CENTRO DE INVESTIGACIÓN Y DOCENCIA ECONÓMICAS, A.C.

FINANCIAL INCLUSION AND INFLATION

TESINA
QUE PARA OBTENER EL TÍTULO DE
LICENCIADO EN ECONOMÍA

PRESENTA
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To my sister, Dafne Dayan.

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ABSTRACT

This paper uses a VAR model to elicit the relationship between financial inclusion variables, inflation and GDP growth rate in Mexico for the period 2002 - 2018. The results for this period show that there is weak evidence that the variables of financial inclusion have an effect on inflation and GDP growth rate. There are two key results in this document that confirm this statement. First, the statistical significance between inflation and the number of debit cards and the number of ATMs per 1, 000 km^2 is 10 %. Second, the statistical significance between GDP growth rate and the number of ATMs and Point of Sales Terminals (POS) per 1, 000 km^2 is 10%. This study also shows that some financial inclusion variables are correlated with better forecasts of inflation and economic growth.

1. Motivation

For central banks, financial inclusion matters for several reasons. First, the use of cash declines and central banks should know how to interpret this trend. The demand for cash decreases as consumers and retailers adopt electronic means in many countries. But Bech and Faruqui (2018) show that in other countries cash is still in high demand; In the last decade there is an increase in cash in circulation in tandem with electronic payments (2008-2018). Carstens (2018) shows that things may change in the future and central banks want to be prepared.

Thus, the purpose of this work is to understand the relationship between financial inclusion, inflation and economic growth in Mexico from 2002 to 2018. Financial inclusion in Mexico is particularly important, among other reasons, because the use of cash in Mexico is in the context of low confidence in formal financial services and tax evasion. Also, the effect of use of cash, or alternative payment systems, that a country has in circulation can have positive or negative effects in the economy. In other words, it is important to study the degree of financial inclusion of Mexico to understand the direction of these effects and its consequences to public policy making. Also, the study of financial inclusion and use of cash has implications for the central bank regarding the decisions of money issuance and inflation control. Therefore, I use historical monetary aggregates series (M0 and M1) that show the use of cash in circulation in the economy with respect to other payment methods. I also use other variables to measure the degree of financial inclusion in the economy: number of ATMs, debit cards, credit cards, points of sale terminals and electronic transfers.

To understand negative aspects of financial inclusion Geanakoplos (2009) develops a model that explain a causal connection between credit cards and stagflation. The surge in price levels in the United States in the 1970s and early 1980s coincided with the introduction of credit cards. To explain this inflationary mechanism, Geanakoplos assumes that all agents have access to bank loans and credit cards. Credit cards double the velocity of money; The same dollar can be used by one agent to buy in the cash-commodity market, and by another to buy in the credit card-commodity market. This creates inflation of the order of 100%.

In addition, there are well tested positive aspects of financial inclusion in the long-term. Burgess and Pande (2005) and Levine (2005) talk about economic growth and poverty reduction. In their view, access to financial instruments may allow the poor to invest in physical assets and education reducing income inequality and contributing to economic growth. Besides, financial inclusion has important implications for monetary and financial stability. Khan (2011) and Tombini (2011) show that financial inclusion changes the behavior of firms and consumers, in turn influencing the efficacy of monetary policy. For example, greater inclusion should make interest rates more effective as a policy tool and it may ease central banks' efforts to maintain price stability.

Carstens (2018) shows that central banks must be ready by the potential decline in the use of cash for new payment systems. In many countries, the demand for cash decreases as consumers and retailers adopt electronic means. Two examples are Sweden and Denmark, where stores and restaurants are reluctant to accept paper money. Instant mobile payment solutions are gaining ground. Mobile payments are being used as often as cash to make payments.

Use of cash in Mexico is different. Seira (2010) argues that likely reasons for low use of formal financial services in Mexico include not only supply constraints but also weak demand. In his view poor have little knowledge of how financial institutions work and low confidence in financial institutions. Even so ENIF, National Survey of Financial Inclusion shows that from 2012 to 2018 the number of adults in financial system increased from 39.4 to 54 million. Figure 1, 2 and 3 show the number of Point of Sale Terminals, credit cards and debit cards from 2002 to 2018 in Mexico. Figures show an increasing trend but it is important to mention that the number of credit cards decreased significantly in the quarters 2008Q4 and 2009Q1. This can be attributed to 2009 crisis.

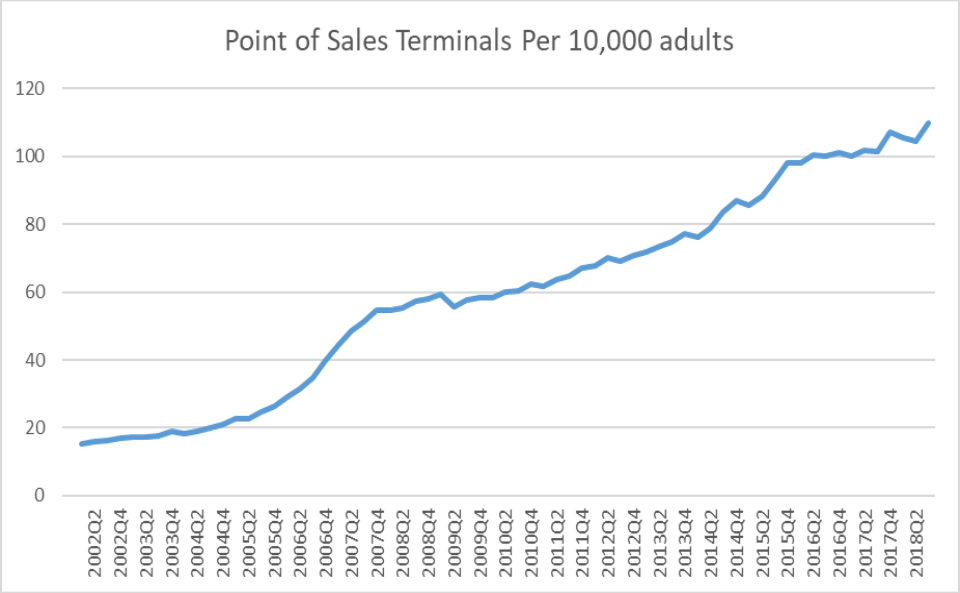
There are other factors that explain the behavior of cash use in Mexico. Arroyo (2008) shows the link between a "hidden economy" and cash transactions from 1996 to 2006. In his view, a greater number of cash transaction between 1996 and 2006 are related to criminal activities and tax evasion. Also, Fuentes (2012) shows that in the period 2002-2011 cash

