firm growth and economic development in emerging economies.

Long-term external finance promotes firm growth since it enlarges entrepreneurs' production scale given their net worth. The role of short-term external finance, however, is different. With the presence of working capital constraints, entrepreneurs in emerging economies tend to stock a substantial amount of cash holdings to meet their needs in upfront payments of working capital. Therefore, short-term external finance promotes firm growth since it allows entrepreneurs to allocate their net worth more efficiently from unproductive cash holdings to productive capital from unproductive cash holdings conditional on their existing net worth.

In this paper, we study the role of short-term external finance on firm growth and economic development both empirically and theoretically. We first investigate the role of short-term external finance on firm growth in a simple analytical model. We then empirically test the implications of the simple model using data on a guarantee program for working capital loans in Morocco. Our main empirical finding is that firms with guaranteed short-term loans expand homogeneously their production scale and sharply decrease their cash holdings. Finally, we use the empirical findings to identify essential financial frictions parameters for short-term external finance and quantify the implications of such frictions on firm growth, capital misallocation, and economic development.

Our empirical work combines firm-level data from Orbis, with loan guarantee data from Tamwilcom, which is a public financial institution under the supervision of the Central Bank of Morocco, Bank Al-Maghrib. We focus on how guaranteed firms choose their capital, cash, and production scale as well as their growth path relative to their un-guaranteed matched peers. Our difference-in-difference (DID) estimates show that guaranteed firms expand homogeneously in their production scales in terms of sales, capital input, and labor input relative to their matched peers. They increase their current liability but do not significantly build up their leverage; instead, they sharply decreases their cash ratio. These effects are especially strong for younger and

[1] Cooley and Quadrini (2001), Albuquerque and Hopenhayn (2004), Quadrini (2004), Clementi and Hopenhayn (2006), DeMarzo and Fishman (2007), and Arellano, Bai, and Zhang (2012), among others.

smaller firms.

Based on our empirical findings, we then build a heterogeneous firm model in which firms face collateral constraints, working capital constraints, and "erosion" in profit (i.e., a fraction of profits is lost at the end of period, due for instance to taxes, expropriation risk, subsistence consumption, etc.). In the model, constrained firms preserve a large proportion of resources in the form of unproductive cash instead of productive capital to finance short-run working capital. A loan guarantee program mitigates credit constraints by inducing firms to reduce their cash holdings and expand their production scale. Moreover, in the presence of profit erosion, relaxing credit constraints not only speeds the convergence of firms to their long-run scale in the presence of working capital constraints by efficiently reallocating resources from cash to capital, but they also increase said long-run scale. In the absence of erosion, the guarantee does not affect the firms' long-run scale, so the initial positive growth effect of relaxing the financial constraint would be partially undone in the following years. In the data, we see on the opposite a permanent increase in the production scale, without any growth reversal (i.e., a growth slowdown relative to non-guaranteed firms in subsequent periods), which points to the existence of erosion in profits.

In progress The next step is to use our empirical findings, especially the dynamics of firm growth (dynamic micro-moments) with access to the loan guarantee programs, to identify the corresponding central parameters of collateral constraints and erosion. Then we would like to decompose how the interactions of size-dependent collateral constraints, working capital constraints, and erosion matter for the observed capital misallocation. We will then use the identified quantitative model to quantify the aggregate effect of the existing loan guarantee programs. And finally, we would like to conduct a counterfactual analysis to examine the effects of further expanding the loan guarantee programs, along with a reduction in profit erosion.

Literature Review. This paper contributes to several strands of literature. First, this paper is related to the large literature on financial frictions and their implications for firm growth and economic development. There is a large literature that studies long-term external finance and firm growth such as Cooley and Quadrini (2001), Albuquerque and Hopenhayn (2004), Quadrini (2004), Clementi and Hopenhayn (2006), DeMarzo and Fishman (2007), Huynh and Petrunia (2010), Arellano, Bai, and Zhang (2012), Moll (2014), Midrigan and Xu (2014), and others. Long-term external finance promotes firm growth in the literature because it enlarges entrepreneurs' production scale given their net worth and improves capital allocation efficiency between firms. We contribute by showing that short-term finance also matters for firm growth. We show that short-term external finance promotes firm growth. It allows entrepreneurs to allocate their net worth more efficiently towards productive capital stock from unproductive cash holdings conditional on their existing net worth.

Second, this paper is related to the financial frictions and capital misallocation literature. Since the seminal work by Restuccia and Rogerson (2008) and Hsieh and Klenow (2009), capital misallocation in emerging economies is taken seriously by researchers. The role of collateral constraints on capital misallocation is then studied by Moll (2014) and Midrigan and Xu (2014) where the former emphasize the interaction between collateral constraints, persistence in productivity shocks and self-financing, and the latter emphasize the interaction between collateral constraints and the transition from a relative unproductive, traditional sector into a modern, productive sector. Further works include Gopinath et al. (2017), who focus on the interaction between collateral constraints and the persistent decline in interest rates, Jo and Senga (2019), who emphasize the interaction between collateral constraints and targeted credit subsidies, and many others. We extend the literature by studying the interactions between collateral constraints, working capital constraints, and profit erosion, and showing how targeted short-term credit subsidies could alleviate capital misallocation induced by such interactions.

Third, this paper contributes to the emerging literature on credit guarantee schemes. A credit guarantee scheme is one of the most common policy tools to facilitate SMEs to access finance. Gudger (1998) and Green (2003) provide an overview of credit guarantee programs' typology, design, implementation and general evaluation around the world. Beck, Klapper, and Mendoza (2010) surveys 76 partial credit guarantee schemes across 46 developed and developing countries. Saadani, Arvai, and Rocha (2011) focuses on the Middle East and North Africa (MENA) and reviews credit guarantee programs in 10 countries in the MENA region. Some empirical contributions study the impact of guarantee programs using micro data, including Oh et al. (2009), Lelarge, Sraer, and Thesmar (2010), Bah, Brada, and Yigit (2011), Banerjee and Duflo (2014), Mullins and Toro (2018), and Barrot et al. (2019). Our paper contributes to the literature by presenting new empirical findings on the use of cash, on the profile of growth post-guarantee and draws novel macroeconomic implications using a theoretical model.

Fourth, this paper contributes to the literature on the existence of credit constraints faced by SMEs.[2] As documented by Berger and Udell (2006), SMEs are more likely to be credit-rationed due to the incomplete information they can provide to banks. The most studied countries are advanced economies due to its data availability.[3] Few studies have been done to examine emerging economies. One notable paper is written by Banerjee and Duflo (2014) on India. They exploit the 1998 policy reform of India's priority sector lending program and confirm that firms in the

[2]The most notable theories on this subject are developed before 2000 including Stiglitz and Weiss (1981), Cho (1986), Myers and Majluf (1984), Greenwald, Stiglitz, and Weiss (1984), de Meza and Webb (1987), and Hellmann and Stiglitz (2000).

[3]A large literature including Hadlock and Pierce (2010), Krishnan, Nandy, and Puri (2014), Hoberg and Maksimovic (2014), and Levenson and Willard (2000) studied the US, and McCarthy, Oliver, and Verreynne (2017), Farinha and Félix (2015), and Steijvers (2013) studied other advanced economies.

program are severely credit-constrained. Our paper contributes to the literature by presenting new empirical findings and a novel theoretical model on the existence of credit constraints faced by SMEs in emerging economies.

2 Our Mechanism in a Simple Example

Before we turn to our empirical analysis and the full model, we construct a simple example to illustrate our mechanism in its starkest and most intuitive form. Specifically, we show how, in the joint presence of collateral constraints and working capital constraints, loan guarantee programs alleviate the liquidity needs of cash and therefore promote firm growth. To do so, we compare the optimal production and financing choices of an SME and its growth in two environments: one in which they can access short-term loan guarantee programs and one in which they cannot. Besides, we introduce profit erosion and show how they interact with collateral constraints.

2.1 Model Setup

Consider an entrepreneur that operates a small and medium-sized enterprise for multiple periods with constant exogenous exit probability, and she only consumes her net worth before exiting.

A. Technology

The entrepreneur begins with some net worth n_t, faces a unity discount factor, produces with a Leontief technology using capital k_t, labor l_t, and her own fixed managerial input $e = 1$ as follows:

$$y_t = A[min(k_t, a^{-1}l_t)]^{\alpha} e^{1-\alpha} \tag{1}$$

where A measures the firm's total productivity, which also stands for the permanent differences between firms for size, a measures the relative labor productivity of the firm, and α measures the share of input of the Leontief technology in capital and labor.

Within each period t, given her net worth n_t, the entrepreneur goes through three stages: In the first stage, she chooses between physical capital k_t and cash holding c_t where $k_t + c_t = n_t$ holds since the entrepreneur does not consume before exiting; In the second stage, she chooses how much labor l_t to hire and how much external debt b_t to borrow; In the third stage, her production y_t happens, and she repays the debt if there is any. The critical issue is that in the second stage, the firm faces both working capital constraints ($w_t l_t \leq$ Credit Limit), which is that wage must be paid before production in the third stage, and collateral constraint ($b_t \leq \theta k_t$), which she could only borrow up to a proportion of physical capital. Without loss of generality, we assume $w_t = 1$, so both constraints merge into:

$$l_t = ak_t \leq c_t + \theta k_t \tag{2}$$

where increasing cash holding c_t could better relax working capital constraint than increasing physical capital k_t.

B. Entrepreneur Optimization

In each period, entrepreneur chooses cash, capital, labor, and debt to maximize its end of period payoff. With the Leontieff assumption, $l_t = ak_t$ always holds, so she maximize:

$$\max_{c_t,k_t} \{\psi(k_t)k_t + (1-\delta)k_t + c_t\} + \lambda_t (c_t + \theta k_t - ak_t) + \mu_t c_t + \gamma_t(n_t - k_t - c_t) \tag{3}$$

where $\psi(k_t) = (A\alpha k_t^{\alpha-1} - a)$ is the equilibrium marginal return on capital, $\lambda_t \geq 0$, $\mu_t \geq 0$, $\gamma_t > 0$ are shadow prices of collateral constraint, cash holdings, and budget constraint, respectively.

The first-order conditions of capital and cash holdings could derive the following relationship between marginal benefit of capital (MBK) and marginal benefit of cash holding (MBC) through the three shadow prices

$$\gamma_t = MBK_t = MBC_t + \mu_t$$

where the marginal benefit of capital (MBK) and marginal benefit of cash holding (MBC) are

$$MBK_t = \underbrace{1}_{\text{Unit Return of Saving}} + \underbrace{(\psi(k_t) - \delta)}_{\text{Real Return of Production}} + \underbrace{\lambda_t(\theta - a)}_{\text{Shadow Return of Finance}}$$

$$MBC_t = \underbrace{1}_{\text{Unit Return of Saving}} + \underbrace{0}_{\text{Real Return of Production}} + \underbrace{\lambda_t}_{\text{Shadow Return of Finance}}$$

where both physical capital and cash holding have a unit marginal return of saving. However, they have different marginal returns of production and finance. First, capital has a positive real return of production ($\psi(k_t)-\delta$) for a sufficiently small SME, while cash has zero real production return. More importantly, the marginal real return of production in MBK is larger for smaller SMEs since $\psi(k_t)$ is monotonically decreasing in the capital. Second, capital has a negative shadow return of finance ($\lambda_t(\theta-a)$).[4] Increasing capital stock increases the financial need of working capital in labor, therefore, increasing the tightness of collateral constraint. However, cash provides a positive marginal shadow return of finance (λ_t) because increasing cash reduces the financial need of working capital in labor, therefore, relaxing the tightness of collateral constraint.

