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The interest rate pass-through by loan size: Evidence for Mexico, 2011-2019

Pablo Cotler[1] - Universidad Iberoamericana, México

Rodrigo Carrillo - Universidad Iberoamericana, México

Abstract

This paper measures the impact of changes in the central bank's reference rate on bank lending rates at both the aggregate level and by loan size. Our data come from the payroll and personal loan markets in Mexico for the period comprising 2011 to 2019. We use an autoregressive model with distributed lags, which allows for the possibility of asymmetric effects. The results show, among other findings, that the pass-through is small; it is not necessarily positive; asymmetric behaviour cannot be ruled out; and, its value depends on the loan size. These results imply that the effectiveness of monetary policy is weakened, in addition to the fact that the reaction of banks to changes in the target interest rate may have distributional implications. The originality of the paper lies in the grouping of interest rates by loan size and the use of a methodology that allows us to assess the existence of asymmetries. Its main shortcoming is the lack of data regarding the characteristics of the borrowers.

JEL Classification: E43, E52, G21.

Keywords: interest rates, payroll and personal loans, Mexico.

El traspaso de la tasa de interés según el tamaño de los préstamos: Evidencia para México, 2011-2019

Resumen

Este documento mide el impacto de los cambios en la tasa de referencia del banco central sobre las tasas de préstamos bancarios tanto a nivel agregado como por tamaño de préstamo. Nuestros datos provienen de los mercados de préstamos de nómina y personales en México para el periodo que comprende de 2011 a 2019. Utilizamos un modelo autorregresivo con rezagos distribuidos, que permite la posibilidad de efectos asimétricos. Los resultados muestran, entre otros hallazgos, que el traspaso es pequeño; no es necesariamente positivo; no se puede descartar un comportamiento asimétrico; y, su valor depende del tamaño del préstamo. Estos resultados implican una reducción de la eficacia de la política monetaria, además de que la reacción de los bancos a los cambios en el tipo de interés objetivo puede tener implicaciones distributivas. La originalidad del trabajo radica en la agrupación de las tasas de interés por tamaño de préstamo y en el uso de una metodología que permite evaluar la existencia de asimetrías. Su principal limitante es la falta de información concerniente a las características socioeconómicas de los deudores.

Clasificación JEL: E43, E52, G21.

Palabras clave: tasas de interés, préstamos personales y de nómina, México.

[1] Corresponding author: Prol. Paseo de la Reforma 880. Col. Santa Fe, Alvaro Obregón. CDMX, 01210; México
Email: pablo.cotler@ibero.mx

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1. Introduction

It is common practice for central banks to adjust their key interest rates when inflation is on a path that deviates from the target set by monetary authorities. Such changes in the policy rate will impact the banks' borrowing costs in the overnight money market, leading to an expected knock-on effect on the interest rates borrowers will have to pay for their loans. However, is this a valid assumption? And, if so, are these changes in interest rates similar for different types of loans and loan sizes? Answering these questions will help us better understand the effectiveness of central banks to reduce the inflation rate. Furthermore, it this could also contribute to the discussion surrounding the distributional impact of monetary policy (Auclert, 2019).

In their meta-analysis on this issue, Gregor et al. (2020) report - for a sample of studies based on the European experience - an average interest rate pass-through of 0.8 and, once explanatory factors are included, 0.6. These results cannot reject the assumption of positive pass-through; nevertheless, most of the studies included in the report do not consider that banks may react asymmetrically to changes in the reference rate. As a result, the average pass-through reported by Gregor et al. (2020) may not be an adequate description of what is actually happening in these credit markets.

Moreover, most of the papers considered by Gregor et al. (2020) measure the value of the passing along of these increases at the aggregate level. While this is an understandable way to begin analyzing how quickly an inflationary process can be stopped, such an aggregate measure neglects the possibility that changes in the reference rate may have a distributional effect, given that the response of banks may depend on the size of the loan. In order to consider this possibility, we have reviewed the case of Mexico, where forty percent of all families are below the official poverty line, while sixty percent of the Mexican workforce is employed within the informal economy.

In a situation such as this one, banks may require a flexible lending technology to measure the level of risk of a given loan. As flexibility comes at a cost, not all banks will necessarily invest the effort and resources to compete in all markets: some may be more interested in corporate lending, while others may try to replicate microfinance technology. Therefore, the mix of banks competing in markets for different loan sizes may vary. Since the interest rate pass-through is a function of each bank's pricing policy, it is possible that the value of the former may differ based on loan size.

To address these omissions, this paper examines whether changes in the reference rate of the Central Bank of Mexico (Banxico) have a positive pass-along effect and whether its value is similar across loan categories and sizes. As such, we consider the possibility that these institutions react asymmetrically to changes in the reference rate, alongside other explanatory factors to help explain banks' behavior with regard to lending rates. To this end, we look at what has happened to interest rates on new payroll and personal loans when Banxico changed its policy rate between 2011 and 2019. At the end of 2019, outstanding loans for these two financial products accounted for 44 percent of all outstanding consumer loans issued by banks.

We will also analyze the impact of the reference rate on lending rates for the personal and payroll loan markets at both the aggregate level and by loan size. For this purpose, the markets for these two types of loans were divided based on their average loan size.

To determine the value of these intervals, we used the only data available: the average income earned by those who took out a payroll loan in December 2019. Using these criteria, the market for these loans was divided into four loan sizes measured in thousands of Mexican pesos: 3-50, 50-100, 100-500, and over 500[2]. Since the market for loans between MXN $3,000 and $50,000 would include a very large proportion of all personal loan borrowers, we divided this interval in two: 3-10 and 10-50. This decision was made given that the vast majority of pawn shop and microfinance loans are below MXN $10,000.

We use an autoregressive model with distributed lags, which allows for the possibility of asymmetric effects. As control variables we include the Herfindahl-Hirschman index, loan arrears, and commercial bank expectations of economic growth and inflation. Using this methodology and these data, we have identified a number of interesting results.

For personal loans, the pass-through is positive when the central bank reference rate falls, otherwise it is zero. This means that the reaction of these lending rates to changes in the reference rate is helpful in avoiding a recession but not in fighting an inflationary process. Nevertheless, when personal loans are divided by size, a positive interest rate pass-through is only observed for loans between MXN $100,000 and $500,000.

In terms of payroll loans, we find that the interest rate pass-along is zero in all but one market. The exception is for loans below MXN $10,000, where the effect is negative. This result may seem strange, but we must consider the possibility of unexpected changes in monetary policy.

If such a variation takes months to affect the dynamics of economic activity, it is possible that the behavior of lending rates will increase in line with banks' expectations regarding delinquencies. In this case, the reduction in the marginal cost of obtaining liquidity may not offset the increase in the marginal cost associated with loan delinquency. Under such circumstances, new loans may be offered at higher interest rates.

Regarding distributional issues, once loans are divided by their size, we find that only in two markets the interest rate pass-through is different from zero. For payroll loans between MXN $3,000 and $10,000, the pass-along is -0.91, while for personal loans between MXN $100,000 and $500,000 it is +0.70. As such, among new borrowers applying for a payroll loan, those demanding the lowest amount will benefit less from the reduction in the reference rate. Among those requesting personal loans, a reduction in the reference rate will only benefit those requesting a loan of between MXN $100,000 and $500,000. This highlights how changes in the reference rate can have distributional effects.

