# Short-term Finance, Long-term Effects*

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**Abstract**

We study the effect of short-term finance on firm growth and its aggregate implications in emerging economies. In theory, short-term finance promotes firm growth by enabling entrepreneurs to allocate their net worth more efficiently away from unproductive cash and towards productive capital. Importantly, these effects are persistent only if firms face intertemporal distortions in the form of exit risk or a tax on net worth. The quantitative model fitted to Moroccan data replicates qualitatively and quantitatively the observational impacts of a loan guarantee program (LGP) designed to relax short-term financial constraints. Fitting the model to the data also reveals that intertemporal distortions are large and that the costs of participating in the LGP are high. This implies that there are potentially large gains from increasing the guaranteed ratio and decreasing the participation costs. These two policies generate substantial growth and welfare gains, with the former generating relatively higher growth and the latter motivating relatively more participation.

Keywords: SME financing; financial frictions; liquidity constraints; developing economy;
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# 1 Introduction

The lack of access to external credit for Small and Medium Enterprises (SMEs) is one of the major development bottlenecks in MENAP (Middle East, North Africa, Afghanistan, and Pakistan) countries. For instance, Blancher et al. (2019) find that closing the SME financial inclusion gap in those countries would increase annual growth by up to 1%. The first purpose of this paper is to study the ability of loan guarantee programs (LGP) targeted at SMEs to improve their access to credit, the extent to which it actually promotes development, and through which channels, using a model calibrated to Moroccan firm-level data on an ongoing LGP.

The second purpose of this paper is to understand the effect of short-term external finance on firm growth and the aggregate economy in emerging countries. Financial frictions hinder the ability of firms to use inputs efficiently, affect firm growth, and, therefore, lower economic development, especially in emerging economies. Extensive literature addresses how the scarcity of long-term external finance leads to under-leveraged small and young enterprises and hinders economic development.[1] However, little attention has been paid to the scarcity of short-term external finance in emerging countries. This paper fills that gap.

The role of short-term external finance is different from long-term external finance. Long-term external finance promotes firm growth since it directly enlarges entrepreneurs' total asset scale, given their net worth. Short-term external finance, as we show in a simple dynamic model, promotes firm growth by enabling a more efficient allocation of the entrepreneurs' existing net worth. Since entrepreneurs in emerging economies tend to hoard a substantial amount of cash to meet their working capital needs, short-term external finance promotes firm growth by allowing entrepreneurs to allocate their net worth more efficiently away from unproductive cash and towards productive capital. Importantly, these effects are persistent only if firms face intertemporal distortions in the form of exit risk or a tax on net worth. These distortions, by discouraging net worth accumulation, prevent firms from outgrowing their financial constraints through savings and self-financing. Therefore, in the presence of intertemporal distortions, better access to external finance has both short-term and long-term impacts.

To evaluate the equilibrium growth and welfare gains of expanding credit guarantee programs, we calibrate and estimate a quantitative model using a loan guarantee program (LGP) designed to relax short-term external financial constraints in Morocco. Our dataset combines Moroccan firm-level data from Orbis with the national-level loan guarantee data from Tamwilcom.[2]

[1]See Cooley and Quadrini (2001), Albuquerque and Hopenhayn (2004), Clementi and Hopenhayn (2006), DeMarzo and Fishman (2007), Buera, Kaboski, and Shin (2011a), and Arellano, Bai, and Zhang (2012), among others.

[2]Tamwilcom is a public financial institution under the supervision of the Central Bank of Morocco, Bank Al-Maghrib. Therefore, the national loan guarantee data covers every firm that has ever been guaranteed in Morocco.

The model includes, for quantitative purposes, a uniformly distributed LGP participation cost and a size-dependent collateral constraint. The participation cost prevents small firms from entering the program as only firms with a high enough growth potential self-select into the program. In contrast, the large firms do not self-select into the program since they do not need the guarantee. These assumptions are important quantitatively to fit the endogenous selection of firms into the program and the observed hump-shaped participation rate in firm size.

There are two main takeaways from the model's calibration. First, a high participation cost, equivalent to one-third of the average net worth, is needed to fit the low LGP participation rate of 3.8%. This implies that only large constrained, or small fortunate firms can access the guarantee. This large number reflects a lack of access of small firms to the guarantee program due to geographical barriers or to the fact that many small firms do not have a relationship with the banking system. Making access to the LGP easier is, therefore, one channel through which the program can be expanded. Second, intertemporal distortions are large. These large distortions imply that credit guarantees have a strong impact on firms both in the short and long run.

We empirically validate the findings from our model by using our Moroccan data. The empirical results show that, relative to their peers, (i) guaranteed firms expand their production scale homogeneously by increasing sales, capital input, and labor input by about 10% relative to their matched peers and (ii) they decrease their cash-to-asset ratio. Importantly, the results are persistent, which is consistent with the presence of intertemporal distortions. We do not interpret these results as causal, as we cannot rule out self-selection: firms that are more productive can endogeneously self-select into the program. However, our quantitative model, which accounts for self-selection, is able to replicate the empirically estimated impact of the guarantee: the model-simulated data yields estimation results that are similar to the empirical model.

We then examine two policies aimed at expanding the LGP: a higher guaranteed ratio and a lower participation cost. We show that the gains from enlarging the loan guarantee programs by reducing both frictions are substantial. Increasing the guaranteed ratio from 60% to 80%, as in Indonesia, more than doubles the participation rate, decreases the cash ratio by 1.2 percentage points, and achieves an output growth of 0.09% and a welfare gain of 0.25%. Decreasing participation costs achieves less extra growth and welfare, but increases the participation rate further without substantially increasing the guaranteed portfolio. Interestingly, increasing the guaranteed ratio also has a positive effect on participation, as it increases the gains from participating in the program. This is especially true for small firms, which are more likely to be constrained while productive.

This paper relates to the large theoretical literature on firms' financial frictions and their aggregate implications, 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), Gopinath et al. (2017), Jo and Senga (2019), Buera, Kaboski, and Shin (2021) and others. We contribute to this literature first by focusing on short-term finance. We show that short-term external finance promotes firm growth by allowing entrepreneurs to allocate their net worth more efficiently towards productive capital stock and away from unproductive cash holdings. Second, we contribute to a better understanding of the aggregate impact of external finance. The literature has shown that the gains from access to external finance are elusive. In particular, when productivity shocks are persistent, firms typically grow out of their collateral constraints through savings and self-financing (Moll, 2014; Buera, Kaboski, and Shin, 2021). We show that intertemporal distortions, that is, distortions in the consumption/saving choices of entrepreneurs, are an overlooked and crucial factor that amplifies the aggregate effect of external finance by hindering firms' self-financing abilities. This intertemporal friction interacts with the external finance frictions to determine the long-run scale of firms. We estimate these distortions and show that they are important in Morocco. We also show, by performing counterfactual exercises, that they contribute substantially to the aggregate effect of the LGPs.[3]

In our model, credit guarantees are modeled explicitly. Firms face a credit constraint that is micro-founded in the spirit of Hart and Moore (1994) and Kiyotaki and Moore (1997). The renegotiation-proof debt contract generates a debt limit equal to the creditors' outside value. This outside option depends on the liquidation value of the firm. Credit guarantees affect the firms' credit constraints by increasing the creditors' outside value. We assume that the firms' participation constraint is always satisfied, which we check ex-post in our quantitative analysis. In other studies, the credit policy is typically modeled as a technology that reduces or annihilates the enforceability constraint of the loan (Jo and Senga, 2019; Buera, Kaboski, and Shin, 2011b, 2021). We acknowledge here that credit guarantees do not improve the firms' credit access through better enforceability of the loan but rather by affecting the banks' incentives to provide loans. Another strand of the literature has shown that when markets are prone to adverse selection (Stiglitz and Weiss, 1981), credit guarantees improve aggregate outcomes (Smith and Stutzer, 1989; Gale, 1990; Philippon and Skreta, 2012). Other papers, some of which were motivated by the Covid-19 crisis, focus on emergency credit guarantee programs that are put in place to limit firms' defaults and debt overhang (Philippon and Schnabl, 2013; Elenev, Landvoigt, and Van Nieuwerburgh, 2022; Glode and Opp, 2023; Martin, Mayordomo, and Vanasco, 2023).

This paper also contributes to the empirical literature on credit guarantee schemes. A credit

[3] Intertemporal distortions are often in the background of theoretical papers studying firms' financial frictions in the form of an exit probability or a tax, but their role is not made explicit or quantified. See for instance Arellano, Bai, and Zhang (2012), Jo and Senga (2019), Cooley and Quadrini (2001).

guarantee scheme is one of the most common policy tools to facilitate SMEs' access to finance. Gudger (1998) and Green (2003) provide an overview of credit guarantee programs' typology, design, implementation, and general evaluation worldwide. Beck, Klapper, and Mendoza (2010) survey 76 partial credit guarantee schemes across 46 developed and developing countries. Saadani, Arvai, and Rocha (2011) focus on the Middle East and North Africa (MENA) and review credit guarantee programs in 10 countries in the MENA region. Some empirical contributions study the impact of guarantee programs using microdata, including Paravisini (2008), Oh et al. (2009), Lelarge, Sraer, and Thesmar (2010), Bach (2013), Banerjee and Duflo (2014), Brown and Earle (2017), Mullins and Toro (2018), Bhue, Prabhala, and Tantri (2019), Wilcox and Yasuda (2019), Barrot et al. (2019) and Bachas, Kim, and Yannelis (2021). Our paper contributes to the literature by presenting new empirical findings on the usage of cash and the profile of growth post-guarantee. Our evidence is not causal but is used to validate our model.

The rest of the paper is organized as follows. Section 2 lays down the full model. Section 3 presents the mechanism and implications of short-term financial constraints in a simple special case. Section 4 calibrates the full model to Moroccan firm-level data and a Moroccan loan guarantee program. Section 5 documents some empirical findings and validates the quantitative analysis. Finally, Section 6 performs policy experiments.

## 2 The Model

We consider an economy with heterogeneous entrepreneurs facing collateral and working capital constraints, intertemporal distortions, and access to short-term loan guarantees with fixed participation costs. Time is discrete. There is a unit mass of entrepreneurs indexed by $i \in [0, 1]$. Each entrepreneur owns a firm that is subject to idiosyncratic productivity shock. We do not distinguish entrepreneurs and firms. Firms decide how much investment to undertake, how much labor to hire, how much debt to issue, how much cash to hold, and how many dividends to pay. They face three frictions: first, external financial friction in the form of a collateral constraint and a working capital constraint; second, intertemporal distortions in the form of an exogenous exit risk and a tax on net worth; third, imperfect selection into the guarantee program in the form of a stochastic participation cost. A capital good producer and a unit mass of other households complete this general equilibrium model.

## 2.1 Technology and Production

**Technology** Each firm $i$ produces with capital $k_{i,t}$, and labor $l_{i,t}$ using the production function $y_{i,t} = z_{i,t}F(k_{i,t}, l_{i,t}) + (1-\delta)q_t k_{it}$, where $z_{i,t}$ is the firm's idiosyncratic stochastic productivity, which follows an exogenous Markov process $\log(z_{i,t}) = \rho_z \log(z_{it-1}) + \sigma_z \varepsilon_{i,t}$, with $\varepsilon_{i,t}$ a standard normal i.i.d. process, $\delta$ is the capital depreciation rate and $q_t$ is the price of capital. The input combination $F(k_{i,t}, l_{i,t})$ features decreasing returns 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: they are required to pay their current period wage bill $w_t l_{i,t}$ before production. They can finance this working capital through both internal and external funds: they can use their cash holdings $c_{i,t}$ or short-term borrowing $b_{i,t} \leq \bar{b}_{i,t}$. Therefore, the working capital constraint is $w_t l_{i,t} \leq c_{i,t} + \bar{b}_{i,t}$.

## 2.2 Credit Market

Firms can access competitive financial intermediaries, who receive deposits from all households (including cash from entrepreneurs) and provide short-term loans to firms. The competitive financial intermediaries make zero net profit with the same market deposit interest rate and loan interest rate of $r_t$. Contracts are imperfectly enforceable, as entrepreneurs can walk away without completing production. This gives rise to a short-term borrowing constraint.

The short-term borrowing $b_{i,t} \leq \bar{b}_{i,t}$ of the firm $i$ is subject to a collateral constraint. Since entrepreneurs can easily transfer their liquid assets (cash holdings), financial intermediaries only consider their illiquid assets (fixed capital) as collateral. As in Hart and Moore (1994) and Kiyotaki and Moore (1997), we assume that the firm's creditors impose a repudiation-proof debt limit on the firm. This debt limit is equal to the liquidation value of the firm, which is the outside option of the creditors.[4] Since the liquidation of the firm's fixed capital would incur fixed costs and proportional re-structuring costs, the collateral constraint could, therefore, be nonlinear in the firm's capital stock (Gopinath et al., 2017). We write the liquidation value as $\Theta(k_{i,t})$, which will be specified later. Without guarantees, the debt limit $\bar{b}_{i,t}$ is equal to the liquidation value $\Theta(k_{i,t})$.