The optimal choice of a constrained entrepreneur, that is a sufficiently small entrepreneur,

[4]Since a measures the input share of labor relative to capital which is usually assumed to be around 2, without loss of generality, $a >> \theta$ always holds.

would be building cash holdings up to achieve a shadow benefit of relaxing the collateral constraint as follows:

$$\lambda_t^* = (\psi(k_t) - \delta)/(1 + a - \theta) > 0$$

Combining the binding collateral constraint ($ak_t = c_t + \theta k_t$) and the budget constraint ($c_t + k_t = n_t$), the constrained entrepreneur's choices of capital and cash proportional to net worth is

$$k_t = \frac{1}{1 + a - \theta} n_t \quad \& \quad c_t = \frac{a - \theta}{1 + a - \theta} n_t. \tag{4}$$

and her end of period payoff would be

$$\text{Payoff}_t(n_t) = \psi(k_t)k_t + (1 - \delta)k_t + c_t = \frac{1 - \delta - \theta}{1 + a - \theta} n_t + A\alpha \left(\frac{n_t}{1 + a - \theta} \right)^{\alpha}$$

C. Enterprise Growth

Given the periodic optimization above, we now consider the growth of an SME with the possibility of net worth erosion. That is, by the end of each period, a fraction ξ of net worth is lost. Examples are red tape, corporate taxes, corruption, tax evasion, and so on. Therefore, the next period net worth of the entrepreneur is

$$\text{n}_{t+1} = (1 - \xi)\text{Payoff}_t(n_t) = (1 - \xi) \left[\frac{1 - \delta - \theta}{1 + a - \theta} n_t + A\alpha \left(\frac{n_t}{1 + a - \theta} \right)^{\alpha} \right] \tag{5}$$

If the SME survives long enough, the net worth growth path admit an optimal net worth n^*:

$$n^* = (1 + a - \theta) \left(\frac{A\alpha}{\frac{\xi}{1-\xi}(1 + a - \theta) + a + \delta} \right)^{1/(1-\alpha)} \tag{6}$$

and an optimal capital stock k^*:

$$k^* = \left(\frac{A\alpha}{\frac{\xi}{1-\xi}(1 + a - \theta) + a + \delta} \right)^{1/(1-\alpha)} \tag{7}$$

In this simple example, $\frac{n_t}{n^*}$ stands for a firm's age. Conditional on surviving, a more prominent $\frac{n_t}{n^*}$ means that the firm survived longer and is older.

2.2 The Effects of Loan Guarantee Programs

Now we discuss the effects of loan guarantee programs (henceforth LGPs for short) on the SME's optimal choices of capital and cash as well as the growth of the SME. The loan guarantee programs provided by a government agency help to scale up the SME's collateral ability (θ) of its collateral capital from a θ_{low} to a θ_{high} where the additional risk of gap ($\theta_{high} - \theta_{low}$) the bank is taking is guaranteed by the corresponding government agency.

A. The Effects on Static Choices of Production and Financing

In the first step, we analyze how scaling up the SME's collateral ability from a θ_{low} to a θ_{high} affects the static choice of SME's production and financing decisions given its net worth n_t. We could first check the shadow benefit of relaxing the collateral constraint as a function of θ:

$$\lambda_t^*(\theta) = \frac{\psi(k_t) - \delta}{1 + a - \theta} = \frac{A\alpha n_t^{\alpha-1}}{(1 + a - \theta)^\alpha} - \frac{\delta}{1 + a - \theta} \geq 0$$

We could take the derivative of the shadow price over θ, we have:

$$\frac{\partial \lambda_t^*}{\partial \theta} = \frac{\alpha^2 A}{(1 - a - \theta)^2} \left[\left(\frac{1 + a - \theta}{n_t} \right)^{1-\alpha} - \frac{\delta}{\alpha^2 A} \right]$$

where given the collateral ratio θ, there is a net worth threshold $\underline{n} = \left(\frac{A\alpha}{\delta/\alpha}\right)^{1/(1-\alpha)}(1 + a - \theta)$ such that an entrepreneur who is smaller than $\underline{n}$ will face an increment in the shadow benefit of relaxing the collateral constraint. In a conventional calibration, such threshold is higher than the optimal net worth of the entrepreneur ($\underline{n} > n^*$), therefore, all entrepreneurs benefit from relaxing the collateral constraint while smaller SMEs benefit more.[5]

From the production equation (1) and capital and cash equations (4), we could simply derive production, capital, and cash choices relative to net worth as functions of θ and n_t (only for $\frac{y_t}{n_t}$):

$$\frac{k_t}{n_t} = \frac{1}{1 + a - \theta} \quad \& \quad \frac{c_t}{n_t} = \frac{a - \theta}{1 + a - \theta} \quad \& \quad \frac{y_t}{n_t} = A \left(\frac{1}{1 + a - \theta} \right)^\alpha n_t^{\alpha-1}.$$

Proposition 1. *Given that $a >> \theta$, loan guarantee programs that increase the SME's collateral ability θ would increase the shadow benefit of relaxing the collateral constraint, and therefore,*

(i). increases the SME's optimal choice of capital. $\left(\frac{\partial k}{\partial \theta} > 0\right)$

(ii). decreases the SME's optimal choice of cash holdings. $\left(\frac{\partial c}{\partial \theta} < 0\right)$

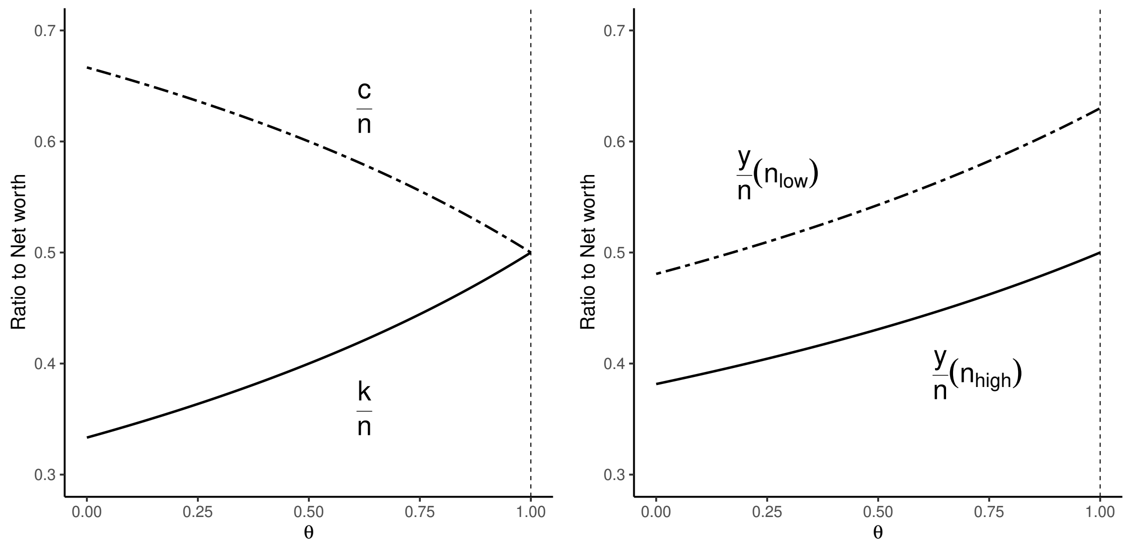
[5] In a conventional calibration at annual frequency, labor share relative to capital $a = 2$, non-managerial input share $\alpha = 0.8$, and annual capital depreciation rate $\delta = 0.1$, $\underline{n} >> n^*$ always holds even without erosion.

(iii). increases the SME's optimal choice of production (sales). $\left(\frac{\partial y}{\partial \theta} > 0\right)$

(iv). increases the SME's optimal choice of production (sales) more if n_t is smaller. $\left(\frac{\partial y}{\partial \theta}(n_{low}) > \frac{\partial y}{\partial \theta}(n_{high})\right)$

Figure 1 demonstrates these four properties in the proposition above.

Figure 1:
Relationship between Optimal Choices and θ



(a) Capital and Cash (b) Production (or Sales)

Note: This plot shows the entrepreneur's optimal capital, cash, and production choices as a function of θ. The numerical calibration of the parameters are conventional to an annual model: $\delta = 0.1$ stands for annual depreciation in capital, $\alpha = 2/3$ stands for decreasing return to scale, $a = 2$ stands for labor share in production, $n_{low} = 1$ and $n_{high} = 2$ stand for smaller and larger entrepreneurs.

B. The Effects on Growth Dynamics of SMEs

In the second step, we analyze how scaling up the SME's collateral ability from a θ_{low} to a θ_{high} affects the growth dynamics of SME. First, we check the long-run growth of SMEs. With the assumption of net worth erosion, a fraction ξ of net worth is lost. The net worth growth path of the SME admit an optimal net worth n^* and an optimal capital stock k^* in the long run:

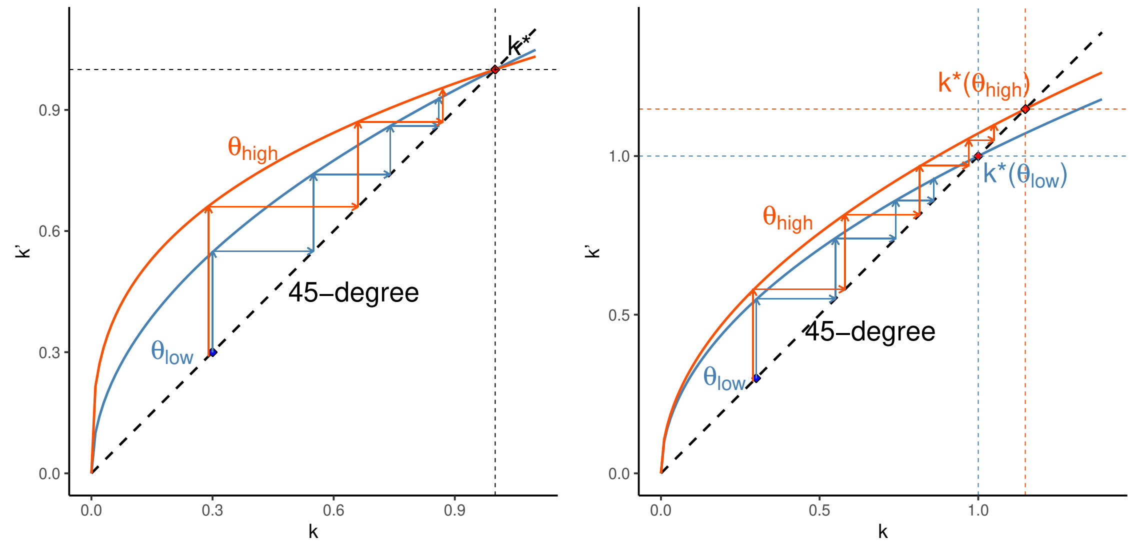
$$n^* = (1 + a - \theta)\left(\frac{A\alpha}{\frac{\xi}{1-\xi}(1 + a - \theta) + a + \delta}\right)^{1/(1-\alpha)}, \quad k^* = \left(\frac{A\alpha}{\frac{\xi}{1-\xi}(1 + a - \theta) + a + \delta}\right)^{1/(1-\alpha)}$$

and an optimal cash holding c^* and an optimal output y^* in the long-run:

$$c^* = (a - \theta)k^*, \quad y^* = A\,(k^*)^{\alpha/(1-\alpha)}\,e^{1-\alpha}$$

Figure 2 demonstrates the two propositions below.

Figure 2:
Growth Dynamics of SMEs



(a) Without Net Worth Erosion (b) With Net Worth Erosion

Note: This plot shows the entrepreneur's growth dynamics given the erosion conditions. The numerical calibration of the parameters are conventional to an annual model: $\delta = 0.1$ stands for annual depreciation in capital, $\alpha = 2/3$ stands for decreasing return to scale, $a = 2$ stands for labor share in production, $n_{low} = 1$ and $n_{high} = 2$ stand for smaller and larger entrepreneurs.

Proposition 2. *Given that $a >> \theta$, depending on whether erosion is larger than zero ($\xi > 0$), loan guarantee programs that increase the SME's collateral ability θ would have different effects on the long-run net worth n^*, capital k^*, cash holding c^*, and production y^*.*

(i). if erosion equals zero ($\xi = 0$), loan guarantee programs have a temporary and reversible growth effect (no long-run scale effect). To be more specific, LGPs have no effect on the capital $\left(\frac{\partial k^*}{\partial \theta} = 0\right)$ and production scale $\left(\frac{\partial y^*}{\partial \theta} = 0\right)$ in the long-run. They reduce the relative amount of cash holding $\left(\frac{\partial (c^*/k^*)}{\partial \theta} < 0\right)$ and net worth $\left(\frac{\partial (n^*/k^*)}{\partial \theta} < 0\right)$ necessary to reach the long-run scale.

(ii). if erosion is larger than zero ($\xi > 0$), loan guarantee programs have a temporary and growth effect and a permanent scale effect. To be more specific, LGPs increase the capital $\left(\frac{\partial k^*}{\partial \theta} > 0\right)$ and production scale $\left(\frac{\partial y^*}{\partial \theta} > 0\right)$ in the long-run. They also reduce the relative amount of cash holding $\left(\frac{\partial (c^*/k^*)}{\partial \theta} < 0\right)$ and net worth $\left(\frac{\partial (n^*/k^*)}{\partial \theta} < 0\right)$ necessary to reach the long-run scale.

