The Excess Burden of Collateral

Farshad R. Ravasan*

Abstract

Using a novel data set on lending technique of banks in three MENA economies and matching data on the location of firms and bank branches, I study the impact of local lending environment that prevails in the vicinity of each firm. I find that firms face tighter credit constraint when they are located in areas in which banks that view themselves as collateral lender have a stronger presence. I find this negative effect is stronger for innovative firms.

* Paris School of Economics
Email: farshad.ravasan@sciencespo.fr.

" When it is costly to transact then institutions matter. And it is costly to transact "

Douglass North
Lecture to the memory of Alfred Nobel
December 9, 1993

1 Introduction

The post 2000 period has seen much political turmoil and social upheaval throughout the world that were closely interconnected to economies' failure to create jobs to fight back persistence or occurrence of high unemployment rates. This lead to renewed interest in developing a deeper understanding of why nations fail to create jobs.

One explanation may lie in the fact that the economy fails to optimally allocate necessary resources to those that are contributing the most to the net job creation. Decomposition of job creation has shown that SMEs play a prominent role in creating jobs in the economy. And among those small and medium size firms there is few set of high impact and innovative enterprises that improportionally contribute to aggregate growth and productivity. However, their ability to expand and create jobs crucially depends on the availability of finance to support their business opportunities and economic activities[1]. Nevertheless, like with any other good quality borrower, information friction tightens their access to external credit. Collateralization has been proven to be an effective lending technique to alleviate the informational inefficiencies by internalizing a firm's risk in its decision to apply for a loan.

This paper argues that the effectiveness of collateral lending closely relates to lower transaction costs faced by banks when taking possession of the collateral in the event of default. When these transaction costs are high, collateral increases the weight of risk to above its optimal level in firms' evaluation of the risk and return to carry out an investment project. This distortion makes the risk-taking behavior of innovative firms suboptimally more costly and hampers the incentives for high risk high return activities such as innovation. In developing countries with lower institutional quality, higher judicial inefficiency and limited law enforcement, collateral lending is subject to high transaction costs. These high costs can discourage firms from applying for a loan and could lead to substantial demand-driven missallocation in the credit market against the innovative firms that face higher knightian risk.

[1] Evans and Leighton (1989),Evans and Jovanovic (1989), Blanchflower and Oswald (1998) and Carpenter and Petersen (2002)

Based on this mechanism, the current paper tries to shed lights on the distortionary impact of collateral lending technique in developing countries by providing evidence from three MENA countries ,Egypt, Morocco and Tunisia. These three countries all show three specific traits[2]: first, all of these economies feature some of the poorest institutional quality in the world in terms of collateral and bankruptcy laws. Second, the banking systems in these economies are eminently dependent on collateral lending and loans are collateralized at a very high rate. Third, financial frictions are mostly demand-driven and attributed to discouraged borrowers.

To investigate the effect of collateral lending on firms' financial constraint, this paper draws on a novel data on banks' lending technique. This data conducted according to face-to-face interviews with bank chief executive officers to classify the lending technique of 36 major banks across Egypt , Morocco and Tunisia. Using the geographical coordiation of the bank branches and firm location, I then combine this data with a unique cross sectional data on firms in these three MENA economies during the fiscal year of 2012. Our firm level data provides information on the terms of loan contracts, including collateral requirements. Nonetheless, unlike credit registry data, this firm survey data contains information about both borrowing and non-borrowing firms with the latter split up into those constrained by rejection (supply-driven financially constrained), those constrained by discouragement (demand-driven financially constrained) and non-constrained firms. Moreover this data set collects information on innovation following the recommendations of the Oslo Manual. This provides us a direct measure to classify innovative firms in these countries.

To guide my empirical investigation, I then build a model of adverse selection with borrowers that are heterogeneous across risk and return dimensions. I deviate from conventional adverse selection models in which the second or first order stochastic dominance assumption boils down the sorting criteria for the quality of borrowers into the risk dimension. In my model, the combination of the Pareto heterogeneity on return and the step distribution on risk leads to the division of firms into two major groups of "low risk-low return" and "high risk-high return" borrowers, in which the latter category represents the innovative firms. In my framework both groups have the same ratio of good quality borrowers within their population. Unlike the common models of adverse selection, which predict that a missallocation against low risk borrowers is created by ex ante asymmetric information, my model suggests that informational friction could generate missallocation against innovative firms (high risk borrowers) in the presence of high degrees of collateralization and high transaction costs of realizing collateral in the event of default. The model predicts that in developing

[2]See table 1

countries with lower quality of collateral and bankruptcy laws, collateral lending could lead to suboptimally low risk taking in credit market and create missallocation against firms that engage in high risk high return activity such as innovation.

To investigate these hypotheses, my empirical analysis faces two main methodological challenges. The first issue is reverse causality. It is not clear whether higher collateral requirements lead firms to have lower performance or whether banks require more collateral from low performance firms. This prevents us from drawing a causal connection between banks' collateral policy and firms' performances. Second, according to the model, collateral policy impacts firms' performance by discouraging them to apply for a loan. Moreover, the descriptive statistics suggest that discouragement is a main driver of financial friction in these four economies. However, the collateral requirements associated with a loan are only defined for firms that currently have a loan outstanding. Thus I do not directly observe the link between collateral requirements and the performance of discouraged borrowers.

To address these challenges, this paper adopts a two-stage procedure[3] . The first stage classifies each bank's lending technique. The bank is defined as collateral lending whether the CEO of the bank considers collateral lending to be of most importance (frequency of use) in lending to SMEs. In a second stage, we link these bank to firms through their branch network.
In this approach, I calculate the share of collateral lending banks in local branches near the firm. To this end, I exploit location data to identify the all bank branches that are located in less than 5km from the firm. This reflects the propensity of collateral lending that has been practicing in local credit market where the firm is located. I then investigate The association of collateral lending and firms' financial constraint and performances.

I found that SMEs face tighter credit constraint when they are located in area that collateral lending banks have a stronger presence. I show they also invest less and grow slower. My results illustrates that this negative impact is significantly biased against innovative firms.

The empirical results also shed lights on the channel that the prevailing collateral lending impacts firms' financial constraint. I indicated that the negative impact of collateral lending arise due to firm's discouragement and self rationing from credit market.

[3]See Beck et al. (2018)

Contribution to the literature

This paper contributes to several strands of the literature. Our conceptual framework contributes to the literature on missallocation of credit, attributing it to ex ante asymmetric information. While the literature's consensus considers the borrowers' tendency toward risk taking, which is suboptimal in the presence of informational friction, this paper shows that a missallocation due to the ex ante informational gap could also arise due to a lack of risk-taking behavior.

The paper also contributes to the previous literature of optimal debt contract that suggests that collateral may not always be optimal within the ex ante private information framework[4]. However, in those models there is an interaction between ex ante and ex post information asymmetry. Here, we demonstrate that even in the absence of an ex post informational gap, there is a threshold $\mathscr{D}^*$ above which the degree of collateralization impairs informational efficiency.

Moreover, it contributes to the studies that investigate the relationship between collateral and credit risk. Adverse selection models predict that low risk borrowers benefit more from pledging collateral while some empirical observation indicates that riskier borrowers are more likely to pledge collateral [5]. Berger and Udell (1990) points out that the inconsistency arises out of the difference between the observable and unobservable parts of the borrower's risk, while most of the adverse selection models concentrate only on the unobserved part of the risk. My model indicates that higher collateral rates benefit those that have lower "unobservable risk" more, whereas lower collateral rates will favor those that have lower "observable risk". Eventually my theoretical framework could contribute to the financial and legal institutions' development[6] by looking at the transaction costs arising from the low quality of collateral and bankruptcy laws.[7] .

Although long-standing theoretical foundations for demand-driven financial friction due to discouragement exist, there is a young and recent line of research that has begun to empirically investigate its importance and impacts on firms' performances[8]. In line with Popov and Udell (2010), I document that credit constraints more frequently take the form of discourage-

[4]See Carlier and Renou (2005, 2006)

[5]See Berger et al. (2011) and their references

[6]Porta et al. (1998)

[7] Barro (1976) andJappelli et al. (2005)

[8]See Cole (2008) Berkowitz and White (2004) and Berger et al. (2011) for the United States, Brown et al. (2011) and Popov and Udell (2010) for Europe, and Chakravarty and Xiang (2013) for developing countries.

ment than rejected loan applications. Furthermore, I empirically investigate how the pattern of discouragement interacts with collateral requirements. Finally, this paper contributes to the literature that investigates the effect of collateral lending on innovative firms. This paper offers a new channel that suggests collateral lending could make the external finance inefficiently more costly for firms that face a higher risk. This could discourage high return high risk borrowers such as innovative firms to apply for a loan.

The remainder of the paper proceeds as follows. Section 2 outlines the link between risk, innovation and discouragement.Section 3 develops the adverse selection model with heterogeneous borrowers across risk and return. Section 4 presents the data. Section 5presents the results and discusses the estimations. Section 6 concludes.

2 Risk , innovative firms and discouragement

The greater availability of firm level data in different countries shows that there exists astounding disparity in firms' performance and their aggregate contributions to the economy such as job creation. First attempts to decompose the macro contribution across the distribution of firms goes back to the seminal works of David Birch (Birch (1979), Birch (1987) and Birch and Medoff (1994)) that showed that a small percentage of high impact firms generate a large share of net new jobs. Looking at the distribution of firms, most of them don't show any dynamics (they neither significantly expand nor contract) which makes the distribution of net employment growth extremely dense around its median at zero. The thin upper tail of this distribution entails high impact firms that account for a substantially large share of net job creation. (Henrekson and Johansson (2010) [9] ,Haltiwanger et al. (2013), Decker et al. (2014) and Decker et al. (2016)).

