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Firm-Level Data and Monetary Policy: The Case of
a Middle-Income Country

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Middle East and Central Asia Department

Firm-Level Data and Monetary Policy: The Case of a Middle-Income Country

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Abstract

We test the existence of the balance sheet channel of monetary policy in a middle-income country. Firm-level data scarcity and quality, in such a context, make the identification of this channel a steep challenge. To circumvent this challenge, we use panel instrumental variables estimation with measurement error to analyze the financial statements of 58 500 Moroccan firms over the period 2010-2016. Our analysis confirms the existence of this channel. It shows that monetary policy has a significant impact on small and medium enterprises' access to banks' financing, and that firm-specific variables are key determinants of firms' financing decisions.

JEL Classification Numbers: E44, E52, E58, G21, G32, C51, C55.

Keywords: Corporate balance sheets, monetary policy transmission, external finance, panel data, measurement error.

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1 Introduction

Because firms' balance sheets are countercyclical with respect to the monetary policy stance, tight credit conditions are likely to have important consequences for the financial resources firms can raise. This channel is known as the balance sheet channel of monetary policy. With the availability of firm-level data in developed countries, research on this channel has expanded rapidly in recent years. Empirical studies in developing and emerging economies, however, remain scarce, partly because of the availability of individual-data in these countries. Apart from data availability, one common problem of microdata in both advanced and developing countries is measurement errors, which can lead to a biased understanding of the transmission mechanism of monetary policy. This paper provides a case study on how to deal with such a limitation by using panel instrumental variables estimation with measurement error using Moroccan firm-level data. It contributes to the literature on monetary policy and corporate finance by empirically investigating the impact of monetary policy on firms' balance sheets in a middle-income country. It contributes to the applied economics literature by demonstrating the use of recent estimation methods to deal with quality issues in data.

Our evidence comes from the confidential microdata underlying Moroccan firms. Morocco has a fixed exchange rate against a basket of currencies, reflecting the structure of Morocco's foreign trade. Within the framework of an exchange rate peg, Bank Al-Maghrib (the central bank of Morocco) adopted a monetary policy framework in 2006 based on various inflation indicators, with the overnight interest rate as its operational target to pursue its main objective of price stability. More recently, Bank Al-Maghrib allowed the trading of foreign currency banknotes against the Moroccan Dirham (MAD) at ± 2.5 percent in relation to the central exchange rate; the limit previously was ± 0.3 percent (IMF (2018)). Modernization of monetary policy and exchange rate framework, including a new central bank law and gradual enhancement of the policy modeling framework, has been a crucial part of reform efforts to move toward more forward looking inflation targeting (IT) framework. In this regard, we wish to investigate the effect of monetary policy on firms' balance sheets for countries that recently made efforts to move toward IT. To do so, we use financial information as registered in the Trade Registry (CIFEN), a survey that collects information on the financial situation of all formal sectors of the Moroccan economy, including manufacturing, construction, services, and retail and wholesale

trade firms. We use these micro records, income statements and balance sheets, to assemble a panel of Moroccan firms from 2010 to 2016. The resulting dataset is made up of approximately 195 500 observations on approximately 58 500 firms. Using this dataset, we examine the significance of firms' balance sheet responses to monetary policy changes using panel instrumental variables estimation (PIVE) with measurement error in the data. Concerns about measurement error are widespread and emerge for a variety of different reasons such as reporting errors on surveys or proxy errors. Failing to account for such errors may lead to significantly distorted conclusions. Indeed, administrative data is collected for the purpose of administration, which means that priorities in the data collection process may differ from those of a researcher and thus variables may not measure the economic concept a researcher would like them to capture. In our compiled database, for instance, many firms declare negative profits for three or more consecutive years without going out of business. A second source of measurement error is that survey measures of other firm- level variables (age, size, collateral) tend to contain substantial survey response errors. Third, the use of the Interbank Offered Rate (TMP henceforth) as a proxy for the monetary policy stance leads to another measurement error issue.¹ To circumvent those limitations of our microdata, we follow the lines of the recent innovation in panel estimation with measurement error (Meijer et al. (2017)).

In this paper, we analyze the sensitivity of debt variables of 58 500 firms to changes in monetary policy in the period 2010-2016. We distinguish between four types of financing; short-term bank debt, long-term bank debt, trade credit, and bond loans. We also investigate the financial structure for small and medium-size enterprises (SMEs) and very small enterprises (VSEs), which are perceived as engines of growth and job creation. We examine whether the availability of external finance to SMEs is likely to vary in important ways with respect to monetary policy stance.² Access to finance has always been a challenge for SMEs. In particular, many small firms find it difficult to finance their production cycle. The latest World Bank Enterprise Survey shows that only 52 percent of all small firms had a line of credit in 2013. Large enterprises have better access than SMEs, with 72 percent of all large firms had a line of credit. The survey also notes that collateral requirements continue to be a constraint, particularly for small enterprises. Credit guarantees could help small firms address

¹During the period 2010-2016, the policy rate of Bank Al-Maghrib has been stable. The central bank lowered the policy rate only five times.

²External financing, as opposed to internal financing, means the ability of firms to borrow from the financial sector.

obstacles to credit access and improve domestic finance. Therefore the response of the banking sector to a monetary tightening has a direct effect on the provision of loans, which affects firms of different sizes in different ways.

Our findings indicate the existence of the balance sheet channel in Morocco. Then contrast with the widespread view that the only working channel of monetary policy transmission in Morocco is the interest rate channel. The results for the overall sample suggest that the impact of monetary policy on firms is muted. Disaggregating the sample by firm size, however, reveals that SME balance sheets are more sensitive to monetary policy than the balance sheets of either large firms or VSEs. For large firms, monetary policy has a significant impact only on long-term financing decisions. Large firms can rely on internal funding during tight monetary policy stance. SMEs bear the burden of costly external financing. VSEs are mostly self-financed and the impact of tight credit conditions is therefore minor. The rest of the paper is organized as follows. The rest of the introduction presents an overview of the literature on the balance sheet channel of monetary policy transmission mechanism. Section 2 presents the estimation method and the specification to investigate the impact of monetary policy on firms' balance sheets. Section 3 describes the CIFEN database. Section 4 reports the results. Section 5 summarizes the paper's conclusions.

Literature survey. The balance sheet channel of monetary policy transmission mechanism is a part of wide channel that [Bernanke and Gertler \(1995\)](#) call the *credit channel*. This channel can be thought as a set of factors that amplify and propagate conventional interest rate effects.³ Amplification is done through variations in the external financing premium induced by monetary policy changes.⁴ Monetary policy affects this premium through two channels. The first is the *balance sheet channel*, through which monetary policy influences the demand side (i.e. firms' balance sheets and revenues). The second is the *bank lending channel*, through which monetary policy induces changes in the volume of credit supplied by private banks. We are interested in the first channel. Research on the existence of the balance sheet channel examines the business cycle fluctuations of small and large firms with a broad range of approaches that have been developed to this end.