Second, we check the short-run growth of SMEs. Given a firm's current net worth n_t, we could derive the short-run growth rate of net worth as follows:

$$\begin{aligned}\frac{n_{t+1}}{n_t} - 1 &= (1-\xi)A\alpha\left(\frac{n^*}{1+a-\theta_t}\right)^{-(1-\alpha)}\left[\left(\frac{n_t}{n^*}\right)^{-(1-\alpha)} - 1\right] \\ &= [\xi(1+a-\theta_t) + (1-\xi)(a+\delta)]\left[\left(\frac{n_t}{n^*}\right)^{-(1-\alpha)} - 1\right]\end{aligned}$$

Output is proportional to the capital stock. Therefore, the growth rate of the capital stock is the growth rate of the economy. It is given by

$$\begin{aligned}\frac{k_{t+1}}{k_t} &= \frac{1+a-\theta_t}{1+a-\theta_{t+1}}\frac{n_{t+1}}{n_t} \\ &= \frac{1+a-\theta_t}{1+a-\theta_{t+1}}\left\{[\xi(1+a-\theta_t) + (1-\xi)(a+\delta)]\left[\left(\frac{n_t}{n^*}\right)^{-(1-\alpha)} - 1\right] + 1\right\}\end{aligned}$$

Suppose that for $s \leq t$, $\theta_s = \theta_{pre}$, and that for $s \geq t+1$, $\theta_s = \theta_{post}$, with $\theta_{post} > \theta_{pre}$. $Theta_{post}$ correspond to the new level of collateral that guaranteed firms benefit from.

Proposition 3. *Given that $a >> \theta$, a loan guarantee programs that increases the SME's collateral ability from θ_{pre} to $\theta_{post} > \theta_{pre}$ in period $t+1$ would have a positive effect on the short-run growth of the firm's capital stock $\frac{k_{t+1}}{k_t} - 1$.*

(i). the growth rate is independent of the permanent size differences in A.

(ii). the growth rate depends on the firm's age (distance to optimal level $\frac{n_t}{n^*}$), younger firms whose distance to the optimal level is lower benefit more from the loan guarantee program.

Third, we examine the dynamic impact of the guarantee beyond the first period. We focus on growth between $t+1$ and $t+2$:

$$\frac{k_{t+2}}{k_{t+1}} = (1-\xi)A\alpha n_{t+1}^{-(1-\alpha)}(1+a-\theta_{post})^{1-\alpha} - [\xi(1+a-\theta_{post}) + (1-\xi)(a+\delta)] + 1$$

where we used the new steady state value n^*_{post}. Note that n_{t+1} results from the economic activity of period t that is not affected by θ_{post}. Depending on the value of ξ, θ_{post} has an ambiguous effect on growth in the second period following the access to the guarantee.

Proposition 4. *Given that $a >> \theta$, a loan guarantee programs that increases the SME's collateral ability from θ_{pre} to $\theta_{post} > \theta_{pre}$ in period $t+1$ would have an ambiguous effect on the short-run growth of the firm's capital stock $\frac{k_{t+1}}{k_t} - 1$.*

(i). If $\xi = 0$, then the effect is negative

(ii). If $\xi > 0$, then there is a positive level ξ^* such that the effect is positive if and only if $\xi > \xi^*$.

The persistence of the growth effect of the guarantee thus gives us an indication on the erosion parameter ξ. Empirically, a persistently positive (or non-negative) growth effect would indicate the presence of erosion ($\xi > 0$).

C. Remarks of the Simple Example

This simple example provides us guidelines for how loan guarantee programs could affect SMEs' static choices in production and finance and dynamic growth in the longer run. LGPs could lower SMEs' collateral constraints and, therefore, the liquidity burden of working capital constraints. SMEs with LGPs could potentially lower their unproductive cash holdings, increase their productive capital stock, and achieve better long-run growth if they face potential erosion in their net worth. In the following empirical sections 3 and 4, we will use data from loan guarantee programs in Morocco to test the propositions in this simple example.

3 Institutional Background and Data

A. Institutional Background

Tamwilcom Tamwilcom (formerly called Caisse Centrale de Garanties, abbreviated Tamwilcom) is a public financial institution under the supervision of the Central Bank of Morocco, Bank Al-Maghrib. Tamwilcom has a long history as a credit institution dating back to 1949. Since its reform in 2012, Tamwilcom has started to focus on SME-related loan guarantees (Tamwilcom, 2013-2018). Our study focuses on the post-reform period of 2012-2018.

Collateral requirements for loans are especially high in Morocco. As reported by WBs (2013), approximately 84% of the loans in Morocco require collateral, compared to an average of 79.7% in MENA countries. In order to reduce potential inefficiency caused by such high collateral requirements, Tamwilcom cooperates with four leading banks who jointly cover an extensive credit network to provide loan guarantee programs. The procedure is as follows. Firms who apply for bank loans at these four leading banks, deemed as "risky" due to lower than sufficient collateral but are still eligible for guarantees are transferred to Tamwilcom for further assessment. Conditional on approval at Tamwilcom, the bank grants credit to qualified borrowers and Tamwilcom underwrites a share of the loan.

The loan guarantee programs are quite successful in both perspectives of benefit and cost. First, on the benefit side, Tamwilcom effectively unlocks credit for SMEs that would have been rationed by the banks. It plays the critical role of facilitating bank credit to under-collateralized SMEs which have economically viable projects and depend on external finance to grow. Second, on the cost side, the default rate of Tamwilcom guaranteed loans is relatively low — it has dropped from 1.4% in 2011 to 0.6% in 2017. This also implies that firms that have been rigorously selected into the guarantee program are indeed profitable and need external finance to further expand their business.

Loan Guarantee Programs Among a range of products offered by Tamwilcom, we focus on two main products catering to the firm's financial needs of working capital, Damane Exploitation (renamed as Damane Atassyir after 2019) and Damane Express.

Damane Exploitation targets medium-sized firms with sales below 175 million dirhams (approximately 18 million US dollars) which is the threshold of SME definitions in Morocco requesting for a short-term loan of maturity up to 18 months. For the majority of firms approved for Damane Exploitation, the threshold has not been binding; approximately 92% of firms in the program have a sales number below 100 million dirhams. The loan size varies substantially, ranging from 180 million to as small as 1 million. Tamwilcom guarantees 60% of the loan and requires a commission fee of 0.5% of the loan amount. The guarantee request can be approved within ten days. Damane Exploitation is a product that specifically targets working capital loans.

Damane Express is a relatively newer product, specifically designed for sufficiently small firms with a much-simplified process and a speedy approval period of 48 hours. It deals with loans below 1 million dirhams and provides a guarantee coverage of up to 70%. The commission fee is 0.5% for loans of maturity up to 12 months and 1.5% for those beyond 12 months. We focus on a subset of Damane Express guarantees that target working capital loans.

Since both programs are designed to alleviate credit constraints of firms ranging from small to medium and jointly cover all SMEs, we will evaluate both programs together as one treatment.

B. Data

Our analysis merges the loan-level database from Tamwilcom with a firm-level database from Orbis.

Loan-level Database The first database used in this paper is a confidential loan-level database from Tamwilcom. The database covers 43,195 loans associated with 23,017 firms guaranteed by Tamwilcom during 2009-2019. There is information on firm identifiers (name, national ID, address, creation date) and loan characteristics (loan approval date, maturity, loan amount, guarantee amount, commission, maturity). It should be noted that canceled guarantees are excluded and we only consider the first guarantee in case of renewal. This results in a database of 23,017 guarantees, which mobilize a loan amount of 22 billion dirhams extended to credit-constrained firms.

Firm-level Database The second database used in this paper is Orbis firm-level database, a commercial database by Bureau van Dijk (henceforth BvD). BvD collects firm-level balance sheet data from a country's business register, which is the Office of Industrial and Commercial Property

(OMPIC) for Morocco, and then standardizes to its global format.

Despite the suitability of the database, Orbis has several issues related to data coverage.[6] The first is the reporting bias, as a number of firms, especially among small firms, do not report their balance sheet to OMPIC, or only partially. The second is the survivor bias, which mainly results from the fact that only businesses that have been active in OMPIC's register for the last 5 years are maintained in Orbis' online version. We discuss later how we take these biases into account in our methodology.

C. Sample Construction and Statistics

Sample Construction We first clean the Orbis firm-level dataset following Kalemli-Ozcan et al. (2015): (i) we deflate data series by the national GDP deflator of Morocco with the 2007 base from the World Bank; (ii) the entire series of company data is dropped if total assets, sales, tangible fixed asset are negative in any year; (iii) values of zero are cleaned for all financial variables; (iv) the series are winsorized by year at 1% (Amamou, Gereben, and Wolski, 2020); (v) as a final step, we exclude firms that are in sectors of finance and insurance, public administration and utilities taking into account the fact that firms in these sectors are not eligible for Tamwilcom guarantees.

We then pair the guaranteed firms in the Tamwilcom database with their balance sheet data in the Orbis firm-level database. See the Appendix A for details.

Table 1:
Summary Statistics of Tamwilcom-Guaranteed Firms:
Whole Sample vs Merged Sample

Statistics	Guaranteed Amount		Guaranteed Loan		Sales	
Sample	Whole	Merged	Whole	Merged	Whole	Merged
Mean	545	663	967	1,162	14,610	15,949
Std	1,336	1,467	3,401	3,598	28,120	28,314
Min	2	4	3	5	3	3
25%	35	42	50	60	775	1,148
Median	105	140	150	200	3,219	4,462
75%	400	560	550	800	14,176	17,039
Max	10,000	10,000	190,000	190,000	163,235	163,235

Notes: This table reports summary statistics of three variables (guaranteed firms' sales, guaranteed loan, and amount) from the whole Tamwilcom sample and the merged sample between the Tamwilcom database and Orbis. All variables are in thousands of Moroccan Dirham.

Sample Statistics After linking the Tamwilcom database to Orbis, we are able to identify 11,344 out of 23,017 guaranteed firms in the Orbis database, implying a rate of the successful pairing of

[6] Please refer to Kalemli-Ozcan et al. (2015) for careful discussions.

49.3%. Further inspection of identified and unidentified guaranteed firms in Orbis shows that the two groups have similar characteristics. As Table 1 shows, loan amount, guaranteed amount, and sales reported by Tamwilcom are comparable for the two groups. One notable difference is that firm size is slightly larger for the subset of guaranteed firms that have been merged with Orbis data. This is expected, as small firms usually report less complete information, which makes it less likely to be identified in Orbis. One potential concern would be that some unidentified treated firms are mistaken as untreated control firms and are matched with other treated firms later in the procedure. This would bias the estimation downward. However, this concern is marginally relevant due to the very low treatment rate. If the total number of firms in Orbis is taken as a representation of the whole business world of Morocco, there are approximately colorred1.58 million firms, of which only 23,027 have been treated. The resulted treatment rate is only 1.5%, indicating a very small possibility of a treated firm being matched with another unpaired treated firm.

It should be pointed out that a substantial portion of the successfully paired firms does not have data coverage for financial variables. In fact, only 4,000 firms have sales data for the year where it is granted the guarantee. The number drops even further to 991 when a panel of at least five consecutive years is required for the matching process later. This implies that only 4.3% of the Tamwilcom-guaranteed firms are in the final sample. The rate is admittedly low but consistent with other studies that use Orbis as a source of firm-level data. In Amamou, Gereben, and Wolski (2020), only 13.25% of the original guaranteed observations are included; Asdrubali and Signore (2015) record a rate of 18.3% and Gereben et al. (2019) report a rate of only 3.6%. In Brown and Earle (2017), 14% of the initial loan sample ends up in the final one. These studies focus on the EU and the US, where data coverage is generally better. Considering this, the low pairing rate for a developing country such as Morocco is expected. Our main concern is the attrition of small firms in the final sample. To correct for this bias, we follow Amamou, Gereben, and Wolski (2020) and use the technique of inverse probability weight (henceforth IPW) to recover the shares of firms of different sizes in the original treated population as a robustness check.

The guaranteed firms in our final sample have had access to a guarantee between 2014 and 2017. This is due to the absence of data before 2011 and our requirement that the firms in our sample have at least three observations before the treatment. Since all the firms that are active in 2014 and beyond stay in Orbis even if they stop reporting data, we do not have a survivor bias in our final sample.

4 Empirical Analysis

In this section, we estimate the causal impact of Tamwilcom guarantees on firm growth, inputs and cash holdings. We do not observe the counterfactual outcome of a guaranteed firm in the absence of the treatment, which poses a challenge to establishing a convincing causal link between the treatment and firm-level outcomes. This amounts to the common "selection bias" problem in impact evaluation studies.[7] Our empirical strategy to account for this selection problem is to combine pre-treatment matching with the difference-in-difference (DID) method, based on a large body of literature originating from Heckman, Ichimura, and Todd (1997). The matching, implemented under the assumption of “selection on observables”, consists in finding statistical twins (control firms) for a guaranteed firm based on a series of time-varying and observable variables that are relevant to selection into the program. The DID method controls for “group” (the treated firm and her control firms) and time unobservable effects. Following the two steps, differences in outcome variables between treated and control firms can be effectively attributed to the guarantees.