The job-creating prowess of high impact firms stems from firms' rich dynamics and their ability to expand at a much higher pace at the different stages of their life cycle. One explanation of their different pattern of growth lies down in their innovative and entrepreneurial activities. Entrepreneurship , innovation and growth potential have a long-standing theoretical grounding in "Learning Theory", which shed light on the dynamics and evolution of firms during their life cycle (Jovanovic (1982) , Lippman and Rumelt (1982) , Evans (1987) , Pakes and Ericson (1998)[10] and Acs and

[9] Henrekson and Johansson (2010) summaries the findings and results for 20 studies on 10 countries (Canada, France, Finland, Germany, Italy, the Netherlands, the U.K., the U.S.A., Spain and Sweden) from the 1990s on. They point out that all studies find high impact firms to generate a large share or all net jobs.

[10] for Jovanovic model with active learning

Mueller (2008)[11]).
Learning Theory points out that there is a gap between the stock of *knowledge* and *know-how* in the economy (Arrow (1962), Mansfield (1974), Teece (1977), Romer (1990) and Acs et al. (2009)). Innovative firm pioneer a business opportunity by filling part of this gap and transforming some knowledge into new know-how. The information on this new know-how is subject to incompleteness and asymmetry across the economy Acs et al. (2009). Incompleteness of information exposes the innovative firm to the risk of possible failure in the future. However, asymmetric information on this new know-how (which implies that there are just few firms that have access to this know-how) creates a local monopoly that enhances the innovative firm's return and potential to expand and grow (Glaeser et al. (1992)).

Learning Theory illustrates two important facets of innovative firms : "High Risk" and "High Return". While innovation raises the risk of failure for firms , it also boosts the firms' growth potential and ability to expand if business ventures succeed.

Nevertheless, the growth potential of these firms highly depends on their access to finance while, like any other good quality borrowers, information friction could dispose them to credit rationing. (Jaffee and Russell (1976)) . Banks use credit rationing to reduce the cost of ex ante informational asymmetry. Credit rationing could happen through supply à la Stiglitz and Weiss (1981) or through demand. Banks could use contractual instruments such as collateral to ration borrowers through demand. (Bester (1985); Chan and Kanatas (1985) andBesanko and Thakor (1987a,b)). Using collateral in debt contracts, banks could indirectly ration a part of the bad quality borrowers by discouraging them to apply through what Salop and Salop (1976) call the "self-selection" mechanism. Collateral shifts part of the risk back to the borrowers and internalizes the risk of default in firms' decisions to apply for a loan. However, the effectiveness of collateral lending in the alleviation of informational asymmetry is closely related to the transaction costs that banks face to get possession of collateral in the event of default. When transaction costs are high due to the low quality of collateral and bankruptcy laws, collateral lending could lead good quality borrowers to self-select themselves out of the credit market. This demand-driven financial friction out of discouragement is biased against new businesses that naturally face higher risks. Cerqueiro et al. (2016a) document the quasi natural experiment where a legal reform in Sweden in 2004 increased the transactional cost of collaterals. The legal change in 2004 reduced the value of all floating liens, a security interest that enables companies to pledge as collateral their movable property (includes inventories and receivables). Before the legal change, a creditor holding a floating lien could seize a firm's property outside bankruptcy and without court order. The 2004 law abolished

[11] for Learning Theory in business studies)

such rights and increased their transactional cost. They indicate that the reform has negative consequences for the real economy with the contraction of investment, employment, and assets.

3 The Model

In this section I develop a stylized model to depict how collateral lending could raise allocational inefficiency in credit markets through its impact on the demand for external finance when the economy is populated by firms who carry out investment plans with heterogeneous risk-return structures. I begin by setting up a multi-period environment with an infinite horizon, a continuum of heterogeneous enterprises and a bank which supplies external finance through collateral lending.
First, I define a financial contract in my environment. Then I find partial demand (participation condition for the borrower) and supply (participation condition for the lender) at period $t+1$, taking the distribution of applicants in period t as given. Then I solve for stationary equilibrium, which gives us a steady state of demand and supply and a stationary distribution in the pool of applicants.

3.1 The Financial Contract

The financial contract is agreed and concluded within two periods. I assume borrowing and lending take place in the first period, while project realization and settling up by lenders and borrowers occurs in the second period a la Bernanke and Gertler (1990)

During the first period the lender offers the borrower a contract in the form of (R , ζ). R is the interest rate for each unit of credit and ζ is the rate for the collateral requirement (percentage of one unit of credit that is secured by the borrower's collateral). In the event of success, borrowers pay back the interest rate. otherwise, they default and the bank keeps the collateral with the interest borne by it. Thus R and ζ define the arrangement of the borrower and the lender for each state of a project's outcome. I assume lending and borrowing happens under ex ante asymmetric information, in which the bank is not able to distinguish the risk return structure of current applicants. Therefore, the bank sets the contract term according to its set of information, which stems from the realized outcome for the pool of applicants in the last period. The bank has adaptive expectations and updates its expectations by setting

$$\mathbb{E}(\bar{\theta}_{t+1}) = \bar{\theta}_t \tag{1}$$

Furthermore, as types of borrowers cannot be observed individually through realized returns, the bank's information is limited to the average risk level of borrowers.

3.2 Bank's supply for external finance

First, I look at the supply side where banks are lenders with inelastic supply. They finance their required funds at the risk-free interest rate r in a deposit market. Furthermore they face a pool of applicants, containing firms that are heterogeneous in terms of the risk and return of the their investment projects. θ_i denotes the risk for firm i. It indicates that with a probability of θ_i the investment project of a borrower will succeed and with a probability of $1-\theta$ its investment will fail. The bank is not able to distinguish among different types of applicants and it therefore makes its decisions based on the risk of the investment plan and the terms of the contract, based on its realized average risk from the pool of applicants in the last period.

$$\Pi^{B}_{t+1} = [\bar{\theta}_t R_{t+1} + (1-\bar{\theta}_t)(1+r)\zeta(1-\eta) - (1+r)] \tag{2}$$

$\zeta(1-\eta)\ \epsilon\ [0,1]$ is the "effective collateral rate" adjusted by the interest rate. Following Barro (1976), Chan and Kanatas (1985) and Jappelli et al. (2005), we assume there is a disparity between the collateral valuation by the borrowers and the bank. This disparity is related to the transaction costs that the bank faces in taking possession of and liquidating the collateral in the event of default. We denote this transaction cost by $\eta\epsilon[0,1]$. The transaction costs reflects institutional quality [12]. In my context they indicate the quality of collateral and bankruptcy laws in each country.[13]

Considering banks as competitive risk-neutral lenders, the rationing interest rate R in the credit market is determined by setting the expected profit equal to zero. Hence to give the rate of the collateral requirement, the inelastic supply of credit will be defined by interest rate R as following

$$R_{t+1} = \frac{(1+r)}{\bar{\theta}_t}[1-\zeta(1-\eta)(1-\bar{\theta}_t)] \tag{3}$$

It is worth noting that the higher expected average risk of applicants increases the interest rate spread. However a higher collateral rate covers part of this risk that banks face and thus reduces the cost of bank finance. Nonetheless, higher transaction costs η diminishes the effectiveness of collateral. Thus the lower expected recovery rate $1-\eta$ increases the interest rate spread and tightens the credit supply, which is in line with empirical evidence such as (Djankov et al. (2007) and BAE and Goyal (2009)).

3.3 Firms' demand for external finance

In my framework, the economy is populated by risk neutral firms that decide to carry out a fixed investment through external finance by considering

[12] Coase (1960) and North (1992)

[13] However the bankruptcy literature suggests that creditor rights sometimes could be excessive and lead to ex post inefficiencies in the form of a liquidation Vig (2013)

the return and risk of their investment project as well as the cost of external credit. With the probability of θ that their investment project will be successful, it will return A for each unit of capital. Successful firms then return rate R to the banks the in second period. With a probability of $1-\theta$, their investment fails with zero return. Hence they default on their loan and the bank seizes their collaterals. Therefore Firm i 's expected return from investing one unit of external credit could be written as follows: period.

$$\Pi^F_{i\ t+1} = \theta_i(A_i - R_{t+1}) - (1-\theta_i)(1+r)\zeta$$

Firm i, which carries out the project with return A_i and with a probability of success of θ_i decides to apply for a bank loan if $\Pi^F_{i\ t+1} \geq 0$. Therefore we could write down the elastic demand which denotes the participation condition for Firm i as follows:

$$A_i \succeq \frac{\theta_i R_{t+1} + (1-\theta_i)(1+r)\zeta}{\theta_i}$$

The collateral rate has two effects on the demand of Firm i. First, the direct effect is that discourages firm to apply for external fund as it reallocate some of the risk involved in the investment from the bank toward the firm. Then there is an indirect effect through the interest rate R. The higher collateral rate reduces the interest rate spread, which increases the firm's incentive to apply. By replacing R from the first stage we could see the outcome of these two opposite effects.

$$A_i \succeq (1+r)[\frac{1}{\bar{\theta}_t} - \zeta(\frac{1}{\bar{\theta}} - \frac{1}{\theta_i}) + \eta\zeta\frac{1}{\bar{\theta}_t}] \tag{4}$$

The "application condition" 4 represents a key point in the interaction of collateral with a borrower's demand for external finance. When there is no collateral requirement $\zeta = 0$, the information asymmetry leads to typical adverse selection inefficiency as competitive interest rates subsidize the high risk firms, whose probability of success is lower than average $\theta_i \leq \bar{\theta}$, and punish the low risk firms, whose probability of success is higher than average $\theta_i \geq \bar{\theta}$.
When there are no transaction costs between the firm's and the bank's evaluation of collateral, $\eta = 0$, collateral works perfectly to clear out the information inefficiency by optimally increasing the incentive to apply for a loan for all low risk types and optimally discouraging the high risk borrowers. When $\eta = 0$ we could rewrite the 4 as follows:

$$A_i \succeq \underbrace{\overbrace{\frac{(1+r)}{\theta_i}}^{\textit{Internal Finance}} \quad \overbrace{[\frac{\theta_i}{\bar{\theta}_t} - \zeta(\frac{\theta_i}{\bar{\theta}_t} - 1)]}^{\textit{External Finance Spread}}}_{\textit{Opportunity Cost of Investment}} \tag{5}$$

The application condition 5 illustrates that for all firms with any vector of risk return A_i, θ_i , the higher collateral rate strictly reduces the wedge between the cost of internal and external finance. When a loan is fully secured $\zeta = 1$, collateral entirely takes out the informational friction and the cost wedge of external finance thoroughly disappears. When there is a transaction cost for the bank to seize the collateral in the event of default, $\eta > 0$, the effective collateral is $\zeta(1-\eta)$.
The "application condition" 6 indicates the effective part of the collateral $\zeta(1-\eta)$ that continues to reduce the information friction between the bank and the borrower for all types of firms with any risk-return structures. Nevertheless, the deadweight part of collateral creates an excess burden for borrowers as it raises the cost of external finance. This deadweight loss also has an allocational effect against high-risk borrowers, since the excess burden soars when the risk of an investment plan is higher.

$$A_i \succeq \underbrace{\overbrace{\frac{(1+r)}{\theta_i}}^{\text{Internal Finance}} \quad [\frac{\theta_i}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{\theta_i}{\bar{\theta}_t} - 1) + \overbrace{\zeta\eta(1-\theta_i)}^{\text{Deadweight Loss}} \quad]}_{\text{Opportunity Cost of Investment}} \tag{6}$$

External Finance Spread

The application condition 6 illustrates not only that fully secured loans ($\zeta(1-\eta) = 1$) could not restore the efficiency on credit market any further, but also that they create missallocation against high-risk high-return borrowers.