increased its importance as a means of payment. Cash held by the public goes from 3.4% in 2002 to 4.6% in 2011. This increase in the use of cash, in contrast with electronic payment methods, can be explained by the use of cash to avoid paying taxes.

The implications of a parallel increase in financial inclusion and use of cash in Mexico can generate an ambiguous effect on the economy. On the one hand, the positive effects of poverty reduction through access to financial instruments can be offset by another sector of the population that in parallel is increasing its use of cash to evade taxes or commit illegal activities. On the other hand, the effects of financial inclusion on price stability are nullified with the increase of use of cash because interest rates cease to be effective in modifying agent behavior and the work of the central bank becomes more difficult. Also, from a theoretical point of view, there is also an effect of the parallel increase in financial inclusion and use of cash. For example, the increase in the use of cash avoids the problem of replacing the central bank's currency with digital money. The reason is that, following the quantitative theory of money, the increase in the use of cash causes an increase in the monetary base at the same time as the use of digital money increases the speed of money.

In order to study the use of money in Mexico and its effect on inflation and economic growth this document is organized as follows: in Section 1, I review the theoretical framework to sustain the theoretical relationship between several indicators of financial inclusion and inflation. I also discuss in detail the mechanisms by which the quantitative theory of money responds to financial inclusion. Next, in Section 2, I review the literature and discuss some of the major research on the study of financial inclusion measures and its potential to explain or predicts inflation. In Section 3.1, I discuss the data used for this study and its source, show descriptive statics of relevant variables, as well as perform a preliminary visual analysis of their behavior. In section 3.2, I analyze the stationarity of all variables testing for unit root test. In Section 3.3 I use a VAR model to understand the dynamics between financial inclusion variables, inflation and GDP growth rate. Last, in Section 4, I share my concluding remarks.

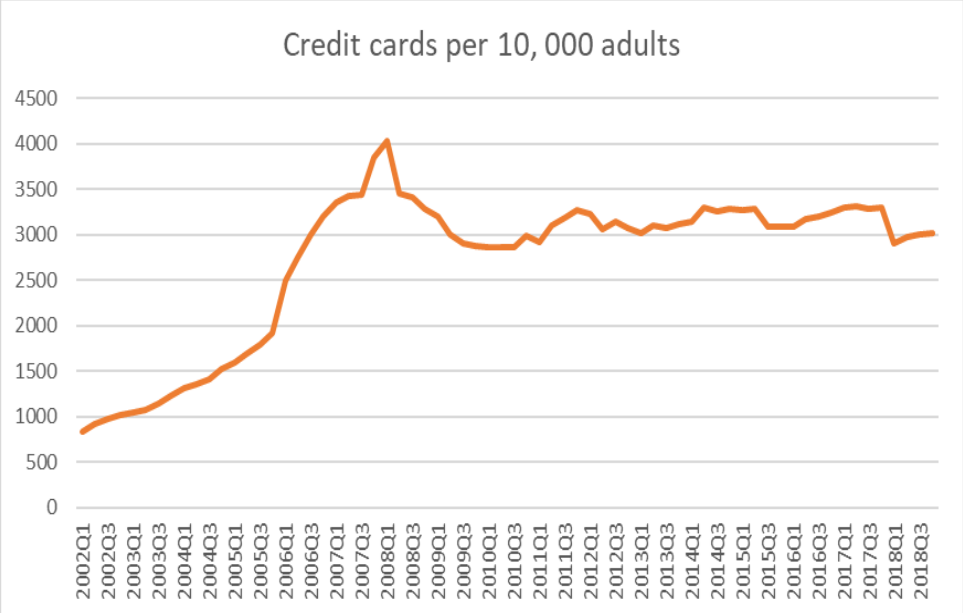
Figure 1: Number of Point of Sales Terminals Evolution (2002-2018)



Time period

Source: Own elaboration with data from Banxico and CNVB

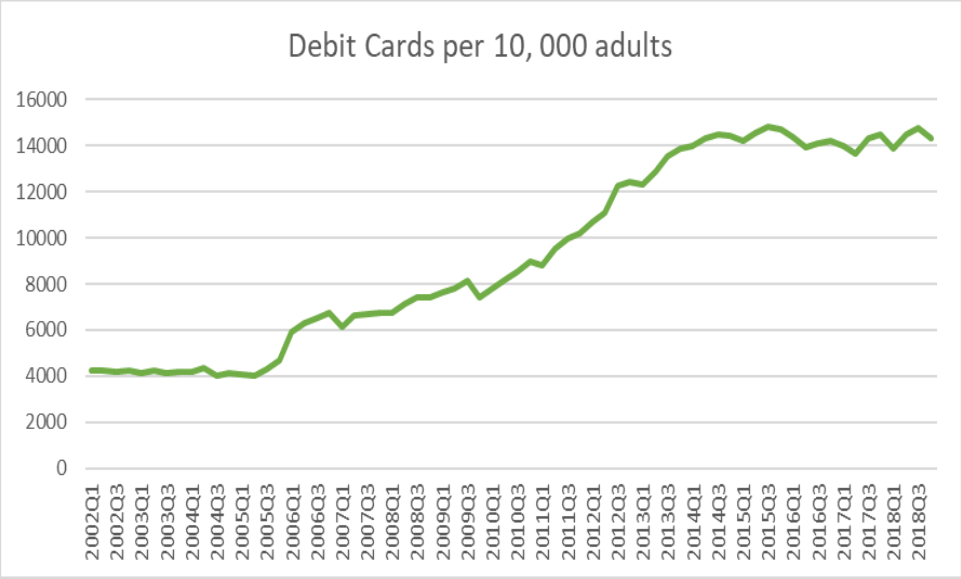
Figure 2: Number Credit Cards Evolution (2002 - 2018)