We are assuming here that the firm participation constraint is always satisfied and firms do not default in equilibrium. In the event of default, the firm does not pay back its debt but loses its capital stock. For default to be ruled out, it is enough that the depreciated value of capital $(1-\delta)k_{it}$ is higher than the total value of debt repayments. We assume this condition is satisfied throughout, but check the ex-post to ensure it is indeed the case in the quantitative analysis.

[4] As in Kiyotaki and Moore (1997), we consider a situation where firms can negotiate the debt down to the liquidation value of the firm's capital because the value of the project is zero without the cooperation of the firm owner.

## 2.3 Loan Guarantee

We now introduce the loan guarantee programs. For the sake of fitting the Moroccan credit market and LGP, we make the following assumptions. First, a certain fraction of credit is non-bank third-party credit, which the government can hardly guarantee.[5] Therefore, we assume that there are two types of intermediaries: banks, which can benefit from the LGP, and non-bank creditors, which cannot. We denote bank loans by $b_{it}^{b}$ and the non-bank loans by $b_{it}^{nb}$. In case of liquidation, banks are entitled to a fraction $s \in [0, 1]$ of the firm's collateral in case of default, while non-bank creditors are entitled to a fraction $1 - s$. This fraction $s$ represents the relative bargaining power of bank and non-bank creditors in appropriating the liquidation value once the firm has defaulted. This means that the firm could renegotiate its formal debt $b_{it}^{b}$ down to $s\Theta(k_{it})$ with the banks and its informal debt $b_{it}^{nb}$ down to $(1 - s)\Theta(k_{it})$ with its informal creditors. Banks and non-bank creditors thus each impose a separate renegotiation-proof debt limit: $b_{it}^{b} \leq s\Theta(k_{it})$ and $b_{it}^{nb} \leq (1 - s)\Theta(k_{it})$. This implies that in practice, a proportion $s$ of a firm's loans comes from formal banks, and a proportion $(1 - s)$ comes from non-bank creditors.

Second, the LGP does not restrict large firms from applying.[6] With a fixed commission fee, unconstrained large firms would self-select not to participate.

Third, a firm's selection into LGP does not perfectly reflect its profitability. Therefore, we assume that firms participating in the LGP incur a uniformly distributed random fixed participation cost $\xi \in [0, \bar{\xi}]$, which is paid in units of labor. This fixed cost accounts for all the explicit and implicit barriers to accessing the guarantees, which can be pecuniary, geographical, or cognitive. In practice, this cost can reflect an unequal access to the guarantee. Moreover, as we will see, because of this cost, only firms that are profitable enough will select into the guarantee. The model can then account for endogenous self-selection.[7]

Finally, upon successfully getting the guaranteed loan, a fraction $x$ of the bank loans $b_{i,t}^{b}$ is guaranteed, and the firm pays a commission fee $\mu$ on top of the interest rate for the guaranteed part of the loan to the government. If the guaranteed firm defaults, the government would repay the guaranteed proportion $x$ of the loan to the banks.

**The LGP multiplier** If the firm obtain the guarantee, then the bank's outside option increases by the amount $xb_{i,t}^{b}$, which means that the renegotiation-proof debt limit on bank loans becomes $b_{i,t}^{b} \leq s\Theta(k_{i,t}) + xb_{i,t}^{b}$. This generates a financial multiplier effect: for each unit of additional bank

[5] For instance, a large fraction of credit in Morocco is composed of trade credit.

[6] In fact, the Moroccan LGP does impose a limit on firm size, but this limit is not binding in practice as very few large firms apply to guarantee. In alternative specifications, we impose a cap on firm size in the LGP. The quantitative results are almost equivalent to the baseline model.

[7] A random fixed cost setup is widely used in the lumpy investment literature, i.e., Khan and Thomas (2008), Fang (2021), and Fang (2023). It is also introduced in Chen, Deng, and Fang (2022) for patent collateral participation.

loan, the firm increases its liquidation value by $x$. The effective constraint, which takes into account this multiplier effect, is then: $b^b_{i,t} \leq s\chi\Theta(k_{i,t})$, where $\chi = \frac{1}{1-x}$ is the LGP multiplier. The LGP multiplier is greater than one and can be very large. For instance, if the government guarantees 60% of the bank loan, then $\chi = \frac{100\%}{100\%-60\%} = 2.5$.

**Effective constraint on total borrowing** Let $F = \{A, N\}$ indicate whether a firm decides to pay the fixed participation cost and participate in the LGP. When $F = N$, the firm does not pay the participation cost and can only borrow up to its original collateral constraint. When $F = A$, the firm pays the participation cost and relaxes its borrowing constraint. In that case, the firm can borrow up to $\chi$ times more in the form of bank loans. Therefore, the effective constraint on total borrowing $b_{i,t} = b^b_{i,t} + b^{nb}_{i,t}$ that the firm faces depends on $F$:

$$b_{i,t} \leq \begin{cases} (1 + (\chi - 1)s)\Theta(k_{i,t}) & if\, F = A \\ \Theta(k_{i,t}) & if\, F = N \end{cases}$$

## 2.4 Recursive Problem for Firms

The individual state variables of a firm are its idiosyncratic productivity $z_{i,t}$ and its beginning-of-period net worth $n_{i,t-1}$. Firm decisions are divided into three sub-periods. In the first sub-period, the firm learns about the participation cost for the next period and decides whether to participate in the LGP. In the second sub-period, the firm makes production and working capital decisions. In the third sub-period, it makes consumption and saving decisions.

**Production Decisions** It is useful first to consider the production decisions, which happen in the second sub-period, before the participation decisions in the first sub-period. In the second sub-period, after having drawn its participation cost $\xi^i_t$ and decided whether to participate ($F^i_t = A$) or not ($F^i_t = N$) in the LGP, the firm maximizes its total net revenue given its productivity, its beginning-of-period net worth, and its LGP participation decision $F^i_t$. The firm decides how much capital $q_t k_{i,t}$ to invest, how much cash $c_{i,t}$ to hold, and how much labor $w_t l_{i,t}$ to hire. Given the working capital and collateral constraints, the firm maximizes its net revenue

$$\pi^*(z_{i,t}, n_{i,t-1}, F_{i,t}) = \max_{k^i_t, c^i_t, l^i_t, b^i_t} \left\{ z_{i,t}F(k_{i,t}, l_{i,t}) - w_t l_{i,t} + (1-\delta)q_t k_{i,t} + (1+r_t)c_{i,t} - r_t b_{i,t} - \mu\tilde{b}_{i,t} \right\} \tag{1}$$

subject to the constraints

$$n_{i,t-1} = q_t k_{i,t} + c_{i,t} \tag{2}$$

$$w_t l_{i,t} \leq c_{i,t} + \mathbb{1}_{F_{i,t}=A} \cdot (1 + (\chi - 1)s)\Theta(k_{i,t}) + (1 - \mathbb{1}_{F_{i,t}=A}) \cdot \Theta(k_{i,t}) \tag{3}$$

$$b_{i,t} = w_t l_{i,t} - c_{i,t} \tag{4}$$

$$\tilde{b}_{i,t} \equiv \mathbb{1}_{F_{i,t}=A} \cdot \chi s \Theta(k_{i,t}) \tag{5}$$

where $\tilde{b}_{i,t}$ is the guaranteed proportion of loans that pays a commission fee $\mu$.

**Participation Decision** Now that we understand how net revenues are affected by participation in the LGP, we can characterize the participation decision $F_{i,t}$. In the first sub-period, the chooses to participate ($F_{i,t} = A$) whenever $\xi_t^i < \xi^*(z_{i,t}, n_{i,t-1})$, where $\xi^*(z_{i,t}, n_{i,t-1})$ is a threshold participation cost:

$$\xi^*(z_{i,t}, n_{i,t-1}) = \frac{\pi^*(z_{i,t}, n_{i,t-1}, A) - \pi^*(z_{i,t}, n_{i,t-1}, N)}{w_t} \tag{6}$$

A firm with state $(z_{i,t}, n_{i,t-1})$ which draws a fixed cost higher than $\xi^*(z_{i,t}, n_{i,t-1})$ will not participate ($F_{i,t} = N$) in the loan guarantee program. Otherwise, it pays the fixed cost and joins the program.

**Intertemporal Decisions and Intertemporal Distortions** Finally, in the third sub-period, the entrepreneur makes saving and consumption decisions. The entrepreneur faces two intertemporal distortions that are relevant to their consumption/saving choices. The first is due to the high exit risk that firms face in emerging countries. We assume an exogenous survival rate $\epsilon \leq 1$. Exiting firms are replaced with the same measure of entrants with an initial low net worth $\underline{n}_0$.[8] The second is the "erosion" of the firm's net worth, which we represent through a tax on net worth $\tau \geq 0$. This erosion could come from effective taxes, but also red tape, corruption, and expropriation risk and captures the entrepreneur's potential losses on their net worth in developing countries. Both the exit risk and net worth erosion work as intertemporal distortions. We will use our Moroccan firm-level data to discipline these distortions and quantify their economic effects.

The entrepreneur makes consumption/saving decisions to maximize her value function $v(z_{i,t}, n_{i,t-1}, F_{i,t})$ given her end-of-period total net revenue $\pi^*(z_{i,t}, n_{i,t-1}, F_{i,t})$ and her participation cost $\xi_t^i$. We write the entrepreneur's optimization recursively:

$$v(z_{i,t}, n_{i,t-1}, F_{i,t}, \xi_t^i) = \max_{d_{i,t}, n_t^i} \left\{ \frac{d_{i,t}^{1-\eta}}{1-\eta} + \beta \epsilon E_t[\tilde{v}(z_{i,t+1}, n_{i,t})] \right\} \tag{7}$$

where $\beta$ is the stochastic discount factor of the entrepreneur.

The net worth follows the accumulation rule:

$$n_{i,t} = (1-\tau) \left\{ \pi^*(z_{i,t}, n_{i,t-1}, F_{i,t}) - d_{i,t} - w_t \xi_{i,t} \right\} \tag{8}$$

[8]The initial net worth $\underline{n}_0$ of all new entrants equals the post-restructuring net worth of exiting firms. We assume that financial institutions owned by all households conduct the restructuring, so such restructuring costs return to households' total income.

Finally, $\tilde{v}(z_{i,t+1}, n_{i,t})$ is the ex-ante value of the firm before drawing the new participation cost in period $t+1$. Therefore, $\tilde{v}(z_{i,t+1}, n_{i,t}) \equiv \frac{\xi^*(z_{i,t+1}, n_{i,t})}{\bar{\xi}} v(z_{i,t+1}, n_{i,t}, A) + (1 - \frac{\xi^*(z_{i,t+1}, n_{i,t})}{\bar{\xi}}) v(z_{i,t+1}, n_{i,t}, N)$, because $\xi^*(z_{i,t}, n_{i,t})$ is bounded between 0 and $\bar{\xi}$.

## 2.5 Other Households and the Capital Good Producer

The general equilibrium model is completed by introducing a unit mass of identical households that consume and supply labor and the capital goods producer who supplies investment goods.

**Other Households** There is a unit measure continuum of identical non-entrepreneur households with preferences over consumption $C_t$ and labor supply $L_t$ whose expected utility is:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{C_t^{1-\eta}}{1-\eta} - \theta \frac{L_t^{1+\omega}}{1+\omega} \right)$$

subject to the budget constraint $C_t + \frac{1}{1+r_t} B_t \leq B_{t-1} + w_t L_t + \Pi_t$, where $\beta$ is the discount factor of households, $\theta$ is the disutility of working, $r_t$ is the interest rate, $B_t$ is a one-period bond, and $w_t$ is the wage. $\Pi_t$ summarizes all the profits from financial institutions and all the government gains or losses in the loan guarantee program that are transferred to other households. Households choose consumption, labor, and bonds, which supply two Euler equations that determine both the wage and the real interest rate:

$$w_t = -\frac{U_l(C_t, L_t)}{U_c(C_t, L_t)} = \theta L_t^{\omega} C_t^{\eta} \tag{9}$$

$$\frac{1}{1+r_t} = \beta \frac{U_c(C_{t+1}, L_{t+1})}{U_c(C_t, L_t)} = \beta \Big( \frac{C_t}{C_{t+1}} \Big)^{\eta} \tag{10}$$

**Capital Good Producer** There is a representative capital good producer who produces new aggregate capital using the technology $\Phi(I_t/K_t)K_t$, where $I_t$ are units of the final good used to produce capital, $K_t = \int k_{jt} dj$ is the aggregate capital stock at the beginning of the period, $\Phi(I_t/K_t) = \frac{\delta/\phi}{1-1/\phi} \left( \frac{I_t}{K_t} \right)^{1-1/\phi} - \frac{\delta}{\phi - 1}$, and $\delta$ is the steady-state investment rate. Profit maximization pins down the relative price of capital as $q_t = \frac{1}{\Phi'(I_t/K_t)} = \frac{I_t/K_t}{\delta}^{1/\phi}$.