³See for example [Bougheas et al. \(2006\)](#), [Fidrmuc et al. \(2010\)](#), [De Haan and Sterken \(2006\)](#), [Prasad and Ghosh \(2005\)](#), and [Acharya and Naqvi \(2012\)](#)

⁴It is defined as the cost gap between funds raised externally, by issuing equity or debt, and funds generated internally, by retaining earnings.

The first stream is inspired by the corporate finance literature. It is interested in the cyclicity of firms' corporate debt. [Covas and Den Haan \(2011\)](#) study the cyclicity of debt and equity financing. They provide evidence on the significance of firm size in explaining financing flows downturns. [Crouzet \(2017\)](#) examines the implications of substitution between bank and bond financing for aggregate investment. He reports that in response to a contraction in bank credit supply, aggregate bond issuance in the corporate sector increases, but not enough to avoid a decline in aggregate borrowing. Moreover, only substitution between bond issuance and banking credit, that keeps leverage constant while retiring bank debt, has major consequences, such as firm financial distress. [Shourideh and Zetlin-Jones \(2012\)](#) consider differences in the reliance on external financing of small and large firms. They provide evidence on the financing of private firms in the United Kingdom (UK). [Gopinath et al. \(2017\)](#) draw on balance sheet data for small firms in Southern European countries to assess the role of integration and capital misallocation in the 2000s.

Information asymmetries in financial markets create a wedge between the costs of internal and external financing. Because of information asymmetries between banks and firms, tight monetary policy causes banks to rebalance their portfolio of loans and cut back on making loans to firms. Small and young firms are more likely to be victims of information asymmetries arising from credit market frictions, because they may be unable to access other markets for funds and therefore dependent on banks for external funds.⁵ Therefore, a change in monetary policy has an impact not only on real economic activity via the interest rate channel but also via the balance sheet channel.

In the empirical literature, the main channels of monetary policy transmission have been thoroughly examined mainly using macro information as surveyed in [Guiso et al. \(1999\)](#). These analyses have been limited in many respects. The aggregation can blur the differences in the transmission of monetary policy and impede the identification of important parts of the transmission mechanism. Recourse to microdata is often motivated by recognition of the limits of aggregate studies. Using microdata has the advantages of panel data estimation versus time series estimation, often recognized in the econometric literature. As [Hsiao \(1995\)](#) notes, "By using information on both the intertemporal dynamics and the individuality of entities being investigated, one is better able to control in a more natural way for the effects of missing or unobserved variables" .

⁵ See [Gertler and Gilchrist \(1994\)](#) and [Oliner and Rudebusch \(1996\)](#)

Many papers investigate how this channel affects the financing behavior of firms. [Bougheas et al. \(2006\)](#) examine firm's access to bank and market finance after accounting for differences in firm-specific characteristics. Their model is conducted on a large panel of UK manufacturing firms. Their results show that smaller, riskier, and younger firms are more noticeably affected by monetary tightening than larger, more secure, and older firms. [De Haan and Sterken \(2006\)](#) analyze the sensitivity of corporate debt structures to changes in monetary policy. They find evidence of the credit view. [Prasad and Ghosh \(2005\)](#) examine the corporate behavior of a sample of manufacturing firms in India. Their findings suggest that a contractionary monetary policy reduces overall debt, including bank debt, although the lagged response is positive, and that firms increase their short-term bank borrowings, after monetary tightening. [Fidrmuc et al. \(2010\)](#) analyze the determinants of corporate interest rates and the financial accelerator. Using a panel of Czech firms, they find that selected balance sheet indicators significantly influence firm-specific interest rates. They also find that debt structure and cash flow have significant effects on interest rates, that indicators of collateral play no significant role, and that monetary policy has stronger effects on smaller firms than on medium-size and larger firms. [Buera et al. \(2017\)](#) use the Bank of Portugal's rich credit registry database together with bank and firm balance sheet information to show that highly leveraged firms and firms that had a larger share of short-term debt on their balance sheets contracted more in the aftermath of a financial shock.

Most of the papers surveyed earlier investigate the balance sheet channel for developed countries. The dearth of such studies on developing countries reflects the fact that data are scarce and of poor quality. The purpose of this paper is to assess the effects of monetary policy changes for a middle-income country, we follow the lines of the recent innovation in panel estimation with measurement error, as in [Meijer et al. \(2017\)](#), and of the recent literature on monetary policy transmission in developing countries, as in [Abuka et al. \(2019\)](#), to provide a clear picture of the monetary policy transmission mechanism in Morocco. We apply a microeconomic approach to analyze firms' access to external finance and investigate the response to changes in interest rates linked to firm-level characteristics, which could indicate the existence of the broad credit channel of monetary policy transmission and a link between the financial and real sectors.

2 Empirical framework : Panel instrumental variables estimation with measurement error (PIVE)

In order to capture the impact of monetary policy shocks on the financing behavior of firms, we estimate the relationship between firm's debt instruments and its specific characteristics using a panel instrumental variable model that enables us to control for firm specific unobservable effects and to account for measurement error. Following [De Haan and Sterken \(2006\)](#), and [Bougheas et al. \(2006\)](#), the model is as follow:

$$y_{it} = \gamma_1 + \gamma_2 TMP_t + \beta' X_{it} + \gamma' TMP_t \times X_{it} + \gamma_3 \Delta GDP_{t-1} + \alpha_i + \eta_{it} \quad (2.1)$$

where, $i = 1, 2, \dots, n$ refers to a cross-section unit (firms in this study), $t = 1, 2, \dots, T$ refers to time period. y_{it} is the dependent variable, which is a specific debt instrument of the firm, and X_{it} denote the vector of non stochastic explanatory variables for firm i and year t . η_{it} is the error term.

We construct four debt ratios for y_{it} : (i) long-term bank loans to total assets, (ii) short-term bank loans to total assets, as our main focus is on the special role of bank loans, (iii) trade credit to total assets, which is a substitution for bank debt, and (iv) bond loans to total assets.

TMP_t is the Interbank Offered Rate, an increase in which corresponds to a monetary tightening. We focus mainly on the short-term market interest rate, which is typically closely linked to the monetary policy rate, because it shows more variability compared to the policy rate.

To ensure that we can control for the effects of the business cycle, we use ΔGDP_{t-1} , which is the one-year-lagged real GDP growth rate. This variable is included to control for cyclical effects.

We include four conditioning variables X_{it} to control for idiosyncratic effects on debt structure decisions. We introduce "size" as an explanatory variable which is measured by logarithm of total assets; the variable "age" measured by the number of years in existence to quantify the firm's reputation build-up and relationship with financial institution; the ratio of tangible assets to total assets to measure "collateral" available to support borrowing; the variable "profit" measured by the ratio of earnings before interest and taxes to total assets, which is a proxy of profitability scaled by capital.

