The Interest Rate Elasticity of Credit Demand: Evidence from Mexican Firms Using a Fixed Effects Approach

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Abstract

In this investigation I estimate the interest rate elasticity of credit demand in Mexico using micro-data level information. I used a novel database of commercial credits from administrative data. I aggregate data to the sector level to create a panel data, and to circumvent endogeneity and omitted variables bias I incorporate fixed effects at the industry, bank and year level. The results indicate that the implied elasticity is -2.66, hence evidence of an elastic demand.

1 Introduction

Several factors affect the demand for credit. In this paper, I focus on one particular aspect: the choice of how much debt firms incur, thus I provide reasonable estimates of the interest rate elasticity of commercial credit. The magnitude of this elasticity has important implications for policy-relevant questions in several areas of the economy. For example, in recent years the leading party in the Mexican congress has expressed its concerns in favour of financial repression, to cap the difference between active and passive interest rates in consumer loans, to limit the amount of fees collected on financial services, and, more recently, to ensure that Small and Medium Enterprises (SME[1]) have access to cheap loans; all these in an effort to reduce

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[1]Defined as those with net annual sales less than 106 million pesos, CNBV

profits of the banks and in the interest of benefiting society. Regarding the latter, a specific bill with the details of the intended reform has not been disseminated, however, we can think of scenarios if the current average interest rate was reduced and how much will the amount of credit increase.

Firms demand credit mainly for innovation, expansion projects, general business activities, acquiring new equipment and meeting financial requirements. The main factors that drive credit are: i) public policy for the development of specific sectors; strategic economic sectors might receive special help from the government, thus increasing the number of firms within it and, in consequence, the industry's demand for credit, ii) confidence in the economy; the phase of the business cycle affects the demand for credit, as expansions increases expectations of companies about future revenue and facilitate the repayment of loans; however, fear for recessions increases banks' fear of potential losses due to defaults and leads to tighten lending standards, iii) change in composition of economic sectors in the economy; I acknowledge that there is heterogeneity in finance needs by sectors. For instance, usually tertiary sectors demand more credit than primary or secondary; thus, the transition of economies towards a tertiary sector, certainly would affect the aggregated demand for credit, iv) new technologies; the availability of new means of production that generate more revenue in an industry may boost the development of specific sectors, so firms within them are prone to ask for credit to be early adopters.

On the other side, banks and financial institution grant credit to firms based on their assessment of their risk profile. Financial intermediaries would set prices to reflect known risks and demand would math supply at that price. However, the efficient allocation of credit through interest rates presupposes that information about borrowers' projects is freely available (Blundell-Wignall et al., 1992).

This thesis presents an econometric model that allows to estimate the interest-rate elasticity of credit demand for Mexican companies through panel data. The model contains additional parameters to control for omitted variables and endogeneity.

This paper is related to an empirical literature in the banking industry, that study the role of credit in the economy from the demand (see Dick (2008), Beck et al. (2012)) and the supply side (Branzoli et al. (2021)).

This paper is also related to a literature that studies Mexican credit markets by using the

same source of information I use, the CNBV's RC04 reports. In that sense, this study is closely related to Cantú et al. (2020), where they use more detailed loan-level information, along with bank's financial statements, to determine whether bank characteristics affect the transmission channel of domestic and foreign shocks through lending. Nonetheless, they focus on the supply side rather than the demand side. Furthermore, in a series of papers Meza, Pratap and Urrutia (Meza et al. (2018), Meza et al. (2019), Meza et al. (2020)), use the same source, but aggregated to the sector and subsector level, along with INEGI's annual manufacturing survey, to explore the influence of financial factors (credit flows and interest rates) on firms' investment decisions and capital accumulation through their effect on dynamic capital distortions in the Mexican manufacturing industry.

Finally, this paper is also related to a literature that employs experimental design to circumvent the problem of endogeneity when estimating credit demand, see Banerjee et al. (2015) for an overview on the subject. For the case of Mexico, outstanding studies have been carried out: Ponce et al. (2017) and Seira et al. (2015) do their own for the credit cards segment, whilst Angelucci et al. (2015) and Karlan and Zinman (2019) do the case for the microfinance segment.