To delve into the allocational effect of collateral, we need to find the pattern of applicants and discouraged borrowers at stationary equilibrium. To do so, first we must lay out a set of assumptions on the distribution of firms with heterogeneous risk and return. We then solve for the applicants' stationary joint distribution of risk and return.

3.4 The Risk Return Structure of firms

In my framework, there is a Pareto heterogeneity on return and a step distribution on risk. This distributional pattern divides firms into two major groups of "low risk-low return" and "high risk-high return" borrowers, in which the latter category represents the entrepreneurial firms. The first group mean preserving the second group and both have the same ratio of good quality borrowers within their population.

I assume in my economy that firms are either of type L ("Low risk") or H ("High risk"). The return of firms within each type $i \epsilon \{L, H\}$ follows a Pareto distribution $G(A) = 1 - (\frac{A}{\underline{A}^i})^{-\alpha}$ for all $A \epsilon [\underline{A}^i, \infty]$. Furthermore, firms of each type are uniformly distributed over the intervals with the length λ_i $i \epsilon L, H$, where $\lambda_L + \lambda_H = 1$. The pool of applicants includes all firms from

both types whose return is higher than their opportunity cost of one unit of investment funded by external finance. Imposing the application condition (6) on the joint distribution of risk and return, I find the average risk of firms in pool of applicants as follows:

$$\bar{\theta}_{t+1} = \lambda_L \theta_L \frac{\Gamma(\theta_L, \bar{\theta}_t)}{\Gamma(\theta_L, \bar{\theta}_t) + \Gamma(\theta_H, \bar{\theta}_t)} + \lambda_H \theta_H \frac{\Gamma(\theta_H, \bar{\theta}_t)}{\Gamma(\theta_L, \bar{\theta}_t) + \Gamma(\theta_H, \bar{\theta}_t)} \tag{7}$$

$\Gamma(\theta_i, \bar{\theta}_t)$ denotes the share of firms with type $i \epsilon \{L, H\}$ that decide to apply as their risk and return satisfies application condition (6)

$$\Gamma(\theta_i, \bar{\theta}_t) = \int_{\frac{(1+r)}{\theta_i}[\frac{\theta_i}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{\theta_i}{\bar{\theta}_t} - 1) + \eta\zeta(1-\theta_i)]}^{\infty} dG(A) \tag{8}$$

In my framework, the credit rationing happens entirely on demand side through self selection and discouragement. Discouragement raises inefficiency when good quality borrowers decide not to apply. My definition of good borrowers differs from those commonly used in adverse selection literature. The first or second order stochastic dominance assumptions widely used in previous works boil down to criteria for sorting the quality of borrowers in the risk dimension. However, in this paper, the quality of borrowers is defined by the efficiency of their investment plan. A good quality borrower is a firm that carries out an investment of which the expected return exceed the opportunity cost (depositing at risk free rate r). Hence the quality of borrowers is defined based on both the risk and the return dimensions and the low- and high-risk groups both include set of good quality borrowers. The following definition gives the criteria for a good quality borrower that is used throughout this paper.

Definition: *Good Quality firm* :

Firm j with a risk return vector of $\{A_i, \theta_i\}$ is of "Good Quality" with an efficient investment if and only if its risk-return satisfies the application condition when there is no spread between internal and external finance as follows

$$A_i \succeq \frac{(1+r)}{\theta_i} \tag{9}$$

The "efficiency condition" 9 also implies that good a quality firm executes this investment plan using internal finance if it is available.

I assume that $\underline{A}^L \theta_L = \underline{A}^H \theta_H$. This condition assures that the ratio of "Good Quality" firms in the two types is equal. Moreover, I assume the shape parameter α is close to one. In this case, the high-risk borrowers do not have a strong first order stochastic dominance over the low-risk borrowers. And finally, for the sake of simplicity, I assume that the masses of low-risk and high-risk borrowers are equal. This set of assumptions underpins the efficient average risk of applicants θ^* at the arithmetic mean of the two types' risk level, Θ

$$\theta^* = \Theta = \frac{\theta_L + \theta_H}{2} \tag{10}$$

where the share of each type is equal in the pool of applicants.

3.5 The allocational effect of collateral

Having outlined the model and characterized its set of assumptions in the previous section, I now move on to find the stationary distribution of applicants, discouraged borrowers and related comparative statics. Our main interest is in investigating the allocational effect of collateral and how it improves (impairs) the allocational efficiency.
Solving the equation (7) , we can find the deviation of the average risk of applicants from an efficient level at stationary equilibrium (when $\bar{\theta}_{t+1} = \bar{\theta}_t$)

$$\frac{\bar{\theta}(\zeta, x) - \theta^*}{\theta^*} = \Delta(\zeta, x) = \mathscr{B}(\zeta, x)(1 - \zeta(1 - \eta) - \zeta\eta\Theta) \tag{11}$$

$$\mathscr{B}(\zeta, x) = \frac{-x^2}{1 + \zeta\eta[1 - \Theta(1 + x^2)]} \preceq 0$$

Proof. in Appendix II.a □

x denotes the half distance between the high and low risk as a percentage of average risk of all firms. $x = \frac{\frac{\theta_H - \theta_L}{2}}{\Theta}$. x indicates banks' screening errors and captures the intensity of uncertainty that banks face. The following four propositions present the key facts about the equation .

Proposition 1. *The average risk of applicants is decreasing in collateral rate ζ.*

Proof. in Appendix II.b □

Proposition 1 points out that more stringent collateral policies reallocate credit from high-risk to low-risk borrowers by discouraging high-risk borrowers from applying for a loan.

Proposition 2. *Banks' screening error x exacerbates the deviation from efficient allocation as $\Delta(\zeta, x)$ is decreasing in x when $\Delta(\zeta, x) \prec 0$ and $\Delta(\zeta, x)$ is increasing in x when $\Delta(\zeta, x) \succ 0$.*

Proposition 2 stresses the fact that informational asymmetry drives allocational inefficiency. When the informational gap is insignificant, the allocation inefficiency disappears.

Definition: *Degree of collateralization and collateral policy* :
$\mathscr{D} = \zeta(1-\eta)$ indicates the degree of collateralization with support $[0,1]$. $\mathscr{D} = 0$ indicates bank lending through unsecured loans, while $\mathscr{D} = 1$ defines bank credit supply under fully secured loans. A higher degree of collateralization means that banks have more stringent collateral policies.

Proposition 3. *Optimal collateral policy : the optimal degree of collateralization that could restore the allocational efficiency is given by*

$$\mathscr{D}^* = \frac{1}{1 + \frac{\eta}{1-\eta}\Theta} \tag{12}$$

In the presence of higher transaction costs for collateral η , the optimal collateral policy suggests that a lower degree of collateralization must be implemented.

When there is no transaction cost on collateral, a higher degree of collateralization strictly improves efficiency. In this instance, fully secured loans $\zeta = 1$ completely remove informational inefficiency and restore efficiency. However in the presence of non-zero transaction costs, for all $\mathscr{D} \succ \mathscr{D}^*$, a higher rate of collateralization strictly impairs this efficiency.

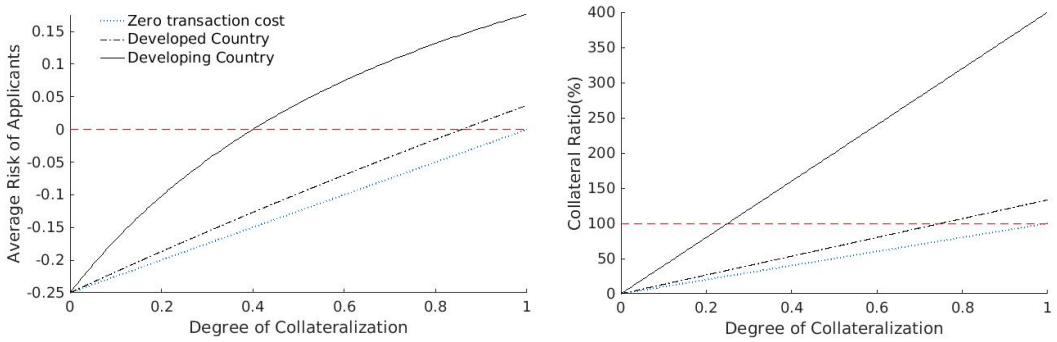
Proposition 4. *Discouraged borrowers : For all $\mathscr{D}$ lower than the optimal level $\mathscr{D}\epsilon[0, \mathscr{D}^*]$, information friction raises allocational inefficiency against low-risk borrowers, as low-risk good-quality borrowers are more likely to get discouraged.*
For all $\mathscr{D}$ higher than the optimal level $\mathscr{D}\epsilon[\mathscr{D}^*, 1]$, information friction raises allocational inefficiency against high-risk borrowers, as high-risk good-quality borrowers are more likely to get discouraged.