It is well-known that not accounting for the error in the explanatory variables could induce biased and inconsistent parameter estimates (for examples, see [Griliches and Hausman \(1986\)](#), [Wansbeek \(2001\)](#), and, [Lee et al. \(2017\)](#)). In many cases, the data may not measure what they purport to measure. For example, many firms declare negative profits for three or more consecutive years without going out of business. A second source of measurement error is that survey measures of other firm-level variables (age, size, collateral) tend to contain substantial survey response errors. Third, the use of the Interbank Offered Rate (TMP) as a proxy for the unobserved monetary policy leads to another bias problem. The above causes for data imperfections lead to measurement error in the sense that observed variables differ from the economic concept the researcher wants to capture. To overcome the measurement error problems, we follow the lines of the recent innovation in panel estimation with measurement error (see [Meijer et al. \(2017\)](#)).

Our model proposes to test whether the financing decisions of Moroccan firms, as reflected in their balance sheet items, are determined by firm-specific characteristics, monetary policy, and the business cycle. We do not control for specific loan-supply effects. Although this is a limitation of our dataset, we believe that its effects on our results are small, since the Moroccan banking sector is resilient and profitable, and loan supply problems caused by bad financial conditions in banks were not apparent in our case study.

Based on the idea of firms' heterogeneity, the availability of external finance to different categories (LFs, SMEs, VSEs) is likely to vary in important ways with the changes in business conditions and the fluctuations in the macroeconomic environment caused by monetary policy shocks. We estimate our model for all firms and also for the different categories (LFs, SMEs, VSEs). Our classification of firms by their turnover into the mentioned categories helps us to understand more the transmission of the monetary policy in the economy.

Estimation strategy

As mentioned, a potential source of bias is the measurement error associated with the explanatory variables. To obtain consistent estimates, [Meijer et al. \(2017\)](#) recently derived moment conditions for GMM based on intertemporal covariance matrix restrictions, moments of regressors with errors and

potential exogenous regressors. One of the advantage of this procedure is that instruments may be constructed using the information over the different time periods. More precisely, they argued that consistent estimates of the parameters could be obtained if we are willing to impose some structure on the variance of the measurement error.

First, we can re-write the equation (2.1) as:

$$y_{it} = S^{*it'}\beta + \alpha_i + \eta_{it}, t = 1, \dots, T, i = 1, \dots, N, \quad (2.2)$$

where

$$S_{it} = S_{it}^* + v_{it}, \quad (2.3)$$

where the true variable S_{it}^* is unobserved, but approximated by S_{it} with an unobserved error v_{it} . y_{it} is the dependent variable, which our measure of the financial choice of the firm. The scalar α_i is an unobserved firm fixed effect and the variable η_{it} are regression errors. Using a matrix notation, we have

$$y_i = S_i^{*t'}\beta + \iota_T \alpha_i + \eta_i, i = 1, \dots, N, \quad (2.4)$$

where

$$S_i = S_i^* + v_i, \quad (2.5)$$

with $y_i = \begin{bmatrix} y_{i1} \\ \vdots \\ y_{iT} \end{bmatrix}$, $\eta_i = \begin{bmatrix} \eta_{i1} \\ \vdots \\ \eta_{iT} \end{bmatrix}$, $S_i = \begin{bmatrix} S_{i1} \\ \vdots \\ S_{iT} \end{bmatrix}$, $S_i^* = \begin{bmatrix} S_{i1}^* \\ \vdots \\ S_{iT}^* \end{bmatrix}$, $v_i = \begin{bmatrix} v_{i1} \\ \vdots \\ v_{iT} \end{bmatrix}$, and $\iota_T = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix} : T \times 1$.

Since $S_i^* = S_i - v_i$, we deduce

$$y_i = S_i'\beta + \iota_T \alpha_i + \varepsilon_i, i = 1, \dots, N,$$

with $\varepsilon_i = \eta_i - v_i\beta$.

To deal with the measurement error problem when estimating a panel data linear regression model in panel data, [Meijer et al. \(2017\)](#) recently derived instrumental variables allowing for consistent

estimation. The technical innovation in [Meijer et al. \(2017\)](#) is that instruments may be constructed using the information over the different time periods. More precisely, they argued that consistent estimates of the parameters could be obtained if we are willing to impose some structure on the variance of the measurement error $\Sigma_v = E(v_i v_i')$.

Construction of the IV matrix (Z):

We consider that there is an integer m and the decomposition $vec(\Sigma_v) = R_0 \lambda$, with R_0 an $(T^2 \times m)$ matrix of known elements, and λ , an $m \times 1$ vector of unknown parameters.

Let R_0^* be a complement of R_0 , that is, a matrix of order $T^2 \times (T^2 - m)$ and rank $T^2 - m$ such that $R_0^{*'} R_0 = 0$.

Let $u_i = y_i - \beta x_i$

[Meijer et al. \(2017\)](#) show that conditions of moments that come from the structure on Σ_v are:

$$R_0^{*'} E(u_i \otimes y_i) = R_0^{*'} E[(I_T \otimes y_i)(y_i - X_i \beta)] = R_0^{*'} E[(I_T \otimes y_i)(u_i)] = 0. \quad (2.6)$$

So the (panel) IVs that are implied by the structure on Σ_v are $Z_i = (I_T \otimes y_i)' R_0^*$. The number of instruments or moment conditions from the structure on Σ_v is $T^2 - m$ (if we assume that we have k control variables, the number of instruments generated from the structure on Σ_v is $(T^2 - m + k)$).

The fixed effect Model

The fixed effect α_i can be eliminated from the model by applying the centering operator $B_T = I_T - \frac{1}{T} 1_T 1_T'$. We put a tilde on a vector or matrix when it has been premultiplied by B_T , so that, $\tilde{X}_i = B_T X_i$, $\tilde{u}_i = B_T u_i$, and $\tilde{y}_i = B_T y_i$.

The panel IVs that are implied by the structure on Σ_v , in the fixed effect case, are $Z_i = (I_{T-1} \otimes \tilde{y}_i)' R_0^*$, where R_0^* is the complement of $(B \otimes B)' R_0$ with R_0 as before but adapted to dimension $T - 1$, because after applying the within transformation, we drop the first row of each individual.

Panel instrumental variables estimation with measurement error (PIVE)

We extend the traditional instrumental variables method to our panel data setting in the presence of measurement error. We consider at this stage a one-step GMM estimator, which can be viewed as an analogue to 2SLS estimator. The idea behind the Panel IV estimation (PIVE) is the same as in the