## 2.6 Equilibrium Definition

We now characterize and define the equilibrium of the model. We focus on the stationary equilibrium, given current government policies.

**Definition 1 (Stationary Equilibrium)** *A stationary equilibrium for this economy is defined by a set of policy functions* $\{v(z,n,F,\xi),\ \xi^*(z,n),\ k(z,n,F),\ c(z,n,F),\ l(z,n,F),\ \pi(z,n,F),\ d(z,n,F,\xi)\}$*, a set of quantities* $\{C, L, Y, K\}$*, a set of prices* $\{w, r, q\}$*, and a distribution* $\mu'(z,n,F,\xi)$ *that solves the firms' problem, capital good producer's problem, household's problem, and market clearing of labor and final goods such that:*

*(i). [Firm Optimization] Taking the aggregate prices* $\{w, r, q\}$ *as given,* $\{v(z,n,F,\xi),\ \xi^*(z,n),\ k(z,n,F),\ c(z,n,F),\ \pi(z,n,F),\ d(z,n,F,\xi)\}$ *solve the firms' static participation and production choices and the dynamic consumption/saving choice.*

*(ii). [Household and Capital Good Producer Optimization] Taking the aggregate prices* $\{w, r, q\}$ *as given,* $C$ *and* $L$ *solve the household's utility maximization problem and* $I$ *and* $K$ *solve the capital producer's maximization problem.*

*(iii). [Market Clearing] Given the aggregate prices* $\{w, r, q\}$ *as given, the labor market clears* $L = \int l(z,n,F)d\mu'(z,n,F,\xi)$*, and the final goods market clears* $Y = C + D + I + \Delta$*, where* $D = \int d(z,n,F,\xi)d\mu'(z,n,F,\xi)$ *is the sum of entrepreneurs' dividend and* $\Delta = \int \tau n(z,n,F,\xi)d\mu'(z,n,F,\xi)$ *is the sum of the net worth erosion across all firms.*

*(iv). The quantities* $\{C, L, Y, K\}$*, prices* $\{w, r, q\}$*, and distribution* $\mu'(z,n,F,\xi)$ *are constant.*

# 3 The Mechanism and Predictions

Before we turn to the quantitative and empirical analyses, we consider a simple, special case of the model in partial equilibrium to illustrate the main mechanisms that could qualitatively guide our empirical analysis and discuss their aggregate implications.

The mechanism generates three predictions. First, we show how, in the joint presence of collateral and working capital constraints, getting access to the loan guarantee program alleviates cash needs, allocates resources to productive capital, and achieves higher sales in the short run. Second, we show that while the loan guarantee always benefits firms in the short run, the guarantee affects the firm's long-run scale only in the presence of intertemporal distortions. Third, selection into the program is endogenous: when the participation cost prevents the participation of small and unproductive firms, it also lowers the participation of large firms due to sufficient self-financing. As a result, we should observe a hump-shaped participation rate in the loan guarantee program over firm size.

### 3.1 A Special Case

We consider a special case of the full model defined as follows:

**Definition 2 (A Special Case)** *In the special case, we make the following assumptions:*

*(i). The technology is Leontief, and productivity is constant:*

$$y_t = Z[min(k_t, a^{-1}l_t)]^{\alpha} \tag{11}$$

*where $Z$ is the firm's constant total productivity, $a^{-1}$ measures the relative labor productivity of the firm, and $\alpha$ is the curvature of the production function.*

*(ii). The collateral constraint is linear: $\Theta(k_t) = \theta k$. Note that in a conventional calibration, labor share relative to capital share is $a \approx 2$, and $\theta < 1$, so we assume that $a > \theta$.*

*(iii). The loan guarantee does not incur fees: $\mu = 0$, the participation cost is zero: $\xi = 0$, and all credits are formal loans: $s = 1$.*

*(iv). The wage, the price of capital, and the interest rate are constant as the economy is in a partial equilibrium: $w_t = q_t = 1$ and $1 + r_t = 1/\beta$.*

In what follows, we discuss the effects of short-term finance in the form of LGPs on the firm's optimal choices of capital and cash and on firm growth. The LGP helps the firm scale up its pledgeable share of capital ($\theta$) from $\theta_{low}$ ($F = N$) to $\theta_{high}$ ($F = A$) where the additional share ($\theta_{high} - \theta_{low}$) is guaranteed by the government. We compare the trajectories of a firm in two worlds, one in which it obtains access to the guarantee and one in which it does not.

Define $\psi_t = Z[min(k_t, a^{-1}l_t)]^{\alpha} - q_t k_t - w_t l_t + (1 - \delta)k_t$ as the equilibrium profits. With the Leontieff assumption, $l_t = ak_t$ always holds. Then, since $w_t = q_t = 1$, $\psi_t = \psi(k_t) = Zk_t^{\alpha} - (a + \delta)k_t$. We consolidate the firm's problem, represented by Equation (1) and Equation (7). The following maximization can summarize the firm's choice:

$$v(n_{t-1}) = \max_{k_t, c_t, d_t, n_t} \left\{ \frac{d_t^{1-\eta}}{1-\eta} + \beta\epsilon v(n_t) \right\} \tag{12}$$

subject to the constraints

$$(1 - \tau)[\psi(k_t) + (1 + r_t)c_t] - d_t - n_t \geq 0 \tag{13}$$

$$n_{t-1} \geq k_t + c_t \tag{14}$$

$$c_t + \theta k_t \geq ak_t \tag{15}$$

$$c_t \geq 0 \tag{16}$$

## 3.2 Short-run Growth and Resource Reallocation from Cash to Capital

In the first step, we analyze how scaling up the firm's pledgeable share from $\theta_{low}$ to $\theta_{high}$ affects the static production and financing choices of the firm's decisions given its net worth $n_t$.

Denote by $\eta_t$ the shadow price of the budget constraint (13), and $\gamma_t\eta_t(1-\tau)$, $\lambda_t\eta_t(1-\tau)$ and $\zeta_t\eta_t(1-\tau)$ the shadow prices of, respectively, the net worth allocation constraint (14), the working capital constraint (15) and the non-negative cash constraint (16). The shadow prices are normalized by $[\eta_t(1-\tau)]^{-1}$ for convenience. From the first-order conditions of the objective equation (12) concerning capital and cash holdings, we can derive the relationship between the marginal benefit of capital ($MBK$) and marginal benefit of cash holding ($MBC$) through the three shadow prices. The full derivation is in Appendix B.1.1. Below we describe the relationship between $MBK$ and $MBC$.

$$\gamma_t = MBK_t = MBC_t + \zeta_t \tag{17}$$

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

$$MBK_t = \underbrace{\psi'(k_t)}_{\text{Physical Return of Assets}} + \underbrace{\lambda_t(\theta - a)}_{\text{Shadow Return of Finance}}$$

$$MBC_t = \underbrace{1 + r_t}_{\text{Physical Return of Assets}} + \underbrace{\lambda_t}_{\text{Shadow Return of Finance}}$$

with $\psi'(k_t) = Z\alpha k_t^{\alpha-1} - (a+\delta)$. Both capital and cash have a physical return on assets and a shadow return on finance. These physical and shadow returns may differ. First, capital has a large physical return $\psi'(k_t)$ for a sufficiently small firm, while cash has a low physical return. Second, capital has a negative shadow return of finance $(\lambda_t(\theta - a))$.[9] Increasing the capital stock increases the demand for labor and, hence, the need for working capital, thus increasing the tightness of the collateral constraint. However, cash provides a positive shadow return of finance ($\lambda_t > 0$) because increasing cash reduces the need for external working capital funds, thus relaxing the tightness of collateral constraint.

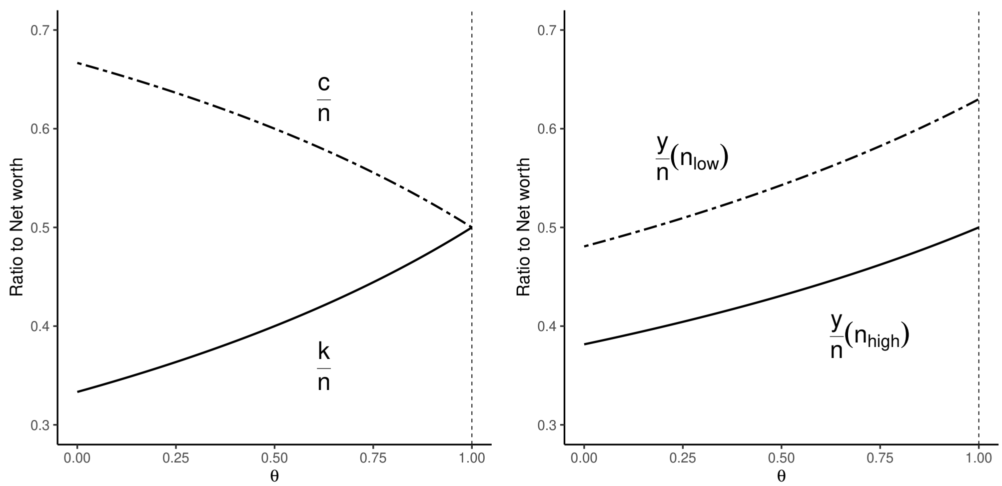
The optimal choice of a constrained firm whose demand for cash is positive ($\zeta_t = 0$), that is, a sufficiently small firm, would be to build cash holdings up to achieve a shadow benefit of relaxing the collateral constraint such that $MBK_t = MBC_t$. This yields an optimal shadow return of finance from cash $\lambda_t^* = \frac{\psi'(k_t)-r_t}{1+a-\theta}$. This shadow return is proportional to the return of capital $\psi'(k_t)$, which is

[9] 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. As a result, $(\lambda_t(\theta - a)) < 0$ always holds.

higher for smaller firms, as $\psi(\cdot)$ decreases in $k$, and $k$ is constrained by $n$. Combining the binding collateral and working capital constraints ($ak_t = c_t + \theta k_t$) and the budget constraint ($c_t + k_t = n_t$), the constrained firm's choices of capital and cash are proportional to net worth:

$$k_t^* = k(\theta, n_t) = \frac{1}{1 + a - \theta} n_t, \quad c_t^* = c(\theta, n_t) = \frac{a - \theta}{1 + a - \theta} n_t. \tag{18}$$

Figure 1: Relationship between Optimal Choices and $\theta$




(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 $\theta$. The numerical calibration of the parameters corresponds to an annual frequency: the annual depreciation in the capital is set to $\delta = 0.1$, returns to scale are set to $\alpha = 2/3$, the labor to capital share is set to $a = 2$, and $n_{low} = 1$ and $n_{high} = 2$ stand for small and large entrepreneurs.

Using the production function (11) along with the optimal capital and cash equations (18), we can determine how the capital, cash, and output choices are affected by $\theta$, which is summarized in Proposition 1 below. Figure 1 illustrates these properties in Proposition 1 visually.

**Proposition 1** *Suppose that the economy is described by the special case laid down in Definition 2. LGPs that increase the firm's collateral $\theta$ increase the shadow benefit of relaxing the collateral constraint and, therefore,*

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

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

*(iii). increase the firm's optimal sales $\left(\frac{\partial y}{\partial \theta} > 0\right)$.*

***Proof.*** *(i), (ii), and (iii) are derived directly from Equation (18).*

## 3.3 Long-run Scales of the Firms with Intertemporal Distortions

In the second step, we analyze how increasing the firm's collateral ability from $\theta_{low}$ to $\theta_{high}$ affects the long-run scale of the firm. We now consider the firm's intertemporal choices and derive the first-order conditions of the firm's objective (12) with respect to dividends, future net worth, and cash. The full derivation is in Appendix B.1.1. The derived Euler equation is as follows:

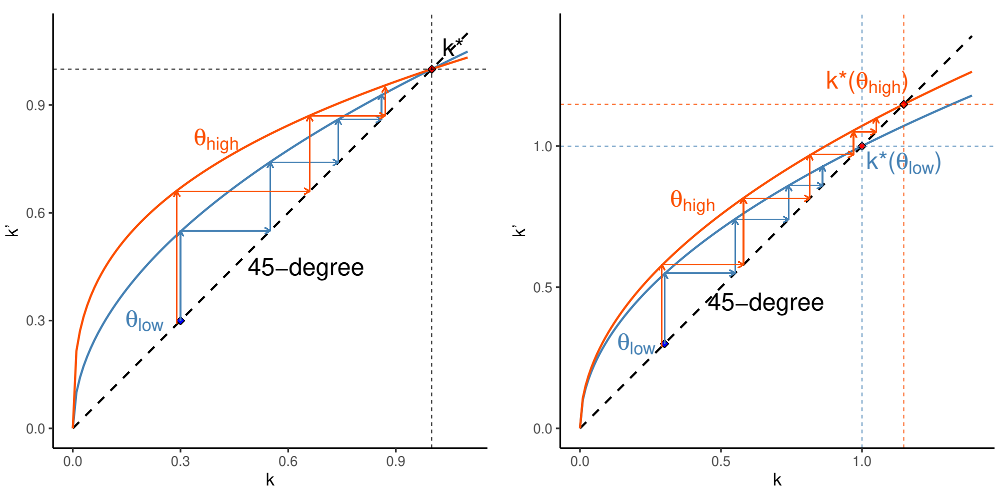
$$1 = \beta\epsilon(1-\tau)\left(\frac{d_{t+1}}{d_t}\right)^{-\eta}((1+r_{t+1})+\lambda_{t+1}) \tag{19}$$

where $\epsilon(1-\tau) < 1$ is the total intertemporal distortion resulting from both the exit risk and the net worth erosion and distorts the entrepreneur's net worth accumulation. If the firm survives long enough, the shadow price of the constraint admits a long-term value that we denote by $\lambda^{LT}$. It is defined by the Euler equation (19) where $d_t = d_{t+1} = d^{LT}$:

$$\lambda^{LT} = \frac{1}{\beta\epsilon(1-\tau)} - (1+r^{LT}) \tag{20}$$

where $\beta(1+r^{LT}) = 1$ if the economy is in a steady state.