Time period

Source: Own elaboration with data from Banxico and CNVB

Figure 3: Number Debit Cards Evolution (2002 -2018)



Source: Own elaboration with data from Banxico and CNVB

2. Theoretical Framework

The theoretical links between financial inclusion, inflation and GDP growth can be traced in the quantitative theory of money (QTM). The relation is expressed throughout the following equation:

$$MV=PY \tag{1}$$

QTM asserts that aggregate prices (P) and total money supply (M) are related, where Y is real output and V is velocity of money. A central implication of the QTM is that a given change in the rate of money growth induces an equal change in the inflation rate. A crucial assumption behind this claim is that the velocity of money or its growth rate is constant and money growth has no effect on real GDP growth, at least at a sufficiently long horizon. However, Yi Men (2006) shows with postwar U.S. data that the velocity of money is not constant.

In fact, replacement of central bank currency and lower demand for transaction deposits also affect monetary aggregates and the functioning of the monetary policy transmission mechanism. Berensten (1995) contributes to this literature by identifying two possible implications of digital money for the level and the stability of the income velocity of money of the monetary base:

The first one takes place through level effects and suggest that digital money could replace central bank currency. This means that with an increase of digital money, the central bank carries out reserve absorption operations and reduces the monetary base. Consequently, the income velocity of base money will increase following QTM equation. Jordan and Stevens (1996) suggest that the income velocity of base money could approach infinity. This means a loss in the ability of central banks to control demand and supply reserves because there will be no appreciable domestic demand at all for central bank money. That is, higher velocity of money makes it more difficult to maintain financial stability, unless there are comparable increases in the precision with which the central bank can control the supply of its monetary liability.

The second one takes place through variability of velocity of money. Jordan and Stevens (1996) show that less stable velocity of money complicate monetary policy decision making for countries that rely on monetary aggregates as targets or indicators because they would be more difficult to define and achieve. Nonetheless the transition from cash to digital money could take a long time, and there is a priori no reason why this transition should be accompanied by large unexpected short-term variations in the income velocity of money. Moreover, during the initial stage, the substitution is expected to be rather moderate, which would allow central banks enough time to observe developments and take necessary steps.

3. Literature Review

Other empirical studies contribute to the literature by proposing empirical measures of financial inclusion. Several indicators of financial development are based on monetary aggregates: Gregorio and Guidotti (1995); Arestis and Demetriades (1997); Sinha and Macri (2001); Odhiambo (2009). Kar, Nazhoglu and Agir (2011) show two facts about financial inclusion indicator based on monetary aggregates. The first on is that this indicator measures the degree of monetization in the economy. In other words, show the real size of the financial sector of a growing economy in which money provides valuable payment and saving services. The second one is that 'narrow money' stock (M1) best reflects the former payment services and "broad money" (M2) the latter, savings function.

There is a large amount of literature for different countries to understand the relationship between monetary aggregates and prices. Horvath and Komarek (2011) show in sample evidence that monetary aggregates M1 and M2 matter to explain future inflation. McCandless and Weber (1995) show that in the long term, there is a high correlation (almost unitary) between the rate of growth of the money supply and the rate of inflation. Ramos-Francia, Rodríguez-Pérez and Noriega (2015) were among the most recently researchers to question some of McCandless and Weber´s key assumptions for Mexico. In their view, two aspects must be considered. The first one was that for periods of price stability correlations are generally lower than those estimated by McCandless and Weber. The second one was that the simple correlation can be contaminated with shocks that affect monetary aggregates or inflation in the short term (i.e., shocks to the velocity of money). Under this argument, Benati (2009) proposes to analyze the correlation between these series in the long term (i.e., in the low frequency). Ramos-Francia, Rodríguez-Pérez and Noriega (2015) use the concept of spectral coherence to formally estimate the correlation in low frequency (long term), between quarterly growth of M1 and quarterly inflation in Mexico. They conclude that the long-term correlation between the growth of M1 and inflation for the case of Mexico seems to correspond with theory, since it is not possible to reject at 95% confidence that the correlation is equal to 1 in the long term.

DemirgüçKunt and Klapper (2012) propose other indicators of financial inclusion. The first one is the number of commercial bank branches per 100,000 adults. Second one is the number of ATMs per 100,000 adults. However, Stix (2004) mentions that findings about the effect of the ATMs network on cash demand are inconclusive. Some studies report a negative effect and others a positive one. Also, Stix (2004) shows the ambiguous effect of payment cards on cash demand. Usually credit and debit cards are variables that measure financial inclusion "intensity". Berentsen (1997) discusses the foreign effect of payment cards on central banks cards and specifies that the effect is a pressure to reduce reserve ratios and the number of types of reservable liabilities. Bisignano (1996) mentions that the central bank reduction in reserve ratios is the case of all the major (G7) industrial countries, since 1990 reserve requirements have been reduced. For example, today in Belgium and Sweden no reserve requirements are in place. Reserve requirements are basically a tax on financial intermediation. In fact, banks that are subject to reserve requirements have a competitive disadvantage compared with nonbank financial intermediaries offering close financial substitutes. There is a risk if foreign intermediaries were to increasingly attract (transaction) deposits of domestic residents across public computer networks. Central banks would be pressed to lower reserve ratios to help domestic banks to compete for domestic (and foreign) deposits.