2SLS estimation in the usual cross-section case but with some specificities associated with panel data. the presence of measurement error increases the bias, but when more instruments are introduced, this bias shrinks. The PIVE estimator is given by:

$$\hat{\beta} = \left(\sum_t \left(\sum_{i,j=1}^n \mathbf{S}_{it} \mathbf{Z}'_{it} \left(\sum_{i=1}^n \mathbf{Z}_{it} \mathbf{Z}'_{it} \right)^{-1} \mathbf{Z}_{jt} \mathbf{S}_{jt} \right) \right)^{-1} \\ \times \left(\sum_t \left(\sum_{i,j=1}^n \mathbf{S}_{it} \mathbf{Z}'_{it} \left(\sum_{i=1}^n \mathbf{Z}_{it} \mathbf{Z}'_{it} \right)^{-1} \mathbf{Z}_{jt} y_{jt} \right) \right)$$

or equivalently expressed as

$$\hat{\delta} = \left(\sum_t \mathbf{S}'_t P_t S_t \right)^{-1} \left(\sum_t \mathbf{S}'_t P_t y_t \right)$$

with $P_t = \mathbf{Z}_t (\mathbf{Z}'_t \mathbf{Z}_t)^{-1} \mathbf{Z}'_t$ with \mathbf{Z}_t is the instrumental variables matrix described earlier. or equivalently expressed as:

$$\hat{\delta} = (\mathbf{S}' \mathbf{P} \mathbf{S})^{-1} \mathbf{S}' \mathbf{P} \mathbf{y} \\ \hat{\delta} = (\mathbf{S}' \mathbf{Z} (\mathbf{Z}' \mathbf{Z})^{-1} \mathbf{Z}' \mathbf{S})^{-1} \mathbf{S}' \mathbf{Z} (\mathbf{Z}' \mathbf{Z})^{-1} \mathbf{Z}' \mathbf{y}$$

with $\mathbf{S}_{(TN \times k)}$, $\mathbf{Z}_{(TN \times (T^2 - m))}$, $(\mathbf{Z}' \mathbf{Z})_{((T^2 - m) \times (T^2 - m))}$, and $y_{(TN \times 1)}$. After applying the within transformation, we replace $\mathbf{S}, \mathbf{Z}, \mathbf{y}$ by $\tilde{\mathbf{S}}, \tilde{\mathbf{Z}}, \tilde{\mathbf{y}}$, and T by $T - 1$ because we drop the first row of each individual.

3 Data

3.1 Database description

Our database comes from the confidential microdata underlying the Moroccan firms' financial information as registered in the Trade Registry (CIFEN), a survey that collects information on the financial situation of all the formal sectors of the Moroccan economy, including manufacturing, construction, retail trade firms and services. CIFEN contains more than 500 000 firms. All the firms are required to report whether a simplified or detailed version of their balance sheet statement each year.

Data collected in the CIFEN was never used as an input of a research question, however, a sample (of about 14000 firms) is used each year by the Moroccan Central Bank in the annual financial stability report.

CIFEN's reporting started in 2000, but it is available in an electronic format only from 2005. In this paper, we use data from 2010 to 2016 due to the inconsistencies appeared in the database before 2010. The inconsistencies include that financial information for many of the observations was incomplete, and for some firms the total of assets does not match the total of liabilities, and components of total liabilities being larger than total liabilities. Moreover, some sub-rubrics do not sum to the rubric in which they are included. There were also occurrences of misleading and wrong numbers, such as negative total assets, and components of total liabilities being larger than total liabilities, and also miscoded observations. The raw data also contained bankrupted, dissolved, in liquidation, and inactive firms, which may not react to monetary policy changes properly. To obtain the final dataset, we cleaned the database in order to assemble a yearly panel of Moroccan firms from 2010 to 2016. The resulting dataset is made up of approximately 195 500 observations on approximately 58 500 firms. The remaining firms are classified according to the Central Bank's classification. Firms having more than 170 million MAD (moroccan dirham) in their turnover are reported as large firms (LEs), whereas those between 10 million MAD and 170 million MAD are considered to be small and medium firms (SMEs). Finally, the remaining firms below 10 million MAD are considered to be very small firms (VSEs).

3.2 Data construction

The micro files of the CIFEN required significant initial work in order to construct a usable panel data set. As described in the previous sub-section, our dataset is made up of 195 500 observations which excludes all the irrelevant observations. The main advantage of the CIFEN is that it constitutes a representative sample of the population of Moroccan firms, given that the sampling frame is drawn from the Moroccan Office of Industrial and Commercial Property and response is mandatory. However, after the database cleaning the degree of representativeness could be affected. Surprisingly, most of deleted observations concerned VSEs, which means that LEs and SMEs are well represented in the

sample. The CIFEN is then an attractive source of information to answer the questions on which this paper focuses.

For the estimation inputs, we do not need the whole variables of the balance sheet, we only need few items of interest. On the asset side, we construct the variable "Size" as log of total assets. The variable "collateral" is simply the ratio between tangible fixed assets to total assets. On the liabilities side, the variable "LTD" means firm's long-term debt. It is constructed as the ratio of long-term debt rubric and total assets. Firm's short-term debt "STD" refers to the ratio of short-term debt to total assets, while firm's trade credit "Ctrade" is the ratio of trade credit to total assets. Finally, "BL" refers to the ratio of Bond loans to total assets.

We calculate the variable "Profit" as the earnings before interest and taxes divided by total assets, and the variable "Age" is simply the firm's age.

3.3 Summary statistics

Figure 1 describes the structure of liabilities averaged across firms for the period 2010-2016. We observe that there was very little variation in the debt structure during 2010-2016, when the share of trade credit was slightly larger than that of other financing choices, ie more than one-third of the debt financing is of a trade credit nature on average. We note also that band loans represent a small proportion of the funds. Debt structure of LFs, SMEs, and VSEs are reported separately in Figures 2-4 in the Appendix.

Before we estimate the model it is informative to explore the covariation of our core variables a bit further. Table 1 presents the correlation between our variables of interest for all firms. All the financing variables and firm's size appears to be positively correlated. This observation seems intuitive to the extent that large firms are able to have access to financial market to allow their investments to grow, in contrast to small and medium firms which depend on self-financing to finance their activities. Age and size are positively correlated, indicating that the older a firm becomes, the more assets it tends to accumulate. Collateral is positively correlated with both long-term debt and band loans, and negatively correlated with short-term debt and credit trade. A comprehensive descriptive statistics of the sample are reported in Table 9 in the Appendix.