Figure 2: Dynamics of Firm's Long-term Growth




(a) Without Intertemporal Distortions $\epsilon(1-\tau) = 1$ (b) With Intertemporal Distortions $\epsilon(1-\tau) < 1$

Note: Given the erosion conditions, this plot shows the entrepreneur's growth dynamics. The numerical calibration of the parameters is conventional to an annual model: $\delta = 0.1$ stands for annual depreciation in the 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.

As a result, the long-term shadow price of cash is positive ($\lambda^{LT} > 0$) in the long run only if $\epsilon(1-\tau) < 1$, that is, if entrepreneurs face intertemporal distortions. Therefore, a key implication is that the firm's long-run scale is affected by financial constraints only in the presence of intertemporal distortions. Otherwise, the financial constraints are irrelevant ($\lambda^{LT} = 0$) in the long run, so financial constraints only affect the speed at which the firm converges to that long-term scale. The following proposition summarizes how the financial constraints affect the firm's long-run scale.

**Proposition 2** *Suppose that the economy is described by the special case defined in Definition 2.*

*(i) The financial constraints remain relevant in the long run (i.e., $\lambda^{LT} > 0$) if and only if the intertemporal distortions are non-negligible: $\epsilon(1-\tau) < 1$. In that case*

$$\lambda^{LT} = \frac{1}{\beta}\left(\frac{1}{\epsilon(1-\tau)} - 1\right) > 0 \tag{21}$$

*(ii) In the long run, the gap between long-term capital $k^{LT}$ and the undistorted capital stock $k^{opt}$ is affected by the long-term shadow value of the financial constraint $\lambda^{LT}$ following*

$$\psi'(k^{LT}) - \psi'(k^*) = (1 + a - \theta)\lambda^{LT} > 0 \tag{22}$$

*where $\lambda^{LT}$ is defined in equation (21), and $\psi'(k^*) = 1/\beta - (1-\delta)$.*

***Proof.*** *See Appendix B.1.2.*

The first point of Proposition 2 restates the above discussion. The second point describes in more detail how the distortion in long-term capital accumulation depends on the interaction between the intertemporal distortions (through $\lambda^{LT}$) and the collateral constraint (through $\theta$). The expression (22) shows clearly that the intertemporal distortions and the collateral constraint reinforce their respective impact on capital accumulation in the long run. An increase in $\theta$ increases the stock of capital for firms that are below their long-run scale compared to a firm that does not benefit from an increased $\theta$. This increase is temporary without intertemporal distortions as the long-run scale is unchanged. In the presence of intertemporal distortions, a firm that benefits from an increased $\theta$ converges to a larger scale.

## 3.4 Endogenous Selection into the Guarantee Program

In the final step, we analyze how increasing the firm's collateral from $\theta_{low}$ to $\theta_{high}$ and the participation cost affects the participation of firms in the guarantee program and discuss the potential aggregate implications.

We still consider the same special case above, except that the participation cost is now strictly positive $\xi > 0$. In this case, we examine which type of firm self-selects into the loan guarantee program. A firm decides to ask for the guarantee only if $\psi(k(\theta_{high}, n_t)) - \psi(k(\theta_{low}, n_t)) > \xi$, which we can approximate as follows:

$$\psi'(k(\theta_{low}, n_t)) \cdot n_t > \frac{\xi}{\Delta\theta} \tag{23}$$

where we used $k(\theta_{high}, n_t) - k(\theta_{low}, n_t) \simeq n_t \Delta\theta$ with $\Delta\theta \equiv \theta_{high} - \theta_{low}$. Importantly, considering the participation cost $\xi$ and the guarantee increment $\Delta\theta$, essentially two factors decide whether a firm joins the loan guarantee program: marginal productivity $\psi'(\cdot)$ and net worth $n_t$.

**Proposition 3** *Suppose that the economy is described by the special case defined in Definition 2, but now the participation cost is positive: $\xi > 0$.*

*(i) Given net worth $n_t$, more productive firms (with high marginal productivity $\psi'(\cdot)$) would be more likely to self-select into the program.*

*(ii) Given marginal productivity $\psi'(\cdot)$, firms with a high net worth $n_t$ would be more likely to self-select into the program.*

*(iii) Neither very large firms ($\psi'(\cdot) \to 0$) nor very small firms ($n \to 0$) will self-select into the program. The participation rate would be hump-shaped in firm size.*

***Proof.*** *(i), (ii), and (iii) are derived directly from Equation (23).*

The first and second points of Proposition 3 indicates that the self-selection into the guarantee program benefits the aggregate as resources are allocated to firms with a higher growth potential or with a higher total output. The third point shows that the limited guarantee resources are not allocated to firms which cannot afford it or firms which do not need it at all.

However, there is still a group of firms that are inefficiently constrained. These high-potential firms with high $\psi'(\cdot)$ but a low net worth $n_t$ may have low incentives to ask for a guarantee. In that case, the firm is limited in its capacity to increase its scale, which limits the incentives to pay the participation cost $\xi$. As a result, some small but productive firms may still not ask for a guarantee if the participation cost is high. Lower participation costs $\xi$ or an increase in the guaranteed ratio $\Delta\theta$ could potentially motivate these firms to participate.

## 3.5 Remarks on the Mechanisms and Predictions

This simple special case suggests that lowering participation costs or increasing the guaranteed ratio could push productive but small firms to participate in the LGPs and achieve a higher scale.

We will test these policy suggestions in the fully parameterized quantitative model in Section 4 below. This simple model also provides three predictions on how LGPs should affect firm static production and financing choices in the short run and in the long run. First, firms with LGPs lower their unproductive cash holdings and increase their productive capital stock. Second, firms with LGPs achieve a persistent increase in their production scale if they face non-negligible intertemporal distortions. Third, the participation rate in the LGPs is hump-shaped over firm size because small firms and firms with lower marginal productivity self-select out of the loan guarantee program. We will confront these predictions to the data in Section 5 below.

# 4 Quantitative Analysis

We now assess quantitatively how short-term finance shapes firm financing and growth. We parameterize the model to our Moroccan firm-level data and LGP program, using information on guaranteed and non-guaranteed firms. The key parameters that capture financial frictions are set to match some cross-sectional and dynamic patterns observed in the data. We then find that the model can quantitatively account for the observed growth effect of LGPs in Morocco.

## 4.1 Institutional Background and Data

Our analysis merges loan-level data from Tamwilcom, a Moroccan government institution that provides SME-related loan guarantees, with firm-level data from Orbis.

**Collateral Requirements and Loan Guarantees in Morocco** Collateral requirements for loans are exceptionally high in Morocco. Approximately 84% of the loans in Morocco require collateral, as reported by World Bank (2013). To reduce potential inefficiency caused by such high collateral requirements, Tamwilcom, as a public financial institution under the supervision of the Central Bank of Morocco, *Bank Al-Maghrib*, cooperates with four leading banks which jointly cover an extensive credit network to provide loan guarantee programs to SMEs.[10] Firms that apply for bank loans at these four leading banks and which do not have insufficient collateral but still eligible for guarantees are transferred to Tamwilcom for further assessment. Once approved, the bank grants credit to qualified borrowers, and Tamwilcom underwrites a share of the loan.

Firms in Morocco are severely financially constrained. They have almost no access to long-term formal bank loans ($<$ 1% of total corporate credit) and very limited access to short-term

[10]Tamwilcom (formerly *Caisse Centrale de Garanties*) has a long history as a credit institution dating back to 1949. Since its reform in 2012, Tamwilcom has focused on SME-related loan guarantees (Tamwilcom, 2013-2018). Our study focuses on the post-reform period from 2012 to 2018.

formal bank loans ($\approx$ 20% of total corporate credit). To fulfill their liquidity needs, they rely heavily on non-bank loans ($\approx$ 80% of total corporate credit), such as trade credit. Meanwhile, they also stockpile cash holdings, equivalent to about 42% of total corporate credit and more than 200% of bank credit[11]. To alleviate such severe financial frictions, the Moroccan government started to provide extensive LGPs for short-term loans to SMEs in 2012. This loan guarantee program is the ideal setup to evaluate the impact of short-term external finance.

**Products of the Loan Guarantee Program** Among the range of products Tamwilcom offers, we focus on two main products catering to the firm's working capital needs: Damane Exploitation and Damane Express. Damane Exploitation targets medium-sized firms requesting a short-term loan of up to 18 months. Access to Damane Exploitation is subject to a firm size threshold, but this size threshold does not appear to be binding in the data.[12] The loan size varies substantially, ranging from 180 million dirhams to as small as 1 million dirhams. Tamwilcom guarantees 60% of the loan and requires a commission fee of 0.5% of the loan amount. Damane Express is a product that targets working capital loans and is designed explicitly for small firms.[13] 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 up to 12 months and 1.5% for those beyond 12 months.

Since both programs are designed to alleviate credit constraints of firms ranging from small to medium and jointly cover almost all SMEs in Morocco, we will pool both programs together as one in our analysis. In practice, firms self-select into different programs based on the size of their liquidity needs, which is implied by the smooth sales distribution for firms guaranteed under both products, as shown in Figure 3 in Appendix A.3.

**Tamwilcom Loan-level Data** The Tamwilcom loan-level database is a unique confidential database. It covers loans guaranteed by Tamwilcom through the short-term loan guarantee programs and provides information on 43,195 loans associated with 23,017 firms guaranteed by Tamwilcom from 2009 to 2019. The database includes firm identifiers (name, national ID, address, creation date) and loan characteristics (loan approval date, maturity, loan amount, guarantee amount, commission, and maturity). The total number of guaranteed loans amounts to 87 billion dirhams, which constitutes about 3.2% of the total short-term loans to SMEs in Morocco.[14]

**Orbis Firm-level Data** The Orbis firm-level database is a commercial database by Bureau van Dijk (BvD) that is widely used in economics research (Kalemli-Ozcan et al., 2015). For Morocco, BvD collects firm-level balance sheet data from Morocco's business register, the Office of Indus-

[11] All calculations are based on firm-level data in Orbis.

[12] The size threshold is 175 million dirhams ($\approx$ 18 million US dollars). Approximately 92% of firms in the program have sales of less than 100 million dirhams. Damane Exploitation was renamed Damane Atassyir in 2019.

[13] Damane Express is also associated with a much-simplified process and a fast approval period of 48 hours.

[14] We exclude canceled guarantees and only consider the first guarantee in case of renewal.

trial and Commercial Property (OMPIC), and standardizes it to its global format. Orbis covers firms throughout the period of our loan-level data from Tamwilcom.

We pair the Tamwilcom guarantee dataset with the Orbis balance sheet dataset to construct our final data sample. Details for the pairing procedure are in Appendix A.1. The targeted moments are computed using the sample of guaranteed and non-guaranteed firms.

## 4.2 Quantitative Specifications

We specify the model's functional forms in the quantitative analysis. First, we assume that the production function is the conventional Cobb-Douglas form:

$$F(k,l) = k^{\alpha} l^{\nu}, \quad \alpha + \nu < 1$$

Second, we follow Gopinath et al. (2017) to model the size-dependent collateral constraint:

$$b_{i,t} \leq \bar{b}_{i,t} \equiv \Theta(k_{i,t}) = \theta_0 k_{i,t} + \theta_1 \Psi(k_{i,t}) = \left[\theta_0 + \theta_1 \frac{\Psi(k_{i,t})}{k_{i,t}}\right] k_{i,t} \tag{24}$$

where $\Psi(k) = exp(\gamma k) - 1$ is an increasing and convex function of capital and $\theta_0$ and $\theta_1$ are parameters characterizing the borrowing constraint. In this micro-foundation, the $\Psi(\cdot)$ function denotes an increasing and convex cost firms incur from disrupting their productive capacity. In contrast to Gopinath et al. (2017), we introduce the elasticity $\gamma$ to change the convexity of the size-dependent component of the collateral constraint to provide additional freedom to match the moments in the Moroccan firm-level data.