To arrive at these results, our paper is divided into six additional sections. The second section reviews the methodology and conclusions of previous studies, which helped us to choose the most appropriate empirical methodology, in addition to showing how the search for potential distributional effects of monetary policy through bank pricing is uncommon in the available literature. The third section provides information on the financial products studied and the main features of the personal and payroll loan markets. The fourth and fifth sections describe the variables used and the empirical methodology chosen. Finally, the last two sections present the empirical results and the conclusions of our work.

[2] From 2011 to 2019, the average exchange rate was MXN $16 to USD $1, with a standard deviation of 2.9.

2. Literature Review

The interest rate pass-through in developed countries has been extensively studied, but the papers that have been written on this topic differ in four respects. The first one focuses on whether bank lending rates are set according to market interest rates or central bank reference rates. In this regard, some authors have used the cost of funds approach (Bernhofer and van Treeck, 2013; Havránek et al., 2016), while others have used the monetary policy approach (Mojon, 2000; Becker et al., 2012; Holton and d'Acri, 2015). The cost of funds approach assumes that bank interest rates are set with a premium over the market rate; however, since it complicated to find matching maturities for all bank interest rates, the majority of scholars have opted for the monetary policy approach (Gregor et al., 2020), which uses the central bank policy rate as the reference rate for the pass-through to all lending rates. In this paper, we use this second approach because we want to investigate whether the banks' responses to changes in the central bank reference rate might have distributional implications.

A second aspect concerns the introduction of other variables that can either help reduce a potential bias in the estimated value of the pass-through or explain its value (Gregor et al., 2018). Market competition, bank characteristics, and macroeconomic factors are typically included as control variables and/or as explanatory variables for the pass-through coefficient. With respect to competition, Cañon et al (2020); van Leuvensteijn et al. (2013), and Mojon (2000) find that the pass-through is faster and more complete at higher levels of competition in credit markets. In terms of bank characteristics, Saborowsky and Weber (2013), and Hainz et al. (2014) report that the value of the pass-along rate depends on the size of banks, their individual sources of funding, loan maturity, capital levels, liquidity, interest rate risk, and market share. With regard to macroeconomic variables, increases in this rate are found when inflation volatility increases (Humala, 2005), when more domestic transactions are conducted in domestic rather than foreign currencies (Barquero et al, 2020) and when the variability of the central bank's policy rate decreases (Mojon, 2000). Several authors also report that pass-along declines during periods of financial crisis (Aristei et al., 2014 and Borstel et al., 2016). Finally, Gregor et al. (2020) report that greater central bank independence has a positive effect on the magnitude of the pass-through, while greater transparency in the information they provide may have the opposite effect, as the result of commercial banks anticipating changes in the funds rate.

The third aspect concerns the treatment of unit roots and structural breaks, given that they may affect the interest rate pass-through. For example, Andries and Billon (2016) argue in favor of testing for unit roots that consider the possibility of one or more structural changes since their occurrence may lead to an under-rejection of the null hypothesis of a non-long-run relationship. In this regard, De Bondt et al. (2005) implement both the Cusum test and the Chow test to select the break date. Furthermore, Sander and Kleimier (2004) use the SupF test to identify the presence of a single unknown break in the cointegration relationship, while Toolsema et al. (2002) use the SupF, Mean F and Lc tests to check the stability of the parameters. Similarly, Aristei and Gallo (2014) apply a Markov switching approach to account for multiple break points in the pass-through. As described in the following section, during the period comprising 2011 to 2019, the Mexican economy was not subject to any event or reform that would lead us to suspect the presence of structural breaks.

The final aspect to be considered is the likelihood that banks could adjust their interest rates in an asymmetric manner. Based on the possible existence of switching costs and asymmetric information, Mojon (2000) finds a larger pass-through to lending rates in periods of upward changes in the policy rate. Moreover, Marotta (2009) tests for asymmetries in the short-run adjustment coefficient, given that any changes to it may depend on whether the variations in the market interest rate are positive or negative. On the other hand, De Bondt et al. (2005) and De Graeve et al. (2007) analyze the existence of asymmetries in the error-correction term, examining the deviations of the retail bank interest rate from its long-run equilibrium.

3. The Payroll and Personal Loans Markets in Mexico

The Mexican banking system is well capitalized, profitable and has a low level of overall risk. From 2011 to 2019, it had a capitalization ratio of 15.7%, a return on equity of 14%, a delinquency loan ratio of 2%, and a liquidity coverage ratio for the period comprising 2015 to 2019 of above 150%; however, it is also characterized by a low financial depth and concentration.

Looking at all forty-six banks in the country, in terms of assets and loans, the top five control 70% of the market. Castellanos et al. (2016) report that the Boone indicator was negative and very small for the period 2009-2012, suggesting a significant lack of competition. In regard to financial depth, the International Monetary Fund reports that during the 2011-2019 period, Mexico had the second lowest depth index among the six largest countries in Latin America (Argentina, Brazil, Chile, Colombia, Mexico and Peru). The World Bank reports that over the last twenty years Mexico has had an average credit to GDP ratio of 25%, a figure that is 14 percentage points below the average reported for Latin America and the Caribbean countries. Furthermore, it reports that, among the six largest Latin American countries, Mexico had the lowest percentage of people aged 15 and over with an account at a financial institution: 27% in 2011 and 37% in 2017.

In 2014, as part of efforts to increase competition and financial depth, Mexico's congress enacted a financial reform aimed at enabling a market-friendly environment while promoting market contestability and contract enforceability. This entailed rolling out legislative changes to improve the quality of information on interest rates and fees, as well as making loan portability a possibility. A national strategy has also been designed to increase financial inclusion while ensuring the stability of the financial system.

Nevertheless, banking institutions offer multiple products and compete in numerous markets, which is why, in order to better understand the markets for personal and payroll loans, we need to go into more detail. At the end of 2019, outstanding loans in these two financial products amounted to USD $26 billion - a figure slightly higher than the amount of outstanding credit card debt. Excluding mortgages, outstanding payroll and personal loans accounted for 44% of household debt to banks, with these loans being spread over fourteen million personal loans and five million payroll loans of various sizes.

Personal and payroll loans are non-revolving financial products that have a fixed repayment schedule and interest rate from the outset. Almost 74% of all personal loans had a repayment period of less than two years, while the vast majority of payroll loans had a repayment period of four years. With fixed interest rates, we measured pass-through by analyzing what happened to the interest

rates paid on new loans. The correlation between the interest rates of outstanding and new loans was 0.92 in the personal loan market and 0.76 in the payroll loan market.

To take out a personal loan, it is usually necessary to have a bank account with the financial institution from which the loan has been requested. This gives the bank access to information about the borrower's creditworthiness, making it easier to determine the amount and repayment terms to offer. Although the borrower does not necessarily get the desired amount, a personal loan can be obtained very quickly.