The main contribution of this research is to show that with minimal data on firm loans, properly handled, and by using appropriate econometric methods, interest rate elasticities can be estimated under a reduced form model of credit demand. To shed light on credit demand, I contribute also to the usage of CNBV's publicly available administrative records. As mentioned above, such source of information has been used in the past by other researchers, but they have usually had access to more detailed privately–disclosed data [2].

The rest of the paper is organized as follows. Section 2 describes the Mexican commercial loans market. I present the identification strategy through Fixed Effects model in section 3. In section 4 the data is described. Section 5 shows the results of the estimation. Finally, in section 6 I discuss the results and conclude.

[2]The codes used to webscrap the data are available on https://github.com/SrChucho/rc04-data

2 Demand for credit to SME in Mexico

In this section I single out Mexican credit figures[3] to answer two questions: Who do banks primarly finance in Mexico? And, from what source are companies financed in Mexico? For the first question, as of December 2021, total banking credit to Mexico's economy represent 19.4%; from these figures, corporates are the main sector they fund, with 49.8 percent, followed by mortgages and consumption, 19.5 and 19.4 percent respectively, the remaining 11.4 percent is devoted to acquire sovereign and subnational public debt. Regarding the second query, the main sources of financing for enterprises come from banks (50.7%), debt issuing (29.6%), other financial intermediaries (12.1%), and development banks (7.7%).

Regarding the extensive margin of credit in Mexican business, according to INEGI's survey on business financing [4] only 46.6% of the corporates have ever requested credit, while only 43.2% have received financing. The same source points out that, within the companies that have received financing, banks represent the main source of financing, with two out of three firms ever receive financing by commercial banks, while supply chain financing (46%) is the secondary source of financing, leaving personal networks funding (10%), financial non-bank institutions (9%) and government (2.5%) as last resource lenders[5]. Thus, this survey corroborates the data presented in the previous paragraph.

For the purpose of this investigation I restrict to SME, to take into account the fact that larger enterprises may have access to other sources of funding, like issuing shares or selling debt, thus its sensitivity to the interest rate for credit is not comparable to firms that are restricted only to credit. In this context, according to the World Bank, only about 11 percent of SME in Mexico use bank credit due to affordability and access issues [6].

SMEs play an important role within the Mexican economy. According to INEGI's National Survey of Productivity and Competitiveness for Micro, Small and Medium Enterprises [7], in Mexico there are more than 4.1 million SMEs , which altogether account for 99.7% of all private frims and 35.6% of national total gross production. Breaked down by sector, more than a half (51.4%) are concentrated in the trade sector, while 36.1% are concentrated in services,

[3] https://www.gob.mx/cnbv/articulos/reporte-de-ahorro-financiero-y-financiamiento-a-junio-de-2022?idiom=es

[4] https://www.inegi.org.mx/programas/enafin/

[5] These figures consider more than one source of funding for each firm

[6] https://www.worldbank.org/en/results/2021/04/09/expanding-financial-access-for-mexico-s-poor-and-su

[7] https://www.inegi.org.mx/programas/enaproce/

and only a 12.1% belong to the manufacturing industry.

3 The Fixed Effects model

I am interested in loans borrowed by industries from banks. Each industry i is characterized by a representative firm who borrows an average loan amount L_{ibt} from bank b at period t. Industries hire loans according to the following equation:

$$ln(L_{ibt}) = -\alpha InterestRate_{ibt} + \beta_1 Term_{ibt} + \beta_2 Inflation_t + \zeta_i + \mu_b + \iota_y + \epsilon_{ibyt} \tag{1}$$

which is a linear function of the weighted average interest rate, term, the inflation rate, and the fixed effects (FE) for industry ζ_i, bank μ_b and year ι_y, plus an industry-bank-year-period specific error term ϵ_{ibyt}. Note that to stabilize the variance of loan amount I take the natural logarithm $\ln(\cdot)$ transformation. The inclusion of the inflation rate into the model is to control for variation in interest rates due to overall inflation in the economy instead of the idiosyncratic conditions of the borrower.