4.1 Empirical Strategy

A. Matching

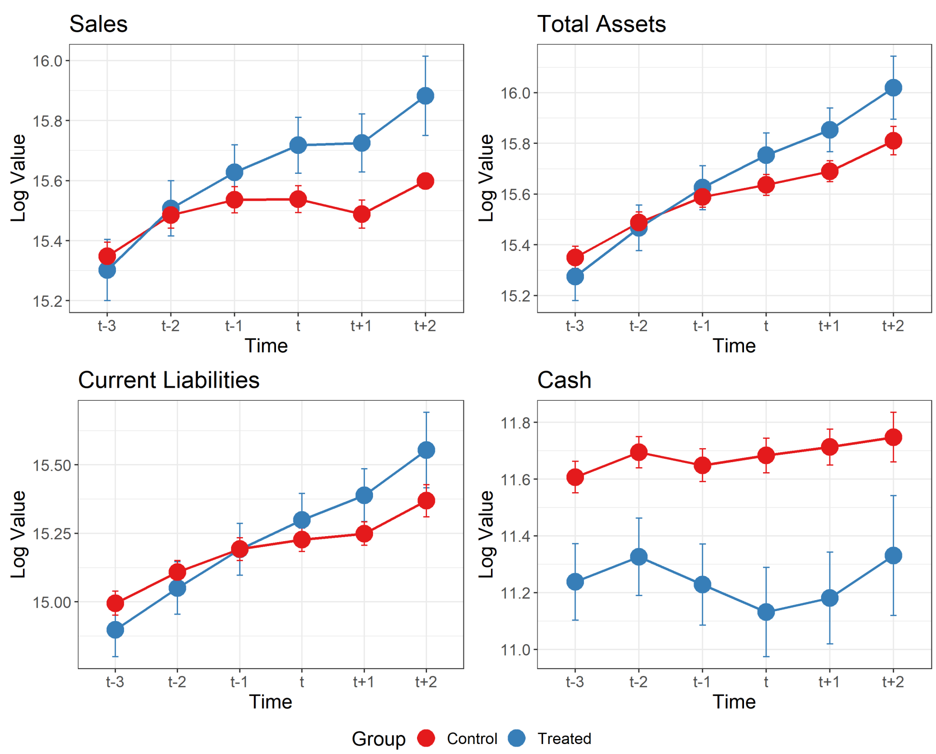
We use the Mahalanobis distance matching (MDM) method to construct a control sample, in which a treated firm is matched with five nearest “neighbors”. The Mahalanobis distance is a matrix that measures the multivariate proximity between two observations based on a set of selected variables. Caliendo and Kopeinig (2008) recommend choosing matching variables based on the existing literature and on information regarding the institutional settings. In view of this suggestion, four financial variables of total assets, sales, current liabilities, cash, and cash equivalent, together with firm age, are used to measure the statistical distance between observations.

Total assets and sales are selected as matching criteria since they are basic balance sheet items to reflect the firm’s size and overall performance. Current liabilities, namely short-term debt, sheds light on the firm’s ability to rely on bank credit as well as the amount of existing indebtedness and risks associated with external credits. Cash and cash equivalent contain short-term investments and funds that can be used for paying current invoices, representing the firm’s liquidity situation. The selected financial variables are log-transformed.

[7] The selection bias refers to the fact that firms that are selected into the guarantee program are likely those who have high-performing balance sheets, and therefore have a higher probability of achieving higher sales even without guarantees. Consequently, if a direct comparison is conducted between guaranteed and non-guaranteed firms, the estimates are expected to be biased upwards.

The matching is based on the firms' three-year history before receiving the credit guarantee. This implies that firms with an insufficient data coverage are excluded from the matching. In addition, we only include those firms that have sales data in at least the year of guarantee and the year after. We later conduct more demanding robustness tests based on the past four and five years, but at the expenses of a smaller sample. In addition to matching on pre-treatment data, we also apply exact matching on four variables: the city where the firm is located, firm size category, sector, and year. It is essential to consider these factors in terms of the local credit markets and conditions faced by firms in need of liquidity. This is especially important for SMEs.

Figure 3:
TREND INSPECTION OF FOUR FINANCIAL VARIABLES USED IN MATCHING



Notes: This figure depicts the weighted average of the log values of sales, total assets, current liabilities, and cash in year $t-3$ to $t+2$ of treated and control firms in the final matched sample. Confidence interval are at the 95% level.

A guaranteed firm is matched with a maximum of five control firms that are closest in terms of Mahalanobis distance. Matched observations of treated firms are assigned with a weight of one, whereas those of control firms are allocated with a weight based on its distance from the corresponding treated firm. Section B in the Appendix provides more details about the matching procedure (choice of caliper, weighing of observations).

We obtain a final matched sample of 991 guaranteed firms and 4,577 control firms, among

Figure 4:
Standardized Mean Difference and Variance Ratio in Raw and Matched Sample

Notes: This figure is a visualization of Table 19. The standardized mean differences ("Std-Dif") and variance ratios ("Ratio") of raw sample and matched sample are reported by Stata *kmatch* package as in Jann (2017). All financial variables are log-transformed.

which 67% have been matched only once. Among those observations that are matched more than once, 22% are used twice. The maximum times that a control firm has been matched is six. There are only 24 firms in this situation. Since the majority of the untreated firms are matched only once, we expect the estimation results to be similar to that of a matching procedure done without replacement. This is confirmed later by a robustness check.

We check the balancedness of the matched sample. Figure 3 illustrates the weighted average of the log value of the four variables used in matching. It confirms the parallel pre-treatment trend between the treated and control firms and provides preliminary evidence on the dynamic impact of working capital loan guarantees on firm's growth. As shown in Figure 3, guaranteed firms experience growth in sales, total assets, current liabilities and a decline in cash. This will be confirmed later in the regressions.

Figure 4 represents the standardized mean difference (SMD) and variance ratios between the treated and control groups in the raw and matched sample.[8] The SMD measures mean difference of a given variable between two groups, normalized by the standard deviation of that variable. Variance ratio refers to the ratio between the variances of a variable across two groups. A value of

[8]See also Table 19 in the Appendix.

zero for the SMD and a value of one for the variance ratio indicate a good balance in the sample. As shown in the Figure, the matching procedure substantially improves the overall balancedness for most variables, except for cash. Guaranteed firms have a lower level of cash holding on average compared to their matched control firms, which also appears in Figure 3. This is likely linked to the firm's short-term credit demand. Firms that apply for a guarantee are those demonstrating with insufficient cash to face their liquidity needs. In order to address this aissue, we conduct a robustness test with an emphasis on precisely matching cash. The results will be discussed later in Section C.

As a second balancedness test suggested by Caliendo and Kopeinig (2008), we evaluate the probability of obtaining a guarantee through a logit model based on the variables used in the matching. Ideally, a drop in R^2 indicates a good balance in the sample. It is indeed what we observe: the pseudo R^2 of the logit model falls from 0.66 with the raw sample to 0.01 with the matched sample. This confirms the loss of in the predictive power of the selected variables after matching. It confirms that the matching procedure has eliminated differences in the pre-treatment observable characteristics between the two groups and that the treatment status is as if "randomized" in the matched sample conditional on the selected variables.

B. Difference-in-difference Regression

Our DID regression follows the setup of Brown and Earle (2017):

$$\Delta Y_{igt} = \delta D_{it} + \lambda_{gt} + \epsilon_{igt}, \tag{8}$$

where i is the firm, g is the group (the guaranteed firm and its matched control firms), and t is the year. The dependent variable ΔY_{igt} is the change in the selected outcome variable in the post-treatment period compared to the year prior to obtaining the guarantee. It has the form $\Delta Y_{igt} = Y_{igs} - Y_{igt-1}$, where year $t-1$ is considered as the base year and $s = t+1, t+2, t+3$ refer to three post-treatment years. The dependent variable can be read as a growth rate since all variables are in logs. D_{it} is a dummy variable indicating if firm i has been granted a guarantee in year t. λ_{gt} are the group-year fixed effects, which controls for the group-specific trend. Other fixed effects (sector, city, year and size) are not incorporated since a group of guaranteed and control firms shares the same characteristics in these dimensions. In addition, firm-level fixed effects are not included since our dependent variable has differenced out any individual fixed effects that are relevant to the outcome.

4.2 Estimation Results

A. Effects on Firms' Scale

We explore the impact of loosening credit constraints on SMEs' growth. As a first step, we gauge this effect by looking at sales as the outcome variable. Columns (1) to (3) of Table 2 report the estimation results. The sales of firms under a Tamwilcom guarantee are pushed up by 14.7%, compared to the pre-treatment period, relative to non-guranteed firms. This impact is persistent over the course of three years after obtaining the guaranteed loan. This large and significant effect on sales indicates that the relaxation of credit constraints directly leads to a firm's expansion in production. Columns (4) to (6) of the Table report the effect of the guarantee on total assets. The coefficients found for the first and second year following the guarantee are remarkably close to those found for sales. This shows that the firm can simultaneously increase its net worth. The coefficient for the third year is very large, but this could be due to a survivor bias, as large firms are more likely to exit the dataset (because of failure or lack of data reporting).

Table 2:
Estimation Results of Tamwilcom Guarantee on Firm's Sales

	(1)	(2)	(3)	(4)	(5)	(6)
	Sales Growth			Total assets Growth		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	0.147***	0.151***	0.174***	0.127***	0.141***	0.251***
	(0.016)	(0.025)	(0.045)	(0.010)	(0.018)	(0.028)
N	30136	24190	18244	30336	24370	18436
Adjusted R^2	0.416	0.426	0.428	0.421	0.446	0.459
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from the DID regression (10). The dependent variable "Sales Growth" is the log difference between sales in year $t+1$, $t+2$ or $t+3$ and sales in year $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. Group-year fixed effects are included. Significance level: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.

Table 3 and Table 4 provide an estimation of the impact of the guarantee on firm's production inputs. We use the variable "costs of employees" to detect changes in a firm's hiring, since we do not have a good coverage of the number of employees in the Orbis database. As Table 3 shows, labor costs increase by 11.6% in the year following the grant of guarantee, and 14% and 15% in the two following years. Along with the increase in wage bill, guaranteed firms also experience a 14% increase in fixed tangible assets according to Table 4, and a 28% increase in the two following years. This variable is a good proxy for investment in productive assets (Amamou, Gereben, and Wolski, 2020). As This confirms that, corresponding to production expansion, guaranteed firms

Table 3:
Estimation Results of Tamwilcom Guarantee on Firm's Labor Costs

	(1)	(2)	(3)	(4)	(5)	(6)
	Costs of Employees Growth			Costs of Employees/Sales		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	0.116***	0.141***	0.151***	0.081	-0.016	0.052
	(0.016)	(0.024)	(0.042)	(0.076)	(0.011)	(0.041)
N	28618	22810	17076	28488	22685	16958
Adjusted R^2	0.301	0.319	0.333	0.447	0.368	0.370
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from the DID regression (10). The dependent variable "Costs of Employees Growth" is the log difference between labor costs in year $t+1$, $t+2$ or $t+3$ and labor costs in year $t-1$. The dependent variable "Ratio of Costs of Employees to Sales" refers to the difference between the ratio of labor costs divided by sales in year $t+1$, $t+2$ and $t+3$ and the ratio in $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. Group-year fixed effects are included. Significance level: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.

Table 4:
Estimation Results of Tamwilcom Guarantee on Firm's Fixed Tangible Assets

	(1)	(2)	(3)	(4)	(5)	(6)
	Fixed Assets Growth			Fixed Assets/Total Assets		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	0.139***	0.281***	0.283***	0.000	0.006	0.004
	(0.026)	(0.041)	(0.071)	(0.002)	(0.004)	(0.006)
N	27576	21862	16286	27576	21862	16286
Adjusted R^2	0.239	0.248	0.261	0.255	0.263	0.265
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from the DID regression (10). The dependent variable "Fixed Assets Growth" is the log difference between fixed tangible assets in year $t+1$, $t+2$ or $t+3$ and fixed tangible assets in year $t-1$. The dependent variable "Ratio of Fixed Assets to Total Assets" refers to the difference between the ratio of fixed tangible assets divided by total assets in year $t+1$, $t+2$ and $t+3$ and the ratio in $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. Group-year fixed effects are included. Significance level: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.

allocate more resources to long-term productive assets. The increase in labor hiring and investment in fixed assets are in line with the firm's expansion, reflected in the unchanged ratios of the two inputs with regards to sales and total assets observed in Table 3 and Table 4.