Other studies contribute to the literature by proposing theoretical models to understand the relationship between payment cards and inflation. Geanakoplos (2009) develops a model that explain a causal connection between credit cards and stagflation. Though he does not make an empirical connection between credit cards and the stagflation in the 1970s and early 1980s. Geanakoplos and Dubey (2010) specify that use of credit cards could be a source of stagflation. Credit cards increase the efficiency of trade but cause massive inflation when there is default. Then the monetary authority would try to stem this inflation by tightening the money supply and raising interest rates. In fact, strictly speaking, since the credit card prices are higher than the cash prices, it is necessary to reduce trade below the original pre-credit card levels in order that the average cash/credit card price be no higher than before. A conservative monetary authority might well compromise by tolerating

a small increase in average prices. But if the increase were small enough, there would necessarily be a drop in efficiency. This is stagflation.

In a cross-country analysis, Apergis (2007) shows a bi-directional causality between financial inclusion and economic growth. In his view, in the long run the association between the impact of the banking system and economic growth weakens because excessive and rapid deepening of the banking system may not result in productive credit and can lead to inflationary pressures. To validate this hypothesis, Demetriades and Hussein (1996), Rousseau and Wachtel (1998) and Arestis (2001) assessed the relationship between financial inclusion and growth across countries. Watchtel (2002) shows that this nexus varies with inflationary pressures. Valev (2004) argue that this nexus varies with level of economic development.

Barajas (2012) argue that the nexus between financial inclusion and growth indicated measurable heterogeneity across countries due to regulatory characteristics and differing performances on financial access for a given level of depth. However, economists in cross-country studies have found that financial deepening is indirectly associated with economic growth: Ndebbio (2004); Wacthel (2005); Berentsen and Shi (2008); Masoud and Hardaker (2012).

Regulatory characteristics are important considering the Mexican case of tax evasion. Fishburn (1981) and Nourzad (1986) argue that inflation reduces the real value of taxpayers' future disposable income. Therefore, taxpayers find optimal to increase their levels of tax evasion, through more use of cash, in order to restore their future purchasing power. This negative effect of inflation on the real fiscal revenue it is known as Tanzi-Olivera effect (1977). Fishlow and Friedman (1994) point out that one of the consequences of the Tanzi-Olivera effect is that governments facing a large amount of evasion due to inflation will increase the rate of monetary growth in order to get additional inflationary financing.

4. Methodology

To explore the nexus between financial inclusion, inflation and economic growth I use a VAR model. The VAR model contained a set of m variables, expressed as a linear function of p lags of itself and p lags of the explanatory variable along with an error term. Brooks (2014) argues that to examine the statistical significance of the coefficients is essential that all the components in the auto- regression (VAR) are stationary. Thus, the stationarity of data series needs to be checked using the Augmented Dickey–Fuller (ADF) and the Phillips-Perron unit root tests. I use the stationary variables in which both criteria reject the null hypothesis that the series has a unit root at the 5% significance level.

Then the analysis with VAR model has two steps. In the first one I define a benchmark model. This model only includes five variables: difference between monetary aggregates M0 and M1, monetary aggregate M0, inflation, and GDP growth rate. Inflation and GDP growth rate are endogenous variables. In the second step I make several model estimates with additional variables of financial inclusion. In this point I test the relation of financial inclusion variables over inflation and economic growth. Optimal lag structure is chosen taking into account four information criteria selection Akaike's Information Criterion (AIC), Hannan-Quinn Criterion (HQ), Schwarz Criterion (SC) and Final Prediction Error (FPE). I get the optimal lag structure with the lowest AIC, Akaike Information Criterion.

The VAR model, thus, provides enough flexibility for choosing endogenous and exogenous variables. Similar models can be run for other financial inclusion dimensions, such as usage, access and their individual parameters. Thus, I explore the empirical association between inflation, economic growth and financial inclusion dimensions for different VAR models.

There are two dimensions of financial inclusion available in institutional datasets: (1) access; (2) use variables. Access variables has been defined based on the following proxies' variables: number of ATMs and POS per 10,000 adults and /or per 10, 000 km^2. The second dimension includes number of credit cards, debit cards deposits, banking transfers and internet transfers per 10,000 adults.

Then I make a forecast analysis to observe how financial inclusion variables and monetary aggregates adds better information to the benchmark model. Following Horvarth and Komarek (2011) some models containing money improve the inflation forecasts in certain periods. Therefore, I compare VAR models forecast estimates with additional variables of financial inclusion and monetary aggregates. Then I test their performance with MAPE, Mean Absolute Percentage Error, criteria. Let A_t and F_t denote the actual and forecast values at data point *t,* respectively. Then, MAPE is defined as:

$$MAPE = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{A_t - F_t}{A_t}\right|$$

where N is the number of data points.