Table 1. Some features of the Market for Personal Loans, 2011-2019
Overall HHI = 2,274

Loan Size (in Mexican pesos)	Share of total number of loans 1st Biggest Lender	Share of total number of loans 2nd Biggest Lender	Share of total number of loans 3rd Biggest Lender	Share of total number of loans 4th Biggest Lender	HHI	Number of Personal loans (in %)
Between $3,000 and $10,000	Azteca (56.4)	Famsa (27.5)	Coppel (7.8)	Compartamos (1.9)	4,332	44.7
Between $10,001 and $50,000	Azteca (36.3)	Famsa (14.3)	Banejercito (12.9)	BBVA (5.2)	2,193	42.4
Between $50,001 and $100,000	Citibank (27.7)	BBVA (15.6)	Banejercito (15.5)	HSBC (8.0)	1,750	6.0
Between $100,001 and $500,000	Citibank (41.1)	BBVA (16.5)	Banejercito (13.0)	Santander (12.5)	2,784	6.6
More than $500,001	BBVA (37.2)	Santander (23.1)	Citibank (20.4)	HSBC (5.3)	3,243	0.3

Data Source: https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx Page visited on March 2021.
Notes: a) The HHI is calculated using the volume of loans of each bank as share. b) For informational purposes, during the sample period the average exchange rate was 1 USD = 15.96 pesos.

As Table 1 shows, almost 80 percent of all personal loans were granted by banks whose assets represented five percent of the banking system. However, in terms of value, approximately 60 percent of the personal loan portfolio was provided by the country's largest banks (BBVA, Citibank, Santander, and Banorte), whose assets represented 60 percent of those of the banking system to the end of 2019. This is a peculiar feature of personal loans. Given that the banks with the largest market share, in terms of value that granted loans of a larger size, were not those with the highest share of borrowers. Since larger loans tend to have lower interest rates, it is possible that the average cost of a loan is lower than the cost paid by the average borrower.

As our focus lies on distributional aspects, we used the volume of loans as a weight to calculate average interest rates, giving us a better indication of what borrowers had to pay. Following this methodology, we constructed the Herfindahl-Hirschman Index (HHI) using the relative number of loans offered by each bank as a share. As Table 1 shows, the market for personal loans is moderately concentrated at the aggregate level (HHI= 2,274); nevertheless, within the market for such loans, there are segments where the HHI is well above this figure, indicating the existence of

highly concentrated markets, such as, for example, for loans of less than MXN $10,000, where the HHI is 4,332.

In the case of payroll loans, the potential borrower must work for a company that is in good standing with the tax authorities, it is necessary that the employer has a bank account where the applicant is requesting a loan, and the company manager must agree to withhold payments and regularly transfer the amount needed to repay the debt. Given the lower risk of default, payroll loan borrowers have had to pay a lower interest rate regardless of the size of their loan (see Figures 1, 2, and 3). For example, in December 2019 the delinquency rate and expected loss –which includes the probability of default and the severity of the loss - were 3.0 and 7.1 percent for payroll loans and 6.5 and 10.9 percent for personal loans, respectively. Nonetheless, given that more than half of all workers in the country are employed under informal contracts, in addition to the fact that firms may be reluctant to commit to withholding payments, personal loans are more widely used. For example, as of December 2019, there were 14 million personal loans with an outstanding balance of MXN $244 billion and 5 million payroll credit contracts with an outstanding portfolio of MXN $260 billion.