B. Effects on Firms' Financial Positions

We explore firms' changing position in current liabilities, which is summarized in Table 5. There is a growth of 14% in short-term leverage associated with treated firms. This is consistent with the buildup of current liabilities as a result of newly granted working capital loans. However, if we inspect the ratio of current liabilities to total assets, we see no significant increase. This implies that guaranteed firms do not use short-term debt more intensively than before; the buildup of leverage is in proportion to its expanding asset size and growing sales. This evidence points to the substantial role played by credit constraints and working capital constraints as bottlenecks for firm growth.

Table 5:
Estimation Results of Tamwilcom Guarantee on Firm's Current Liabilities

	(1)	(2)	(3)	(4)	(5)	(6)
	Current Liabilities Growth			Current Liabilities/Total Assets		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	0.140***	0.144***	0.224***	-0.009	0.038	-0.014
	(0.016)	(0.025)	(0.052)	(0.009)	(0.044)	(0.023)
N	30382	24427	18487	30039	24069	18139
Adjusted R^2	0.395	0.411	0.413	-0.108	-0.052	0.068
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from the DID regression (10). The dependent variable "Current Liabilities Growth" is the log difference between current liabilities in year $t+1$, $t+2$ or $t+3$ and current liabilities in year $t-1$. The dependent variable "Ratio of Current Liabilities to Total Assets" refers to the difference between the ratio of current liabilities divided by total assets in year $t+1$, $t+2$ and $t+3$ and the ratio in $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. Group-year fixed effects are included. Significance level: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.

On the opposite, we observe a drop of about 12% in cash for guaranteed firms in Table 6. The ratio of cash to total assets drops by 1 percentage point. This result highlights the precautionary motive for holding cash for financially constrained firms, which have to self-insure against liquidity risk (Abel and Panageas, 2020; Han and Qiu, 2007). This is especially true in an emerging economy such as Morocco with a credit market featuring a high level of financial frictions. When the liquidity risk is reduced by a guarantee for short-term loans, the firm reduces the accumulation of precautionary liquid assets and redirect them to production-related activities. This is an additional growth channel for financially constrained firms.

C. Conditional Effect of Guarantees

We now examine whether the effect of the guarantee depends on firm size. We estimate the

Table 6:
Estimation Results of Tamwilcom Guarantee on Firm's Cash

	(1)	(2)	(3)	(4)	(5)	(6)
	Cash Growth			Cash/Total Assets		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	-0.122*	-0.060	-0.272*	-0.011***	-0.015***	-0.028***
	(0.050)	(0.075)	(0.117)	(0.002)	(0.003)	(0.005)
N	30083	24109	18184	30083	24109	18184
Adjusted R^2	0.385	0.362	0.341	0.293	0.293	0.284
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from the DID regression (10). The dependent variable "Cash Growth" is the log difference between cash and cash equivalents in year $t+1$, $t+2$ or $t+3$ and cash and cash equivalents in year $t-1$. The dependent variable "Cash Ratio" refers to the difference between the ratio of cash and cash equivalents divided by total assets in year $t+1$, $t+2$ and $t+3$ and the ratio in $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. Group-year fixed effects are included. Significance level: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.
Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression. The dependent variable "Cash Growth" is the log difference of cash and cash equivalent in year $t+1$, $t+2$ and $t+3$ from year $t-1$. The dependent variable "Ratio of Cash to Total Assets" refers to the amount of cash and cash equivalent divided by total assets in year $t+1$, $t+2$ and $t+3$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

following extension of Equation (10):

$$\Delta Y_{igt} = \delta D_{it} + \alpha D_{it} \times \log(X_i t) + \lambda_{gt} + \epsilon_{igt}, \tag{9}$$

where X_{it} is either the firm's age in t, the firm's total assets in $t-1$ or the firm's sales in $t-1$. We run these regressions for sales and cash. The results are represented in Table 7. In columns (1) to (3), the negative coefficient of the interaction term means that the impact of the guarantee on firms' expansion is decreasing in firm age and firm size, measured by total assets and sales. In columns (4) to (6), the positive coefficient means that older and larger firms (measured by total assets and sales) do not decrease their cash holdings as much as the younger and smaller firms. The role of size that we document here is in line with the assumption of size-dependent financial constraints that we make in the full model. Besides, the role of age is in line with our simple model's prediction.

D. Dynamic Effect of Guarantees

In this exercise, we examine in more detail the dynamics of the firm after they access a guar-

Table 7:
ESTIMATION RESULTS OF TAMWILCOM GUARANTEE DEPENDING ON FIRM'S AGE AND SIZE

	(1)	(2)	(3)	(4)	(5)	(6)
	Sales Growth			Cash Growth		
	t+1	t+1	t+1	t+1	t+1	t+1
Guaranteed	0.413***	0.955***	1.175***	-0.392*	-2.491***	-1.865***
	(0.084)	(0.280)	(0.310)	(0.190)	(0.570)	(0.519)
Guaranteed × log(Age)	-0.115***			0.116		
	(0.032)			(0.077)		
Guaranteed × $log(\text{Total Assets})_{t-1}$		-0.052**			0.152***	
		(0.017)			(0.036)	
Guaranteed × $log(\text{Sales})_{t-1}$			-0.066***			0.112***
			(0.019)			(0.033)
N	30136	30058	30136	30083	30083	29773
Adjusted R^2	0.416	0.417	0.417	0.385	0.385	0.384
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: this table reports the coefficients of treatment ("Guaranteed") from the DID regression (10). The dependent variable "Sales Growth" is the log difference between sales in year $t + 1$ and sales year $t - 1$. The dependent variable "Cash Growth" is the log difference between cash and cash equivalents in year $t + 1$ and cash and cash equivalents year $t - 1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The explanatory variable "log(Age)" refers to the log value of firm age in year t. Variables "$log(\text{Total Assets})_{t-1}$" and "$log(\text{Sales})_{t-1}$" are the log value of total assets and sales from year $t - 1$. Group-year fixed effects are included.

antee. We estimate the following equation:

$$\log(Y_{igt}) - \log(Y_{igt-1}) = \delta_0 D_{it} + \delta_1 D_{it-1} + \delta_2 D_{it-2} + \delta_3 D_{it-3} + \delta_4 D_{it-4} + \lambda_{gt} + \epsilon_{igt}, \tag{10}$$

This equation enables us to assess the effect of the guarantee on the growth of a variable Y year after year following the first year of guarantee. This will enable us to determine whether growth decelerates after some time, as we would expect would happen in the absence of net worth erosion.

The results are shown in Table 8. In column (1) we can see that the growth effect of the guarantee spans over two years: the year the firm is granted the guarantee, and the following year. After that, there is neither a positive nor a negative effect of the guarantee. This absence of relative deceleration of growth relative to the control group implies that there must be some net worth erosion, as explained in the simple model section. This absence of deceleration is confirmed when looking at total asset growth, and at inputs growth.

Table 8:
ESTIMATION RESULTS OF TAMWILCOM GUARANTEE ON FIRM'S OUTCOMES OVER TIME

	(1)	(2)	(3)	(4)
	Sales growth	Total assets growth	Labor costs growth	Fixed assets growth
	$t-1$ to t	$t-1$ to t	$t-1$ to t	$t-1$ to t
Guaranteed	0.092***	0.079***	0.058***	0.057***
	(0.011)	(0.008)	(0.012)	(0.017)
L.Guaranteed	0.058***	0.044***	0.049***	0.096***
	(0.013)	(0.009)	(0.011)	(0.020)
*L*2.Guaranteed	0.008	0.005	0.010	0.108***
	(0.019)	(0.013)	(0.014)	(0.026)
*L*3.Guaranteed	-0.015	0.076***	-0.013	-0.022
	(0.028)	(0.019)	(0.020)	(0.039)
*L*4.Guaranteed	0.013	0.003	0.067	0.106
	(0.053)	(0.025)	(0.058)	(0.068)
N	30933	30914	29848	28770
adj. R^2	0.325	0.303	0.242	0.204
Group × Year FE	0.325	0.303	0.242	0.204

Standard errors in parentheses
$^+$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: this table reports the coefficients of treatment ("Guaranteed") from DID regression. The dependent variable "Dummy of Firm Exit" is a dummy variable to approximate firm exit in year $t+1$, $t+2$ and $t+3$ compared to year t. It is one if a firm has data recorded for the next year and zero otherwise. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

4.3 Robustness Checks

More pre-treatment years The first robustness test deals with concerns regarding the number of pre-treatment years used in the matching procedure. Existing literature suggests that we should rely on at least three years of data before treatment, which corresponds to our main estimation. In this robustness check, we extend the number of years to four and five. Table 9 in the Appendix reports the estimated results when we match on four years' data. As a result of the stricter matching requirement, the number of treated firms that have at least one matched control firm drops to 622, compared to 991 in the main setup. The results in year $t+1$ and year $t+2$ remain robust and significant, with small changes in the scale of the coefficients. However, the results of year $t+3$ mostly lose significance due to the loss of observations. This is within expectation due to the limited length of our panel. When we increase the number of years used for matching to five, we only have 346 guaranteed firms in the final sample, about a third of observations in our main setup. The estimated coefficients for the year $t+1$ in Table 10 in the Appendix are smaller and less significant for sales, costs of employees, and cash, whereas the results for fixed assets and inventory are not significant. Here, a small sample bias may have been introduced due to the stricter matching procedure.

Inverse probability weighing The second robustness test tackles the data attrition issue. The main concern arises from the loss of small firms observations because of our data-demanding matching procedure. Given that small firms often report limited financial data, it could potentially lead to their exclusion due to missing data points. In order to correct for this bias, we use an inverse probability weighting (IPW) (Amamou, Gereben, and Wolski, 2020) to increase the weight of underrepresented SMEs and decrease the weight of those that are over-represented. As a first step, we calculate the number of small, medium, and large firms in the sample of Tamwilcom-guaranteed firms that can be merged with Orbis. As discussed earlier, this sample shares similar statistical properties with the sample of all guaranteed firms. The reason for choosing this merged sample rather than the full sample is that we can use the more reliable size information provided by Orbis. As a second step, we count the number of firms of different sizes in the processed sample after matching and divide the number of small, medium, and large firms in the processed sample by its number in the original sample before matching. The inverse of the proportion is then used as weight to re-scale the weight of firms depending on their size in the final sample. As Table 11 in the Appendix shows, the estimation results are similar to the main ones. The scale of coefficients for sales and fixed assets are similar; however, the scales are smaller for costs of employees and inventory and are much larger for cash. This is potentially in line with the fact that small firms, which are less resistant to liquidity shocks, hoard more cash. As a result, the reduction of cash hoarding after accessing the guarantee is more pronounced.

Matching on cash variables The third set of checks intends to test the robustness of the main results when we emphasize matching on cash-related variables to reduce the difference in cash level between the treated and control firms that we can see in Figure 3. As a first test, we use one-to-one nearest neighbor matching to ensure that only the closest control firm is selected. This is to see if the difference in gap results from any chosen control firm that is not similar enough to its matched neighbor. As we can see in Figure 5, the gap remains large and is very similar to the five-to-one nearest neighbor matching. In view of this, we rule out the possibility that remote control firms contribute to the difference in cash. As a further test, we only include logged cash and the ratio of cash to total assets in the matching process. This setup “forces" a good matching result on cash by not including other variables so that the measurement of Mahalanobis distance is only based on cash-related variables. In addition, we divide the variable of logged cash into 20 quantile intervals and apply exact matching on the interval. Figure 6 in the Appendix shows that this procedure manages to substantially improve the matching performance on cash. Furthermore, total assets is balanced as well due to the incorporation of the ratio of cash to total assets. However, we observe a gap in sales. In order to reduce this gap, we modify the setup to match on cash ratio and logged sales. As Figure 7 indicates, the good balancedness in cash, total assets, and current liabilities are preserved while the difference in sales is decreased. Estimation results on cash-related variables for these two robustness tests are in the Appendix Tables 12 and 14, whereas the Appendix Tables 13 and 15 include estimation results on other outcome variables. As we can observe in Table 12 and Table 14, there is a large decline in the ratio of cash to total assets, showing the robustness of our main results. In addition, We can observe a large and positive effect on sales and fixed assets in Table 12 and Table 14. However, there is no significant effect on labor cost and inventory. This is possibly due to the loss of data points since the matched samples in both set-ups have less than 200 guaranteed firms that have matches.