3.6 Implications of the model

Effectiveness of Collateral and the Quality of Institutions

The four propositions that have been outlined in the previous subsection suggest that in the presence of transaction costs, aggressive collateralization could raise allocational inefficiency against innovative firms (high-risk borrowers) by discouraging them from applying for a loan. In a developing country with lower institutional quality, higher judicial inefficiency and limited law enforcement, banks face more barriers to liquidating their collaterals. Thus, in these countries, collateral lending is subject to higher transaction costs. This implies that misallocation against innovative through discouragement is more likely and more severe in developing countries. Figure

1-(a) visualizes this comparison between developed and developing countries. [14]



(a) Allocational Inefficiency (b) Collateral Ratio

Figure 1

My four propositions summarize the model's predictions and hypothesize that the less stringent a collateral policy, the less likely it is that innovative businesses will be discouraged from applying for a loan. Thus, they have more access to bank finance and they invest more. The latter effect enhances the employment growth of innovative businesses and leads them to grow faster.

Figure 1-(b) indicates that when transaction costs are higher, the same degree of collateralization would result in a higher collateral ratio. This is in line with the recent findings of Cerqueiro et al. (2016b) that document the impact of the legal change on collateral policy of the banks.They document the quasi natural experiment where a legal reform in Sweden in 2004 increased the transactional cost of collaterals. Before the legal change, a creditor holding a floating lien could seize a firm's property outside bankruptcy and without court order. The 2004 law abolished such rights and increased their transactional cost. They show bank's internal assessment of the value of the assets that pledged over the loan dropped following the legal change.

It implies the same collateral ratio in different countries does not necessarily imply the same collateral policy due to different quality of laws and institutions. Thus my estimates should be limited to exploiting the variation in collateral practices within a country by a given institutional framework.

Collateral and Composition of Risk

These four propositions also shed light on an important side-prediction of the model highlighted before by Berger and Udell (1990). Each firm's risk θ

[14] To implement this numerical example we set the transaction cost η respectively to 25% and 75% for developed and developing countries. We also assume that the observed risk of borrowers Θ is equal to 50%. The results hold for all sets of parameters independent of how we discipline them.

has two parts: the observable part, Θ , and the non-observable part, $\theta - \Theta$. Proposition 1 suggests that higher collateral rates benefit firms with lower "unobservable risk". However proposition 3 implies that lower collateral rates favor firms that have lower "observed risk". Berger and Udell (1990) have pointed out that in the literature, most studies find that safer borrowers are more likely to pledge collateral (Chan and Kanatas (1985)). However, this view is not generally consistent with conventional wisdom in banking which holds that riskier borrowers are more likely to pledge collateral (Morsman (1996)). An essential difference between most of the theoretical models and conventional wisdom is that the former usually concentrate on private information about risk known only to borrowers, while the latter concentrates on observed risk. It is worth noting that the negative association between optimal collateral rates and observed risk is magnified when the disparity is larger.

4 Data and empirical strategy

My data comes from three important sources. I combine three important pieces of information: Data on firms , Data on the lending techniques of the banks and the geo-coordinates of firms and the bank branches surrounding these firms.

4.1 Firms data : The MENA Enterprise Survey

My data on firms comes from The Middle East and North Africa Enterprise Survey (MENA ES), funded jointly by EBRD, EIB and the World Bank. The MENA ES provides the firm level data of the formal private sectors in our sample of three MENA economies: Egypt, Morocco and Tunisia . The survey covers manufacturing and service firms , where services includes retail, wholesale, hospitality, repairs, construction, transport and information technology (IT) sectors. However sectors such as agriculture, fishing, and extractive industries, as well as utilities has been not covered in the survey. Also some of services sectors such as financial services, education, and healthcare has been not included in the survey.

The MENA ES addresses a broad range of business environment issues such as access to finance, The organization and quality of firms, managers characteristics , market structure and the political instability that firm faces, as well as their performance measures. The samples are stratified by firm size, sector of activity, and location within these four economies. The survey covers 6083 firms in total with sample size ranging from 407 firms in Morocco to 2897 in Egypt. The MENA ES follows the World Bank's global methodology for enterprise surveys. The data are therefore comparable with enterprise surveys in 126 countries covering more than 94,000 firms. EBRD et al. (2016) presents first results of the MENA ES. Data collection

took place in the aftermath of the Arab Spring. Respondents were interviewed in 2013 and 2014, but the reference period of the survey is firms' fiscal year 2012.

4.1.1 Firm's Performances and Characteristics

Firms' performance in terms of job creation is our variable of interest that we seek to explain. We compute employment growth through expansion for all incumbent firms comparing the number of their full time employees at the end of last fiscal year and three fiscal years ago.

$$g_i = \frac{1}{t_{LFY} - t_{FY-3}} \frac{l_{LFY} - l_{FY-3}}{\alpha l_{LFY} + (1-\alpha) l_{FY-3}} \tag{13}$$

A common choice of weight is to set $\alpha = 1/2$. It has the advantage of making the growth measure symmetric and more comparable across different size groups(Moscarini and Postel-Vinay (2012)). By design the survey only covers firms that have survived until the interview. Therefore I could not observe job creation and destruction by entry and exit of firms. This narrows down my analysis to intensive margin of firms' ability to create jobs. Furthermore this also implies that my results are subject to survivor bias in the sense that I cannot observe firms that have exited since $FY - 3$.

Moreover as I try to explain the pattern of employment growth through access to external finance , I investigate the firm's performance in terms of fixed investment. MENA ES provides information on whether firms have purchased fixed asset during the last fiscal year. I construct a set of control variables that may plausibly affect the ability of the firm to either grow or carry out fixed investment.

In particular, the MENA ES questionnaire includes three questions which provide information on characteristics and quality of firm's manager: gender, education and experience . *Manager education* assume a value of 1 if the manager holds a university degree and 0 otherwise. *manager experience* captures how many years of experience the manager has in the present sector. *Female CEO* is a dummy variable that indicates whether the top manager is female. Bloom and Van Reenen (2007) highlights the importance of manager's characteristics and argues it could attribute to explain the differences that exist in performance of firms even within narrowly defined sectors.

The MENA ES further provides information on the organization of firms. The variable *Foreign ownership* is a dummy variable that takes the value of 1 if it at least 10 percent of the firm is owned by foreign private individual or company. Foreign-owned firms may have access to internal capital markets and therefore be less dependent on the local banking system. The questionnaire also elicits firms' age and their initial size three fiscal yeas ago. The firms' employment growth are highly related to their initial size as the employment growth often slows down as the number of employees increase.

Also firm's ability to grow and their strategic decision to carry out an investment highly depends on the life cycle of firms. Furthermore, I construct three measures of firm quality. *Audited* equals one if the firm's accounts have been certified by an external auditor. This reduces information asymmetries and thereby facilitates access to finance. *Exporter* is an indicator equal to one if the firms exports at least ten percent of sales. This signals that the firm is competitive in international markets. Finally, *Iso Holder* indicates if the firm has earned a quality certification recognized by the International Organization for Standardization (ISO).Summary statistics are provided in Table REF. Some other studies such as Gorodnichenko and Schnitzer (2013) that use similar data (BEEPS) control in addition for total factor productivity, estimated based on cost shares for labour, material, and capital, adjusted for capacity utilization. Item non-response to quantitative questions in the MENA ES is high implying a large and likely non-random loss of observations, as a result of which I decide to not control for TFP.

4.1.2 Access to Finance

The MENA ES measures firm access to finance along various dimensions. In particular, the MENA ES contains a set of questions that elicit the properties of these loans, which enables us to construct the measure representing collateral requirements by the ratio of collateral to loan value. To eliminate outliers, I winsorize the variable at the 5th and the 95th percentile of its distribution.

To measure the the discouragement I rely on a standard set of questions as used for instance in Popov and Udell (2010). The MENA ES first asks firms whether they have applied for a loan in the last fiscal year. Firms that did not apply for a loan are asked for the main reason they did not apply. Those firms that respond "no need for a loan" are classified as not credit constrained. Firms that cite other reasons such as complex application procedures, too high interest rates or collateral requirements, or simply did not believe that the application would be approved are considered credit constrained through demand or "discouraged". The MENA ES also asks firms to report the share of bank's credit in financing their expenses or fixed investment. They are considered that they do not have access to bank finance if they report zero.

Furthermore collateral environment indices could be correlated with locality variables and lending environment characteristics that also affects firm's performance and financial choices. We add set of variables that control for characteristics of the local banking landscape, such as banks' funding structure and organization as well as local competition.

4.1.3 Innovative firms

MENAES asks firms to report various types of innovation activity. That enable us to construct a measures of innovation that follow the recommendations of the Oslo Manual developed by Eurostat and OECD for innovation surveys of OECD countries. This manual defines what is meant by an innovation, suggesting the use of survey measures capturing initiatives that are "new to the firm".

Following Gorodnichenko and Schnitzer (2013) I define firm as innovative whether they have developed a major new product line or upgraded an existing product line (New Product) or acquired new production technology (New Technology) during the last three years.

These self-reported qualitative measures of innovation are by definition more prone to measurement error and cultural bias than are more objective measures such as patents and R&D expenditures. Nevertheless,Gorodnichenko and Schnitzer (2013) argues these measures of innovation have several advantages over the indirect measures based on patents and R&D expenditures, especially when studying innovation activities in developing countries. Most importantly for our purposes, patent activity and formal R&D are less likely to be observed in emerging market economies. Domestically owned firms are expected to engage more in imitation and adaptation of already created and tested technologies.

Thus in context of developing countries, it is crucial to rely on measures of innovations that are "new to the firm", not "new to the world". This recommendation of the Oslo Manual is substantiated in my data, where the innovative firms dispose substantially higher likelihood to invest in fixed assets and higher growth potential across their life cycle.