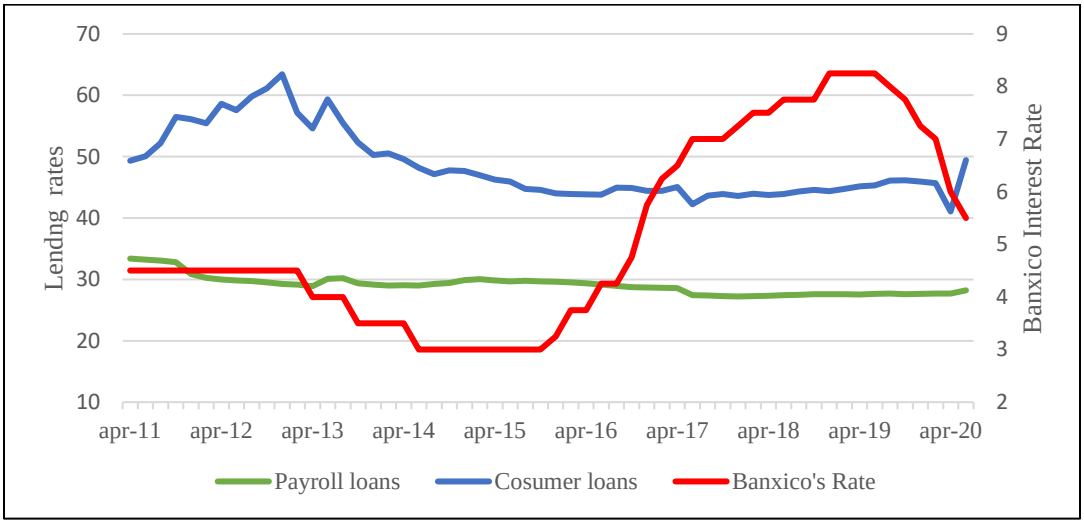

Figure 1. Lending Interest Rates and Banxico's Rate

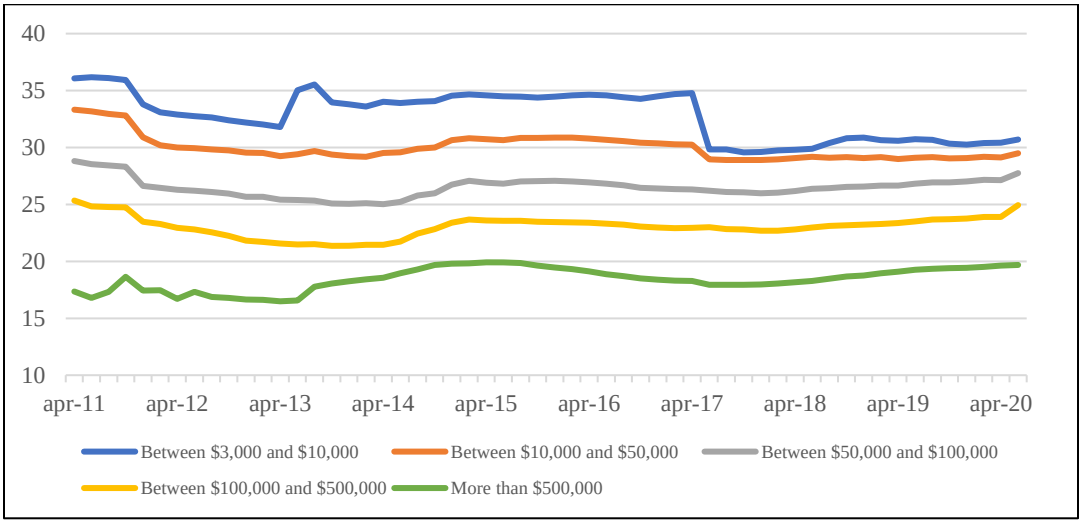

Figure 2. Interest Rates for Payroll loans, by loan amount

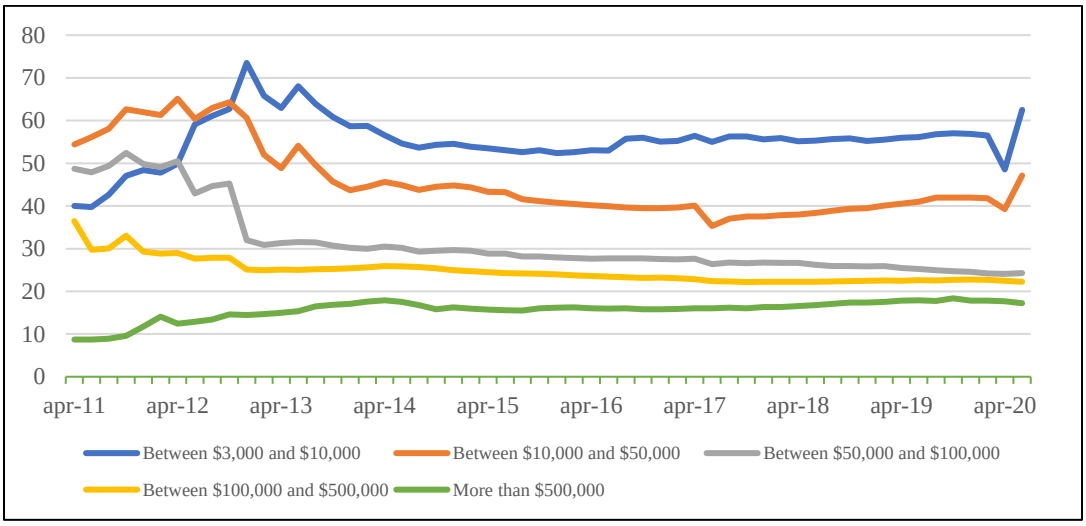

Figure 3. Interest Rates for Personal loans, by loan amount

As Table 2 shows, the four largest payroll lenders had similar market shares. Moreover, in contrast to the market for personal loans, the value of the HHI index is very similar, no matter whether or not we use the value or the volume of loans as the share. In the first case, the HHI is 2,442 and in the second case, it is 2,342.

Table 2. Some features of the Market for Payroll Loans, 2011-2019
Overall HHI = 2,342

Loan Size (in pesos)	Share of 1st Biggest Lender	Share of 2nd Biggest Lender	Share of 3rd Biggest Lender	Share of Fourth Biggest Lender	HHI	Number of Personal loans (in %)
Between $3,000 and $10,000	BBVA (36.7)	Citibank (23.6)	Banorte (15.6)	HSBC (13.4)	2,494	16.1
Between $10,001 and $50,000	BBVA (33.6)	Citibank (24.8)	Banorte (16.6)	HSBC (10.1)	2,274	53.7
Between $50,001 and $100,000	BBVA (34.8)	Citibank (26.9)	Banorte (13.5)	Santander (10.9)	2,447	12.3
Between $100,001 and $500,000	BBVA (32.4)	Citibank (27.2)	Banorte (15.7)	Santander (14.3)	2,470	17.6
More than $500,001	BBVA (67.4)	Santander (15.1)	Banorte (8.9)	HSBC (7.8)	5,321	0.3

Data Source: https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx Page visited on March 2021.
Notes: a) The HHI is calculated using the volume of loans of each bank as share. b) For informational purposes, during the sample period the average exchange rate was 1 USD = 15.96 pesos.

Although the average annual inflation rate between 2011 and 2019 was below 4% - a figure within the inflation target of the Central Bank of Mexico (Banxico) - the reference rate underwent both downward and upward movements (see Figure 1). The former corresponds to the period

comprising 2011 to 2016, during which the inflation rate stood at 3.5%, with a standard deviation of 0.6 percentage points. This situation ended when the federal government increased the price of energy by more than 50%, bringing the inflation rate to 6.8% by the end of 2017. Thereafter, a slow process of disinflation began, and, two years later, inflation was back within Banxico's target rate. In terms of economic activity, the National Statistics Institute (INEGI) reports that economic activity grew every month between 2011 and 2019, with an average annual rate of 2.7%; however, since December 2018, economic activity declined over a period of eleven months, resulting in a negative annual growth rate of 0.2%.

4. Data

According to standard economic theory, loan interest rates can be decomposed into risk-free and risk-premium components, the latter depending on the economic and financial environment as well as on the idiosyncratic characteristics of borrowers and banks. To account for this, we included loan arrears and the Herfindahl-Hirschman index for each loan size and type. We also included private bank expectations for annual economic growth and inflation for the six months ahead, as reported by Banxico. Data on lending rates for new contracts, loan delinquencies, and bank shares have been taken from the National Banking and Securities Commission (CNBV). These rates are bimonthly and have been available since the beginning of the second half of 2011. Given that the pandemic brought regulatory changes regarding delinquencies and that the demand for new loans experienced a sharp decline, our analysis concludes at the end of 2019. Statistics on these data can be found in Table 3.

Table 3. Descriptive statistics for aggregated data

Variable		Mean	Median	SD	Mín.	Max.
Central bank interest rate		5.1	4.5	1.8	3.00	8.25
Expected economic growth		2.4	2.4	1.0	0.2	4.8
Expected inflation		1.9	1.6	1.0	0.5	3.3
Personal Loans	Lending interest rate	43.1	41.2	4.8	37.4	56.0
	Arrears	15.1	16.3	4.9	1.7	20.0
	HHI	2,274	2,325	400	1,553	2,824
Payroll Loans	Lending interest rate	29.0	28.6	1.4	26.6	33.4
	Arrears	9.4	10.4	2.3	4.0	12.1
	HHI	2,342	2,222	232	2,059	2,712

Data Source: https://www.banxico.org.mx/SieInternet/ (for the reference rate) and https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx (for lending interest rates).

Tables 4 and 5 show the partial correlation between the aforementioned variables for each loan type and size. For personal loans, Table 4 shows that there is no correlation between lending rates and the reference rate in two of the six markets considered. Moreover, the statistical

correlation is negative in three of these four markets. Table 5 shows a somewhat similar scenario for payroll loans, as lending rates in these markets are correlated with the reference rate in only two markets, and in both cases the correlation is negative. Thus, without taking control variables or lags into consideration, the data from these two tables suggest that the pass-through of the reference rate is usually not positive.