3.1 Data

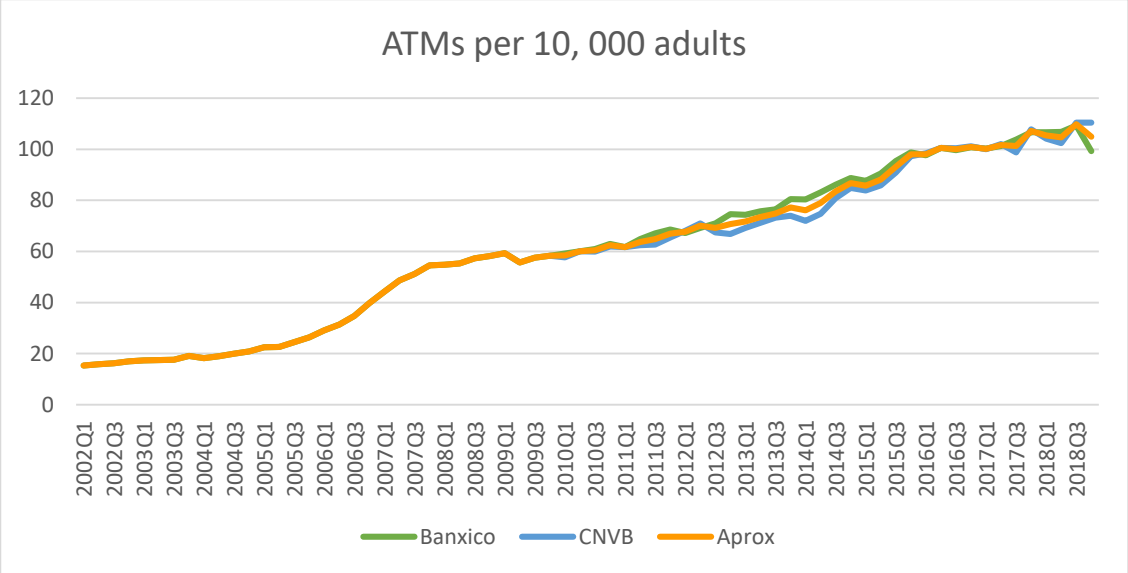
Raw data for individual financial inclusion indicators is available at CNVB, National Banking and Securities Commission. There are two divisions for financial inclusion variables available at CNVB: Access index and usage index. The first one includes number of bank branches, ATMs and POS per 10,000 adults and/or per 1,000 km^2. The second one includes number of credit cards, debit cards and deposits per 10,000 adults. Beck (2007) and Ghost (2010) consider that these indicators exhibit geographical and demographical financial outreach. Data records available begins on the first month of 2009 (2009Q1) and end on the last quarter of 2018(2018Q4).

Also, the same financial inclusion indicators plus electronic banking transfers and internet transfers are available at Banco de Mexico, Banxico. Data records available begins on the first month of 2002 (2002Q2) and end on the last quarter of 2018(2018Q4) without the geographical and demographical conversion. So, following CNVB methodology for demographical variables each data quarter are divided by the total adult population of each year times 10,000. For geographical conversion all data quarters are divided by the constant number of square kilometers of Mexico´s territorial extension times 1,000. Nonetheless

CNBV data did not match with Banxico data as of 2009. Then to have more reliable data from 2009 to 2018 I make an approximation in the mean with each variable of the two datasets: Banxico and CNVB. Figures 4,5 and 6 show graphically the difference in time series of both data sources. The first part of the series takes the values provided by Banxico from 2002Q1 to 2009Q3; from 2009Q4 to 2018Q4 I make a simple average of the values of the two data sources.

Final data records begin on the first month of 2002 (2002Q1) and end on the last quarter of 2018(2018Q4) with the approximation from 2009. The latest five variables are sourced from Banxico: Monetary aggregates M1 and M0, inflation and GDP. The same starting period (2002Q1) is considered.

Figure 4: Number of ATMs Evolution (2002 -2018)



Source: Own elaboration with data from Banxico and CNVB; Final data records start the first month of 2002 (2002Q1) and end the last quarter of 2018(2018Q4) with the approximation of the two data sets as of 2009.

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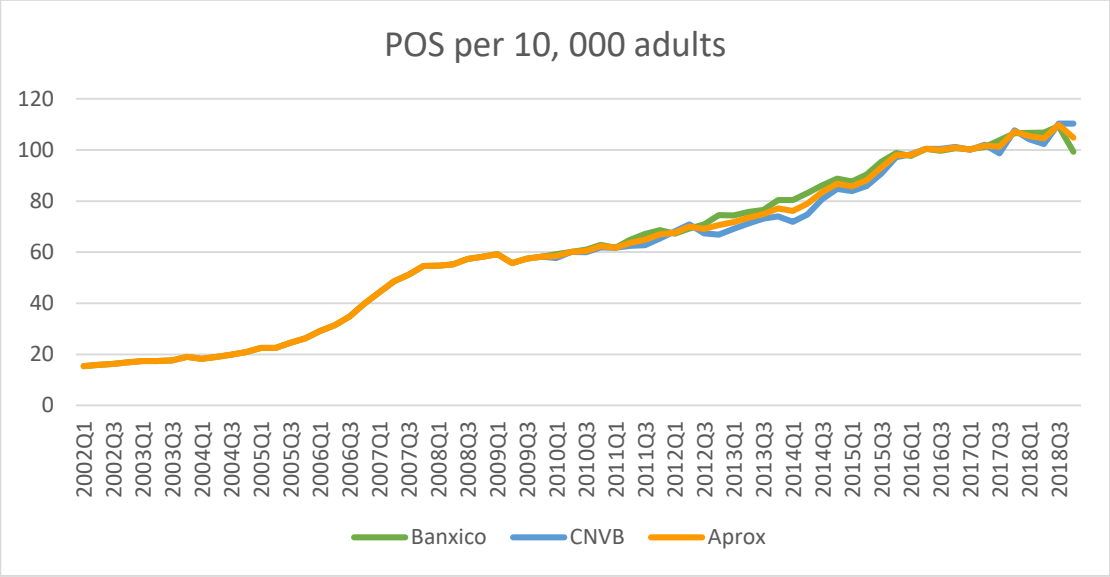
Figure 4 shows the evolution number of ATMs. Units are in ATMs per 10,000 adults. For Banxico data, the average quarterly annual growth rate during the period of study is 1.43%. We observe 9 quarters of negative annual quarterly growth and 58 quarters of growth. The highest growth quarter was 2004Q3 with a 7.74 % increment. The largest negative growth quarter was 2018Q3 with a fall of 4.03%.

For CNBV data, the average quarterly annual growth rate during the period of study is 0.76%. We observe 11 quarters of negative annual quarterly growth and 56 quarters of growth. The highest growth quarter was 2004Q3 with a 4.68% increment. The largest negative growth quarter was 2012Q1 with a fall of 2.80%.