4.2 Bank lending data : Banking Environment and Performance Survey

The second source in my data, that provides inside information on banks' lending technique, comes form the second Banking Environment and Performance Survey (BEPS II).[15] As part of BEPS II, a questionnaire was administered during a face to face interview with bank CEOs by a specialized team of senior financial consultants, each with considerable first hand banking experience. The banks represent all major banks that hold more tham 80 % of all bank assets in these three countries.
I use BEPS II question Q6, which asked CEOs to rate on a five-point scale

[15] Look Beck et al. (2018)

the importance (frequency of use) of the following techniques when dealing with SMEs: relationship lending, fundamental and cash flow analysis, business collateral, and personal collateral (personal assets pledged by the entrepreneur). Question Q6 does not refer to a specific date. However, Fahlenbrach et al. (2012); Beck et al. (2018) show that bank business models and lending technique hardly change over time. Following Beck et al. (2018) approach to classify the lending technique of banks, I classify the banks as collateral lending if its CEO views the collateral lending (either personal or commercial) as very important. 80% of government owned , 43% of private domestic and 33% of foreign banks in my sample view themselves as collateral lending banks.

4.3 Bank-firm network data set

I use a hand collected data on the location of bank branches. The data comes from Bank Branch Network data set Beck et al. (2018) that collected by EBRD. The data gathered by contacting the banks or by downloading data from bank websites. All information was double-checked with the bank as well as with the SNL Financial database. The data focuses on branches that provide funding to SMEs, excluding those that lend only to households or large corporates. EBRD kindly shared with me part of this interesting dataset that covers bank branches in Morocco, Tunisia and Egypt.

Using this data set, I construct the set of lending environment characteristics. These locality level bank characteristics has been constructed based on branch-weighted average of the banks' characteristics that have branches in a circle with radius 10km centered on the sample firm. The data for bank characteristics comes two sources. Bureau Van Dijk's BankScope provides information on banks' balance sheet and income statement as well as information about public vs private ownership, and the Claessens and Van Horen (2014) database on bank ownership to determine whether a bank is foreign or domestic owned. A bank is classified as foreign owned if at least half of its equity is in foreign hands.

My lending environment variables includes Local share of Small banks that has less than EUR 5 billion in assets which is The lowest quartile of asset distribution in sample of all banks. Local share of foreign banks. I identify A bank as foreign owned if at least half of its equity is in foreign hands. I also construct the locality-level Herfindahl-Hirschmann index where market shares are measured by branches. This index captures the banking competition in the vicinity of each firm.Finally I also control for healthiness of banks that present in the locality. To this end I built the branch-weighted average of the banks' non performing loan to gross loans at locality level. Additionally I also control for the branch-weighted average of the banks' net loan to total assets. Table 3 reports the statistics and source of these lending environment variables. The locality level variable also includes the matrix of dummies for five categories of cities. It includes Capital city ,

city with more than one million population , city with population less than one million and more than 250,000 population, city with population less than 250,000 and more than 50,000 population villages with Less than 50000. villages with Less than 50000 contain 30% of observed firms while Capital cities account for roughly 25% of firms in our dataset.

4.4 Identification strategy

Using the geographical variation of collateral lending banks' branch network, I define to what extent collateral lending prevails in local lending market where firm is located. This enables me to investigate the impact of collateral lending on firm's financial constraint and performances. To this end , I calculate the share of collateral lending banks in total branches near the firm . I consider all branches that are located less than 5 km from the firm.

To study the effect of collateral policies on firms' performance, I follow three steps. First, following the two stages process proposed by Beck et al. (2018), I construct my treatment and control groups. The treatment group includes all firms located in localities in which banks with less stringent collateral policies have stronger presences.

To estimate the link between the share of collateral lending banks in local branches near the firm and firm's performances and financial choice , I use the following model.

$$y_{ijkz} = \beta_1 \delta_{ijkz}^{Innovator} + (\beta_2 + \beta_3 \delta_{ijkz}^{Innovator}) \times share\ collateral\ lenders_{ijzk} + \beta_4 X_{ijkz} + \beta_5 \Omega_{ijkz} + \beta_6 L_{jk} + \beta_7 \delta_j^{Country} + \beta_8 \delta_z^{Industry} + \epsilon_{ijkz}$$

Where y_{ijkz} is a dummy variable equal to one if firm i in locality k of country j in industry z is credit constrained of country j from industry z. X_{ijz} is a matrix of firm covariates to control for observable firm-level heterogeneity. Ω_{ijz} is is a matrix of bank characteristics in locality of firm i in country j. The locality variables also includes the matrix of fixed effects for city categories . I saturate my model with country, and industry (ISIC 2 digits) fixed effects . I further cluster error terms at the country industry level to allow them to be correlated due to country or industry specific unobserved factors. $\delta_{ijkz}^{Innovator}$ is a dummy for innovative firms that takes 1 if firm has undertake innovative activities during the last three years that could include either introducing a new product or a new process. $share\ collateral\ lenders_{ijzk}$ is our main variable of interest. It is a share of collateral lending bank in local branches near the firm. The coefficient of interest are β_2 and β_3. Normalizing the continuous variables in the regression, β_2 captures the collateral lending impact on non innovative firms while β_3 indicates the differential impact of collateral lending on innovative firms.

Results

4.5 Main Findings

This section first provides our baseline results and then discusses how the local presence of collateral lenders affects different types of firms to a different extent.

4.5.1 Access to Finance

Table 4 presents our core results. All columns control for country and sector specific macro shocks by including a full set of country and sector dummies [16] as well as our standard set of firm and locality variables. "Share of collateral lenders" is the variable of interest that represents the share of bank branches in vicinity of the firm that belong to banks that think collateral lending is “very important” in dealing with SMEs. We consider all local branches that are located in less than five kilometers from the firm. Column (1) of table 4 indicates how local collateral lending affects SMEs’ financial constraint. The dependent variable is a dummy that takes value 1 if a firm is credit constraint and zero otherwise. The significant positive coefficient of share of collateral lenders indicates the positive relation between the local importance of collateral lenders and firms’ financial constraint. It implies that SMEs in localities with stronger presence of the banks that use collateral lending more frequently were more credit constrained than similar firms in localities with relatively few collateral lending banks. The one standard deviation increase in the share of collateral lenders in local branches raises the likelihood of being credit-constrained by 4.9%. Column (2) assesses the composition of constrained firms in localities that collateral lending banks have stronger presence. I argue that collateral lending could affect firms’ financial constraints through its impact on firms’ evaluation of their potential investment plans that tend to be financed by external credit. Thus firms may self-ration themselves from the loan market, leading to a specific form of financial constraint called discouragement. Under discouragement, low access to external finance is accompanied by low demand and lower applicant numbers due to higher discouragement.
Generally, the self selection mechanism of collateral lending should increase the quality of applicants. However, according to the prediction of my theoretical model, distortionary effect of collateral on risk taking behavior of borrowers could overturn this result and reduce the quality of applicants.

In Column (2) I estimate the heterogeneous effect of the the local share of collateral lenders on Innovative firms’ financial constraint. The results suggest that the negative impact of collateral lending is significantly biased against innovative firms. The coefficient in column (2) indicates that there is no significant relation between stronger presence of collateral lenders and

[16] ISIC 2-digit classification

non innovative firms. However, one standard deviation increase in share of collateral lenders in local branches near the firms raise the probability of being credit constrained by 8.4 % among innovative firms. In column (3), I estimate the firms' propensity to get discouraged from applying to a bank for a loan. It turns out that the effect of collateral on discouragement follows the same pattern as the effect of collateral on financial constraint. In Column (3), the significant and positive interaction term with share of collateral lenders indicate that innovative firms are more likely to get discouraged when they are faced with collateral lenders in local lending market. In contrast, I observe no significant impact of collateral lenders on non innovative.

4.5.2 firms' performance

Collateral lending can alter firms' ability to invest and bind their potential to create jobs - by tightening their access to external finance. Table 5reports estimates that quantify the real impact of local share of collateral lenders on firms' investment behavior and growth potential.
Column (1) of Table 5 presents the results for the effects of collateral requirements on firms' propensity to purchase fixed assets during the last fiscal year. The significant coefficient of the dummy for innovative firms indicates that innovative firms are more likely to invest in fixed assets. The probability of investing in fixed asset is 11.4 % is higher than non innovative firms. However, when innovative firms are located in areas where the collateral lending banks have stronger presence their are substantially less likely to invest. The one standard deviation increase in share of collateral lenders in local branches reduce the likelihood of an innovative firm to invest by 9.5%. The results in Column (1) show no statistically significant gap between the average investment propensity of non innovative firms when they face higher local presence of collateral lending banks. Column (2) investigate the impact of collateral lending on firms' employment growth potential. The dependent variable in column (2) is employment growth during the last three fiscal years. In line with conventions in firms' growth accounting, Column (1) controls for the *Initial Size* , dummy for small (less than 20 employees) and medium size (less than 100 employees) firms which captures the systematic relationship between firm size and growth rate. These size control variables assure our results are not affected by size-growth relationship. [17]

Column (2) of table 5 shows that, the innovative firms grow 2.46 % faster than non innovative firm. The economic magnitude of this gap is substantially large when I consider that the difference in the growth rate of firms growing at the 75th percentile and the 25th percentile of the growth rate distribution is just about 7.41 % percentage points. However, in areas where

[17] Evans (1987); Sutton (1997)

collateral lending banks have a higher share in local branch network, the positive growth gap of innovative firms significantly diminishes. The results indicates that the the higher local share of collateral lenders has no statistically significant effect on non innovative firms.

4.6 Robustness Check

4.6.1 The endogeneity of demand

In this section, I address whether our findings could be driven by endogeneity of demand for specific firms or specific localities. Table 6 reports a Heckman regressions in which the need for a loan is the dependent variable in first stage regression. I use two selection variables that are excluded from our baseline regression for the identification of the model.