## 4.3 Parameterization

We group parameters into two categories. The first category includes preference and technology parameters that are difficult to identify using our data. We fix these parameters using values that are standard in existing work. The second category includes parameters that determine the process for productivity, financial frictions, and LGPs. We pin down these parameters by requiring that the model fits the salient features of the Moroccan data.

**Fixed Parameters** Table 1 lists the parameters that are calibrated from the literature. The frequency of the model is a year, so we set the discount factor $\beta = 0.96$ to match an annual interest rate of 4%. We assume log utility, which implies a unit elasticity of intertemporal substitution ($\eta = 1$). We set the Frisch elasticity of labor supply to 2, within the range of macro elasticities identified by Chetty et al. (2011), which implies an inverse Frisch $\omega = 0.5$. We then set leisure

Table 1: Fixed Parameters

| Parameter | Description | Value |
|---|---|---|
| ***Firms*** | | |
| $\alpha$ | Capital coefficient | 0.21 |
| $\nu$ | Labor coefficient | 0.64 |
| $\delta$ | Capital depreciation | 0.10 |
| $\phi$ | Capital adjustment cost | 4.0 |
| ***Households*** | | |
| $\beta$ | Discount factor | 0.96 |
| $\eta$ | Elasticity of intertemporal substitution | 1 |
| $\theta$ | Leisure preference | 2 |
| $\omega$ | Inverse Frisch | 0.5 |

Table 2: Fitted Parameters

| Parameter | Description | Value |
|---|---|---|
| ***Output Dynamics*** | | |
| $\rho_z$ | Persistence of TFP shock | 0.90 |
| $\sigma_z$ | Volatility of TFP shock | 0.06 |
| $\underline{n}_0$ | Net worth of entrants | 0.08 |
| $\epsilon$ | Survival rate | 0.91 |
| $\tau$ | Net worth erosion | 0.02 |
| ***Financial Frictions*** | | |
| $s$ | Share of formal bank loans | 0.20 |
| $\theta_0$ | Collateral constraint (size-irrelevant) | 0.01 |
| $\theta_1$ | Collateral constraint (size-dependent) | 0.26 |
| $\gamma$ | Collateral constraint (size-dependent) | 1.35 |
| ***Loan guarantee program*** | | |
| $\mu$ | Guaranteed loan commission fee | 0.005 |
| $\chi$ | Multiplier of LGP on loans | 2.5 |
| $\bar{\xi}$ | Upper bound of LGP fixed cost | 0.35 |

preference $\theta = 2$ to match the fact that households spend a third of their time working. On the firm side, we set the capital coefficient $\alpha = 0.21$ and the labor coefficient $\nu = 0.64$ to match a labor share of two-thirds and return to scale of 85%. Capital depreciates at a rate of $\delta = 0.10$ annually, and the capital adjustment cost is set to $\phi = 4.0$, which generates an average aggregate nonresidential fixed investment rate as in Bachmann, Caballero, and Engel (2013).

**Fitted Parameters** The second category of parameters, listed in Table 2, are jointly pinned down by the requirement that the model accounts for the firm-level facts in Morocco to match the moments in Table 3. First, the four parameters related to output dynamics: persistence of TFP shock $\rho_z$, volatility of TFP shock $\sigma_z$, the net worth of entrants $\underline{n}_0$, and survival rate $\epsilon$ jointly match the three moments of productivity persistence, the relative size ratio of entrants to an average firm, and the annual exit rate of firms in the data. Second, the loan guarantee parameters:

Table 3: Target Moments

| Moments | Data | Model |
|---|---|---|
| ***Output Dynamics*** | | |
| 1-year autocorrelation of output | 0.89 | 0.89 |
| 3-year autocorrelation of output | 0.69 | 0.71 |
| 5-year autocorrelation of output | 0.53 | 0.56 |
| Size ratio of entrant relative to average | 17% | 16.4% |
| Annual exit rate of firms | 9.0% | 9.0% |
| ***Financial Frictions*** | | |
| Mean debt/asset ratio (non-guaranteed) | 51% | 39% |
| Mean debt/asset ratio (guaranteed) | 64% | 64% |
| Mean cash/asset ratio (non-guaranteed) | 22% | 21% |
| Mean cash/asset ratio (guaranteed) | 9% | 6% |
| Guaranteed loan/current liability ratio | 22% | 22% |
| ***Loan guarantee program*** | | |
| Guaranteed loan commission fee | 0.5% | 0.5% |
| Percentage of loan guaranteed | 60% | 60% |
| Percentage of firms participating LGP | 3.4% | 3.4% |

Note: This table reports the moments from both the Orbis firm-level database and the Tamwilcom loan-level database. Moments of *productivity* and *entry/exit* are from all the Moroccan firms in the Orbis firm-level database. The output level of a firm is measured by its sales. The size ratio of the entrant relative to the average is calculated using total assets. The exit rate is calculated for Moroccan firms from 2006 to 2017. Moments of *financial frictions* are calculated from both the sample of the Orbis firm-level database and the sample of the Tamwilcom guarantee-level database. The debt/asset ratio only includes current liability because, for SMEs in Morocco, the long-term debt is less than 1% of their total credit.

commission fee $\mu$, multiplier of LGP on loans $\chi$, and share of guaranteed loans $s$ explicitly match the three corresponding moments of the commission fee, percentage of loan guaranteed, and guaranteed loan to current liability ratio in the data.

Then, we parameterize the other three financial friction parameters: the size-irrelevant collateral parameter $\theta_0$, the size-dependent collateral parameter $\theta_1$, and the net worth erosion parameter $\tau$ to jointly match the five moments of LGP participating rate, cash asset ratios, and debt asset ratios. The collateral constraint parameters and net worth erosion then jointly pin down the cash asset ratios and debt asset ratios of both the guaranteed and non-guaranteed firms. These four moments reflect that guaranteed firms have, on average, a 13 percentage point lower cash ratio and a 13 percentage point higher debt ratio.

The fitted exit rate $(1 - \epsilon)$ and net worth erosion $\tau$ yield a high intertemporal distortion $(1 - \epsilon) + \tau = 0.11$. Note that the exit rate $(1 - \epsilon)$ is probably overestimated, as part of the firms that exit the dataset, in fact, fail to update their registration in the trade registry. However, as the average cash and debt ratios are determined mostly by the saving behavior of firms, the total level of intertemporal distortions is strongly disciplined by these variables. Therefore, the overestimation of the exit rate is compensated by the underestimation of the net worth erosion.[15]

Finally, the upper bound of the LGP participation cost $\bar{\xi}$ mostly uniquely pins down the percentage of firms participating in LGP of 3.8%. The value of that upper bound implies an average cost of 0.175. This represents one-third of the average net worth. This number is large, implying that the barriers to participation remain important so that only large constrained firms or small lucky firms would have the chance to self-select into the program. This large number reflects an imperfect penetration of the guarantee program among small firms due to geographical barriers or the fact that many small firms do not have a relationship with the banking system. In 2023, many firms still did not have checking or deposit accounts (27% against 11% in the rest of the world, according to the World Bank Enterprise Survey) and did not interact with the banking system, which could increase the informational barriers. Many firms also cannot provide reliable financial information (only 24% of firms produce an annual financial statement reviewed by external auditors, compared to 46% in the rest of the world, according to the same source), which prevents them from submitting relevant information to banks. Administrative and cognitive costs related to the application procedure are also far from negligible. As an illustration, after 2018, when the guarantee allocation procedure was automated, the number of applications increased dramatically. Policies that lower the fixed cost by simplifying the application procedure, advertising the LGP, or diversifying the application channels are, therefore, one potential important margin to expand guarantee programs, which we discuss in the policy section.

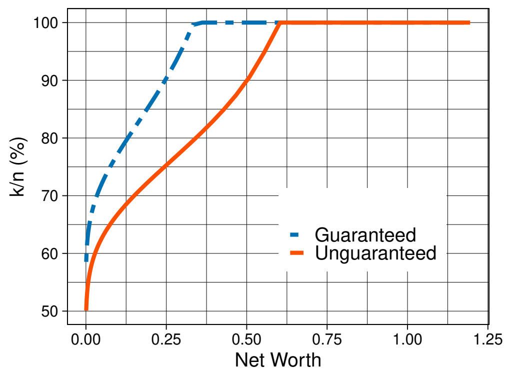
## 4.4 Model Implications

With the calibrated model, we show how the loan guarantee program affects the firm's static choice between capital and cash, the participation rate in the loan guarantee program, and the firm's long-term scale. We find that the quantitative model reproduces the mechanisms from the special case in Section 3.

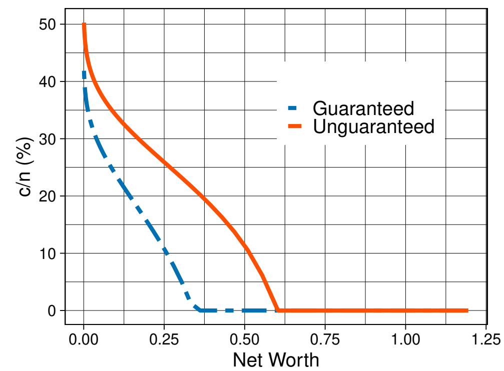
**Short-term Growth and Resource Reallocation** We first show the effects of short-term finance on the reallocation of resources from cash to capital. Figure 3 plots the optimal capital, cash, and debt policies and the realized output of guaranteed and unguaranteed firms. First, we compare the optimal policies among the dimension of net worth, focusing on unguaranteed firms. Due to their limited access to short-term external finance, smaller firms borrow less, hoard more cash, and accumulate less capital. When firms grow, their short-term financial constraints are

[15]We later check that our parametrization is consistent with the estimated long-term effect of the guarantees. Besides, as we show below, a higher exit rate reduces the aggregate impact of the guarantee for a given total intertemporal distortion. Fitting $\epsilon$ in this way thus generates conservative parameters.

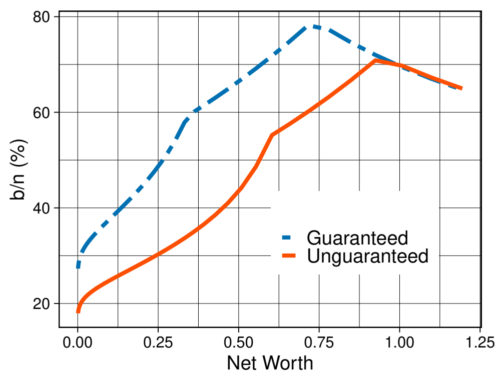
Figure 3: Reallocation of Resources from Cash to Capital



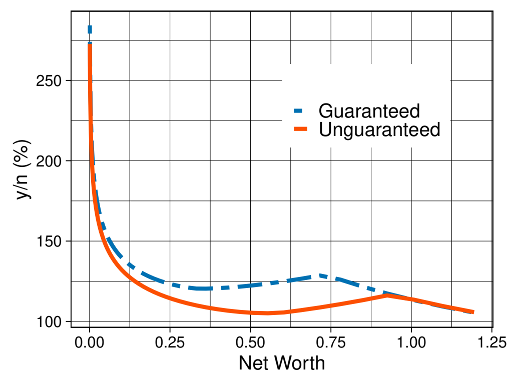

(a) Capital Policy




(b) Cash Policy




(c) Debt Policy




(d) Realized Output

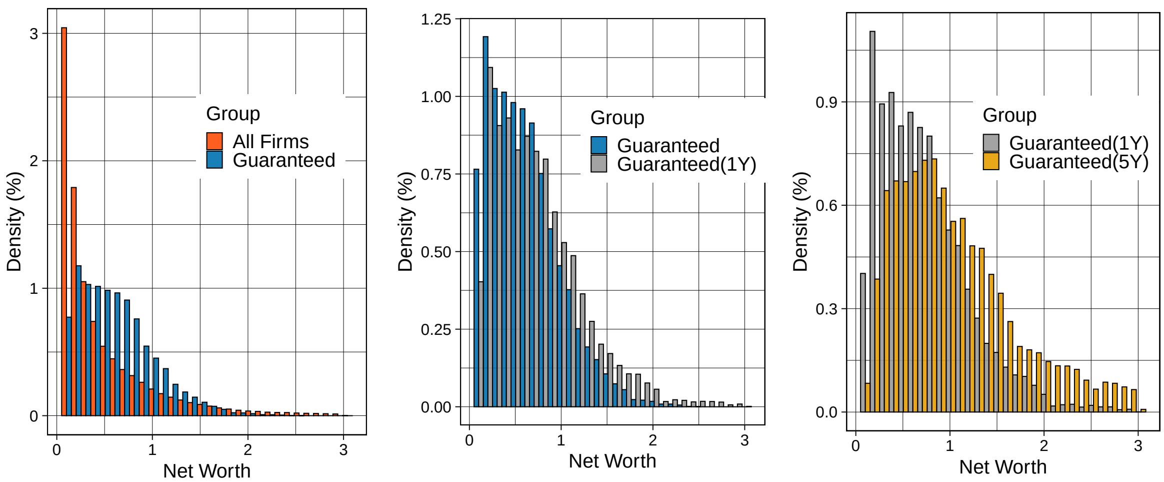
Notes: This figure shows the capital, cash, debt, and output policies as a function of net worth for firms with median productivity. The blue line stands for guaranteed firms, and the red line stands for unguaranteed firms. Net worth is truncated at 1.25 because the measure of firms larger than 1.25 is tiny, and the decision rules are monotone in net worth beyond 1.25.

relaxed, so they start borrowing more and lowering their cash holdings. Finally, if firms grow further, they become unconstrained.