A threat to identification comes from the fact that the variation in $InterestRate_{ibt}$ is not independent of loan amount, L_{ibt}, as it would be under an experimental approach. To deal with this, the specification in (1) allows to control for the variation of each industry, bank and year via the corresponding fixed effects. Under this setup I throw out all cross-sectional variation. In this context, FE by industry allows me to control for economic sectors that may be perceived more riskier and thus are therefore charged a higher interest rate. The FE by bank allows to control for the cases where different interest rates are offered to same firms due to specific bank characteristics. Additionally, the FE at the year level allows to control for other omitted variable bias due to factors that are not constant over time.

Thus, by using FE I assess the problem of omitted variable bias, that is, there are unobservable factors that are correlated with the variables included in the model, which affect both interest rate and loan amount. Also, with this specification, I assume that the explanatory variables have the same effects over each industry, and that they differentiate by their own specific characteristics measured by the intercepts $(\zeta_i, \mu_b, \iota_y)$, and they are time-invariant. Such an assumption is plausible since, for example, firms do not easily change sector or production

within the economy.

For this research I considered only large commercial banks, which I claim that have a perfectly elastic supply, since they face very few limitations to expand its credit supply, given that they have easy access to cheap fundin sources that keep their marginal costs constant, see Table 1. First, their long seasoning in the Mexican market gives access to a broad depositors base. Second, their outstanding credit ratings give them access to the international financial markets at more competitive rates. Thus, under this assumption, variations in price affect the demand only and not the supply, thus this lessens the problem of endogeneity between supply and demand. For example, (Karlan and Zinman, 2019, p. 170) consider Compartamos Banco to be unconstrained in supplying credit on the margin, due to its access to financial markets.

Table 1: G7 Financial indicators

Institution	**Customer Deposits/Total Non-Equity Funding**	**Rating** (Long-Term IDR)
Banorte	79.2	'BBB-'
BBVA México	75.3	'BBB'
Citibanamex	85.4	'BBB+'
HSBC	82.1	'BBB+'
Inbursa	71	'BBB-'
Santander	64.6	'BBB+'
Scotiabank	70.7	n.r.

Notes: Source www.fitchratings.com, Mexico's Long-Term Issuer Default Rating: 'BBB–'. Information from last report available as of October 27, 2022.
n.r. - not rated under similar rating scale.

4 Data

I webscrapped Comision Nacional Bancaria y de Valores's (CNBV) R04C public administrative records on the universe of commercial loans to Mexican firms[8]. The raw data has information of all loans granted by a bank or financial entity to one firm. Note that one firm can have one or more loans, thus at this level quantitative variables already represent weighted averages of all the loans a firm received by the same bank.

For confidentiality reasons CNBV does not provide individual identification in the public reports, but includes detailed information on firm size, sector, destination of funds, type of currency among others. Consequently, it is not possible to construct an individual level panel,

[8] https://portafolioinfo.cnbv.gob.mx

however following Deaton (1985), among others, I aggregate the data by cohort, in this case at the industry level, to construct a repeated cross-sectional panel. Note that, when using this panel for estimation purposes I must normalize by the number of firms within each industry.

The variables that I use to measure the credit conditions of loans are:

- **Loan amount**: Industry average amount of credit. I consider only new loans (disbursement > 0 in month t).
- **Interest rate**: Industry average of interest rate in annual percentage, weighted by the size of loans. Negative values on this variable were removed (2.6% of the sample).
- **Term**: Industry average of months to maturity , weighted by loan size. We consider only loans with $Term \leq 36$ months, that is 98.5% of the database collected.
- **Inflation rate**: Annual variation of INEGI's consumer's price index (INPC). High inflation is likely to be associated with asset price speculation and the misallocation of real resources. It is possible that banks may be relatively more cautious lenders, other things being given, in a high-inflation environment (Blundell-Wignall et al., 1992). Hence, the inclusion of the inflation rate into the model is to control for variation in interest rates due to overall inflation in the economy instead of the idiosyncratic conditions of the borrower.