The first variables constructed according to information on whether firms resort to nonconventional forms of payment such as barter typical responses when faced with exogenous shocks to cash flow. MENA ES data indicate the extent to which firms suffered losses from input delivery delays or breakage and spoilage of goods. This instrument have been used by Gorodnichenko and Schnitzer (2013) and they provide evidence that this instruments are unlikely to be affected by innovation activities and are reliable measures of exogenous shocks to a firm's financial constraints. Thus our first selection variable to instrument the demand for external finance is a dummy variable that takes value equal to one if firm faces any cost due to delays or breakage and spoilage of goods in transportation. Furthermore, MENA ES data provide information on the extent to which firms suffered tangible losses due to power outage. We consider this loss as an negative exogenous shock that unexpectedly could impact the cash flow. Loss due to outage is our second selection variable. It is a dummy equal to one if firm states that it experienced a tangible lost due to power outage in last fiscal year.

The Heckman regression mitigate the concern on endogeneity of demand among specific firms however it does not completely rule out the possibility of endogenous demand in different localities.The insignificant coefficient of "Share of collateral lenders" and its interaction with innovative firms in the demand regressions is reassuring . It suggests that collateral lenders did not select into localities with a higher demand for external finance. However, it can not be excluded the possibility that new specific firms selected and enter into localities with a lower or higher share of collateral banks due to their different credit supply Beck et al. (2018). We therefore use two measures to control for local credit demand and supply. Using the geographical coordinates of firms. I define ,for each firm, the first 20 closest neighboring firms. Then I construct the local credit demand and supply according to the information of these 20 neighboring firms. Local demand is a ratio

of neighboring firms that state their need for an external finance. likewise, Local supply is a share of neighboring firms that have a loan.

4.6.2 Alternative geographical link between firms and bank branches network

Here in this section, I provide the results when I connect the firm and branch data in three different ways. First, I match by narrow locality. I draw circles with a radius of 5 km around the geo-coordinates of each firm and then link the firm to all branches inside that circle. Then I calculate the share of collateral lenders in these branches that are geographically linked to the firm. Thus I consider all branches that are located in less than 5 km from the firm. Column (1) in table 7 reports the estimates for this approach that I use as a the base line definition of the localities. Then I enlarge the radius of this circle to 10 km that could be assumed as a size of a large city. Column (2) indicates the coefficient stays very stable with this new definition of localities. Finally I also connect firms to 20 first closest branches.Thus for each firm I just consider first 20 branches in less than 5 km. The column (3) indicates the coefficients stay very similar to the coefficients of two other approaches.

4.6.3 Collateral lending and efficiency of court enforcement

There are number of notable studies such as Calomiris et al. (2017); Liberti and Mian (2010); Jappelli et al. (2005) show that the quality of institution such as judicial efficiency in law enforcement promote financial development and easing borrowing constraints by lowering the collateral spread and shifting the composition of acceptable collateral towards firm-specific assets. Our theoretical model indicates that this collateral spreed is larger for firms that facing higher risk. using this fact, I investigate the robustness of my finding by comparing the impact of collateral lending in localities with high and low quality of enforcement. MENAES ask firms how they rate the quality of court enforcement from 1 to 4 scale. We construct the index for local quality of court near the firm. Four each firm we calculate the average rating of court enforcement by its 20 closest neighboring firms. I then compare the impact of collateral lending for subsample of firms that are located in area above and below the country median level of this local collateral index. Results in table 8 are reassuring as they indicate the collateral spreed is much larger for innovative firms that are located in area with lower quality of court enforcement.

4.6.4 Are bank CEOs' views in line with collateral spread rate

Our measure of collateral lending is unique compared with the existing literature as it is based on a survey of bank CEOs. In light of possible biases due to peceptions of individual CEOs or cross-country cultural differences,

I look for external validation of this measure by exploiting information from the MENAES loan data. This data contains information on interest rate and collateral rate of the loans. I then investigate if collateral lending banks, after controlling for firm and bank characteristics, impose higher collateral rate on their loans. The estimates in table 8 indicates that collateral lending banks tend to charge 15% higher collateral rates on their borrowers.

5 Conclusion

Innovative firms play a prominent role in contributing to aggregate growth and development. Hence, governments seek a variety of policy instruments to support them and to promote their potential impacts. This paper shed lights on the new aspect of financial friction caused by collateral lending that could harness the growth prowess of innovative firms in developing countries.

Developing a model of adverse selection with heterogeneous borrowers across risk and return metrics, this paper argues that in contexts of low-quality collateral and bankruptcy laws, the resulting inefficient collateralization generally observed influences the demand-driven financial constraints of innovative firms that tend to face higher risk.

Drawing on a novel dataset on three MENA economies that have some of the poorest legal strength in terms of their collateral and bankruptcy laws, I document the economic importance of innovative firms and the potential role of demand-driven financial constraints and discouragement in binding their ability to invest and expand.

Using the geographical variation in collateral lending banks, I investigate the impact of collateral lending on innovative firms' financial constraint and performance. I find that innovative firms are more likely to be credit constrained when they are located in areas where collateral lending banks have a stronger presence. I also find that in areas where collateral lenders have higher share in local branches, innovative firms are less likely to invest in fixed assets and they grow slower than similar firms in localities with relatively few collateral lending banks.

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Appendix I : Tables and Figures

Table 1: Business Environment In Four MENA Economies

Economy	Quality of Institutions	Collateral Lending		Credit Constrained		Quality of Entrepreneur
	Strength of Collateral and Bankruptcy Law index (0-12)	Collateral ratio (%)	Share of Collateralized Loans (%)	Rationed by Demand Discouraged (%)	Rationed by Supply Applied and Rejected (%)	Manager with University Degree
Egypt, Arab Rep.	2	272	92.4	95.2	4.8	79.9
Morocco	2	166	84	86	14	78
Tunisia	2	252	87	88.3	11.7	70.4
MENA ES	1.1	208	78.8			
Lower middle income	5.2	197	79.7			
Upper middle income	5.3	190	74.8			
High income: nonOECD	4.6	180	76			
High income: OECD	5.8	148	63.7			

Note: The table presents statistics on, Strength of legal rights index that measures the quality of collateral and bankruptcy laws . The index ranges from 0 to 12, with higher scores indicating the better quality.(Source: World Bank, Doing Business project) ; Collateral lending practices ; the composition of credit constrained firms and Quality of Entrepreneurs

Table 2: Summary statistics

	Sectoral Composition		Age and Size		Manager Characteristics		
	(1) Manu-facturing	(2) Retail	(3) Younger than 5 years	(4) SME	(5) University degree	(6) Experience in years	(7) Female CEO
Morocco	0.380	0.090	0.087	0.882	0.780	22.388	0.043
Egypt	0.551	0.156	0.330	0.932	0.799	18.354	0.071
Tunisia	0.422	0.057	0.102	0.888	0.704	24.574	0.085

	Firm Organization	Firm Quality			Political Environment	
	(8) Foreign owned	(9) Audited accounts	(10) Exporter	(11) Iso Holders	(12) Political instability	(13) Number of firms
Morocco	0.120	0.473	0.119	0.162	0.313	407
Lebanon	0.029	0.844	0.318	0.134	0.906	561
Tunisia	0.117	0.745	0.302	0.162	0.593	592

Note: The Table presents statistics on, sectoral composition between manufacturing, retail and services, share of firms younger than 5 years old, share of SMEs (firms which have less than 100 permanent employees), share of firms whose manager has a university degree, average experience of the manager, share of firms with female CEO, share of firms which more than 10% of them owned by private foreign individuals, share of audited firms, share of firms that exports, share of firms that hold Iso (organizational quality) certificate, share of firms that declare political instability is "Major" or "very severe" obstacle and total number of firms by country.

Table 3: Banks' characteristics at locality level

	Mean	Standard Deviation	Source
Foreign Bank	0.37	0.16	BEPS II
Small Bank	0.24	0.21	BankScope
Non Peforming Laon to Gross Loan	7.79	2.46	BankScope
Net loan to asset	43.67	15.28	BankScope
HHI	0.17	0.23	Bank branch networks data Beck et al. (2018)
Bank's average Collateral ratio	201.85	25.14	MENA ES
Bank's propensity to lend with Collateral ratio>200 %	0.34	0.08	MENA ES

Note: The Table presents statistics on the locality level lending environment. These locality level bank characteristics has been constructed based on branch-weighted average of the banks' characteristics that have branches in a circle with radius 10km centered on the sample firm. Locality level controls include banks' characteristics at locality level.It includes the local share of Small banks that has less than EUR 5 billion in assets (The lowest quartile of asset distribution in sample of all banks). Local share of foreign banks (A bank is classified as foreign owned if at least half of its equity is in foreign hands).local share of Relationship Lenders (Bank defines soft information as very important in lending to SME) The locality-level Herfindahl-Hirschmann index where market shares are measured by branches. The branch-weighted average of the banks' non performing loan to gross loans. The branch-weighted average of the banks' net loan to total assets.