Second, in Figure 3, we compare the policies and realized output of guaranteed firms versus unguaranteed firms. Generally, guaranteed firms with access to the guarantee accumulate more productive capital, lower their unproductive cash holdings, borrow more external debt, and produce more output per net worth. The changes are most significant for median-sized firms. The policies converge when firms become large and unconstrained. These effects on the reallocation of resources from cash to capital and its consequences are consistent with our empirical findings in Section 5.1 and our analytical findings in Section 3.2.

**Firms Long-Term Scale** We then show the effects of short-term finance on the long-term scale

Figure 4: Distribution of Firm Long-term Scale




(a) LGP Self-Selection (b) One Year Growth (c) Five Year Growth

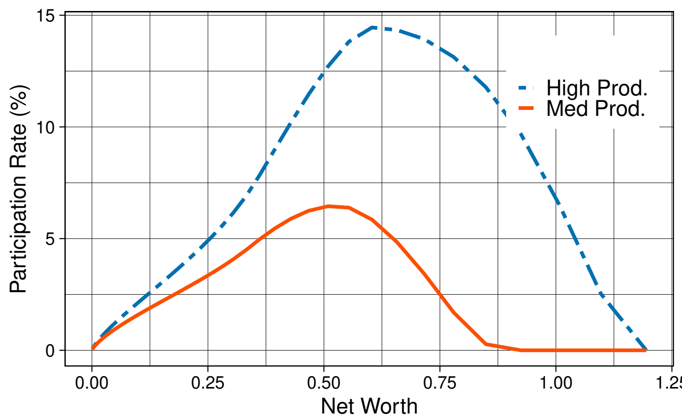
Notes: This figure shows the net worth distributions of all firms, of guaranteed firms upon their self-selection into the loan guarantee program, of guaranteed firms after one-year growth without exiting, and of guaranteed firms after five years, conditional on not exiting. It helps to distinguish the selection effect and growth effect. The mean net worth of the distributions are 0.51, 0.72, 0.85, and 1.27, respectively.

of firms. Figure 4 plots the distributions of all firms and guaranteed firms alone. More specifically, the distribution of guaranteed firms is shown in three stages. The first stage is the distribution of firms that self-select into the loan guarantee program before accessing the additional credit line. Given the random fixed participation cost, medium firms are more likely to be able to pay the fixed cost and enter the program, which is consistent with our data in Section 5.1. The difference between the distributions of *Guaranteed* and *All Firms* shows the selection effect of the loan guarantee program.

The second stage is the distribution of these guaranteed firms in the first stage after one year of growth without exiting. The additional credit line from the loan guarantee program helps them accumulate more net worth, so the distribution shifts to the right. Finally, we show the third stage, the distribution of the guaranteed firms after five years of guarantee without exiting. These firms grow significantly larger with a distribution shifting to the right. These effects on the long-term scale of firms are consistent with our empirical findings in Section 5.1 and our analytical findings in Section 3.3.

**Participation In the Guarantee Program** Figure 5 shows the participation probability for firms with two different productivity levels as a function of net worth. First, the participation rate is hump-shaped over the net worth dimension. The smallest firms hardly participate in the

Figure 5: Participation In the Guarantee Program




Notes: This figure shows the proportion of firms participating in the LGP as a function of net worth for two different productivity levels. The blue line stands for the higher-productivity firms, and the red line stands for the lower-productivity firms (in this plot, the median productivity). Net worth is truncated at 1.25 because the measure of firms above 1.25 is tiny, and the decision rules are monotone beyond 1.25.

LGP programs since they can hardly support the fixed cost of participation, while the largest firms also hardly participate because they are much less financially constrained. As a result, the median-sized firms are the most engaged in the LGP. Second, high-productivity firms have a higher participation rate than low-productivity peers with the same net worth since these firms gain more from participating in the LGP and are more able to pay for the participation costs with their higher profits. These effects on the participation rate in the LGP are consistent with our empirical findings in Section 5.2 and our analytical findings in Section 3.4.

# 5 Model Validation with Firm-level Data

In this section, we empirically validate the findings illustrated in our quantitative model using Moroccan firm-level data. Specifically, we document empirical evidence on a guaranteed firm's enlarged production scale and reduced cash holdings.

Our empirical strategy combines nearest-neighbor matching with a difference-in-difference (DID) approach. The matching procedure is to find statistical twins for a guaranteed firm based on a series of time-varying and observable variables. Details on the matching procedure are in Appendix A.1 and the summary statistics of the firm-level data are in Appendix A.3. The DID method controls for unobservable group-specific time effects, where the "group" refers to the guaranteed firm and its matched unguaranteed firms.

It is important to note that we do not interpret these results as causal evidence. Because we cannot fully control for time-varying unobservable drivers of selection into the program (like the firm productivity), the differences in outcome variables between guaranteed and matched firms cannot be fully interpreted as causal evidence. Our results are instead compared with the model, which accounts for selection since only firms that are productive enough enter the program (see Proposition 3). This will constitute our model validation.

## 5.1 Estimation Results on Short-term Growth and Long-Term Scale

We first try to validate the short-term growth and resource reallocation, as shown in Figure 3 and firms' long-term scale, as shown in Figure 4 through regressions. Our regression follows Brown and Earle (2017)'s matched DID setup:

$$\Delta Y_{igs} = \delta D_{it} + \lambda_{gs} + \epsilon_{igs}, \tag{25}$$

where $i$ indexes the firm, $g$ is the group (the guaranteed firm and its matched unguaranteed firms), $t$ is the guarantee year, and $s = t+1, t+2, t+3$ refers to three post-guarantee years. The dependent variable $\Delta Y_{igs}$ is the change in the selected outcome variable in the post-guarantee period compared to the year before obtaining the guarantee. It has the form $\Delta Y_{igs} = Y_{igs} - Y_{igt-1}$, where year $t-1$ is considered as the base year and $s = t+1, t+2, t+3$ refers to three post-guarantee years. We cannot estimate $t+5$ as in the model due to short data length. All $Y$ variables are in logs so that the dependent variable can be read as a growth rate. $D_{it}$ is a dummy variable indicating whether firm $i$ has been granted a guarantee in year $t$. $\lambda_{gs}$ are the group-year fixed effects, which control for the group-specific trend. We also include city-year fixed effects to control local credit demand and financial conditions.[16] Standard errors are clustered at the city level.

We first examine whether the guarantee is associated with an expansion in production scale, measured in sales growth, total asset growth, cost of employee growth, and fixed asset growth. Columns (1) to (3) of Table 4 report the estimation results for sales growth. Firm sales growth under a Tamwilcom guarantee increases by 13.5% in the first year, compared to the pre-guarantee period, relative to non-guaranteed firms. The impact is close to 12.5% in the third year after obtaining the guaranteed loan. This large and significant effect on sales indicates that the guarantee goes together with a firm's expansion in production. Columns (4) to (6) of Table 4 report the significant and positive association of the guarantee with total asset growth. This shows that the

[16] Other fixed effects (sector, year, and size) are not incorporated since a group of guaranteed and control firms share the same characteristics in these dimensions due to the specifications in the matching procedure. Firm-level fixed effects are not included since our dependent variable has differenced out any individual fixed effects relevant to the outcome.

firm simultaneously increases its net worth. All in all, access to the loan guarantee coincides with a persistent increase in firm scale.

Table 4: Effects on Firm Sales and Total Assets

| | Sales Growth | | | Total Asset Growth | | |
|---|---|---|---|---|---|---|
| | (1) t+1 | (2) t+2 | (3) t+3 | (4) t+1 | (5) t+2 | (6) t+3 |
| Guaranteed | 0.135*** | 0.101*** | 0.125*** | 0.092*** | 0.092*** | 0.166*** |
| | (0.010) | (0.021) | (0.020) | (0.011) | (0.021) | (0.014) |
| *N* | 18503 | 10610 | 5585 | 18959 | 11018 | 5952 |
| adj. $R^2$ | 0.332 | 0.315 | 0.357 | 0.299 | 0.264 | 0.268 |
| Group × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| City × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |

Note: This table reports the coefficients of ("Guaranteed") treatment from the DID regression (25). Each outcome variable in each year is based on a different matched sample where we drop firms without data for that outcome variable in that year before matching and excluding outliers. The dependent variable "Sales Growth" is the log difference between sales in year $t+1$, $t+2$ or $t+3$, and sales in year $t-1$. The dependent variable "Total Assets Growth" is the log difference between total assets in year $t+1$, $t+2$ or $t+3$, and total assets in year $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year $t$. Group-year and city-year fixed effects are included. Standard errors are clustered at the city level. Significance level: $^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$.

Table 5: Effects on Firm Production Inputs

| | Cost of Employee Growth | | | Fixed Asset Growth | | |
|---|---|---|---|---|---|---|
| | (1) t+1 | (2) t+2 | (3) t+3 | (4) t+1 | (5) t+2 | (6) t+3 |
| Guaranteed | 0.115*** | 0.106*** | 0.105*** | 0.116** | 0.230*** | 0.241** |
| | (0.015) | (0.023) | (0.025) | (0.037) | (0.062) | (0.079) |
| *N* | 17852 | 10422 | 5416 | 18344 | 10624 | 5760 |
| adj. $R^2$ | 0.252 | 0.223 | 0.239 | 0.183 | 0.174 | 0.236 |
| Group × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| City × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |

Note: This table reports the coefficients of ("Guaranteed") treatment from the DID regression (25). Each outcome variable in each year is based on a different matched sample where we drop firms without data for that outcome variable in that year before matching and excluding outliers. The dependent variable "Cost of Employee 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 "Fixed Asset Growth" is the log difference between fixed tangible assets in year $t+1$, $t+2$ or $t+3$, and fixed tangible assets in year $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year $t$. Group-year and city-year fixed effects are included. Standard errors are clustered at the city level. Significance level: $^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$.

We then examine how guaranteed firms change their production inputs in Table 5. We use the variable "cost of employee growth" to detect changes in a firm's hiring since we do not have good coverage for the number of employees in the Orbis database. As Table 5 shows, labor costs increase by 11.5% in the year following the granting of a guarantee relative to non-guaranteed firms and remain 10.6% and 10.5% higher in the two following years. Along with the increase in the wage bill, guaranteed firms also experience increases in fixed tangible assets after the treatment, according to Table 5. This variable is a good proxy for investment in productive assets (Amamou, Gereben, and Wolski, 2020). It shows that guaranteed firms allocate more resources to long-term productive assets, consistent with an expansion in productive capacities.

Table 6: Effects on Firm Balance Sheet

| | Current Liability Growth | | | Cash Growth | | |
|---|---|---|---|---|---|---|
| | (1) t+1 | (2) t+2 | (3) t+3 | (4) t+1 | (5) t+2 | (6) t+3 |
| Guaranteed | 0.131*** | 0.122*** | 0.167*** | -0.061 | -0.210*** | 0.088 |
| | (0.014) | (0.015) | (0.025) | (0.069) | (0.054) | (0.070) |
| $N$ | 19299 | 11171 | 5969 | 18761 | 10683 | 5814 |
| adj. $R^2$ | 0.252 | 0.276 | 0.243 | 0.321 | 0.304 | 0.291 |
| Group × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| City × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |

Note: This table reports the coefficients of ("Guaranteed") treatment from the DID regression (25). Each outcome variable in each year is based on a different matched sample where we drop firms without data for that outcome variable in that year before matching and excluding outliers. The dependent variable "Current Liability 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, "Cash Growth," is the log difference between cash and cash equivalents in years $t+1$, $t+2$ or $t+3$, and cash and cash equivalents in years $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year $t$. Group-year and city-year fixed effects are included. Standard errors are clustered at the city level. Significance level: $^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$.

We then explore changes in the firm's balance sheet, including current liabilities and cash, summarized in Table 6. There is a persistent 12-17% increase in current liabilities in guaranteed firms relative to control firms. This arises naturally from the buildup of current liabilities from newly granted working capital loans. Conversely, we observe stagnation and decline (though only significant for the period $t+2$) in cash for guaranteed firms. The decrease in cash holdings is significantly negative in $t+2$ and not significant in the other two years. Combined with the guaranteed firms' sharp increase in total assets documented in Table 4, this result implies that cash holdings decrease relative to the production scale. To further validate our mechanism, we test for cash ratio changes in Table 7. The results are consistent with our predictions.

**Robustness Checks** We also perform a series of robustness checks, which are reported in Appendix A.5. We check for (1) changing the number of pre-treatment years in matching, (2) correcting the data attrition bias, (3) emphasizing cash in matching, and (4) including propensity score in Mahalanobis distance. The estimation results remain mostly unchanged.