Figure 5: Number of POS Evolution (2002-2018)

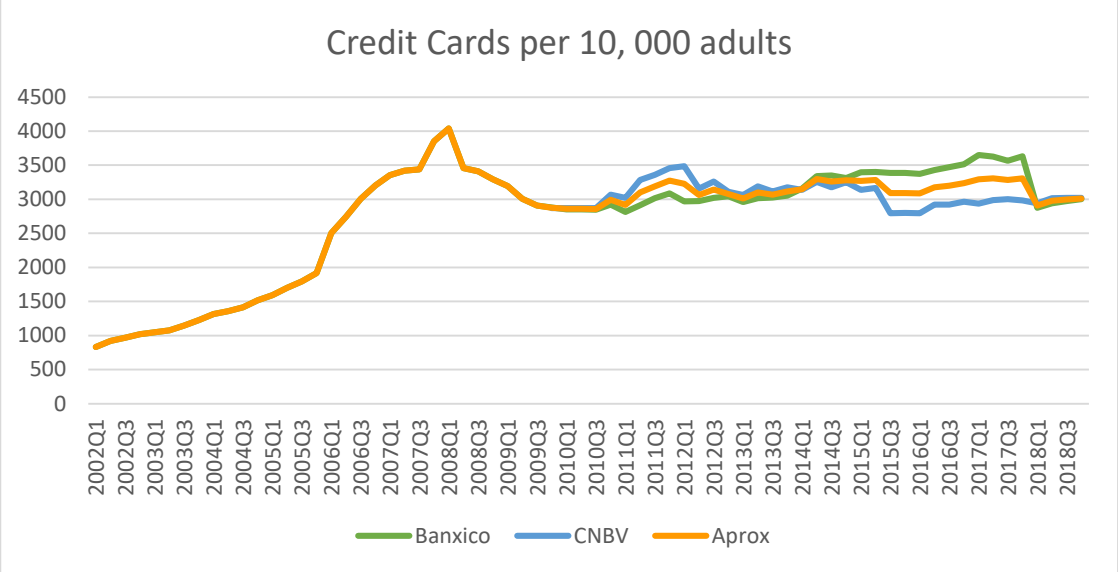


Source: Own elaboration with data from Banxico and CNVB; Final data records start the first month of 2002 (2002Q1) and end the last quarter of 2018(2018Q4) with the approximation of the two data sets as of 2009.

Figure 5 shows the evolution number of POS. Units are in POS per 10,000 adults. For Banxico data, the average quarterly annual growth rate during the period of study is 2.90%. We observe 11 quarters of negative annual quarterly growth and 56 quarters of growth. The highest growth quarter was 2006Q4 with a 14.29% increment. The largest negative growth quarter was 2018Q3 with a fall of 9.11%.

For CNBV data, the average quarterly annual growth rate during the period of study is 1.84%. We observe 12 quarters of negative annual quarterly growth and 55 quarters of growth. The highest growth quarter was 2017Q4 with a 9.14 % increment. The largest negative growth quarter was 2012Q3 with a fall of 4.94%.

Figure 6: Number of Credit Cards Evolution (2002 -2018)



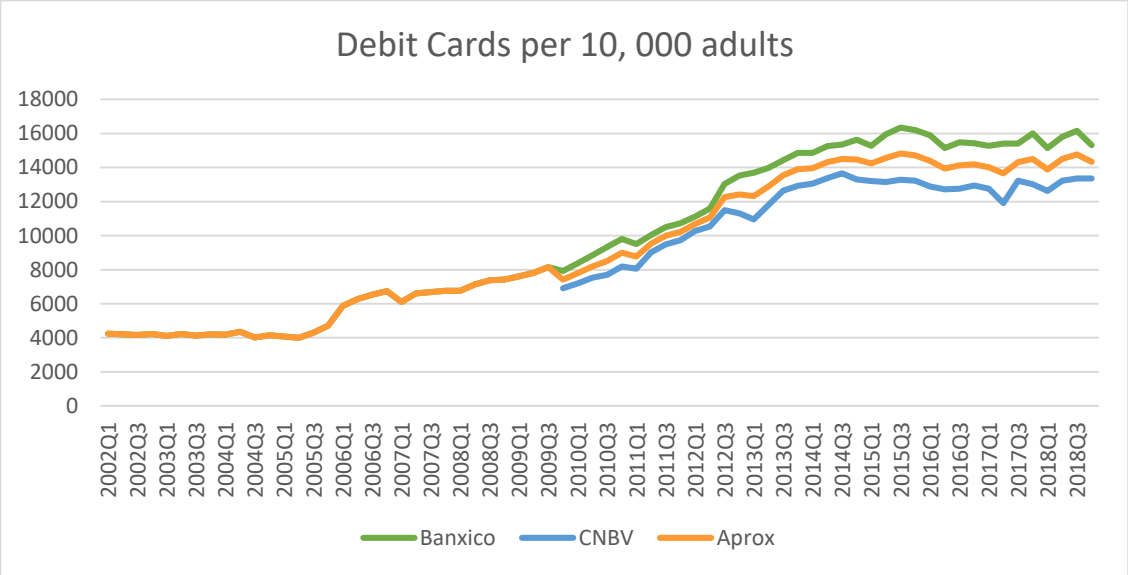
Source: Own elaboration with data from Banxico and CNVB; Final data records start the first month of 2002 (2002Q1) and end the last quarter of 2018(2018Q4) with the approximation of the two data sets as of 2009.

Figure 6 shows the evolution number of Credit Cards. Units are in Credit Cards per 10,000 adults. For Banxico data, the average quarterly annual growth rate during the period of study is 2.11%. We observe 19 quarters of negative annual quarterly growth and 48 periods of growth. The highest growth quarter was 2006Q1 with a 30.57% increment. The largest negative growth quarter was 2018Q4 with a fall of 20.73%.