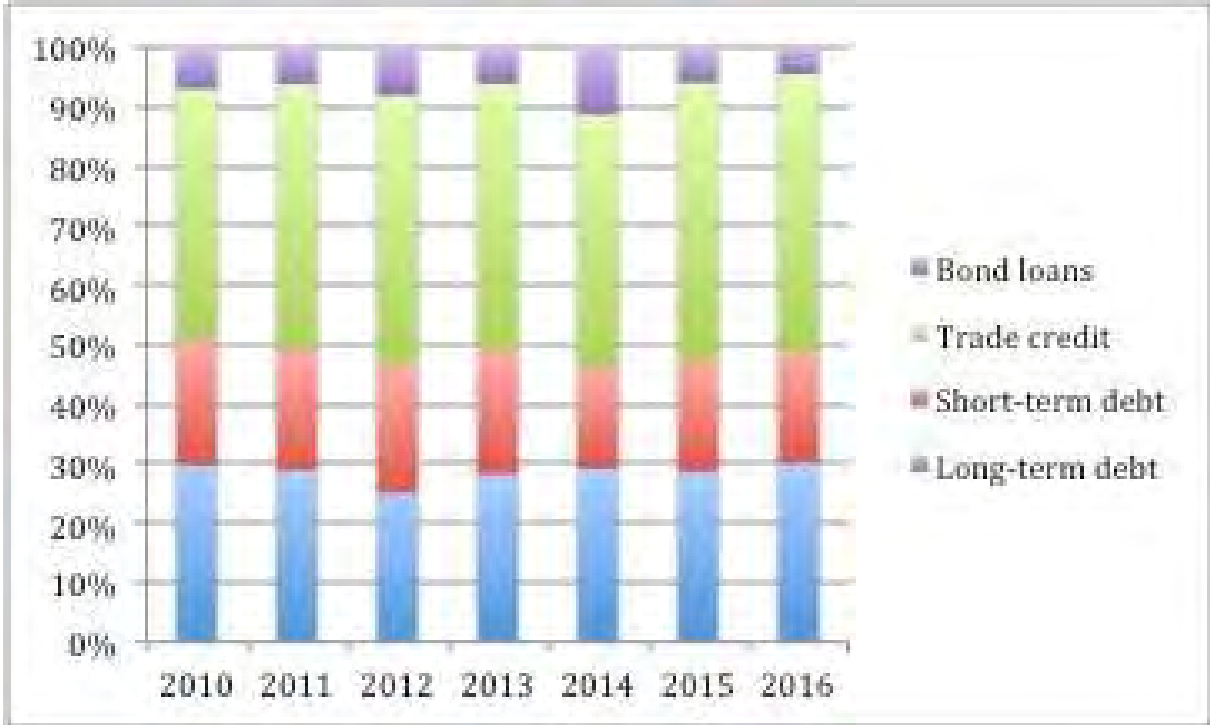


Figure 1: Average Structure of Liabilities for all firms

Table 1: Correlation Coefficients for all Firms

	LTD	STD	Ctrade	Bond loans	Profit	size	TMP	GDP	Age	Collateral
LTD	1	0.031	-0.099	-0.004	-0.001	0.193	0.025	0.008	0.007	0.262
STD	0.031	1	0.041	0.005	-0.001	0.311	0.055	0.015	0.138	-0.071
Ctrade	-0.099	0.041	1	-0.020	0.001	0.244	0.044	0.009	0.008	-0.228
Bond loans	-0.004	0.005	-0.020	1	-0.001	0.015	0.015	0.003	-0.007	0.057
Profit	-0.001	-0.001	0.001	-0.001	1	0.011	-0.002	-0.002	0.001	0.002
size	0.193	0.311	0.244	0.015	0.011	1	0.018	0.020	0.303	-0.030
TMP	0.025	0.055	0.044	0.015	-0.002	0.018	1	0.212	-0.018	0.033
GDP	0.008	0.015	0.009	0.003	-0.002	0.020	0.212	1	0.008	0.004
Age	0.007	0.138	0.008	-0.007	0.001	0.303	-0.018	0.008	1	-0.033
Collateral	0.262	-0.071	-0.228	0.057	0.002	-0.030	0.033	0.004	-0.033	1

4 Results

Our results show that firm-specific variables affect how firms' debt variables react to monetary policy. Table 2 presents the results for the full sample.⁶ The next three tables show the results for large firms (Table 3), SMEs (Table 4), and VSEs (Table 5). Each table has four columns for four measures of firms' indebtedness: short-term bank loans to total assets; long-term bank loans to total assets; trade credit to total assets; and bond loans to total assets. We discuss the impact of monetary policy while controlling for firm characteristics, business cycles, and interaction terms between interest rates and firm-specific indicators (age, size, profit, and collateral), which capture the heterogeneity of responses to monetary policy.

Before focusing on the monetary policy effects, we briefly discuss the results for the control variables. Profit has a negative impact on both short-term and long-term debt ratios for large firms; it also has a negative effect on the long-term debt ratio for SMEs, meaning that large firms and SMEs with higher earnings use less external debt. This result makes sense, as more profitable firms may use more of their own capital - which tends to be less expensive - and hence be less dependent on external financing than less profitable firms. Age appears to be a significant explanatory variable for both short-term and long-term debt, suggesting the importance of a track record. Firms with more years of operation in the market may have better reputation and stronger relationships with the banking sector than younger firms. Size, taken as the log of total assets, is an important determinant of debt. Firms with more real assets tend to have greater access to long- and short-term debt. The ratio of tangible assets in total (collateral) enhances access to longer-term debt for SMEs and VSEs. Our findings support the evidence that collateral is an important factor in reducing the riskiness of a loan by giving the financial institution a claim on a tangible asset without diminishing its claim on the outstanding debt, as in [Stiglitz and Weiss \(1981\)](#). Many firms lack access to marketable debt because they cannot provide the necessary collateral to reduce default risk. We control for the business cycle, in order to determine whether the effects of monetary policy depend on the state of the economy. We test whether more credit is issued in good times because of better economic prospects and the perception by both banks

⁶In a robustness test, we estimate equation (2.1) using the fixed effect method without taking into account the measurement error issue. We find that almost all the parameters are not significant, which means that there is measurement error in data.

and firms of higher profitability of investment perceived by both banks and firms.

Table 2: Results for all firms

	<i>Dependent variable:</i>			
	LTD (1)	STD (2)	Ctrade (3)	Bond loans (4)
Size	0.006*** (0.001)	0.006*** (0.001)	0.052*** (0.001)	-0.0003 (0.0003)
Age	-0.002*** (0.0002)	-0.001*** (0.0002)	-0.010*** (0.0005)	0.0001 (0.0001)
Profit	0.0001 (0.0002)	0.00001 (0.0002)	0.001 (0.0005)	-0.00000 (0.0001)
Collateral	0.004 (0.005)	0.006 (0.004)	0.109*** (0.010)	0.001 (0.002)
TMP	-0.041*** (0.003)	0.0002 (0.003)	0.064*** (0.006)	-0.004*** (0.001)
GDP	0.0003** (0.0002)	-0.00001 (0.0001)	-0.001* (0.0003)	-0.0001 (0.0001)
TMP*profit	-0.00003 (0.0001)	-0.00001 (0.0001)	-0.0002 (0.0002)	0.00000 (0.00003)
TMP*size	0.002*** (0.0002)	0.0001 (0.0002)	-0.003*** (0.0004)	0.0003*** (0.0001)
TMP*age	-0.0002*** (0.00003)	0.0001*** (0.00002)	-0.001*** (0.0001)	-0.00005*** (0.00001)
TMP*collateral	0.026*** (0.002)	-0.005*** (0.001)	-0.057*** (0.003)	0.002*** (0.001)
Observations	195,415	195,415	195,415	195,415
R^2	0.452	0.470	0.391	0.41

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2 reports the results of our estimation for the full sample. Panel estimations show that size and age are significant in explaining the financial structure of firms. In contrast, neither profit nor

collateral is significant in this sample. Heterogeneity across firms mutes some important explanatory variables, however, monetary policy has a significant impact on some debt measures, including long term debt, credit trade, and bonds. Interactions of monetary policy with firm-specific characteristics point to mixed effects. For instance, the interactions of monetary policy with the size of a firm is significant, pointing to the fact that when a firm is large, monetary policy can have a powerful impact on its long-term debt. The opposite effect is found for trade credit. When a firm grows, monetary policy has less of an impact on its trade credit.