Table 7: Effects on Firm Cash Ratio

| | Cash Ratio Growth | | |
|---|---|---|---|
| | (1) t+1 | (2) t+2 | (3) t+3 |
| Guaranteed | -0.004$^{+}$ | -0.010$^{*}$ | -0.008$^{*}$ |
| | (0.002) | (0.004) | (0.004) |
| $N$ | 18766 | 10716 | 5818 |
| adj. $R^2$ | 0.215 | 0.161 | 0.126 |
| Group × Year FE | Yes | Yes | Yes |
| City × Year FE | Yes | Yes | Yes |

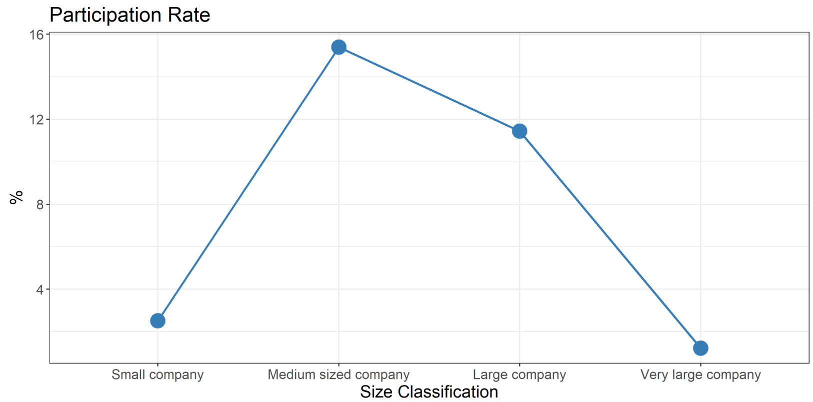
Note: This table reports the coefficients of ("Guaranteed") treatment from the DID regression (25). Each outcome variable in each year is based on a different matched sample where we drop firms without data for that outcome variable in that year before matching and excluding outliers. The dependent variable, "Cash Ratio Growth," is the difference between cash ratio in years $t+1$, $t+2$ or $t+3$, and cash and cash ratio in years $t-1$. "Guaranteed" indicates that a firm receives a Tamwilcom guarantee in year $t$. Group-year and city-year fixed effects are included. Standard errors are clustered at the city level. Significance level: $^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$.

## 5.2 Participation in the Loan Guarantee Program

We finally examine the propensity of firms to participate in the loan guarantee program. Figure 6 represents the percentage of Orbis firms that have been identified as benefiting from a guarantee, which proxies for the participation rate. The participation rate is hump-shaped, as both small and very large companies have a low rate compared to medium and large firms. This hump-shaped distribution is maintained when looking at the participation rate by total asset quantile bins. More details are in Appendix A.4.

It is important to note that these results are biased by the size-dependent probability of Tamwilcom firms being paired with Orbis firms, as this probability increases in firm size. In particular, the probability of a small firm being paired may be underestimated. However, the probability of a small firm being paired is 1.7 times lower than that of a medium firm (30% versus 52%). This cannot explain the strong difference in the estimated participation rate. Moreover, this concern is valid only if we have a lot of false negatives in our dataset, that is, if many firms identified as not having a guarantee do, in fact, have a guarantee. While this risk cannot be ruled out altogether, it is minimized by our thorough pairing procedure described in Appendix A.1. In fact, the most likely reason for a failed pairing is that a guaranteed firm is not in the Orbis dataset. In that case, the participation rates by firm size will not be significantly underestimated.

Figure 6: PARTICIPATION RATE BY SIZE




Notes: This figure shows the participation rate of our Orbis firm sample in Morocco by size. The size classification defines very large companies as those with an operating revenue larger than 100 million euros, total assets larger than 200 million euros, and more than 1000 employees. Large companies have an operating revenue larger than 10 million euros, total assets larger than 20 million euros, and more than 150 employees. Medium-sized companies have an operating revenue larger than 1 million euros, total assets larger than 2 million euros, and more than 15 employees. All the remaining companies are defined as small. The participation rate is calculated as the ratio of guaranteed firms to the total number of firms existing in Orbis.

## 5.3 Quantitative Model Validation with Regressions

Our empirical estimates from Tables 4 to 7 cannot be interpreted causally because unobservable time-dependent variables, like productivity, may drive selection. We, however, can use these estimates as "untargeted moments" to validate our model. To do so, we simulate a panel of five million firm-year observations and conduct the same empirical procedure of nearest neighbor matching and DID. We refer to these results as "Matched-DID". We also show how "Naive OLS" regressions would overestimate the effects of short-term loan guarantees since relatively larger and higher growth SME firms are more likely to self-select into loan guarantee programs.

We show the results in Table 8. In the table, "Matched-DID (Data)" is taken from our empirical analysis above, and "Matched-DID (Model)" is obtained by applying exactly the same method to our model-simulated data. "Naive OLS (Model)" runs the following OLS regression: $\Delta Y_{is} = \delta D_{it} + \gamma_z' Z_{is-1} + \gamma_i + \gamma_s + \epsilon_{is}$, where $i$ is the firm, $t$ is the guarantee year, and $s$ is the year ahead of the guarantee year. The dependent variable $\Delta Y_{it}$ is the same as in the Matched-DiD. Similarly, $D_{it}$ is a dummy variable indicating whether firm $i$ has been granted a guarantee in year $t$, and $\gamma_j$ and $\gamma_t$ are the firm and year fixed effects, respectively. $Z_{js-1}$ is the group of control variables that are used in the matching process for the regression (25).

Our model matches the empirical analysis results well both in the magnitude and significance

Table 8: Quantitative Model Validation with Empirical Analysis

| Effects of Credit Guarantee | Matched-DID (Data) t+1 | t+2 | t+3 | Matched-DID (Model) t+1 | t+2 | t+3 | Naive OLS (Model) t+1 | t+2 | t+3 |
|---|---|---|---|---|---|---|---|---|---|
| $\Delta log(Sales)$ | 0.135*** | 0.101*** | 0.125*** | 0.187*** | 0.163*** | 0.150*** | 0.524*** | 0.511*** | 0.461*** |
| | (0.010) | (0.021) | (0.020) | (0.013) | (0.016) | (0.018) | (0.007) | (0.010) | (0.012) |
| $\Delta log(TotalAsset)$ | 0.092*** | 0.092*** | 0.166*** | 0.143*** | 0.147*** | 0.139*** | 0.257*** | 0.238*** | 0.215*** |
| | (0.011) | (0.021) | (0.014) | (0.010) | (0.013) | (0.014) | (0.006) | (0.008) | (0.009) |
| $\Delta log(CurrentLiability)$ | 0.131*** | 0.122*** | 0.167*** | 0.191*** | 0.196*** | 0.187*** | 0.391*** | 0.371*** | 0.341*** |
| | (0.014) | (0.015) | (0.025) | (0.012) | (0.016) | (0.019) | (0.008) | (0.011) | (0.013) |
| $\Delta log(Cash)$ | -0.061 | -0.210*** | 0.088 | -0.451*** | -0.445*** | -0.632*** | -1.772*** | -1.787*** | -1.545*** |
| | (0.069) | (0.054) | (0.070) | (0.051) | (0.063) | (0.077) | (0.049) | (0.061) | (0.065) |

Note: "Matched-DID (Data)" is taken from our empirical analysis above, and "Matched-DID (Model)" is obtained by applying exactly the same method to our model simulated data. "Naive OLS (Model)" runs the following OLS regression: $\Delta Y_{is} = \delta D_{it} + \gamma_z' Z_{is-1} + \gamma_i + \gamma_s + \epsilon_{is}$, where $i$ is the firm, $t$ is the guarantee year, and $s$ is the year ahead of the guarantee year. The dependent variable $\Delta Y_{it}$ is the same as in the Matched-DiD. Similarly, $D_{it}$ is a dummy variable indicating whether firm $i$ has been granted a guarantee in year $t$, and $gamma_j$ and $\gamma_t$ are the firm and year fixed effects, respectively. $Z_{js-1}$ is the group of control variables that are used in the matching process for the regression (25). Significance level: $^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Robust standard errors are in parentheses.

levels for sales, total assets, and current liabilities. Although the model over-predicts the effects on cash growth relative to our empirical findings, the directions are mainly consistent. In contrast, the effects of credit guarantee are highly overestimated in the naive OLS regression.

# 6 Policy Counterfactuals and Aggregate Implications

We finally conduct two groups of policy counterfactuals to demonstrate the aggregate implications of liquidity constraints. More specifically, we show how expanding the short-term loan guarantee program could further reduce liquidity constraints and promote firm growth in Morocco. The loan guarantee program can be expanded mainly along two dimensions, as our analysis suggested in Section 3.4: the fixed participation cost and the guaranteed ratio. We show below in this Section how much firm growth we can achieve by further relaxing these restrictions in four counterfactuals. We focus on both the aggregate output expansion and the coverage and "inclusiveness" of the loan guarantee program.

## 6.1 Policy Counterfactuals

We show four counterfactuals with realistic alternative participation costs and guaranteed ratios that stand for LGP expansions.

**Participation Cost Reduction (PCR)** First, in the original benchmark, the upper bound of the participation cost ($\bar{\xi}_{bm} = 0.35$) gives us a participation rate of 3.4%. More importantly, the fixed cost is an overhead cost that is relatively expensive for smaller entrepreneurs, as our analytical analysis suggested in Section 3.4. We explore two counterfactuals below ($PCR\downarrow_{by\,\frac{1}{3}}$ and $PCR\downarrow_{by\,\frac{2}{3}}$), where we cut the upper bound of the participation cost to two-thirds ($\bar{\xi}_{PCR\downarrow_{\text{by }\frac{1}{3}}} = 0.233$) and to one-third ($\bar{\xi}_{PCR\downarrow_{\text{by }\frac{1}{3}}} = 0.117$). These could be understood in the real world as the government requiring fewer financial documents, simplifying the evaluation procedures, directly assisting the application, and subsidizing applications to the LGP.

**Guaranteed Ratio Increment (GRI)** Second, in the original benchmark, the guaranteed ratio is 60%, which gives a bank loan multiplier of $\chi_{bm} = \frac{100\%}{100\%-60\%} = 2.5$. This is lower than guaranteed ratios in many other countries. For instance, in Kazakhstan, it is equal to 70%; in India, it is equal to 75%; in Indonesia and Japan, it is equal to 80% according to Yoshino and Taghizadeh-Hesary (2019). We explore two counterfactuals below ($GRI\uparrow_{by\,10\%}$ and $GRI\uparrow_{by\,20\%}$), where the guaranteed ratio goes up to 70% and 80%. Correspondingly, the new multipliers are $\chi_{GRI\uparrow_{\text{by }10\%}} = \frac{100\%}{100\%-70\%} = 3.33$ and $\chi_{GRI\uparrow_{\text{by }20\%}} = \frac{100\%}{100\%-80\%} = 5.00$. Participating firms have thus more relaxed financial constraints. Moreover, the increased guaranteed ratio could potentially incentivize more firms to participate.

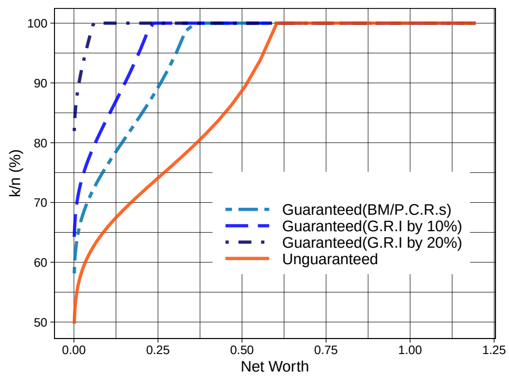
## 6.2 Firm-level and Aggregate Implications

**Implications for Firm Decisions** Figure 7 shows the effects of LGP expansions on firm decisions. We mainly focus on how the expansions of LGP affect the choices of capital, cash, output, and participation in the LGP as a function of firm size. First, regarding capital and cash choices, the PCR has no effect conditional on participation. In contrast, the GRI would benefit smaller guaranteed firms more, as shown in plot (a). Second, the same patterns also hold in terms of output, as shown in plot (b).

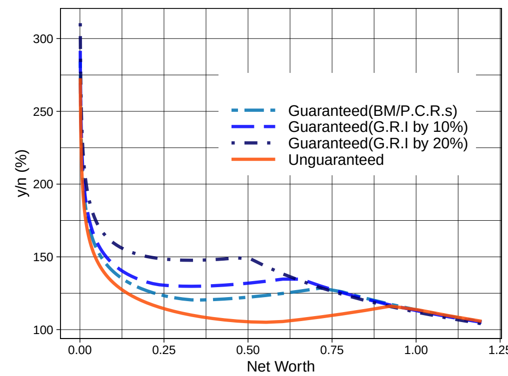
Third, both types of policies affect the participation rate. Plot (c) shows the changes in the participation rate of the PCR. Lowering the fixed participation cost would increase the participation rate across all firm sizes. Median-sized firms benefit the most and increase their participation even more. Plot (d), on the other hand, shows the changes in participation rate following a GRI. Since an increased guaranteed ratio changes the capital policy and the output, which benefits the smaller firms more, the participation rate increments are skewed towards smaller firms. These distributional results show that although all counterfactuals benefit firm financing in general, the effects are quite different across firms of different sizes.