Other robustness checks In the next robustness test, we include the propensity score as one variable in the calculation of Mahalanobis distance. We exploit the predictive power of a logit model, where the dependent variable is a dummy equal to one if a firm is guaranteed in a certain year and zer otherwise, and independent variables are the same as those selected for calculating the Mahalanobis distance. Table 16 in the Appendix reports the estimation results, which are similar to our main ones. We conduct another robustness test where we increase the number of nearest neighbors matched with the guaranteed firms to ten. What we find is that the results are not sensitive to the number of controls chosen for the treated firm, as shown in Table 17 in the Appendix. We also apply a matching procedure without replacement and confirm that estimation results stay the same, as shown in Table 18 in the Appendix.

5 The Full Model

We now consider the full model of an economy with heterogeneous firms facing size-dependent collateral constraints and working capital constraints. Time is discrete. Each firm $i = 1, ..., N$ is subject to idiosyncratic productivity shock. Firms decide on how much investment to do, how much labor to hire, how much materials to buy, how much debt to borrow, how much cash to hold in hand, and how much dividends to pay. Firms also face exogenous exit risk that is independent and identically distributed and erosion of profit due to red tape, taxes, corruption, tax evasion, and many others.

5.1 Production Firm's Problem

Technology: Each firm i produces with idiosyncratic stochastic productivity $z_{i,t}$ and accumulative stock of capital $k_{i,t}$, labor $l_{i,t}$, and materials $m_{i,t}$ using the following decreasing return to scale production function:

$$y_{i,t} = z_{i,t} k_{i,t}^{\alpha} l_{i,t}^{\nu} m_{i,t}^{\gamma}, \quad \alpha + \nu + \gamma < 1 \tag{11}$$

where $z_{i,t}$ is the stochastic idiosyncratic component of productivity for the firm i, which follows an exogenous Markov process $\log(z_{i,t}) = \rho_z \log(z_{it-1}) + \sigma_z \varepsilon_{i,t}$, where $\varepsilon_{i,t}$ follows a standard normal random process. γ, α and ν are the income shares of capital, labor and materials. We require that $\gamma + \alpha + \nu < 1$ so that the production technology features decreasing return to scale.

Working Capital Constraint: At the beginning of each period, before the realization of their productivity shocks, firms pay in advance for their working capital: current period hiring $l_{i,t}$, and materials $m_{i,t}$ before production. They can finance this working capital through both internal and external funds: cash holdings $c_{i,t}$ and short-term credit line $b_{i,t} \leq \bar{b}_{i,t}$. We have:

$$w_t l_{i,t} + p_t m_{i,t} \leq c_{i,t} + \bar{b}_{i,t} \tag{12}$$

Collateral Constraint: The short-term credit line $b_{i,t} \leq \bar{b}_{i,t}$ of firm i is constrained by its collateral holdings. Since firms can easily transfer their liquid asset (cash holdings), banks only consider their illiquid asset (fixed capital) as collateral. Also, banks have less trust in SMEs for their balance sheet data. The resale of SMEs' fixed capital would incur higher average costs, i.e., organizing firm restructure incurs some fixed costs, which will be averagely higher when dividing by the size of smaller firms. In this paper, we take a reduced-form approach as in Gopinath et al. (2017) to model a size-dependent collateral constraint as follows:

$$b_{i,t} \leq \bar{b}_{i,t} \equiv \theta_0 k_{i,t} + \theta_1 \Psi(k_{i,t}) = \left[\theta_0 + \theta_1 \frac{\Psi(k_{i,t})}{k_{i,t}}\right] k_{i,t} \tag{13}$$

where $\Psi(k) = exp(k) - 1$ is an increasing and convex function of capital and θ_0 and θ_1 are parameters characterizing the borrowing constraint. In this micro-foundation, the $\Psi(\cdot)$ function denotes an increasing and convex cost that firms incur from the disruption of their productive capacity.

5.2 Loan Guarantee Program for SMEs

The firm i can potentially apply for a loan guarantee program to finance its working capital $w_t l_{i,t} + p_t m_{i,t}$ if it is an qualified SMEs according to certain criteria. Firms need to hire a professional appraisal agency to evaluate whether the firm meets the certain criteria in order to be included in the loan guarantee program, which incurs an uniformed distributed random fixed inspection cost $\xi \in [0, \bar{\xi}]$. We do not allow firms to issue equity, so dividend $d_{i,t} \geq 0$.

Let $F = \{A, N\}$ indicate whether a SME firm decides to pay the fixed cost. When $F = A$, the firm is active in paying the inspection cost and relax its borrowing constraint, and when $F = N$, the firm does not pay the inspection cost and can only borrow up to its size-dependent collateral constraint. Therefore, SME firms facing collateral constraints:

$$b_{i,t} \leq \begin{cases} \chi\left(\theta_0 k_{i,t} + \theta_1 \Psi(k_{i,t})\right) & if\, F = A \\ \theta_0 k_{i,t} + \theta_1 \Psi(k_{i,t}) & if\, F = N \end{cases}$$

where χ is a multiplier larger than 1, which reflects the ratio of a loan guarantee from the government, i.e., if the government guarantee 60% of the loan, then $\chi = \frac{100\%}{100\%-60\%} = 2.5$. The firm can now borrow up to 2.5 times its size-dependent collateral constraint.

5.3 Recursive Problem for Firms

The individual state variables of a firm are its idiosyncratic productivity $z_{i,t}$ and its net worth

$$n_{i,t}(z_{i,t}, k_{i,t}, c_{i,t}, F_{i,t}) = (1 - \tau)\pi(z_{i,t}, k_{i,t}, c_{i,t}, F_{i,t}) + c_{i,t} \tag{14}$$

where τ is the erosion and the profit function $\pi(z_{i,t}, k_{i,t}, c_{i,t}, F_{i,t})$ is

$$\pi(z_{i,t}, k_{i,t}, c_{i,t}, F_{i,t}) = \max_{l,m} \left\{ E_{t-1}[z_{i,t}] k_{i,t}^{\alpha} l_{i,t}^{\nu} m_{i,t}^{\gamma} - (w_t l_{i,t} + p_t m_{i,t}) \right\} \tag{15}$$

subject to collateral constraint

$$w_t l_{i,t} + p_t m_{i,t} \leq c_{i,t} + F_{i,t} \cdot \chi\left(\theta_0 k_{i,t} + \theta_1 \Psi(k_{i,t})\right) + (1 - F_{i,t}) \cdot \left(\theta_0 k_{i,t} + \theta_1 \Psi(k_{i,t})\right) \tag{16}$$

where $F_{i,t} = 1$ (or A) denotes that the firm participates in the loan guarantee program and $F_{i,t} = 0$ (or N) denotes that the firm is not participating in the loan guarantee program. Firms with net worth lower than certain cutoff $\bar{n}$ are classified as SME firms. Only SME firms are allowed to participate in the loan guarantee program. We assume the exogenous exit rate equals $(1 - \epsilon)$.

We write the SME firm's optimization recursively. The equity value of a SME firm is given by $v(z_{i,t}, n_{i,t})$. We denote by the active inspection value function $v^A(z_{i,t}, n_{i,t} | n_{i,t} \leq \bar{n})$ as maximizing the present value of current and future dividends:

$$v^A(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n}) = \max_{k_{i,t+1},c_{i,t+1}} \{n_{i,t} - q_t k_{i,t+1} - c_{i,t+1} + \epsilon E\Lambda_{t,t+1} v(z_{i,t+1}, n_{i,t+1}(z_{i,t+1}, k_{i,t+1}, c_{i,t+1}, A))\} \tag{17}$$

subject to the time t non-negative dividend constraint:

$$n_{i,t} - q_t k_{i,t+1} - c_{i,t+1} \geq 0 \tag{18}$$

When a SME firm chooses not to pay the inspection cost or the firm is not eligible to participate in the loan guarantee program, the non-active value function is:

$$v^N(z_{i,t}, n_{i,t}) = \max_{k_{i,t+1},c_{i,t+1}} \{n_{i,t} - q_t k_{i,t+1} - c_{i,t+1} + \epsilon E\Lambda_{t,t+1} v(z_{i,t+1}, n_{i,t+1}(z_{i,t+1}, k_{i,t+1}, c_{i,t+1}, N))\} \tag{19}$$

also subject to the time t non-negative dividend constraint:

$$n_{i,t} - q_t k_{i,t+1} - c_{i,t+1} \geq 0 \tag{20}$$

where the stochastic discount factor $\Lambda_{t,t+1} = \frac{1}{1+r_{t+1}}$ because all the firms are collectively owned by all households.

A SME firm will choose to pay the fixed inspection cost if and only if the value from doing so is higher than not paying the fixed cost, that is, if and only if $V^A(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n}) - \xi > V^N(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n})$. For each tuple of $(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n})$, there is a unique threshold $\xi^*(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n})$ which makes the firm indifferent between these two options. The threshold is:

$$\xi^*(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n}) = V^A(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n}) - V^N(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n}) \tag{21}$$

If a SME firm in state $(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n})$ draws a fixed cost ξ below $\xi^*(z_{i,t}, n_{i,t}|n_{i,t} \leq \bar{n})$, the firm pays the fixed cost and then actively external finance its working capital, otherwise it does not.

Given the distribution of the random fixed cost and the optimal thresholds over the space of $(z_{i,t}, n_{i,t})$, the value function is eventually determined as:

$$v(z_{i,t}, n_{i,t}) = \begin{cases} -\frac{\xi^*(z_{i,t},n_{i,t})}{2} + \frac{\xi^*(z_{i,t},n_{i,t})}{\bar{\xi}} v^A(z_{i,t}, n_{i,t}) + \left(1 - \frac{\xi^*(z_{i,t},n_{i,t})}{\bar{\xi}}\right) v^N(z_{i,t}, n_{i,t}) & if\, n_{i,t} \leq \bar{n} \\ v^N(z_{i,t}, n_{i,t}) & if\, n_{i,t} > \bar{n} \end{cases} \tag{22}$$

where the cutoff $\bar{n}$ is determined in equilibrium to match the share of total output of SMEs in the model economy comparing to the data.

5.4 Quantitative Analysis (to-be-completed)

In the to-be-completed quantitative analysis section, we aim to calibrate the model to the economy of Morocco and use our findings to quantitatively exercise the following analysis:

- **Identification** Using our empirical findings, especially the dynamics of firm growth (dynamic micro-moments) with access to the loan guarantee programs, we could identify the corresponding central parameters (3) of collateral constraints (2) and profit erosion (1).
- **Quantification** Given the identified central parameters, we could then decompose how the interactions of size-dependent collateral constraints, working capital constraints, and erosion matter for the observed capital misallocation.
- **Counterfactuals** We will then use the quantitative model to quantify the magnitude of the effects of the existing loan guarantee programs. And finally, we will conduct a counterfactual analysis for the effects of further expansions of the loan guarantee programs.

6 Conclusion

In this paper, we study through what channels loan guarantee programs promote firm growth and we examine their macroeconomic implications.

Empirically, using a unique firm-level dataset of a credit guarantee program in Morocco, we show that firms with guaranteed loans expand homogeneously their production scale with an increase in both labor and capital inputs and sharply decrease their cash holdings. These indicate that the guarantee programs mitigate SMEs' credit constraints, especially in the short run. These effects are especially strong for younger and smaller firms.

Based on our empirical findings, we then build a heterogeneous firm model in which firms face the interactions of collateral constraints, working capital constraints, and erosion in profits. In the model, constrained firms preserve a large proportion of resources in the form of unproductive cash instead of productive capital to finance short-run working capital. A loan guarantee program mitigates credit constraints by inducing firms to reduce their cash holdings and expand their production scale. Also, with the presence of erosion in profit, a loan guarantee program generate a permanent increase in the scale of production, without any growth reversal.

In progress The next step is to use our empirical findings, especially the dynamics of firm growth with access to the loan guarantee programs (dynamic micro-moments), to identify the corresponding central parameters of collateral constraints and profit erosion. Then we would like to decompose how the interactions of size-dependent collateral constraints, working capital constraints, and profit erosion matter for the observed capital misallocation. We will then use the identified quantitative model to quantify the magnitude of the effects of the existing loan guarantee programs. And finally, we would like to conduct a counterfactual analysis to study the effects of further expansions of the loan guarantee programs, along with a reduction in profit erosion.