Terms of interaction between monetary policy and profit or collateral are sometimes insignificant. These results highlight the limitations of an analysis based on the full sample. Because the heterogeneity of the sample can mute some effects that could be viewed in an homogeneous sample of observations, we examine the results for different categories of firms.

For large firms (table 3), monetary policy is significant for long-term debt and bond loans but not for trade credit or short-term loans. Regarding the terms of interaction, large firms with more profit tend to be less affected by monetary policy. For other interactions, the impact is negligible.

The results for SMEs are different. Profitable SMEs show a substitution effect from long-term debt instruments to short-term debt when the monetary policy stance is expansionary. Larger SMEs are less constrained by monetary policy in financing their activities than smaller SMEs. During a monetary easing, more collateralized firms increase their credit trade and reduce their long-term debt and bond loans. More collateral means better backing of the debt and therefore greater credibility among lenders. Highly collateralized firms, which have better access to long-term bank debt and the bond market, may be more flexible in shifting their maturity preferences. Regarding age, older SMEs are just as constrained as younger ones. Following an expansionary monetary policy, all firms increase their indebtedness by other instruments other than short term debt. When monetary policy is tight, However, SMEs at all ages reduce all forms of debt except short-term debt.

Table 5 reports the results for VSEs. It shows that several characteristics, including age and size, are significant in explaining debt. Profits have no explanatory power for this category of firms. The four debt instruments show sensitivity to monetary policy, but the effect is more modest than it is for SMEs because VSEs are mostly self-financed, largely insulating them from the effect of monetary policy.

Our results show that firm-specific characteristics are important in explaining the variation in the de-

mand for credit as monetary policy stance changes. The balance sheet channel thus exists in Morocco. The effect of monetary policy is more important for SMEs than large firms or VSEs. During tight financing conditions, large firms can rely on internal funding. SMEs lack access to such funds. Monetary policy makers should take into account the impact of their decisions on SMEs, in order to avoid deadweight losses in job creation and growth.

Table 3: Results for large firms

	<i>Dependent variable:</i>			
	LTD (1)	STD (2)	Ctrade (3)	Bond loans (4)
Size	0.008 (0.008)	0.036*** (0.012)	0.027* (0.014)	0.012** (0.005)
Age	-0.004*** (0.001)	0.002 (0.002)	-0.003 (0.002)	0.002** (0.001)
Profit	-0.169* (0.092)	-0.285** (0.130)	-0.388** (0.154)	-0.051 (0.053)
Collateral	0.076 (0.046)	-0.061 (0.065)	-0.090 (0.077)	0.053** (0.027)
TMP	-0.097** (0.048)	-0.074 (0.068)	-0.0002 (0.080)	0.053* (0.028)
GDP	-0.001 (0.001)	0.001 (0.002)	-0.0005 (0.002)	0.001* (0.001)
TMP *Profit	0.032** (0.030)	0.051* (0.043)	0.119** (0.051)	0.013 (0.018)
TMP *size	0.004* (0.002)	0.005 (0.003)	0.001 (0.004)	-0.002 (0.001)
TMP *age	-0.00003 (0.0001)	0.0001 (0.0002)	-0.001*** (0.0002)	-0.0002** (0.0001)
TMP *collateral	0.061*** (0.014)	-0.013 (0.019)	-0.021 (0.023)	-0.020** (0.008)
Observations	3,989	3,989	3,989	3,989
R ²	0.461	0.480	0.370	0.401
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01			

Table 4: Results for SMEs

	<i>Dependent variable:</i>			
	LTD (1)	STD (2)	Ctrade (3)	Bond loans (4)
Size	0.016*** (0.003)	0.016*** (0.003)	0.065*** (0.005)	-0.001 (0.001)
Age	-0.003*** (0.0005)	0.0005 (0.001)	-0.010*** (0.001)	0.00005 (0.0002)
Profit	-0.025* (0.013)	-0.011 (0.015)	0.036 (0.024)	0.004 (0.005)
Collateral	-0.029** (0.013)	-0.011 (0.014)	0.056** (0.023)	0.001 (0.005)
TMP	-0.075*** (0.013)	-0.026* (0.015)	0.091*** (0.024)	-0.013** (0.005)
GDP	0.001*** (0.0003)	0.001* (0.0004)	-0.001 (0.001)	-0.0001 (0.0001)
TMP*profit	0.007* (0.005)	-0.003* (0.005)	-0.016* (0.009)	-0.002 (0.002)
TMP*size	0.004*** (0.001)	0.002** (0.001)	-0.004*** (0.001)	0.001*** (0.0003)
TMP*age	-0.0003*** (0.0001)	0.0001** (0.0001)	-0.001*** (0.0001)	-0.0001*** (0.00002)
TMP*collat	0.064*** (0.004)	-0.007 (0.004)	-0.062*** (0.007)	0.005*** (0.001)
Observations	43,986	43,986	43,986	43,986
R^2	0.482	0.471	0.390	0.421
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01			

Table 5: Results for VSEs

	<i>Dependent variable:</i>			
	LTD (1)	STD (2)	Ctrade (3)	Bond loans (4)
Size	0.005*** (0.001)	-0.001* (0.001)	0.048*** (0.002)	-0.001 (0.0004)
Age	-0.002*** (0.0003)	-0.001*** (0.0002)	-0.010*** (0.001)	0.00003 (0.0001)
Profit	0.0001 (0.0002)	-0.00004 (0.0002)	0.001 (0.001)	-0.00001 (0.0001)
Collateral	0.011** (0.005)	0.006 (0.004)	0.119*** (0.012)	0.001 (0.002)
TMP	-0.038*** (0.004)	-0.023*** (0.003)	0.056*** (0.010)	-0.005*** (0.002)
GDP	0.0003* (0.0002)	-0.0001 (0.0001)	-0.001 (0.0004)	-0.0001 (0.0001)
TMP*profit	-0.00003 (0.0001)	0.00001 (0.0001)	-0.0002 (0.0002)	0.00000 (0.00003)
TMP*size	0.002*** (0.0003)	0.001*** (0.0002)	-0.003*** (0.001)	0.0004*** (0.0001)
TMP*age	-0.0001*** (0.00003)	0.0001*** (0.00003)	-0.001*** (0.0001)	-0.00003** (0.00001)
TMP*collatral	0.019*** (0.002)	-0.004*** (0.001)	-0.055*** (0.004)	0.002*** (0.001)
Observations	147,440	147,440	147,440	147,440
R ²	0.422	0.410	0.320	0.309

Note:

*p<0.1; **p<0.05; ***p<0.01

5 Conclusion

This paper use a new estimation strategy to circumvent the limitations of microdata in a middle-income country. It uses firm-level data to investigate how monetary policy affected the financing behavior of firms in Morocco over the period 2010-2016.