Table 4. Personal Loans' Correlation Matrix

Aggregated data	Lending interest rate	Central bank interest rate	Expected. economic growth	Expected inflation rate	Arrears
Lending interest rate	1				
Central bank interest rate	-0.08	1			
Expected economic growth	0.60*	-0.47*	1		
Expected. inflation rate	0.03	0.02	0.01	1	
Arrears	0.53*	-0.24*	-0.33*	0.02	1
HHI	0.19*	-0.22*	0.01	0.07	0.23*
Less than $10,000					
Lending interest rate	1				
Central bank interest rate	0.06	1			
Expected economic growth	-0.27	-0.47*	1		
Expected inflation rate	-0.00	0.02	0.01	1	
Arrears	0.45*	-0.18	-0.28*	0.08	1
HHI	0.45*	0.68*	-0.68*	0.02	0.18
Between $10,001 and $50,000					
Lending interest rate	1				
Central bank interest rate	-0.38*	1			
Expected economic growth	0.74*	-0.47*	1		
Expected inflation rate	0.05	0.02	0.01	1	
Arrears	-0.23	-0.23	-0.32*	0.02	1
HHI	0.83*	0.04	0.41*	0.13	-0.27*
Between $50,001 and $100,000					
Lending interest rate	1				
Central bank interest rate	-0.34*	1			
Expected economic growth	0.79*	-0.47*	1		
Expected inflation rate	0.06	0.02	0.01	1	
Arrears	-0.33*	-0.42*	-0.28*	-0.08	1
HHI	0.29*	-0.53*	0.30*	0.00	0.27
Between $100,001 and $500,000					
Lending interest rate	1				
Central bank interest rate	-0.47*	1			
Expected economic growth	0.76*	-0.47*	1		
Expected inflation rate	0.03	0.02	0.01	1	
Arrears	-0.12	-0.53*	-0.25	-0.08	1
HHI	0.64*	-0.80*	0.63*	-0.02	0.29*

More than $500,000					
Lending interest rate	1				
Central bank interest rate	0.30*	1			
Expected economic growth	-0.80*	-0.47*	1		
Expected inflation rate	-0.09	0.02	0.01	1	
Arrears	0.19	-0.24	-0.41*	0.03	1
HHI	0.26	-0.75*	0.02	-0.04	0.27*

Data Source: https://www.banxico.org.mx/SieInternet/ (for the reference rate and for expectations on growth and inflation) and https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx (for lending interest rates and arrears).

Table 5. Payroll Loans' Correlation Matrix

Aggregated data	Lending interest rate	Central bank interest rate	Expected. economic growth	Expected inflation rate	Arrears
Lending interest rate	1				
Central bank interest rate	-0.07	1			
Expected economic growth	0.75*	-0.47*	1		
Expected. inflation rate	0.07	0.02	0.01	1	
Arrears	0.34*	0.06	-0.74*	-0.05	1
HHI	-0.66*	-0.17*	0.52*	0.07	-0.25*
Less than $10,000					
Lending interest rate	1				
Central bank interest rate	-0.79*	1			
Expected economic growth	0.49*	-0.47*	1		
Expected inflation rate	-0.00	0.02	0.01	1	
Arrears	-0.42*	0.39*	-0.85*	0.00	1
HHI	0.37*	-0.47*	0.56*	0.05	-0.47*
Between $10,001 and $50,000					
Lending interest rate	1				
Central bank interest rate	-0.49*	1			
Expected economic growth	0.61*	-0.47*	1		
Expected inflation rate	0.06	0.02	0.01	1	
Arrears	-0.51*	0.03	-0.75*	-0.06	1
HHI	0.11	-0.31*	0.51*	0.08	-0.53*
Between $50,001 and $100,000					
Lending interest rate	1				
Central bank interest rate	0.08	1			
Expected economic growth	0.28*	-0.47*	1		
Expected inflation rate	0.12	0.02	0.01	1	
Arrears	-0.47*	0.00	-0.72*	-0.06	1
HHI	-0.33*	-0.074	0.38*	0.13	-0.55*
Between $100,001 and $500,000					
Lending interest rate	1				
Central bank interest rate	0.17	1			
Expected economic growth	0.19	-0.47*	1		

Expected inflation rate	0.12	0.02	0.01	1	
Arrears	-0.49*	-0.24	-0.55*	-0.08	1
HHI	-0.37*	-0.49*	0.45*	0.10	-0.21
More than $500,000					
Lending interest rate	1				
Central bank interest rate	-0.04	1			
Expected economic growth	-0.52*	-0.47*	1		
Expected inflation rate	0.04	0.02	0.01	1	
Arrears	0.56*	-0.03	-0.65*	-0.10	1
HHI	0.46*	-0.70*	0.101	-0.06	0.40*

Data Source: https://www.banxico.org.mx/SieInternet/ (for the reference rate and for expectations on growth and inflation) and https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx (for lending interest rates and arrears).

5. Methodology

To measure the impact of changes in Banxico's reference rate on lending rates, we estimated a Nonlinear Autoregressive Model with Distributed Lags (NARDL) and an Autoregressive Model with Distributed Lags (ARDL), both of order (p, q1...qn), for which the lags were selected according to the Bayesian information criterion.

We made six estimations for each loan type: five by loan size and one more with aggregate data. For ease of understanding, we will first present the specification of the ARDL model:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=0}^{q} \beta_i' x_{t-i} + \sum_{i=0}^{q} \gamma_i' Z_{t-i} + u_t \quad (1)$$

Where y_t is the average interest rate for each loan type and interval loan value in period t. The Central Bank's prime rate is represented by x_t, and vector Z includes aforementioned variables that could help reduce the possibility of estimation bias. Following Pesaran and Shin (1998) and Pesaran et al. (2001), equation (1) can be rewritten in its error correction form as:

$$\Delta y_t = \phi(y_{t-1} - \theta x_t) + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_i' \Delta x_{t-i} + \sum_{i=0}^{q-1} \omega_i' \Delta Z_{t-i} + u_t \quad (2)$$

Where ϕ is the error correction term, θ contains the long-run coefficients, and λi is the short-run coefficient for the lag of the dependent variable, while δi and ωi are the short-run coefficients of the independent variables. One of the advantages of this approach is that it permits the use of variables with different orders of integration; therefore, the validity of the results depends mainly on both the existence of a long-run relationship between the variables and the absence of autocorrelation, for which the cointegration test and the Portmanteau test are useful. In Appendix 1 we present unit root tests for the variables used, which are in all cases I(0) or I(1).

However, once the reference rate changes, its effect on bank lending rates may depend on how much competition each bank faces. If a bank faces elevated competition, it is likely to lower its lending rates when the marginal cost of liquidity falls. On the other hand, if the reference rate rises,

the market structure may lead to a situation in which banks do not raise their lending rates for fear of losing market share. Consequently, a non-symmetric response may be a strategy followed by banks in some markets, which is why it is necessary to consider the use of a non-linear autoregressive model with distributed lags.

As proposed by Shin et al. (2014), equation (1) can also be depicted in its NARDL version as:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=0}^{q} \beta_i^+ x_{t-i}^+ + \sum_{i=0}^{q} \beta_i^- x_{t-i}^- + \sum_{i=0}^{q} \gamma_i' Z_{t-i} + u_t \quad (3)$$

Where x_{t-i}^+ takes the value of one when the change in the Central Bank's funding rate is positive, otherwise its value is zero; whereas, x_{t-i}^- takes the value of one when the change in such rate is zero or negative, or else it takes the value of zero.

In its error correction form, equation (3) may be portrayed as:

$$\Delta y_t = \phi(y_{t-1} - \theta^+ x_{t-i}^+ - \theta^- x_{t-i}^-) + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_i^+ \Delta x_{t-i}^+ + \sum_{i=0}^{q-1} \delta_i^- \Delta x_{t-i}^- + \sum_{i=0}^{q-1} \omega_i' \Delta Z_{t-i} + u_t \quad (4)$$

Where the coefficients θ and δ are the long-run and short-run effects of changes in the Central Bank's interest rate.