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Online Appendix

A Sample Construction and Statistics

We pair the Tamwilcom guarantee dataset and the Orbis balance-sheet dataset in four rounds. In the first round, considering that firm's registered ID with the chamber of commerce is not unique across regions, a unique combination of two variables of national ID and date of firm creation is applied to conduct the first round of pairing. This yields good pairing results owing to the good coverage of both variables. In the second round, we use the firm's national ID and name as a unique combination. As a first step, redundant elements in firm names are trimmed away, such as STE, SARL, and Société. With more compact firm names, the Levenshtein distance between two firm names is calculated to locate the closest match. A string distance of up to two generally indicates a good match. The third round of pairing relies on the combination of firm name and address. Paired results from this step only yield a small number of matches. The final round is based on the firm's name and the date of firm creation; the pairing rate is low as well.

B Matching procedure

Caliper A caliper is implemented with the purpose of ensuring the common support assumption. A caliper refers to the maximum distance allowed between a treated firm and its controls. Any control firm that is beyond this caliper is dropped. This is to ensure that all control firms in the final sample are similar enough to the treated firm that it is matched with. The choice of caliper is derived from the 0.9-quantile of the distribution of distances between observations in nearest neighbor pairwise matching with replacement, multiplied by 1.5. The choice is based on Jann (2017), Huber, Lechner, and Wunsch (2013), Huber, Lechner, and Steinmayr (2015) after considering the variance-bias trade-off: choosing a large caliper would include more control observations, thus decreasing variance; however, the bias would increase if a non-comparable and distant control is included.

Weighing The analysis unit is firm-year, based on a similar procedure in Brown and Earle (2017). Matched observations of treated firms are assigned with a weight of one, whereas those of control firms are allocated with a weight based on its distance from the corresponding treated firm. We first calculate the kernel weight of each matched control observation based on its distance from the treated firm, using the Epanechnikov kernel function with the same bandwidth used in the matching. Subsequently, the weight of each control observation is rescaled as the share of its kernel weight in the sum of kernel weights of all controls matched with the same treated firm. This weight rescaling intends to up-weight those control firms close to treated firms and down-weight those that are far away. For treated firms, only the firm-year observation of guarantee receipt year is kept. This is to avoid the situation where a treated observation is matched with another observation from a treated firm in a year where it does not receive a guarantee. For control firms, multiple firm-year observations that belong to the same firm are maintained in the pool of potential controls for matching, provided that the firm's data covers a three-year history of selected financial variables. The matching is carried out with a replacement, which implies that one firm-year observation of an untreated firm can be selected more than once.

C Robustness Checks

The first robustness test corresponds to concerns regarding the number of pre-treatment years used for matching. Existing literature suggests that we should rely on at least three years' pre-treatment performance for matching, which is our main estimation. In this robustness check, we extend the number of years to four and five. Table 9 reports the estimated results when we match on four years' data. As a result of the stricter matching requirement, the number of treated firms that have at least one matched control firm drops to 622, compared to 991 in the main setup. The results in year $t + 1$ and year $t + 2$ remain robust and significant on a similar level, with small changes in the scale of coefficients. However, the results of year $t + 3$ mostly lose significance due to the loss of observations. This is within expectation due to the limited length of our data panel. When we increase the number of years used for matching to five, we only have 346 guaranteed firms that enter in the final sample, about a third of observations in our main setup. The estimated results for the year $t + 1$ in Table 10 are less significant for sales, costs of employees, and cash with a smaller scale of coefficient, whereas the results for fixed assets and inventory are not significant. As we can see, small sample bias is introduced due to the stricter matching procedure.

The second robustness test is to correct the bias from the data attrition issue. The main concern arises from the loss of observations of small firms during matching. Considering that small firms often report very limited financial data, it could potentially lead to their exclusion in the matching process due to missing data points. In order to correct this bias, we use inverse probability weighting (ipw) (Amamou, Gereben, and Wolski, 2020) to increase the weight of under-represented SMEs and decrease the weight of those that are over-represented. As a first step, we calculate the number of small, medium, and large firms in the sample of Tamwilcom-guaranteed firms that can be merged with Orbis. As discussed earlier, this sample shares similar statistical properties with the sample of all Tamwilcom guaranteed firms. The reason for choosing this

Table 9:
Estimation Results of Year $t+1$ from Matching on Four Pre-Treatment Years' Data

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.123***	0.114***	0.123***	-0.117+	0.071*
	(0.019)	(0.020)	(0.033)	(0.064)	(0.034)
N	20083	19332	18514	19959	14087
Adjusted R^2	0.415	0.285	0.213	0.420	0.257
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we match on four pre-treatment years' data. The dependent variables are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash, and inventory) in year $t+1$ from year $t-1$. Only year $t+1$ is reported for reasons of space. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 10:
Estimation Results of Year $t+1$ from Matching on Five Pre-Treatment Years' Data

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.064**	0.073**	0.026	-0.250**	0.046
	(0.024)	(0.026)	(0.039)	(0.083)	(0.046)
N	11768	11325	10920	11690	8204
Adjusted R^2	0.434	0.291	0.232	0.426	0.266
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we match on five pre-treatment years' data. The dependent variables are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash, and inventory) in year $t+1$ from year $t-1$. Only year $t+1$ is reported for reasons of space. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

merged sample rather than the full sample is that we can use the size information provided by Orbis. We assume that information on firm size composition in this merged sample can reflect that of the full sample. As a second step, we count the number of firms of different sizes in the processed sample after matching and divide the number of small, medium, and large firms in the processed sample by its number in the original sample before matching. The inverse of the proportion is then used as weight to re-scale the representation of different-sized firms in the final sample. As Table 11 shows, estimation results are similar to the main ones. The scale of coefficients for sales and fixed assets are similar; however, the scales are smaller for costs of employees and inventory and are much larger for cash. This is potentially in line with the fact that small firms, which are less resistant to liquidity shocks, prefer to stock more resources in cash. As a result, the effect of reduced cash hoarding is more pronounced with a guaranteed loan.

Table 11:
Estimation Results of Year $t + 1$ with Inverse Probability Weight

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.126***	0.094***	0.131***	-0.241***	0.083*
	(0.020)	(0.019)	(0.032)	(0.058)	(0.032)
N	30136	28618	27576	30083	21066
Adjusted R^2	0.431	0.302	0.246	0.391	0.271
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment (“Guaranteed") from DID regression in the robustness test, where we use the technique of inverse probability weight to correct data attrition bias. The dependent variables are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash and inventory) in year $t + 1$ from year $t - 1$. Only year $t + 1$ is reported for reasons of space. “Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

The third set of checks intends to test the robustness of the main results when we emphasize matching on cash-related variables to reduce the difference in cash level of treated and control firms after matching in Figure 3. As a first test, we use one-to-one nearest neighbor matching to ensure that only the closest control firm is selected. This is to see if the difference in gap results from any chosen control firm that is not similar enough to its matched neighbor. As we can see in Figure 5, the gap remains large and is very similar to the five-to-one nearest neighbor matching. In view of this, we rule out the possibility that remote control firms contribute to the difference in cash. As a further test, we only include logged cash and the ratio of cash to total assets in the matching process. This setup “forces" a good matching result on cash by not including other variables so that the measurement of Mahalanobis distance is only based on cash-related variables. In addition, we divide the variable of logged cash into 20 quantile intervals and apply exact matching on the interval. Figure 6 shows that this procedure manages to substantially improve the matching performance on cash. Furthermore, total assets is balanced as well due to the incorporation of the ratio of cash to total assets. However, we observe a gap in sales. In order to reduce this gap, we modify the setup to match on cash ratio and logged sales. As Figure 7 indicates, the good balancedness in cash, total assets, and current liabilities are preserved while the difference in sales is decreased. Estimation results on cash-related variables for these two robustness tests are in Table 12 and Table 14, whereas Table 13 and Table 15 include estimation results on other outcome variables. As we can observe in Table 12 and Table 14, there is a large decline in the ratio of cash to total assets, attesting to the robustness of our main results. In addition, We can observe a large and positive effect on sales and fixed assets in Table 12 and Table 14. However, there is no significant effect on labor cost and inventory. This is possibly due to the loss of data points since the matched samples in both set-ups have less than 200 guaranteed firms that have matches.

In the next robustness test, we include propensity score as one variable in the calculation of Mahalanobis distance. We exploit the predictive power of a logit model, where the dependent variable is a dummy of one if a firm is guaranteed in a certain year, and independent variables are the same as those selected for calculating Mahalanobis distance. Table 16 reports the estimation results, which are similar to our main results. We conduct another robustness test where we increase the number of nearest neighbors matched with guaranteed firms to ten. What we find is that the results are not sensitive to the number of controls chosen for the treated firm, as shown in Table 17. We also apply the matching procedure without replacement and confirm that estimation results stay similar as shown in Table 18.

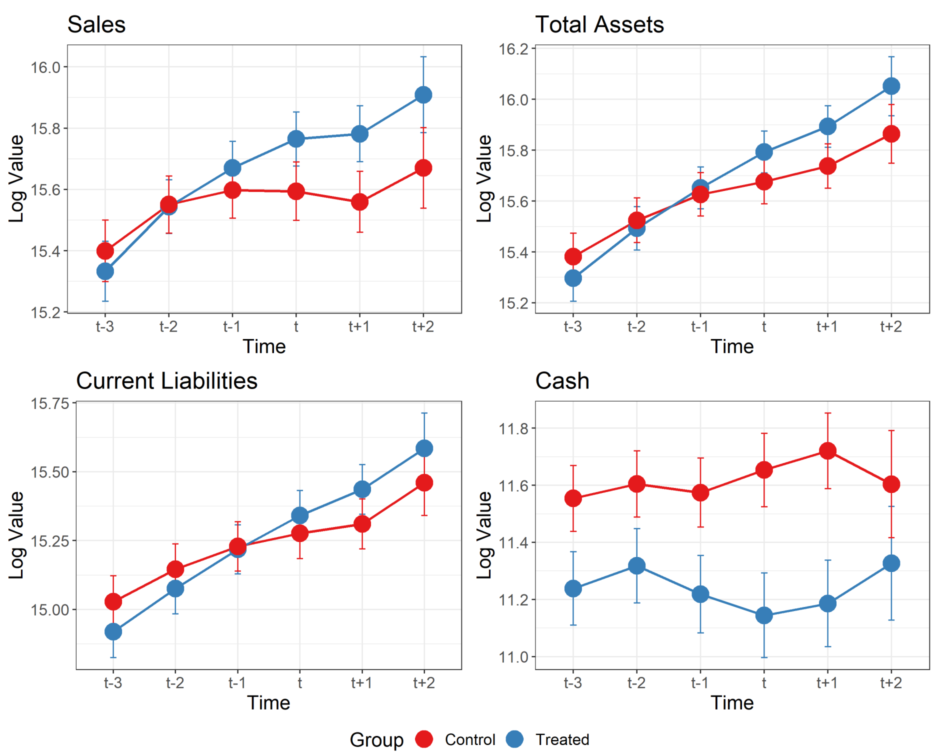
Table 12:
Estimation Results of Cash from Matching on Logged Cash and Cash Ratio

	(1)	(2)	(3)	(4)	(5)	(6)
	Cash Growth			Cash/Total Assets		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	-0.152	-0.436**	-0.042	-0.032***	-0.037***	-0.031*
	(0.109)	(0.138)	(0.244)	(0.007)	(0.010)	(0.014)
N	4414	3551	2699	4414	3551	2699
Adjusted R^2	0.323	0.337	0.350	0.332	0.323	0.280
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we only include logged cash and the ratio of cash to total assets from three pre-treatment years for matching. In addition, we divide the variable of logged cash into 20 quantile intervals and apply exact matching on the interval. The dependent variable "Cash Growth" is the log difference of cash and cash equivalent in year $t+1$, $t+2$ and $t+3$ from year $t-1$. The dependent variable "Ratio of Cash to Total Assets" refers to the amount of cash and cash equivalent divided by total assets in year $t+1$, $t+2$ and $t+3$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