The results show the existence of the balance sheet channel in Morocco—a conclusion that contrasts with the widespread view that the only working channel of monetary policy is the interest rate. Results for the full sample—composed of 58 500 heterogenous firms— suggest that the impact is minimal. Disaggregating the results reveals that the effects depend on firm size. Monetary policy affects the long-term—but not the short-term—financing decisions of large firms, which are able to rely on internal funding during periods of monetary contraction. It has only a minor effect on VSEs, which are largely self-financed. The effects are greatest on SMEs.

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Appendix

Table 6: Correlation Coefficients for large firms

	DLT	DCT	Ctrade	Bond laons	Profit	size	TMP	GDP	Age	Collateral
DLT	1	-0.112	-0.272	-0.002	-0.145	0.253	0.015	0.002	-0.046	0.438
DCT	-0.112	1	-0.186	-0.055	-0.253	-0.067	0.064	0.023	0.006	-0.175
Dtrade	-0.272	-0.186	1	-0.137	-0.042	-0.310	0.009	0.0001	-0.096	-0.345
Bond loans	-0.002	-0.055	-0.137	1	-0.039	0.240	0.010	0.029	-0.007	0.195
Profit	-0.145	-0.253	-0.042	-0.039	1	-0.071	-0.006	0.019	0.005	-0.021
Size	0.253	-0.067	-0.310	0.240	-0.071	1	-0.021	-0.002	0.141	0.296
TMP	0.015	0.064	0.009	0.010	-0.006	-0.021	1	0.188	-0.030	-0.021
GDP	0.002	0.023	0.0001	0.029	0.019	-0.002	0.188	1	-0.011	-0.007
Age	-0.046	0.006	-0.096	-0.007	0.005	0.141	-0.030	-0.011	1	0.054
Collateral	0.438	-0.175	-0.345	0.195	-0.021	0.296	-0.021	-0.007	0.054	1

Table 7: Correlation Coefficients for SME Firms

	LTD	STD	Ctrade	Bond loans	Profit	Size	TMP	GDP	Age	Collateral
LTD	1	-0.012	-0.216	-0.004	-0.068	0.277	0.019	0.002	-0.030	0.363
STD	-0.012	1	-0.137	-0.004	-0.124	0.145	0.054	0.014	0.075	-0.091
Ctrade	-0.216	-0.137	1	-0.043	-0.063	-0.115	0.023	0.005	-0.071	-0.276
Bond loans	-0.004	-0.004	-0.043	1	-0.016	0.039	0.016	-0.003	-0.015	0.065
Profit	-0.068	-0.124	-0.063	-0.016	1	-0.163	-0.010	-0.004	-0.037	0.023
Size	0.277	0.145	-0.115	0.039	-0.163	1	-0.026	-0.008	0.153	0.109
TMP	0.019	0.054	0.023	0.016	-0.010	-0.026	1	0.201	-0.024	0.009
GDP	0.002	0.014	0.005	-0.003	-0.004	-0.008	0.201	1	-0.001	-0.001
Age	-0.030	0.075	-0.071	-0.015	-0.037	0.153	-0.024	-0.001	1	-0.001
Collateral	0.363	-0.091	-0.276	0.065	0.023	0.109	0.009	-0.001	-0.001	1

Table 8: Correlation Coefficients for VSE Firms

	LTD	STD	Ctrade	Bond loans	Profit	Size	TMP	GDP	Age	Collateral
LTD	1	0.021	-0.089	-0.005	-0.0004	0.163	0.023	0.008	-0.004	0.243
STD	0.021	1	0.016	0.008	-0.001	0.162	0.047	0.009	0.074	-0.056
Ctrade	-0.089	0.016	1	-0.016	0.001	0.164	0.042	0.005	-0.039	-0.214
Bond loans	-0.005	0.008	-0.016	1	-0.001	0.005	0.015	0.004	-0.009	0.053
Profit	-0.0004	-0.001	0.001	-0.001	1	0.016	-0.002	-0.002	0.001	0.002
Size	0.163	0.162	0.164	0.005	0.016	1	0.001	0.019	0.239	-0.031
TMP	0.023	0.047	0.042	0.015	-0.002	0.001	1	0.216	-0.026	0.042
GDP	0.008	0.009	0.005	0.004	-0.002	0.019	0.216	1	0.007	0.006
Age	-0.004	0.074	-0.039	-0.009	0.001	0.239	-0.026	0.007	1	-0.038
Collateral	0.243	-0.056	-0.214	0.053	0.002	-0.031	0.042	0.006	-0.038	1

Table 9: Descriptive statistics for all firms

	Min	1st Quantile	Median	mean	3rd Quantile	Max
TMP	2.27	2.51	2.95	2.87	3.19	3.29
GDP growth	2.55	3.11	4.21	3.91	4.54	5.06
size	1.70	13.40	14.82	14.80	16.20	25.59
Age	1	3.00	7	11.14	14	112
collaterall	0.000	0.013	0.087	0.209	0.299	3.240
Profit	-4577.365	0.004	0.028	0.036	0.079	1996.676
trade credit (ratio)	0.00000	0.01988	0.13168	0.203	0.32872	1
short-term bank debt (ratio)	0.00	0.00	0.00	0.034	0.016	0.966
long-term bank debt (ratio)	0.00	0.00	0.00	0.0309	0.00	0.995
bond loans (ratio)	0.00	0.00	0.00	0.0021	0.00	0.992