6. Results

To discuss which results are worth looking at we first examine the results obtained using a NARDL approach without control variables. If a long- or short-term asymmetry is found, the variables are cointegrated and autocorrelation is rejected. We then examine whether the inclusion of control variables still reports an asymmetric response of lending rates. If the control variables are statistically significant and asymmetry is still reported, we use the results obtained through a NARDL approach with controls; however, if the inclusion of control variables precludes the use of a NARDL approach, we use the results obtained using an ARDL approach.

Using aggregated data (Est 1N), our results in Tables 6 and 7 show that when the reference rate is in the down cycle, a decrease in this rate leads to a downturn in lending rates for personal loans. On the other hand, in the up cycle, an increase in the reference rate has no statistical effect on lending rates. Such results are independent of whether we include control variables or not, yet it is worth noting that the inclusion of control variables reduces the estimated parameter of the long-run effect and the statistical significance of the asymmetry.

Given this result, the behavior of lending rates in this market may help monetary policy aimed at avoiding a recession, but it does not counteract an inflationary process. Nevertheless, once personal loans are divided based on their size, the lack of asymmetry and the results of the cointegration test show that a positive interest rate pass-through is found only for loans between MXN $100,000 and $500,000 - the latter amount is equivalent to USD $26,000 in 2019. For all other markets, we cannot reject that the pass-through is equal to zero.

Table 6. Estimation Results for Personal Loans without controls

	Aggregated data	Less than $10,000	Between $10,001 and $50,000	Between $50,001 and $100,000	Between $100,001 and $500,000	More than $500,000	Aggregated data	Less than $10,000	Between $10,001 and $50,000	Between $50,001 and $100,000	Between $100,001 and $500,000	More than $500,000
	Results using NARDL						**Results using ARDL**					
	Est 1N	**Est 2N**	**Est 3N**	**Est 4N**	**Est 5N**	**Est 6N**	**Est 1A**	**Est 2A**	**Est 3A**	**Est 4A**	**Est 5A**	**Est 6A**
Speed of adjustment	-0.8***	-0.4**	-0.2	-0.1	-0.3***	-0.2*	-0.1	-0.4***	-0.1	-0.1	-0.1*	-0.2*
	(0.2)	(0.1)	(0.2)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)
Constant	42.3***	21.3***	10.4	2.1	6.8***	3.7**	5.6	18.7***	0.9	1.3	2.4	2.9
	(8.8)	(5.7)	(8.3)	(4.7)	(1.8)	(1.3)	(4.6)	(4.8)	(3.0)	(1.7)	(1.5)	(1.5)
Observations	51	51	51	51	49	51	51	51	51	51	49	51
Adjusted R^2	0.36	0.19	0.01	-0.11	0.46	0.13	0.04	0.20	0.01	-0.04	0.33	0.10
Long Term impact [+]	0.4	1.1	0.0	1.5***	1.2	-0.2	0.5	1.1	3.6	-1.3	-0.7	0.1
	(0.4)	(0.9)	(0.6)	(0.6)	(0.4)	(0.4)	(1.7)	(0.7)	(6.6)	(3.1)	(0.7)	(0.6)
Long Term impact [-]	-7.3***	-1.3	1.7**	-2.7	-11.3	-4.8						
	(1.1)	(1.2)	(1.9)	(1.9)	(0.6)	(0.7)						
Long Term Asymmetry (F)	98.2***	0.0	6.0***	0.6	6.2***	0.3						
Short Term Asymmetry (F)	0.5	0.6	0.1	0.0	0.2	0.1						
Cointegration test (t) a/	-4.8***	-3.5*	-2.1	-4.7***	-1.4	-0.8	-1.4	-3.9***	-1.0	-1.4	-2.0	-2.4
Portmanteau	21.4	17.8	17.9	17.3	11.9	19.8	16.3	14.6	13.1	19.2	12.8	14.0
Breusch/Pagan	8.4***	0.8	4.7**	13.5***	10.7***	50.2***	24.1***	0.1	17.2***	54.8***	10.2***	3.0*
Ramsey RESET (F)	1.4	0.8	1.0	7.5	4.0**	0.7	6.0***	0.3	1.3	0.4	1.5	7.6***
Jarque-Bera (chi2)	17.2***	230.6***	8.7	51.9***	20.5***	462.8***	5.6	200.5***	19.0***	441.4***	70.2***	3.0

* p<0.1, ** p<0.05, *** p<0.01.

a/ The limits of the Pesaran et al. (2001) test are as follows for each significance level: 10%: [-3.21, -2.57], 5%: [-3.53, -2.86] and 1%: [-4.10, -3.43] for NARDL and 10%: [-2.91,-2.57], 5%: [-3.22, -2.86] and 1%: [-3.82, -3.43] for ARDL. If t is less than the lower limit, the null hypothesis of no long-term relationship is rejected.

Table 7. Estimation Results for Personal Loans with controls

	Aggregated data	Less than $10,000	Between $10,001 and $50,000	Between $50,001 and $100,000	Between $100,001 and $500,000	More than $500,000	Aggregated data	Less than $10,000	Between $10,001 and $50,000	Between $50,001 and $100,000	Between $100,001 and $500,000	More than $500,000
	Results using NARDL						**Results using ARDL**					
	Est 1N	**Est 2N**	**Est 3N**	**Est 4N**	**Est 5N**	**Est 6N**	**Est 1A**	**Est 2A**	**Est 3A**	**Est 4A**	**Est 5A**	**Est 6A**
Speed of adjustment	-0.9***	-0.7***	-0.4*	-0.2	-0.4***	-0.4	-0.5**	-0.6***	-0.5**	-0.0	-0.4***	-0.2
	(0.2)	(0.1)	(0.2)	(0.2)	(0.1)	(0.3)	(0.2)	(0.1)	(0.2)	(0.1)	(0.1)	(0.2)
Constant	42.5***	10.5	4.6	19.4	0.8	9.4*	9.4	12.0	7.6	6.6	-0.7	5.6
	(10.7)	(9.3)	(9.2)	(10.7)	(2.9)	(3.8)	(5.6)	(8.1)	(4.7)	(4.5)	(1.7)	(4.1)
Observations	51	51	51	50	49	50	51	51	51	50	49	50