Hence, the database has information for 14 sectors (North America Industrial Classification System, NAICS), for a time span of 68 months from April 2016 to December 2021, a total of 5,749 sector-month observations. For the purposes of this research, I restrict interest to the large commercial banks, commonly known as G7[9], which by December 2021 account for 77% of the total assets of the Mexican financial system. I also focus on loans granted to small and medium enterprises.

In Table 2 I show summary statistics of the model variables. On average, SME within each sector ask loans amounting 23,342 thousand Mexican Pesos with an interest rate of 12.56% for a term of 11.3 months.

Figure 1 plots on the left–hand side boxplots of the interest rate by sector and on the right–hand side the evolution of interest rates along with inflation; both reveal the importance of including FE at the industry level and the inflation rate as controls to the model.

[9]G7: Banorte, BBVA, Citibanamex, HSBC, Inbursa, Santander and Scotiabank

Table 2: Summary statistics

Variable	N	Mean	Std Dev	P10	P25	P50	P75	P90
Loan amount (Th. MXN)	5,484	23,342	77,536	548	1,768	6,143	19,200	53,523
Interest rate (%)	5,484	12.6	4.5	7.1	9.6	12.5	15.2	17.7
Term (months)	5,484	11.3	5.2	5.2	7.7	10.9	14.4	17.5
Inflation rate (%)	5,484	4.4	1.3	2.8	3.2	4.4	5.5	6.3

Notes: CNBV's R04 report data, panel data from individual firms aggregated to NAICS industry code for April 2016 - December 2021, restricted to G7 banks and SME firms.
Source: https://portafolioinfo.cnbv.gob.mx