Table 4: Collateral lending and firms' financial constraint

	(1) Constrained b/se	(2) Constrained b/se	(3) Discouraged b/se
Share of collateral lenders	0.049**	0.024	0.021
	(0.02)	(0.02)	(0.02)
Innovator	0.007	-0.000	-0.018
	(0.03)	(0.03)	(0.03)
Innovator × Share of collateral lenders		0.083**	0.086**
		(0.04)	(0.04)
Firm's Level Controls	Yes	Yes	Yes
Banks' Controls	Yes	Yes	Yes
Country	Yes	Yes	Yes
Locality Level Controls	Yes	Yes	Yes
Sectors	Yes	Yes	Yes
Observations	2502	2502	2502

*Note: LPM (linear probability model) in all three columns using survey-weighted observations (Stata's svy prefix). The dependent variable in column 1-2 is a dummy variable takes value 1 if firm is constrained and zero otherwise. The dependent variable in column 3 is a dummy variable takes value 1 if firm is discouraged (does not apply for a loan for any reason other than no need for a loan due to sufficient funds). " share of collateral lenders " is a share of banks that self identified themselves as collateral lenders in total branches that in a distance less than 5km from the firm. Locality level controls include banks' characteristics at locality level.It includes the local share of Small banks that has less than EUR 5 billion in assets (The lowest quartile of asset distribution in sample of all banks). The locality-level Herfindahl-Hirschmann index where market shares are measured by branches. The branch-weighted average of the banks' non performing loan to total assets. The branch-weighted average of the banks' equity to total assets and branch-weighted average of the banks' wholesales finance. Locality variables also contains the matrix of dummies for five categories of cities from (Capital city to small villages). In all columns Other Firm's control variables included but not reported include dummy variable which takes value 1 if firm is a small (less than 20) or medium size establishment with less than 100 employees, manager education, manager experience , a dummy variable that takes value 1 if the share of workers that have university education is higher than median, manger experience, exporting status, gender of the manager, foreign ownership, having a quality certification recognized by the International Organization for Standardization (ISO), having audited financial reports. . ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels respectively.*

Table 5: Collateral Lending and Firm's performances

	(1) Investing in Fixed Asset b/se	(2) Annual Employment Growth % b/se
Share of collateral lenders	-0.003	-0.243
	(0.02)	(0.90)
Innovator	0.114**	2.457**
	(0.05)	(0.99)
Innovator × Share of collateral lenders	-0.095**	-3.018**
	(0.04)	(1.21)
Firm's Level Controls	Yes	Yes
Banks' Controls	Yes	Yes
Country	Yes	Yes
Locality Level Controls	Yes	Yes
Sectors	Yes	Yes
Observations	2558	2320

*Note: LPM (linear probability model) in all three columns using survey-weighted observations (Stata's svy prefix). The dependent variable in column 1 is a dummy variable takes value 1 if firm invested in fixed asset during the last three fiscal year. The dependent variable in column 2 is a continuous variable captures the annual employment growth. " share of collateral lenders " is a share of banks that self identified themselves as collateral lenders in total branches that in a distance less than 5km from the firm. Locality level controls include banks' characteristics at locality level.It includes the local share of Small banks that has less than EUR 5 billion in assets (The lowest quartile of asset distribution in sample of all banks). The locality-level Herfindahl-Hirschmann index where market shares are measured by branches. The branch-weighted average of the banks' non performing loan to total assets. The branch-weighted average of the banks' equity to total assets and branch-weighted average of the banks' wholesales finance. Locality variables also contains the matrix of dummies for five categories of cities from (Capital city to small villages). In all columns Other Firm's control variables included but not reported dummy variable which takes value 1 if firm is a small (less than 20) or medium size establishment with less than 100 employees, manager education, manager experience , a dummy variable that takes value 1 if the share of workers that have university education is higher than median, manger experience, exporting status, gender of the manager, foreign ownership, having a quality certification recognized by the International Organization for Standardization (ISO), having audited financial reports. . ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels respectively.*

Table 6: Endogenous demand : Collateral Lending and Firm's performances

	(1) Constrained b/se	(2) Constrained b/se	(3) Constrained b/se	(4) Constrained b/se	(5) Constrained b/se
Share of collateral lenders	0.024	0.021		-0.025	-0.042
	(0.02)	(0.02)		(0.05)	(0.04)
Innovator	-0.000	-0.001	0.010	0.055	0.076
	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
Innovator ×					
Share of collateral lenders	0.083**	0.084**		0.163**	0.157**
	(0.04)	(0.04)		(0.07)	(0.07)
Innovator ×					
Share of collateral lenders (at city level)			0.080*		
			(0.05)		
Local Credit demand		0.153*			
		(0.09)			
Local credit supply		-0.142*			
		(0.08)			
					Need
Lost due to spoilage					0.224*
					(0.12)
lost due to power outage					0.312**
					(0.15)
Share of collateral lenders					0.091
					(0.09)
Innovator					-0.007
					(0.15)
Innovator ×					
Share of collateral lenders					0.160
					(0.16)
Firm's Level Controls	Yes	Yes	Yes	Yes	Yes
Banks' Controls	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes
Locality Level Controls	Yes	Yes	Yes	Yes	Yes
city	No	No	Yes	No	No
Sectors	Yes	Yes	Yes	Yes	Yes
Observations	2502	2502	2502	905	2225

*Note: LPM (linear probability model) in all three columns using survey-weighted observations (Stata's svy prefix). The dependent variable in all column is a dummy variable takes value 1 if firm is constrained and zero otherwise. " share of collateral lenders " is a share of banks that self identified themselves as collateral lenders in total branches that in a distance less than 5km from the firm. In column 3 city fixed effects included and "share of collateral lenders" is aggregated at city level. Locality level controls include banks' characteristics at locality level.It includes the local share of Small banks that has less than EUR 5 billion in assets (The lowest quartile of asset distribution in sample of all banks). The locality-level Herfindahl-Hirschmann index where market shares are measured by branches. The branch-weighted average of the banks' non performing loan to total assets. The branch-weighted average of the banks' equity to total assets and branch-weighted average of the banks' wholesales finance. Locality variables also contains the matrix of dummies for five categories of cities from (Capital city to small villages). In all columns Other Firm's control variables included but not reported include dummy variable which takes value 1 if firm is a small (less than 20) or medium size establishment with less than 100 employees, manager education, manager experience , a dummy variable that takes value 1 if the share of workers that have university education is higher than median, manger experience, exporting status, gender of the manager, foreign ownership, having a quality certification recognized by the International Organization for Standardization (ISO), having audited financial reports. . ***, ** and * denote statistical significance at the 1, 5 and 10*

Table 7: Collateral lending and firms' financial constraint

	Constrained		
	(1)	(2)	(3)
	5 km	10 km	First 20 branches
	b/se	b/se	b/se
Share of collateral lenders	0.024	0.013	0.003
	(0.02)	(0.05)	(0.02)
Innovator	-0.000	-0.012	0.004
	(0.03)	(0.04)	(0.04)
Innovator × Share of collateral lenders	0.083**	0.086*	0.084*
	(0.04)	(0.04)	(0.04)
Firm's Level Controls	Yes	Yes	Yes
Banks' Controls	Yes	Yes	Yes
Country	Yes	Yes	Yes
Locality Level Controls	Yes	Yes	Yes
Sectors	Yes	Yes	Yes
Observations	2502	2761	2502

*Note: LPM (linear probability model) in all three columns using survey-weighted observations (Stata's svy prefix). The dependent variable in column 1-2 is a dummy variable takes value 1 if firm is constrained and zero otherwise. The dependent variable in column 3 is a dummy variable takes value 1 if firm is discouraged (does not apply for a loan for any reason other than no need for a loan due to sufficient funds). " share of collateral lenders " is a share of banks that self identified themselves as collateral lenders in total branches that in a distance less than 5km from the firm. Locality level controls include banks' characteristics at locality level.It includes the local share of Small banks that has less than EUR 5 billion in assets (The lowest quartile of asset distribution in sample of all banks). The locality-level Herfindahl-Hirschmann index where market shares are measured by branches. The branch-weighted average of the banks' non performing loan to total assets. The branch-weighted average of the banks' equity to total assets and branch-weighted average of the banks' wholesales finance. Locality variables also contains the matrix of dummies for five categories of cities from (Capital city to small villages). In all columns Other Firm's control variables included but not reported include dummy variable which takes value 1 if firm is a small (less than 20) or medium size establishment with less than 100 employees, manager education, manager experience , a dummy variable that takes value 1 if the share of workers that have university education is higher than median, manger experience, exporting status, gender of the manager, foreign ownership, having a quality certification recognized by the International Organization for Standardization (ISO), having audited financial reports. . ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels respectively.*

Table 8: Collateral lending and court enforcement

	Constrained		
		Local court enforcement	
	(1)	(2)	(3)
	All	More Efficient	Less efficient
	b/se	b/se	b/se
Share of collateral lenders	0.024	0.002	0.044
	(0.02)	(0.02)	(0.03)
Innovator	-0.000	-0.029	0.033
	(0.03)	(0.06)	(0.05)
Innovator × Share of collateral lenders	0.083**	0.065	0.140**
	(0.04)	(0.06)	(0.05)
Firm's Level Controls	Yes	Yes	Yes
Banks' Controls	Yes	Yes	Yes
Country	Yes	Yes	Yes
Locality Level Controls	Yes	Yes	Yes
Sectors	Yes	Yes	Yes
Observations	2502	1077	959

*Note: LPM (linear probability model) in all three columns using survey-weighted observations (Stata's svy prefix). The dependent variable in column 1-3 is a dummy variable takes value 1 if firm is constrained and zero otherwise. " share of collateral lenders " is a share of banks that self identified themselves as collateral lenders in total branches that in a distance less than 5km from the firm. Locality level controls include banks' characteristics at locality level.It includes the local share of Small banks that has less than EUR 5 billion in assets (The lowest quartile of asset distribution in sample of all banks). The locality-level Herfindahl-Hirschmann index where market shares are measured by branches. The branch-weighted average of the banks' non performing loan to total assets. The branch-weighted average of the banks' equity to total assets and branch-weighted average of the banks' wholesales finance. Locality variables also contains the matrix of dummies for five categories of cities from (Capital city to small villages). In all columns Other Firm's control variables included but not reported include dummy variable which takes value 1 if firm is a small (less than 20) or medium size establishment with less than 100 employees, manager education, manager experience , a dummy variable that takes value 1 if the share of workers that have university education is higher than median, manger experience, exporting status, gender of the manager, foreign ownership, having a quality certification recognized by the International Organization for Standardization (ISO), having audited financial reports. . ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels respectively.*

Table 9: Collateral lending and collateral rate spread

	(1)	(2)
	Collateral ratio (%)	Collateral ratio(%)
	b/se	b/se
Collateral lenders	15.190***	14.439*
	(5.49)	(8.49)
Innovator	-5.421	-3.385
	(5.96)	(7.25)
Average interest rate	-4.067	-10.365**
	(3.12)	(4.46)
Foreign bank		-16.487**
		(7.78)
Public bank		1.071
		(14.03)
Firm's Level Controls	Yes	Yes
Time	Yes	Yes
Country	Yes	Yes
Locality Level Controls	Yes	Yes
Sectors	Yes	Yes
Banks' Controls	No	Yes
Observations	527	343