Adjusted R^2	0.30	0.29	0.07	0.10	0.57	0.12	0.11	0.27	0.12	0.08	0.59	0.11
Long Term impact [+]	0.3	-0.7	-0.8	-2.1	0.7	0.1	-0.1	-0.7	-0.8	-15.0	0.7*	-0.6
	(0.1)	(0.2)	(0.9)	(1.7)	(0.1)	(0.1)	(0.8)	(0.8)	(0.8)	(111.4)	(0.3)	(2.5)
Long Term impact [-]	-6.6***	-1.2	1.5	-15.2**	-0.8	-3.4*						
	(1.2)	(0.2)	(1.0)	(7.6)	(0.1)	(1.4)						
Long Term Asymmetry (F)	18.4***	0.9	0.0	6.2**	0.0	2.4						
Short Term Asymmetry (F)	0.5	1.5	0.0	1.4	0.6	0.0						
Cointegration test (t) a/	-4.3***	-4.7***	-2.4	-1.2	-5.2***	-1.4	-2.7	-4.7***	-3.1*	-0.1	-5.3***	-0.9
Portmanteau	18.8	21.6	15.1	21.5	15.3	15.0	15.3	15.0	11.7	16.9	13.5	9.5
Breusch/Pagan	7.16***	3.0*	12.8***	56.9***	0.6	7.5***	10.3***	0.2	14.6***	71.3***	0.2	7.5***
Ramsey RESET (F)	2.8*	2.7*	2.2	10.8***	2.7*	3.1**	2.8*	4.2**	1.8	11.1***	3.0**	4.0**
Jarque-Bera (chi2)	11.0***	16.7***	22.9***	45.0***	92.8***	9.9***	8.0*	43.5***	16.9***	74.3***	106.8***	1.7

* p<0.1, ** p<0.05, *** p<0.01.

a/ The limits of the Pesaran et al. (2001) test are as follows for each significance level: 10%: [-3.21, -2.57], 5%: [-3.53, -2.86] and 1%: [-4.10, -3.43] for NARDL and 10%: [-2.91,-2.57], 5%: [-3.22, -2.86] and 1%: [-3.82, -3.43] for ARDL. If t is less than the lower limit, the null hypothesis of no long-term relationship is rejected.

For payroll loans, we find asymmetric effects for different loan sizes when control variables are not included. In this scenario, as shown in Table 8, the pass-through value is usually negative. To explain this result, it is necessary to consider that changes in the reference rate may provide new information about inflation or output that was not included in bank forecasts – made six months ahead of time – regarding these variables. Consider, for example, an unexpected cut in the federal funds rate, which in itself could drive down lending rates; however, given that such a change would be unexpected, banks may consider the possibility that loan delinquencies may be higher than expected six months earlier. Under such circumstances, new loans may be offered at higher interest rates as a result of the regulatory cost of such unanticipated delinquencies, meaning that the likely impact of changes in the reference rate may be the result of two forces working in opposite directions: the marginal cost of funds and the regulatory cost of expected default. Our negative results may therefore imply that, on average, the latter force was stronger.

Despite finding some cases in which the customer share of some banks has changed, this is not very common, so it is therefore unlikely that this factor could explain the results. Other omitted variables could also help explain the result, but the lack of information on customer and bank strategies makes such a study impossible. Moreover, our relatively small sample size and empirical methodology limit the number of explanatory variables, but once bank expectations of inflation and output, arrears, and the HHI are included in the estimations, the asymmetric behavior is no longer relevant and the interest rate pass-through is zero in all but one market (see Table 9). The only exception is for loans below MXN $10,000 (Est 2A), where the pass-through is negative.

Table 8. Estimation Results for Payroll Loans without controls

	Aggregated data	Less than $10,000	Between $10,001 and $50,000	Between $50,001 and $100,000	Between $100,001 and $500,000	More than $500,000	Aggregated data	Less than $10,000	Between $10,001 and $50,000	Between $50,001 and $100,000	Between $100,001 and $500,000	More than $500,000
	Results using NARDL						**Results using ARDL**					
	Est 1N	**Est 2N**	**Est 3N**	**Est 4N**	**Est 5N**	**Est 6N**	**Est 1A**	**Est 2A**	**Est 3A**	**Est 4A**	**Est 5A**	**Est 6A**
Speed of adjustment	-0.3***	-0.4***	-0.3***	-0.3**	-0.4***	-0.3*	-0.3***	-0.3***	-0.3**	-0.2*	-0.3**	-0.1
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Constant	8.4***	12.6***	9.6***	7.1**	7.8***	4.5*	8.3***	11.4***	7.4**	5.3*	5.7**	2.2
	(2.3)	(2.9)	(2.4)	(2.2)	(1.6)	(2.1)	(2.3)	(3.1)	(2.5)	(2.1)	(1.6)	(1.3)
Observations	51	51	51	51	49	51	51	51	51	51	49	51
Adjusted R^2	0.17	0.22	0.20	0.13	0.42	0.07	0.16	0.14	0.07	0.04	0.29	0.06
Long Term impact [+]	-0.2	-0.7***	-0.1	-2.1***	-0.1	0.2	-0.1	-0.6**	0.1	0.4	0.4*	0.3
	(0.2)	(0.3)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.3)	(0.2)	(0.5)
Long Term impact [-]	1.1	2.2***	1.8***	1.4**	1.8***	1.5*						
	(0.1)	(0.4)	(0.3)	(0.3)	(0.3)	(0.3)						
Long Term Asymmetry (F)	1.9	7.1***	8.5***	1.4	8.5***	5.5***						
Short Term Asymmetry (F)	1.7	0.3	2.7	0.3	2.7	2.8						
Cointegration test (t) [a/]	-3.8**	-4.4***	-4.1**	-4.8***	-4.1**	-3.4*	-3.7**	-3.6**	-2.9*	-2.6	-3.5**	-1.7
Portmanteau	19.9	14.9	15.9	26.6	15.9	23.7	16.6	14.4	15.5	26.8	22.1	19.6
Breusch/Pagan	19.1 ***	0.1	37.6***	1.5	37.6***	33.4***	11.4***	2.3	12.5***	19.2***	2.3	0.1
Ramsey RESET (F)	5.6***	3.5**	1.9	0.8	1.9	3.5***	6.5***	1.7	3.2**	3.2**	4.1**	0.5
Jarque-Bera (chi2)	3.2	2.7	9.0*	1.8	9.0***	24.0***	8.9**	1.7	33.1***	88.7***	3.7	18.3***

* p<0.1, ** p<0.05, *** p<0.01.

a/ The limits of the Pesaran et al. (2001) test are as follows for each significance level: 10%: [-3.21, -2.57], 5%: [-3.53, -2.86] and 1%: [-4.10, -3.43] for NARDL and 10%: [-2.91,-2.57], 5%: [-3.22, -2.86] and 1%: [-3.82, -3.43] for ARDL. If t is less than the lower limit, the null hypothesis of no long-term relationship is rejected.