**Aggregate Implications** Table 9 shows the effects of LGP expansions on aggregate financing, economic growth, and welfare. All four counterfactuals improve aggregate TFP, output, and consumption. Participation cost reductions significantly change firm financing patterns. The

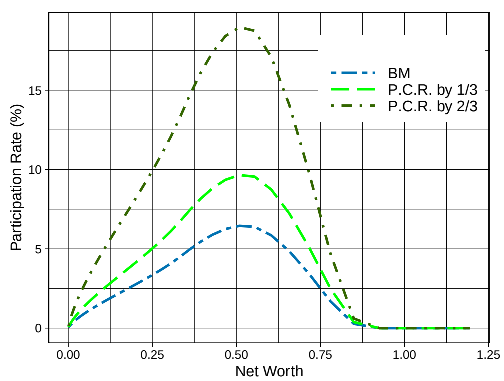
Figure 7: Effects on Firm Financing, Output, and Participation



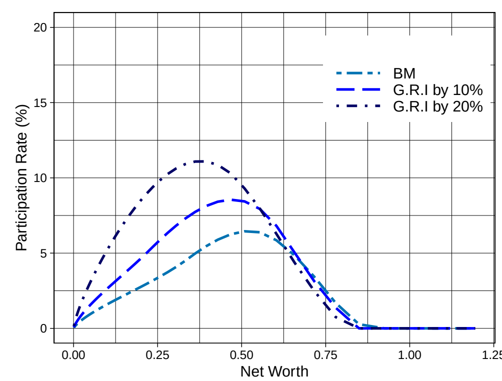

(a) Capital Policy




(b) Realized Output




(c) Participation Rate (Scale I)




(d) Participation Rate (Scale II)

Notes: This figure shows the capital and output policy, as well as the participation rate, as a function of net worth for firms with the median productivity level. In plot (a) of the capital policy, the k/n ratio will essentially decrease as the net worth grows over a certain scale. However, we do not show these patterns since we focus on small and median-sized firms.

participation rate increases from 3.4% to 5.1% and 10.1%, and the ratio of guaranteed credit in the economy increases from 1.3% to 2.0% and 3.8%, respectively. The fixed participation cost changes do not substantially affect the guaranteed firm cash and debt ratios. However, more firms are guaranteed, so the average credit ratio increases, and the average cash ratio decreases. Given that most firms that benefit from these policies are small and medium firms, the changes in aggregate outcomes are not substantial at first glance. Nonetheless, we find that reducing the fixed participation cost increases aggregate TFP, total output, consumption, and welfare. Considering the small changes in total credit, the gains are substantial.

Increasing the guaranteed ratio also significantly changes firm financing patterns. The participation rate increases from 3.4% to 5.0% and 7.6%, and the ratio of guaranteed credit in the

Table 9: Aggregate Implication of LGP Expansion

| Model Outcomes (%) | Benchmark | $PCR\downarrow_{by\ \frac{1}{3}}$ | $PCR\downarrow_{by\ \frac{2}{3}}$ | $GRI\uparrow_{by\ 10\%}$ | $GRI\uparrow_{by\ 20\%}$ |
|---|---|---|---|---|---|
| ***Penal A: Firm Financing*** | | | | | |
| LGP participation rate | 3.4 | 5.1 | 10.1 | 5.0 | 7.6 |
| Guaranteed credit/total credit | 1.3 | 2.0 | 3.8 | 3.1 | 8.0 |
| Mean cash/asset ratio (guaranteed) | 6.0 | 6.0 | 6.0 | 2.9 | 0.1 |
| Mean cash/asset ratio (all firms) | 20.0 | 19.8 | 19.3 | 19.6 | 18.8 |
| Mean debt/asset ratio (guaranteed) | 64.3 | 64.2 | 64.0 | 72.1 | 85.8 |
| Mean debt/asset ratio (all firms) | 40.0 | 40.3 | 41.3 | 40.8 | 42.7 |
| ***Penal B: Aggregate Outcomes*** | | | | | |
| Δ Total Credit | n.a. | 0.28 | 1.25 | 0.60 | 1.63 |
| Δ Aggregate TFP | n.a. | 0.04 | 0.14 | 0.08 | 0.25 |
| Δ Total Output | n.a. | 0.01 | 0.10 | 0.05 | 0.09 |
| Δ Total Consumption | n.a. | 0.06 | 0.29 | 0.15 | 0.47 |
| Δ Welfare | n.a. | 0.04 | 0.15 | 0.08 | 0.25 |

Note: This table reports the counterfactual results. The results are reported in two groups: (1) firm financing, which shows how the counterfactual changes the financing patterns of firms in the model, and (2) economic outcomes, which show how the counterfactual changes the aggregate economic conditions. The Benchmark stands for our benchmark calibration of both the fixed participation cost and the guaranteed ratio ($\bar{\xi}_{bm} = 0.26$, $\chi_{bm} = 2.5$). Each of the four counterfactuals changes only one parameter, reflecting participation cost reduction or guaranteed ratio increment.

economy increases from 1.3% to 3.1% and 8.0%, respectively. Contrary to the PCR counterfactuals, guaranteed firms substantially decrease their cash ratio and increase their debt ratio. This reduces the average cash ratio and significantly increases the debt ratio. Finally, we also find that increasing the guaranteed ratio significantly increases aggregate TFP, total output, consumption, and welfare. As for PCR, considering the small changes in total credit, the gains are substantial.

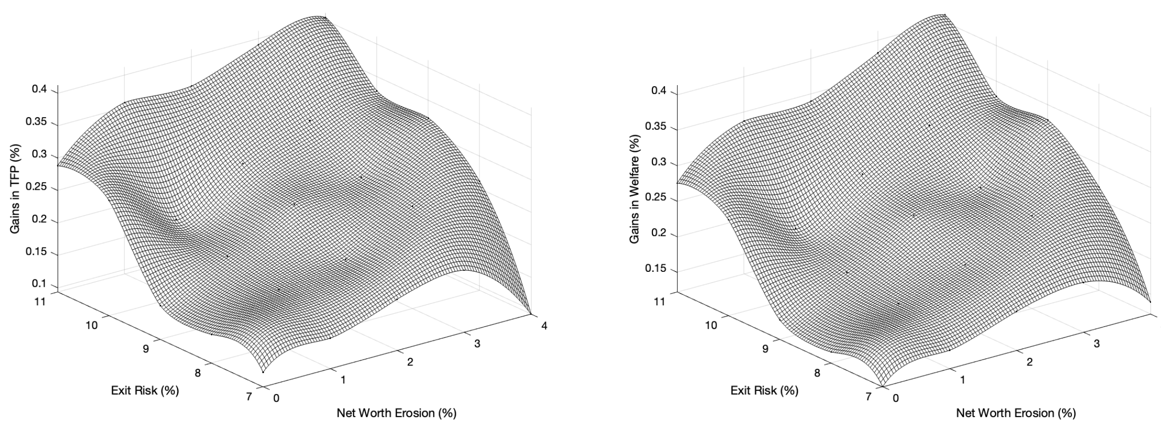
It is worth noticing that two counterfactuals $PCR\downarrow_{by\ \frac{1}{3}}$ and $GRI\uparrow_{by\ 10\%}$ almost increase participation by the same amount, but they have different aggregate outcomes. Because $GRI\uparrow_{by\ 10\%}$ affects credit access over the whole distribution of firms, and not only self-selection into the program, total credit increases more, as well as output and welfare. In that sense, a guaranteed ratio increment kills two birds with one stone: it can both increase participation and total output. However, participation cost reduction is more "cost-effective" if the objective is to increase participation without significantly increasing the guaranteed portfolio.

Unfortunately, we cannot directly discuss the exact cost-benefit analysis of such loan guarantee program expansions since we do not know exactly the direct and indirect costs of such expansions in the data, that is, how much direct organization costs the government pays to reduce the participation cost or how much indirect costs the government pays to increase the guaranteed ratio. We leave these to future work due to data limitations.

## 6.3 The Essential Role of Intertemporal Distortions

Finally, we examine quantitatively how intertemporal distortions determine the aggregate impact of relaxing liquidity constraints. In Section 3.3, we show in Proposition 2 that the long-term growth depends on the interaction between the intertemporal distortions and the collateral constraint. Without intertemporal distortions, the effect of short-term LGPs is temporary as the long-run scale is unchanged. Below, we show how the aggregate long-term economic impacts of a guaranteed ratio increment, demonstrated with the counterfactual of guaranteed ratio increment by 20% above, change under variations of both intertemporal distortions.

Figure 8: The Role of Intertemporal Distortions




(a) Effects on Productivity

(a) Effects on Welfare

Notes: This figure shows how the intertemporal distortions affect the aggregate impact of a higher guarantee ratio. We consider alternative net worth erosion $\tau$ and exit risk $1-\epsilon$ around the benchmark specification ($\tau = 2\%, 1-\epsilon = 9\%$). The impact on TFP and welfare is more than halved if both intertemporal distortions are reduced by 2%. This arises from a smaller-scale effect, as discussed earlier. In other counterfactuals, with higher net worth erosion and exit risk, the effect of the policy on output, TFP, and welfare is higher than in the benchmark because of the more severe intertemporal distortions.

First, both intertemporal distortions determine the effects of the LGP expansion. Figure 8 shows how the intertemporal distortions affect the aggregate impact of a higher guarantee ratio. We consider alternative net worth erosion $\tau$ and exit risk $(1-\epsilon)$ around the benchmark specification ($\tau = 2\%, 1-\epsilon = 9\%$). The impact on TFP and welfare is lower if either intertemporal distortion is reduced. This arises from a smaller scale effect, as discussed earlier. In other counterfactuals, with higher net worth erosion and exit risk, the effect of the policy on output, TFP, and welfare is higher than in the benchmark because of the more severe intertemporal distortions.

Second, net worth erosion matters more than exit risk. Table 10 shows the aggregate impact

Table 10: Effect under alternative intertemporal distortions

| Model Outcomes | Benchmark ($\tau = 0.02, \epsilon = 0.91$) | Lower $\tau$ ($\tau = 0, \epsilon = 0.91$) | Higher $\epsilon$ ($\tau = 0.02, \epsilon = 0.93$) |
|---|---|---|---|
| Changes in Aggregate TFP (%) | 0.25 | 0.14 | 0.17 |
| Changes in Total Welfare (%) | 0.25 | 0.15 | 0.18 |

Note: This table reports the effects of policy $\text{GRI}\uparrow_{\text{by } 20\%}$ with different assumptions on $\tau$ and $\epsilon$ to illustrate the differences between the roles of net worth erosion and exit risk.

of a 20% higher guarantee ratio under two alternative assumptions on $\tau$ and $\epsilon$ from Figure 10. We first consider a lower $\tau$ ($\tau = 0$ as opposed to $\tau = 0.02$ in the benchmark) while $\epsilon$ is unchanged. The impact on output and welfare dropped by about 45% (0.25% to 0.14%). This arises from a smaller scale effect, as discussed above. In another counterfactual, we consider a higher $\epsilon$ ($\epsilon = 0.93$ as opposed to $\epsilon = 0.91$ in the benchmark) while $\tau$ remains unchanged. The effect of the policy on TFP and welfare dropped by about 30% (0.25% to 0.18%). Even though the lower $\tau$ and higher $\epsilon$ counterfactuals generate the same reduction in intertemporal distortion $(1-\tau)\epsilon$, the effects of the policy are stronger in the high $\epsilon$ counterfactual than in the low $\tau$ counterfactual. With a higher $\epsilon$, firms exit less frequently, which gives them time to reach their long-run scale. This reinforces the long-term scale channel as opposed to the case with a lower $\tau$. However, the effect of the policy remains lower than in the benchmark because of the milder intertemporal distortions. LGP effects are thus particularly strong when intertemporal distortions come from net worth erosion as opposed to when they come from firm exit risk.

# 7 Conclusion

In this paper, we study the effect of short-term finance and how relaxing liquidity constraints affects firm growth and the aggregate economy.

We first build a heterogeneous firm model in which firms face collateral and working capital constraints and show the theoretical predictions. In the model, constrained firms preserve many resources in 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. Additionally, a loan guarantee program generates a permanent increase in production scale due to intertemporal distortions.

We then take the model to a unique firm-level dataset of a credit guarantee program in Morocco. The model matches Moroccan firm-level moments well and replicates the patterns of our empirical findings: we show that firms with guaranteed loans expand their production scale homogeneously and persistently with increased labor and capital inputs and decreased cash ratios, which is consistent both qualitatively and quantitatively with the model. We then conduct counterfactual analyses to relax the severity of the short-term financial constraints. The gains from relaxing the severity of the short-term financial constraints by expanding the loan guarantee programs are substantial in terms of firm growth and welfare.

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