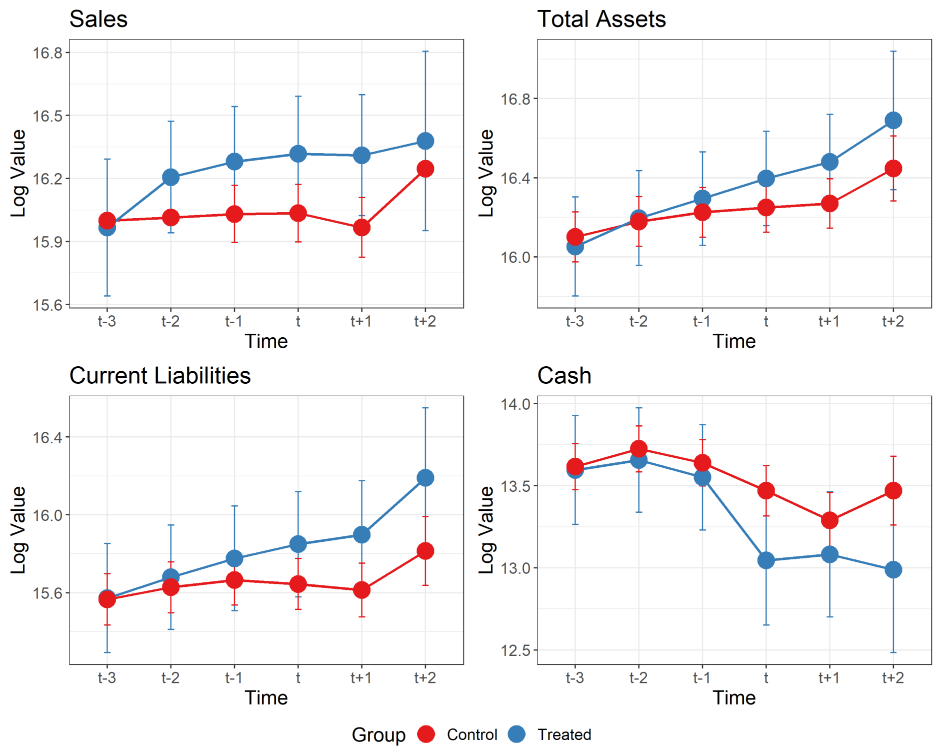
D Additional Tables and Figures

Figure 5:
Robustness: Trend Inspection from Matching with One Nearest Neighbor



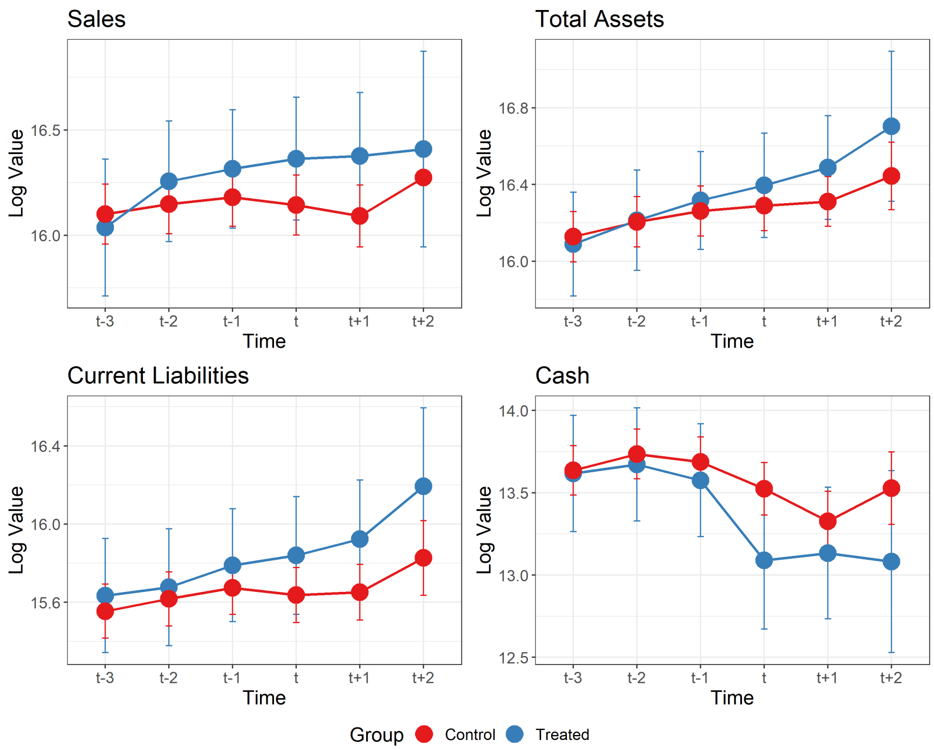
Notes: This figure depicts the weighted average of the log values of sales, total assets, current liabilities, and cash in year $t-3$ to $t+2$ of treated and control firms from the robustness test, where we match only one nearest control firm for a treated firm. Confidence interval is at 95% level.

Figure 6:
Robustness: Trend Inspection from Matching on Log Cash and Cash Ratio



Notes: This figure depicts the weighted average of the log values of sales, total assets, current liabilities, and cash in year $t-3$ to $t+2$ of treated and control firms from the robustness test, where we only include logged cash and the ratio of cash to total assets from three pre-treatment years for matching. In this robustness test, we also divide the variable of logged cash into 20 quantile intervals and apply exact matching on this interval. Confidence interval is at 95% level.

Figure 7:
Robustness: Trend Inspection from Matching on Log Sales and Cash Ratio



Notes: This figure depicts the log values of sales, total assets, current liabilities, and cash in year $t-3$ to $t+2$ of both treated and control firms from the robustness test, where we only include logged sales and the ratio of cash to total assets from three pre-treatment years for matching. In this robustness test, we also divide the variable of logged cash into 20 quantile intervals and apply exact matching on this interval. Confidence interval is at 95% level.

Table 13:
Estimation Results of Year $t + 1$ from Matching on Logged Cash and Cash Ratio

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.095*	0.007	0.286***	-0.152	0.072
	(0.043)	(0.032)	(0.056)	(0.109)	(0.075)
N	4373	4116	4179	4414	3200
Adjusted R^2	0.265	0.294	0.197	0.323	0.243
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment (“Guaranteed") from DID regression in the robustness test, where we only include logged cash and the ratio of cash to total assets from three pre-treatment years for matching. In addition, we divide the variable of logged cash into 20 quantile intervals and apply exact matching on the interval. The dependent variables reported in this table are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash, and inventory) in year $t + 1$ from year $t - 1$. Only year $t + 1$ is reported for reasons of space. “Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 14:
Estimation Results of Cash from Matching on Logged Sales and Cash Ratio

	(1)	(2)	(3)	(4)	(5)	(6)
	Cash Growth			Cash/Total Assets		
	t+1	t+2	t+3	t+1	t+2	t+3
Guaranteed	-0.102	-0.400**	0.278	-0.026***	-0.040***	-0.020
	(0.113)	(0.141)	(0.252)	(0.008)	(0.010)	(0.014)
N	3982	3198	2422	3982	3198	2422
Adjusted R^2	0.293	0.317	0.318	0.349	0.346	0.294
Group × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment (“Guaranteed") from DID regression in the robustness test, where we only include logged sales and the ratio of cash to total assets from three pre-treatment years for matching. In addition, we divide the variable of logged cash into 20 quantile intervals and apply exact matching on the interval. The dependent variable “Cash Growth" is the log difference of cash and cash equivalent in year $t + 1$, $t + 2$ and $t + 3$ from year $t - 1$. The dependent variable “Ratio of Cash to Total Assets" refers to the amount of cash and cash equivalent divided by total assets in year $t + 1$, $t + 2$ and $t + 3$. “Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 15:
ESTIMATION RESULTS OF YEAR $t + 1$ FROM MATCHING ON LOGGED SALES AND CASH RATIO

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.150***	0.029	0.278***	-0.102	0.070
	(0.038)	(0.037)	(0.054)	(0.113)	(0.075)
N	4029	3849	3795	3982	2988
Adjusted R^2	0.312	0.277	0.221	0.293	0.228
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we only include logged sales and the ratio of cash to total assets from three pre-treatment years for matching. In addition, we divide the variable of logged cash into 20 quantile intervals and apply exact matching on the interval. The dependent variables reported in this table are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash and inventory) in year $t + 1$ from year $t - 1$. Only year $t + 1$ is reported for reasons of space. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 16:
ESTIMATION RESULTS OF YEAR $t + 1$ WITH PROPENSITY SCORE IN MULTIVARIATE MATCHING

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.152***	0.111***	0.125***	-0.140**	0.119***
	(0.016)	(0.016)	(0.026)	(0.050)	(0.029)
N	29905	28434	27409	29882	20895
Adjusted R^2	0.417	0.288	0.237	0.378	0.259
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we include propensity score as one variable in the calculation of Mahalanobis distance. The dependent variable in the logit model is a dummy of one if a firm is guaranteed in a certain year, and the independent variables are the same ones selected for calculating Mahalanobis distance in the main setup. Outcome variables reported in this table are the log difference of five main variables (sales, labor costs, fixed assets, cash, and inventory) in year $t + 1$ from year $t - 1$. Only year $t + 1$ is reported for reasons of space. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 17:
Estimation Results of Year $t + 1$ from Matching on 10 Nearest Neighbors

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.131***	0.108***	0.118***	-0.137**	0.112***
	(0.014)	(0.014)	(0.022)	(0.044)	(0.024)
N	50579	47910	46174	50490	35372
Adjusted R^2	0.435	0.323	0.276	0.413	0.310
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we match up to 10 nearest control firms for a treated firm. The dependent variables are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash, and inventory) in year $t + 1$ from year $t - 1$. Only year $t + 1$ is reported for reasons of space. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 18:
Estimation Results of Year $t + 1$ from Matching without Replacement

	(1)	(2)	(3)	(4)	(5)
	Sales	Costs of Employees	Fixed Assets	Cash	Inventory
Guaranteed	0.117***	0.094***	0.132***	-0.305***	0.146***
	(0.019)	(0.021)	(0.033)	(0.062)	(0.036)
N	18698	17892	17137	18577	13442
Adjusted R^2	0.392	0.273	0.222	0.396	0.245
Group × Year FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports the coefficients of treatment ("Guaranteed") from DID regression in the robustness test, where we apply the matching procedure without replacement. The dependent variables are the log difference of five main outcome variables (sales, labor costs, fixed assets, cash, and inventory) in year $t + 1$ from year $t - 1$. Only year $t + 1$ is reported for reasons of space. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year t. The interaction of group and year fixed effects is included.

Table 19:
Standardized Mean Difference and Variance Ratio:
Raw and Matched Sample

Sample	Raw			Matched		
Mean	Treated	Untreated	StdDif	Treated	Untreated	StdDif
ln(total assets)$_{t-1}$	15.65	14.32	0.81	15.63	15.59	0.02
ln(sales)$_{t-1}$	15.67	13.99	1.00	15.63	15.54	0.05
ln(current liabilities)$_{t-1}$	15.20	13.90	0.74	15.19	15.19	-0.001
ln(cash)$_{t-1}$	11.21	11.02	0.08	11.23	11.65	-0.18
ln(total assets)$_{t-2}$	15.49	14.26	0.74	15.47	15.49	-0.01
ln(sales)$_{t-2}$	15.54	13.99	0.91	15.51	15.49	0.01
ln(current liabilities)$_{t-2}$	15.06	13.85	0.69	15.05	15.11	-0.03
ln(cash)$_{t-2}$	11.28	11.00	0.12	11.33	11.70	-0.17
ln(total assets)$_{t-3}$	15.28	14.14	0.65	15.28	15.35	-0.04
ln(sales)$_{t-3}$	15.28	13.86	0.77	15.30	15.35	-0.02
ln(current liabilities)$_{t-3}$	14.88	13.73	0.63	14.90	15.00	-0.05
ln(cash)$_{t-3}$	11.22	10.98	0.11	11.24	11.61	-0.17
ln(age)	2.33	2.28	0.07	2.32	2.38	-0.09
Variances	Treated	Untreated	Ratio	Treated	Untreated	Ratio
ln(total assets)$_{t-1}$	1.98	3.33	0.60	1.94	2.14	0.91
ln(sales)$_{t-1}$	2.15	3.54	0.61	2.18	2.46	0.89
ln(current liabilities)$_{t-1}$	2.47	3.58	0.69	2.29	2.24	1.02
ln(cash)$_{t-1}$	5.44	4.94	1.10	5.28	4.26	1.24
ln(total assets)$_{t-2}$	2.14	3.41	0.63	2.06	2.25	0.92
ln(sales)$_{t-2}$	2.22	3.54	0.63	2.18	2.48	0.88
ln(current liabilities)$_{t-2}$	2.49	3.67	0.68	2.35	2.31	1.02
ln(cash)$_{t-2}$	5.05	4.77	1.06	4.80	3.89	1.24
ln(total assets)$_{t-3}$	2.48	3.62	0.68	2.31	2.45	0.94
ln(sales)$_{t-3}$	2.97	3.91	0.76	2.67	2.85	0.94
ln(current liabilities)$_{t-3}$	2.74	3.97	0.69	2.47	2.48	1.00
ln(cash)$_{t-3}$	4.83	4.70	1.03	4.65	3.95	1.18
ln(age)	0.37	0.37	1.01	0.37	0.31	1.18

Notes: This table reports the standardized mean differences (“StdDif") and variance ratios (“Ratio") of the raw sample and the matched sample, reported by Stata *kmatch* package (see Jann (2017)). All variables are log-transformed.