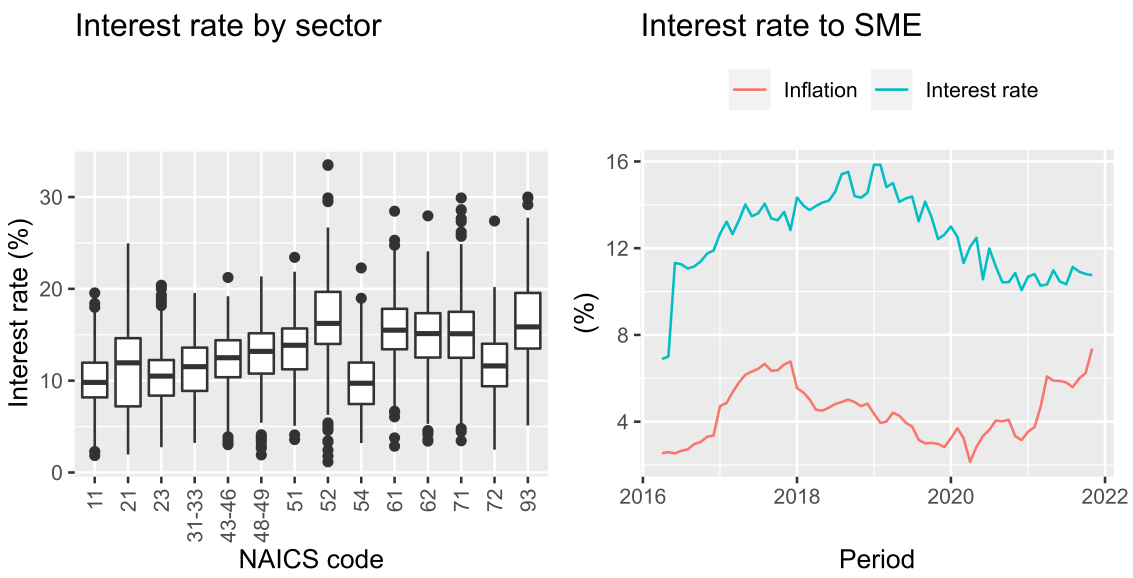

Figure 1: Interest rates

Notes. CNBV's R04 report data, panel data from individual firms aggregated to NAICS industry code for April 2016 - December 2021, restricted to G7 banks and SME firms. NAICS codes: 11 - Agriculture, forestry, and fishing, 21 - Mining , 23 - Construction, 31–33 - Manufacturing, 43–46 Wholesale and retail, 51 - Information, 52 - Finance and insurance, 54 - Professional, scientific and technical services, 61 - Education services , 62 - Health care and social assistance, 71 - Arts, entertainment and recreation, 72 - Accommodation and food services, 93 - Public administration.

5 Results

In this section I present the results of the estimating of equation (1). In this research, I inquire about the marginal change in loan demand with respect to a marginal change in the interest rate, that is $\frac{\partial L}{\partial InterestRate}\frac{InterestRate}{L}$. Given the log-lin model, the interest rate elasticity is obtained from the associated parameter α, mutiplied by the average interest rate.

Table 3 shows the results of this estimation, I show the raw parameters of the estimation for interest rate, term and inflation. In the bottom, I present the implied interest rate and term

elasticities. Regarding the standard errors of the estimated parameters, I used robust variance estimation, which take into account issues concerning heterogeneity and non-normality of the errors ϵ_{ibyt} and clustered by sector (See the literature based on Arellano et al. (1987), Cameron and Trivedi (2005) and Wooldridge (2010) for fixed effects estimation, and Rogers (1994) for the Stata implementation or Millo (2017) for R commands).

Table 3: Estimation results

	ln Loan Amount
Interest rate	-0.21***
	(0.0176)
Term	0.3***
	(0.0934)
Inflation rate	0.08***
	(0.0232)
Citibanamex	0.29***
	(0.0966)
Santander	-0.68***
	(0.167)
HSBC	-0.86***
	(0.125)
Inbursa	-0.09
	(0.246)
Scotiabank	-0.08
	(0.0870)
Banorte	0.13
	(0.146)
IMPLIED ELASTICITIES	
Interest rate elasticity	-2.66
	(0.221)
Term elasticity	0.89
	(0.281)
Sector effects	Yes
Year effects	Yes
Observations	5,749
Adjusted R^2	0.488

Notes:
Stars: *** significant at the 1% level; ** at 5%; * at 10%.
CNBV's R04 report data, panel data from individual firms aggregated to NAICS industry code for April 2016 - December 2021, restricted to G7 banks and SME firms. Robust standard errors in parenthesis clustered by sector.

The estimated pseudo interest rate elasticity is -0.21, that is, an increment of 100 basis points in the interest rate, decreases the logarithm of the average loan amount by -0.21. Furthermore, the implied interest rate elasticity is -2.66, which indicates the demand curve to be elastic, that is, by increasing the percentage interest rate in 1% decreases the average loan

amount by 2.66. Note that the associated standard errors are relatively small, given the robust estimation method.

This result is similar to those found by Karlan and Zinman (2019), who under an experimental approach, find short-run and long-run demand elasticities $\in (-2.9, -1.1)$ for pesos borrowed loans. Their study, however, is performed within borrowers of Mexican microlender Compartamos Banco, which grants loans only to (aspiring) entrepreneurs. Similary, DeFusco and Paciorek (2017) estimate the interest rate elasticity for mortgages using microdata on over 2.7 million mortgages and an identification strategy that leverages "bunching" at nonlinearities of the household budget constraints. These estimates imply a change of $\in (-5, -1.5)$ percent for a 1 percentage point increase in the mortgage rate.

In an analogous manner, the estimated coefficient for the term of the loan has the expected sign in economic terms: the larger the term, the larger the size of credit that the borrower bids. In this case, the size 0.3 indicates that an additional month in the loan term, increases the logarithm of the average loan amount by 0.3. In terms of elasticities, a 1% increase in the loan term implies an increase of 0.89 in the average loan amount.