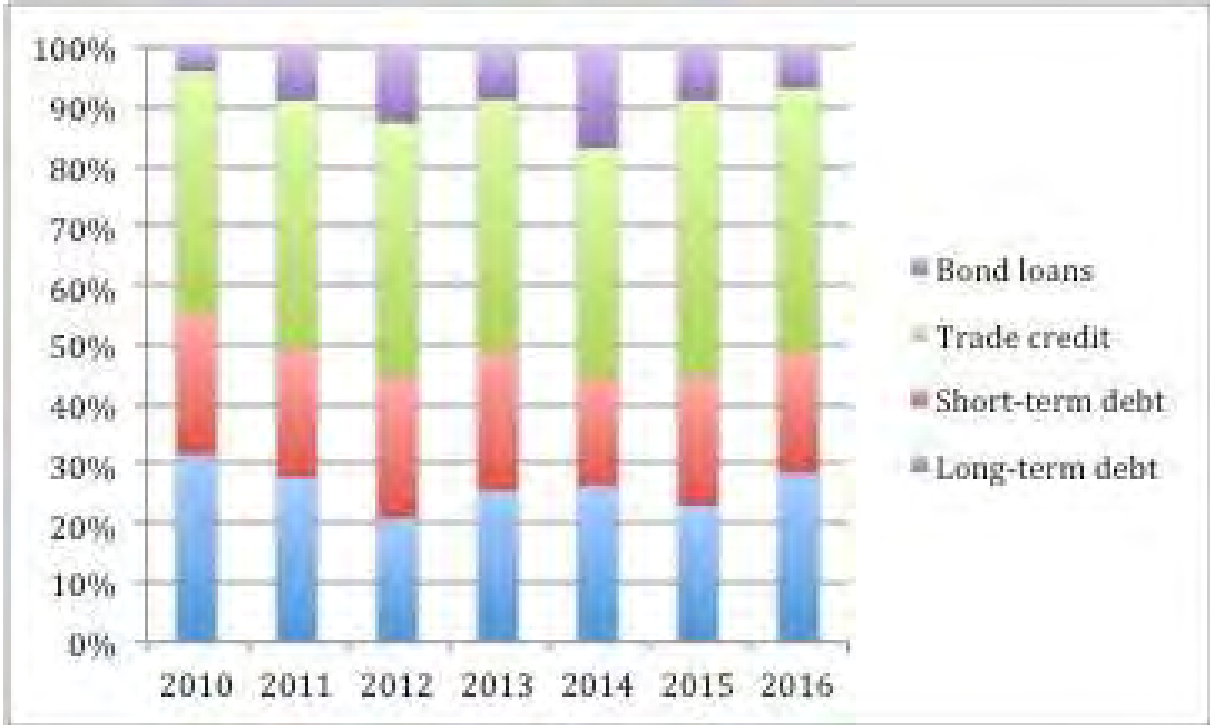


Figure 2: Average Structure of Liabilities for large firms

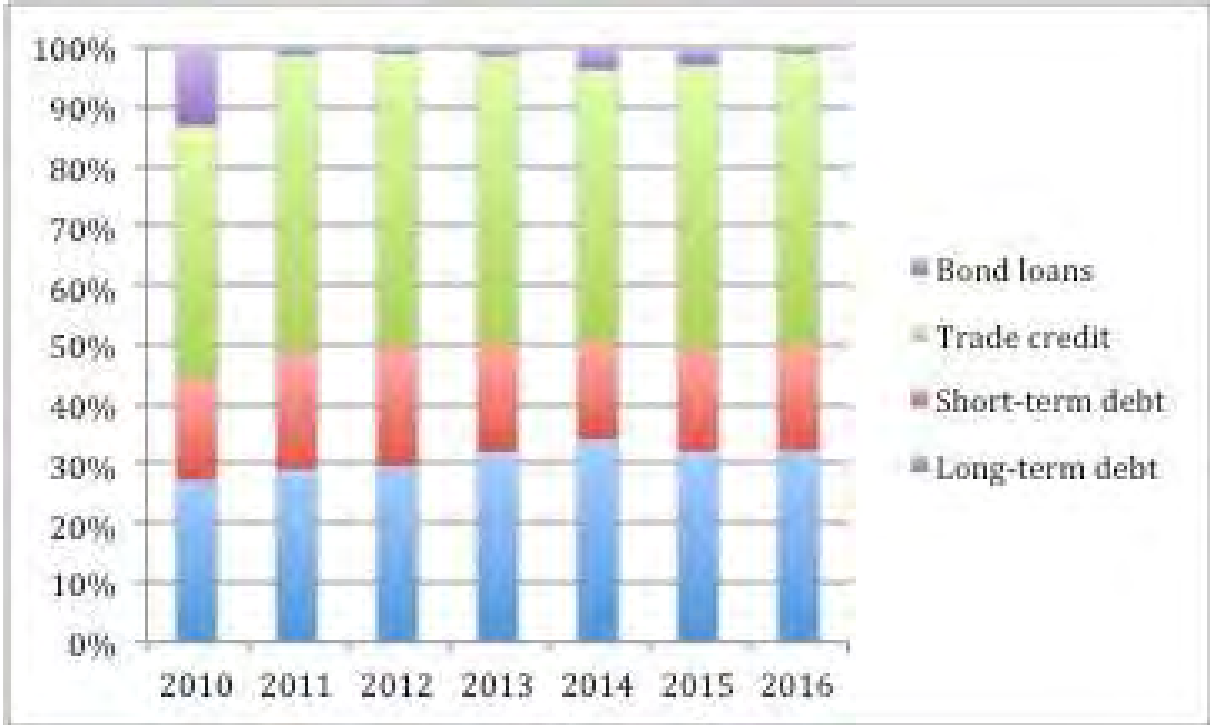


Figure 3: Average Structure of Liabilities for SMEs

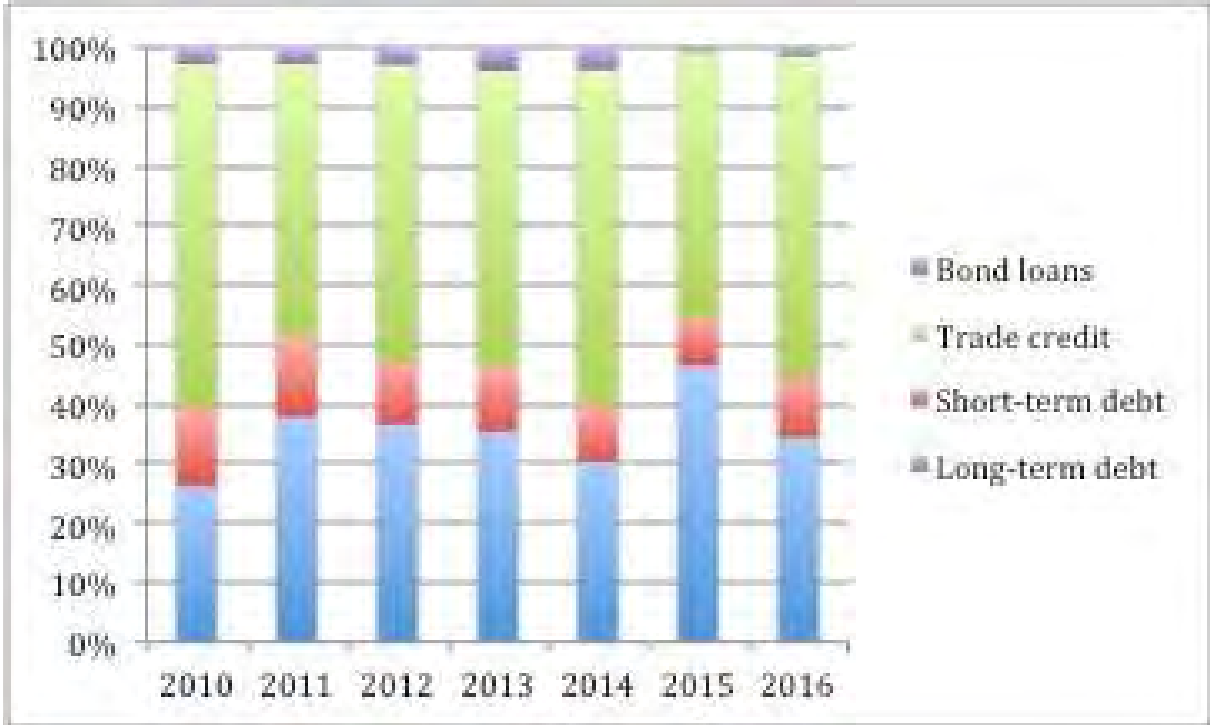


Figure 4: Average Structure of Liabilities for VSEs