Table 9. Estimation Results for Payroll Loans with controls

	Aggregated data	**Less than $10,000**	**Between $10,001 and $50,000**	**Between $50,001 and $100,000**	**Between $100,001 and $500,000**	**More than $500,000**	**Aggregated data**	**Less than $10,000**	**Between $10,001 and $50,000**	**Between $50,001 and $100,000**	**Between $100,001 and $500,000**	**More than $500,000**
	Results using NARDL						**Results using ARDL**					
	Est 1N	**Est 2N**	**Est 3N**	**Est 4N**	**Est 5N**	**Est 6N**	**Est 1A**	**Est 2A**	**Est 3A**	**Est 4A**	**Est 5A**	**Est 6A**
Speed of adjustment	-0.3**	-0.4***	-0.4*	-0.5***	-0.2*	-0.3	-0.3**	-0.3***	-0.4**	-0.5***	-0.2	-0.2
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Constant	6.6	8.8	10.0	19.8**	4.7	4.7	11.1*	11.3*	18.1**	22.3**	6.7	1.4
	(5.9)	(4.4)	(7.2)	(6.8)	(4.2)	(3.8)	(4.9)	(4.3)	(6.4)	(6.6)	(4.3)	(2.2)
Observations	51	51	51	51	51	50	51	51	51	51	51	50

Adjusted R^2	0.1	0.18	0.16	0.16	0.05	0.01	0.11	0.21	0.12	0.15	0.01	0.05
Long Term impact [+]	-0.2	-0.8**	-0.2	0.1	0.3	0.1	-0.2	-0.9**	-0.2	0.2	0.2	0.9
	(0.1)	(0.3)	(0.1)	(0.1)	(0.4)	(0.5)	(0.3)	(0.3)	(0.2)	(0.2)	(0.5)	(0.7)
Long Term impact [-]	1.9	2.5	3.0	1.0	1.9	2.2						
	(0.9)	(0.6)	(0.9)	(0.3)	(1.9)	(11.3)						
Long Term Asymmetry (F)	0.9	0.9	2.3	1.7	2.2	1.7						
Short Term Asymmetry (F)	1.1	0.2	1.4	0.9	1.5	0.5						
Cointegration test (t) a/	-2.9	-3.6**	-3.0	-3.6**	-2.3	-1.6	-3.1*	-3.7**	-3.3**	-3.6**	-1.9	-1.8
Portmanteau	20.1	16.6	18.1	27.1	21.4	17.6	17.1	9.8	15.9	24.9	24.4	18.4
Breusch/Pagan	22.0***	0.0	33.9***	29.2***	26.7***	2.4	17.4***	0.0	24.8***	19.0***	17.7***	7.2***
Ramsey RESET (F)	9.7***	4.9***	1.4	12.5***	7.8***	1.2	7.5***	5.1***	2.5*	13.1***	6.4***	1.6
Jarque-Bera (chi2)	3.6	4.2	8.6	16.1***	13.9***	15.87***	5.9*	5.1*	10.9***	22.8***	8.9**	28.6***

* p<0.1, ** p<0.05, *** p<0.01.

a/ The limits of the Pesaran et al. (2001) test are as follows for each significance level: 10%: [-3.21, -2.57], 5%: [-3.53, -2.86] and 1%: [-4.10, -3.43] for NARDL and 10%: [-2.91,-2.57], 5%: [-3.22, -2.86] and 1%: [-3.82, -3.43] for ARDL. If t is less than the lower limit, the null hypothesis of no long-term relationship is rejected.

7. Conclusions

Three conclusions can be drawn from these results. Firstly, changes in the reference rate do not imply that lending rates move in the same direction. More often than not, the pass-through in the payroll and personal loan markets is zero, and given that they represent almost half of all outstanding household loans to banks, the ability of the Bank of Mexico to reduce inflation is not overly strong.

A second implication concerns the heterogeneity of our results. Estimates of pass-through are typically measured using aggregate data, and our research shows that results obtained in this way do not necessarily reflect what happens within loans of different sizes. This may be the result of pricing strategies differing over time and across markets and/or because the relative importance of banks may also change over time. Nevertheless, the likelihood of different interest rate channels for each product type and loan size could mean that changes in the reference rate have different effects on new borrowers. Once loans are divided by size, we find that the pass-through rate is different from zero in only two markets. For payroll loans between MXN $3,000 and $10,000, the pass-through is -0.91, while for personal loans between MXN $100,000 and $500,000 thousand pesos, it is +0.70. In the supposition that the central bank lowers its reference rate, among new borrowers of payroll loans, those who demand the lowest amount will be the group that will benefit less from the reduction of the reference rate. On the other hand, among those requesting personal loans, the reduction in the reference rate will only benefit those borrowers who demand a loan of between MXN $100,000 and $500,000. This clearly highlights how changes in the reference rate can have distributional effects.

Finally, according to Gregor et al. (2020), it is common to find papers covering this topic that do not include control variables or do not consider the possibility of asymmetric behavior, and these

omissions may bias the results; however, the cost of using this methodology may - given the size of the data - the need to reduce the inclusion of control variables. If this is the case, it may be best to consider results with and without control variables in order to learn more about the reactions of banks when the central bank changes its policy rate.

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Appendix 1

Dickey-Fuller Unit Roots Test – Personal Loans		
	t test for levels [a/]	t test for differences[b/]
Central bank interest rate	-1.356	-3.962
Expected economic growth	-2.880	-7.619
Expected inflation rate	-4.414	-4.929
Aggregated data		
Lending interest rate	-3.292	-9.379
Arrears	-3.335	-8.821
HHI	-0.486	-4.959
Less than $10,000		
Lending interest rate	-4.170	-8.083
Arrears	-3.665	-9.467
HHI	-2.016	-8.311
Between $10,001 and $50,000		
Lending interest rate	-1.724	-9.026
Arrears	-3.083	-7.419
HHI	-0.455	-5.983
Between $50,001 and $100,000		
Lending interest rate	-1.947	-7.913
Arrears	-2.912	-6.928
HHI	-1.868	-6.530
Between $100,001 and $500,000		
Lending interest rate	-4.545	-11.434
Arrears	-2.625	-7.082
HHI	-2.751	-7.106
More than $500,000		
Lending interest rate	-2.780	-8.850
Arrears	-2.898	-6.469
HHI	-1.582	-4.850

Notes: Tests with trend term. H0: The variable contains a unit root; H1: The variable was generated by a stationary process.

a/ Critical Values 1%: -4.143; 5%: -3.497; 10%: -3.178

b/ Critical Values 1%: -4.146; 5%: -3.498; 10%: -3.179

Dickey-Fuller Unit Roots Test – Payroll Loans		
	t test for levels [a/]	t test for differences[b/]
Central bank interest rate	-1.356	-3.962
Expected economic growth	-2.880	-7.619
Expected inflation rate	-4.414	-4.929
Aggregated data		
Lending interest rate	-2.978	-6.604
Arrears	-1.947	-7.124
HHI	-1.287	-6.501
Less than $10,000		

Lending interest rate	-2.162	-7.086
Arrears	-1.068	-5.680
HHI	-0.086	-8.901
Between $10,001 and $50,000		
Lending interest rate	-3.069	-6.849
Arrears	-2.011	-7.581
HHI	-1.214	-6.486
Between $50,001 and $100,000		
Lending interest rate	-3.228	-7.384
Arrears	-1.861	-7.700
HHI	-1.975	-6.561
Between $100,001 and $500,000		
Lending interest rate	-3.450	-8.318
Arrears	-1.995	-8.030
HHI	-2.379	-6.220
More than $500,000		
Lending interest rate	-2.584	-9.760
Arrears	-1.529	-7.973
HHI	-1.038	-4.617

Notes: Tests with trend term. H0: The variable contains a unit root; H1: The variable was generated by a stationary process.

a/ Critical Values 1%: -4.143; 5%: -3.497; 10%: -3.178

b/ Critical Values 1%: -4.146; 5%: -3.498; 10%: -3.179