5.1 Counterfactual regulation

Recently, policymakers have raised concerns on the importance of access of SME to commercial credit [10]. Members of the ruling party have claimed that they are drafting a bill to force banks to lend to small and medium-sized business at lower interest rates. Previously, this parliamentary group also considered an initiative against bank fees to cap them to a 50%. However, in this case, the orientation of the reform is not that clear, but I can propose similar counterfactuals to visualize possible scenarios. In Figure 2 I show possible values of the average loan amount by industry under different scenarios of the interest rate. In particular, I single out the case when the interest rate is ought to be reduced by 500 basis points reduction and how it affects the demand for credit.

[10] See for example https://www.elfinanciero.com.mx/empresas/2022/03/10/a-intereses-chiquitos-monreal-impulsa-ley-para-dar-creditos-a-pequenos-negocios/

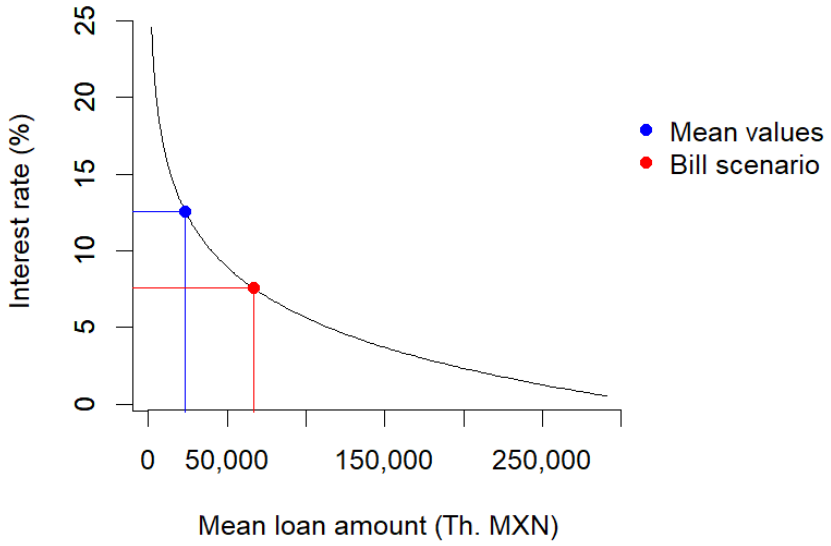

Figure 2: Demand curve for credit.

Note: A decrease of 500 basis points to interest rate, from 12.6% to 7.6%, leads to an increase in the average loan amount by industry, from 23,392 to 66,845 thousand MXN.

I find the demand for credit in the Mexican market to be elastic, -2.66, thus a regulation aimed at reducing the interest rate will largely increase the average loan amount. Note that, under such scenario, banks will increase their exposure at default and, eventually, its loss given default; thus, despite we are assuming G7 banks can increase its supply inelastically, the increase in expected loss could derive into more stringent underwriting criteria, by requiring better credit scores or increasing the amount of collateral to guarantee future repayment. In consequence, credit may be reduced in general and the reform would have opposite results to those expected. Price rationing is abandoned in favour of equilibrium quantity rationing (Blundell-Wignall et al., 1992, p. 4).

An alternative policy that does not distort prices is recommended. For example, by providing collateral, in the form of recommendation, to those companies in compliance with fiscal burdens such as taxes and social security obligations, which would enhance its credit profile and reduce their interest rates.

6 Conclusions

I estimated interest rate elasticities that evidence an elastic credit demand curve using a reduced form demand model. This model allow me to disentangle the effects of interest rate and loan term on loan amount of credit, which I found to be -2.66 and 0.89 respectively. This results can be used to analyze possible regulatory policies in the credit sector. I find evidence that such a price distortion policy may possibly reduce credit in case a reform oriented to decrease interest rates is carried out, contrary to the expected results.

Further research topics are the use of instrumental variables to deal with endogeneity, which can be addressed using bank–level operational information also available from CNBV; these data can also be used to estimated the supply for credit. Additionally, the results can be extrapolated to consider the group of medium and small commercial group of banks not considered herein.

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