*Note: OLS in both columns . The dependent variable in column 1-2 is collateral ratio (log). collateral lenders is a dummy variable that takes 1 if bank's CEO views the collateral lending as very important in lending to SMEs. Banks characteristics include non performing loan to total assets, equity to total assets and wholesales finance. Locality variables contains the matrix of dummies for five categories of cities from (Capital city to small villages). In all columns Other Firm's control variables included but not reported include dummy variable which takes value 1 if firm is a small (less than 20) or medium size establishment with less than 100 employees, manager education, manager experience , a dummy variable that takes value 1 if the share of workers that have university education is higher than median, manger experience, exporting status, gender of the manager, foreign ownership, having a quality certification recognized by the International Organization for Standardization (ISO), having audited financial reports. . ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels respectively.*

Appendix II : Theoretical Appendix

Appendix II.a:

The average θ is given by

$$\bar{\theta}_{t+1} = \frac{\theta_l \Gamma(\theta_L, \bar{\theta}_t) + \theta_h \Gamma(\theta_H, \bar{\theta}_t)}{\Gamma(\theta_L, \bar{\theta}_t) + \Gamma(\theta_H, \bar{\theta}_t)} \tag{14}$$

In which

$$\Gamma(\theta_i, \bar{\theta}_t) = \frac{1}{\frac{(1+r)}{\theta_i}[\frac{\theta_i}{\bar{\theta}_t} - \zeta(\frac{\theta_i}{\bar{\theta}_t} - 1) + \zeta\eta(\frac{1}{\theta_i} - 1)]}$$

Therefore we could rewrite equation 14 as

$$\bar{\theta}_{t+1} = \frac{\frac{1}{(1+r)}[\theta_l \frac{\frac{1}{1-x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_l}) + \zeta\eta(\frac{1}{\theta_l} - 1)]} + \theta_h \frac{\frac{1}{1+x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_h}) + \zeta\eta(\frac{1}{\theta_h} - 1)]}]}{\frac{1}{(1+r)}\frac{\frac{1}{1-x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_l}) + \zeta\eta(\frac{1}{\theta_l} - 1)]} + \frac{\frac{1}{1+x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_h}) + \zeta\eta(\frac{1}{\theta_h} - 1)]}} \tag{15}$$

In which $\Theta = \theta^* = \frac{\theta_L + \theta_H}{2}$, $x = \frac{\frac{\theta_H - \theta_L}{2}}{\Theta}$ and $\Delta_t = \frac{\bar{\theta}_t - \Theta}{\Theta}$

Δ is variable of my interest that shows the deviation of average risk of applicants from allocationally efficient level. If Δ is not equal to zero. It implies there is a missallocation of credit in the market $\Delta \succ 0$ suggests that missallocation is against Low risk borrowers and $\Delta \prec 0$ implies that missallocation is against high risk borrowers. Rewriting θ_L,θ_H and $\bar{\theta}$ as a function of x and Θ I could drive the following equations

I could simplify the equation 15 as following

$$\bar{\theta}_{t+1} = \frac{\frac{1}{(1+r)}[\theta_l \frac{\frac{1}{1-x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_l}) + \zeta\eta(\frac{1}{\theta_l} - 1)]} + \theta_h \frac{\frac{1}{1+x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_h}) + \zeta\eta(\frac{1}{\theta_h} - 1)]}]}{\frac{1}{(1+r)}[\frac{\frac{1}{1-x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_l}) + \zeta\eta(\frac{1}{\theta_l} - 1)]} + \frac{\frac{1}{1+x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{1}{\theta_h}) + \zeta\eta(\frac{1}{\theta_h} - 1)]}]}$$

$$\bar{\theta}_{t+1} = \Theta\frac{\frac{1}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{\Theta}{\theta_l}\frac{1}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_l}\frac{1}{\Theta} - \Theta\frac{1}{\Theta})]} + \frac{1}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{\Theta}{\theta_h}\frac{1}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_h}\frac{1}{\Theta} - \Theta\frac{1}{\Theta})]}}{[\frac{\frac{1}{1-x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{\Theta}{\theta_l}\frac{1}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_l}\frac{1}{\Theta} - \Theta\frac{1}{\Theta})]} + \frac{\frac{1}{1+x}}{[\frac{1}{\bar{\theta}_t} - \zeta(1-\eta)(\frac{1}{\bar{\theta}_t} - \frac{\Theta}{\theta_h}\frac{1}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_h}\frac{1}{\Theta} - \Theta\frac{1}{\Theta})]}]}$$

$$\bar{\theta}_{t+1} = \frac{\frac{1}{1-\zeta(1-\eta)(1-\frac{\Theta}{\theta_l}\frac{\bar{\theta}_t}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_l}\frac{\bar{\theta}_t}{\Theta} - \Theta\frac{\bar{\theta}_t}{\Theta})} + \frac{1}{1-\zeta(1-\eta)(1-\frac{\Theta}{\theta_h}\frac{\bar{\theta}_t}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_h}\frac{\bar{\theta}_t}{\Theta} - \Theta\frac{\bar{\theta}_t}{\Theta})}}{\frac{\frac{1}{1-x}}{1-\zeta(1-\eta)(1-\frac{\Theta}{\theta_l}\frac{\bar{\theta}_t}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_l}\frac{\bar{\theta}_t}{\Theta} - \Theta\frac{\bar{\theta}_t}{\Theta})} + \frac{\frac{1}{1+x}}{1-\zeta(1-\eta)(1-\frac{\Theta}{h}\frac{\bar{\theta}_t}{\Theta}) + \zeta\eta(\frac{\Theta}{\theta_h}\frac{\bar{\theta}_t}{\Theta} - \Theta\frac{\bar{\theta}_t}{\Theta})}}$$

$$\bar{\theta}_{t+1}\frac{\frac{1}{1-\zeta(1-\eta)(1-\frac{1+\Delta_t}{1-x}) + \zeta\eta(\frac{1+\Delta_t}{1-x} - \Theta(1+\Delta_t))} + \frac{1}{1-\zeta(1-\eta)(1-\frac{1+\Delta_t}{1+x}) + \zeta\eta(\frac{1+\Delta_t}{1+x} - \Theta(1+\Delta_t))}}{\frac{\frac{1}{1-x}}{1-\zeta(1-\eta)(1-\frac{1+\Delta_t}{1-x}) + \zeta\eta(\frac{1+\Delta_t}{1-x} - \Theta(1+\Delta_t))} + \frac{\frac{1}{1+x}}{1-\zeta(1-\eta)(1-\frac{1+\Delta_t}{1+x}) + \zeta\eta(\frac{1+\Delta_t}{1+x} - \Theta(1+\Delta_t))}}$$

Simplifying the equations we could proceed as follows

$$\bar{\theta}_{t+1} = \Theta\frac{\zeta(1+\Delta_t) + (1-x^2)[1-\zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta]}{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta}$$

$$\bar{\theta}_{t+1} = \Theta\frac{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta - x^2[1-\zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta]}{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta}$$

$$\bar{\theta}_{t+1} = \Theta(1 - \frac{x^2[1-\zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta]}{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta})$$

$$\bar{\theta}_{t+1} - \Theta = -\Theta\frac{x^2[1-\zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta]}{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta}$$

$$\frac{\bar{\theta}_{t+1} - \Theta}{\Theta} = -\frac{x^2[1-\zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta]}{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta}$$

$$\Delta_{t+1} = -x^2\frac{1-\zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta}{\zeta(1+\Delta_t) + 1 - \zeta(1-\eta) - \zeta\eta(1+\Delta_t)\Theta}$$

x is a indicator for bank's screening error. When x=.5 it means bank has 100 % screening error. The last equation shows $\|\Delta\| \preceq x^2$. Thus , for $x \preceq .5$ $\Rightarrow \Delta^2 \preceq .0125$
By assuming $\Delta^2 \approx 0$, we could drive Δ_{t+1} as following.

$$\Delta_{t+1} = \alpha\Delta_t + \beta \tag{16}$$

$$\alpha = \frac{x^2\zeta\eta\Theta}{1+\zeta\eta(1-\Theta)}$$

$$\beta = \frac{-x^2[1-\zeta(1-\eta(1-\Theta))]}{1+\zeta\eta(1-\Theta)}$$

As α is lower than unity , the time series shown in 16 is a stationary process and stationary equilibrium is given by

$$\frac{\bar{\theta} - \Theta}{\Theta} = \Delta = -x^2\frac{1-\zeta(1-\eta) - \zeta\eta\Theta}{1+\zeta\eta[1-\Theta(1+x^2)]}$$

Appendix II.b:

First let us note that

$$\Theta(1+x) \preceq 1$$
$$\Theta \preceq \frac{1}{1+x} \overset{0 \prec x \prec 1}{\Rightarrow} \Theta \prec \frac{1}{1+x^2} \Rightarrow \Theta(1+x^2) \prec 1$$

$\frac{\partial \Delta}{\partial \zeta} \succeq 0$ if only if

$$\overset{\text{if and only if}}{\Leftrightarrow} \overbrace{[1-\eta(1-\Theta)]}^{\succeq 0}(1+\zeta\eta[1-\Theta(1+x^2)]) + \overbrace{\eta[1-\Theta(1+x^2)][1-\zeta(1-\eta)]}^{\succeq 0} \succeq \zeta\eta\Theta\eta[1-\Theta(1+x^2)]$$
$$\overset{\text{if and only if}}{\Leftrightarrow} [1-\eta(1-\Theta)]\zeta\eta[1-\Theta(1+x^2)] \succeq \zeta\eta\Theta\eta[1-\Theta(1+x^2)]$$
$$\overset{\text{if and only if}}{\Leftrightarrow} [1-\eta+\Theta\eta]\zeta\eta[1-\Theta(1+x^2)] \succeq \zeta\eta\Theta\eta[1-\Theta(1+x^2)]$$
$$\overset{\text{if and only if}}{\Leftrightarrow} (1-\eta)\zeta\eta[1-\Theta(1+x^2)] \succeq 0$$