For CNBV data, the average quarterly annual growth rate during the period of study is 0.22%. We observe 12 quarters of negative annual quarterly growth and 55 quarters of

growth. The highest growth quarter was 2011Q2 with an 8.83 % increment. The largest negative growth period was 2015Q3 with a fall of 11.83%.

Figure 7: Number Debit Cards Evolution (2002-2018)



Source: Own elaboration with data from Banxico and CNVB; Final data records start the first month of 2002 (2002Q1) and end the last quarter of 2018(2018Q4) with the approximation of the two data sets as of 2009.

Figure 7 shows the evolution number of Debit Cards. Units are in Debit Cards per 10,000 adults. For Banxico data, the average quarterly annual growth rate during the period of study is 2.04%. We observe 19 quarters of negative annual quarterly growth and 48 periods of growth. The highest growth quarter was 2006Q1 with a 25.02% increment. The largest negative growth quarter was 2007Q1 with a fall of 9.55%.

For CNBV data, the average quarterly annual growth rate during the period of study is 1.93%. We observe 13 quarters of negative annual growth and 54 quarters of positive growth. The highest growth quarter of growth was 2011Q2 with a 11.92 % increment. The largest negative growth quarter was 2017Q2 with a fall of 6.58%.

5. Results

5.1 Unit Root Test

In this section, the presence of a unit root is tested for the Mexican GDP growth rate (Y), the Mexican inflation growth rate (π), variables of financial inclusion and monetary aggregates using two different methodologies: Augmented Dickey Fuller (ADF) and Phillips-Perron.

Table 1 shows that there are three orders of integration of the variables. Integrated of order cero, I (0): M0, M1, M0 in public and M0 in banks. These variables reject the null hypothesis of unit root test at 5% without applying any difference. Integrated of order one, I (1): Y, π, Electronic Transfers, ATMs per km^2 and ATMs per adults. These variables require the first difference to reject the null hypothesis of unit root test at 5%. Integrated of order two, I (2): POS per km^2, POS per adults, Debit Cards, Credit Cards and Internet Transfers. These variables require a second difference to reject the null hypothesis of unit root at five percent. Thus, for VAR model I consider all the stationary variables in which both criteria coincide in rejecting the null hypothesis.

Then the analysis with VAR model has two steps. In the first one I define a benchmark model. This model only includes five variables: difference between monetary aggregates M0 and M1, monetary aggregate M0, inflation, and GDP growth rate. Inflation and GDP growth rate are endogenous variables. In the second step I make several model estimates with additional variables of financial inclusion. In this point I test the relation of financial inclusion variables over inflation and economic growth.

Table 1. Results of the unit root test

	ADF unit root test		PP unit root test			ADF unit root test		PP unit root test	
Variables	t-statics	p-value	t-statics	p-value	Variables	t-statics	p-value	t-statics	p-value
Y	-3.3975	0.0636	-39.472	0.0432	Δ Y	-5.146	0.01	-53.929	0.01
π	-5.0506	0.0664	-69.121	0.0453	Δ π	-5.0593	0.01	-70.269	0.01
POS per km^2	-1.2557	0.8775	-0.8854	0.9871	ΔΔ POS per km^2	-9.174	0.0496	-100.28	0.01
ATMs per adults	-1.4671	0.7916	-1.0629	0.9843	Δ ATMs per adults	-3.9894	0.0155	-39.681	0.01
POS per adults	-1.4174	0.8118	-0.77791	0.9886	ΔΔ POS per adults	-3.4914	0.0494	-56.804	0.01
ATMs per km^2	-1.0891	0.9174	-0.87832	0.9771	Δ ATMs per km^2	-3.9415	0.0177	-37.142	0.01
Debit Cards per adults	-0.7542	0.9614	-1.32145	0.9002	ΔΔ Debit Cards per adults	-4.4025	0.01	-63.843	0.01
Credit Cards per adults	-2.2292	0.4823	-3.3971	0.9145	ΔΔ Credit Cards per adults	-4.2692	0.01	-54.231	0.01
Electronic Transfers	-3.0953	0.1307	-7.5981	0.6933	Δ Electronic Transfers	-3.7671	0.0258	-72.094	0.01
Internet Transfers	-1.6301	0.7254	-7.0436	0.7004	ΔΔ Internet Transfers	-6.0414	0.01	-81.508	0.01
M1	-3.6512	0.0356	-48.623	0.01					
M0	-3.6251	0.0379	-48.767	0.01					
M0 in public	-4.2901	0.0157	-42.023	0.01					
M0 in banks	-3.4481	0.0555	-70.667	0.04					
M1-M0	-3.0489	0.1491	-75.972	0.14	Δ (M1-M0)	-0.44834	0.9814	-26.83	

Source: Own elaboration with data from Banxico and CNBV (2019); Notes: p-values 0.05 reject the null hypothesis that the series has a unit root at the 5% significance level. Δ Denotes first differentiation. ΔΔ Denotes second differentiation.

5.2 VAR model

Table 2 Shows that optimal lag structure is considered taking into account four information criteria selection Akaike's Information Criterion (AIC), Hannan-Quinn Criterion (HQ), Schwarz Criterion (SC) and Final Prediction Error (FPE). Then, choosing the lowest AIC (4 lags), the model is described as follows:

$$\Delta\pi_t = B_0 + \sum_{i=1}^{4} B_i \Delta\pi_{t-i} + \sum_{i=1}^{4} B_i \Delta Y_{t-i} + \sum_{i=1}^{4} B_i \Delta M0_{t-i} + B_4 \Delta(M1 - M0)_t + \epsilon_t$$

$$\Delta Y_t = B_0 + \sum_{i=1}^{4} B_i \Delta Y_{t-i} + \sum_{i=1}^{4} B_{i\Delta} \pi_{t-i} + \sum_{i=1}^{4} B_i \Delta M0_{t-i} + B_4 \Delta(M1 - M0)_t + \epsilon_t$$

where GDP (ΔY_t) and monetary aggregate ($\Delta M0_t$) are in growth rates.

Table2. **Selection Criteria Information**

	Number of lags					
	1	2	3	4	5	Minimum
AIC(n)	-3.79051054	-3.94856184	-3.90076439	-4.0472725	-3.9296186	4
HQ(n)	-3.62886539	-3.73303497	-3.6313558	-3.7239822	-3.5524466	2
SC(n)	-3.3788071	-3.39962394	-3.21459201	-3.2238657	-2.9689772	2
FPE(n)	0.02261153	0.01933828	0.02034173	0.0176436	0.0199649	4

Source: Own elaboration. Minimum criterion is 4 lags for AIC(n) and FPE(n)

5.3 Financial Inclusion and Inflation

In this section, I explore the association between financial inclusion and inflation. Therefore, I present all significant models where inflation is considered as a dependent variable. I ran separate models for two different dimensions of financial inclusion: access and usage.

Model 1 is the benchmark model. This model investigates the relationship between inflation and the difference between monetary aggregates M0 and M1, monetary aggregate M0, inflation, and GDP growth rate. Monetary aggregate M0 with two lags confirms a positive and significant association at 10% with inflation measured in growth rate. This means that this evidence is weak to show that inflation is significantly influenced by past values of monetary aggregate M0 and cannot be confirmed McCandless and Weber (1995) relation between inflation and monetary aggregate M0.

Models 2 and 3 explore the relation between inflation and number of ATMs and POS terminals per 10´000 adults. Also, monetary aggregate with two lags confirms a positive and significant association with inflation measured in growth rate. Also, the number of ATMs and POS terminals indicate a positive relationship with economic growth but do not exhibit any statistically significant association with the current value of the inflation.

Models 4-7 allows us to investigate the association between inflation and banking services: credit cards, debit cards, banking transfers and internet transfers. Results indicate a positive and significant association at 10 % between inflation and number of credit cards. This evidence is weak to confirm a positive nexus between the demographic outreach of credit cards and Mexican economy.

The results of the VAR model with geographical variables of financial inclusion are shown in models 8 and 9. Monetary aggregate M0 with two lags confirms a positive and significant association at 10% with inflation. Also, results indicate a positive and a significant association at 10% between inflation and number of ATMs per 1, 000 km^2. This evidence is weak to confirm Stix (2004) theory about the geographic penetration of banking services results in an efficient flow of cash and further fosters inflation. Also, the evidence is insufficient to show Apergis (2007) theory about that the rapid deepening of the banking

system may not result in productive credit and can lead to inflationary pressures. It is important to mention that the effects thus can go both ways. The Tanzi-Olivera effect shows that in periods of inflation taxpayers find optimal to increase their levels of tax evasion, through more use of cash, in order to restore their future purchasing power. The effect of inflation on financial inclusion variables is negative in this case.

Table 3. VAR Models for Inlfation

	Dependent variable: Inflation (π)								
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	0.016	0.015	0.015	0.0179	0.0177	0.0155	0.0184	0.0228	0.0152
Y (t-1)	0.167	0.167	0.166	0.1606	0.1669	0.1694	0.1663	0.1567	0.1673
Y (t-2)	0.084*	0.084*	0.087*	0.0714*	0.0759*	0.0829*	0.0784*	0.0756*	0.0839*
Y (t-3)	0.154	0.153	0.151	0.1651	0.1670	0.1580	0.1649	-0.0282	0.1538
Y (t-4)	-0.465	-0.463	-0.465	-0.4564	-0.4596	-0.0003	-0.4624	-0.4571	-0.4631
π (t-1)	-0.024	-0.024	-0.024	-0.0225	-0.0224	0.1891	-0.0226	-0.0233	-0.0235
π (t-2)	0.049	0.049	0.049	0.0481	0.0477	0.1408	0.0480	0.0482	0.0487
π (t-3)	-0.031	-0.030	-0.031	-0.0291	-0.0292	0.1942	-0.0298	-0.0306	-0.0302
π (t-4)	0.001***	0.001***	0.001***	0.002***	0.002***	-0.4711***	0.002***	0.003***	0.001***
m0 (t-1)	-0.025	-0.025	-0.009	-0.0553	-0.0820	-0.0296	-0.0785	-0.1394	-0.0262
m0 (t-2)	-1.451*	-1.479*	-1.37*	-1.4639*	-1.4676*	-1.4401*	-1.4683*	-1.3462*	-1.4498*
m0 (t-3)	0.285	0.435	2.671	2.4593	2.2339	2.6751	2.6892	2.8152	2.2123
m0(t-4)	2.183	1.161	2.387	2.1152	2.0896	2.3661	2.8341	2.8974	2.6911
(Δm)= m1-m0	0.00003	0.00000	0.00001	0.00001	0.00003	0.00001	0.00001	0.00001	0.00003
ΔmXln (ATM´s per adults)		0.0003							
ΔmXLn (POS per adults)			0.0004						
ΔmXln (credit cards)				0.0002					
ΔmXLn (debit cards)					0.0002*				
ΔmXln (transfer bank)						-0.0001			
ΔmXLn (transfer internet)							0.0000		
ΔmXln (POS per km^2)								-0.0002	
ΔmXLn (ATM´s per km^2)									0.0002*
R^2	0.350	0.349	0.351	0.3579	0.3567	0.3487	0.3564	0.3534	0.3487
Adjusted R^2	0.225	0.224	0.226	0.2320	0.2305	0.2235	0.2302	0.2241	0.2235
F-statistic	2.795	2.785	2.810	2.8430	2.8280	2.7840	2.8240	2.7330	2.7840
p-value	0.008	0.008	0.007	0.0069	0.0072	0.0078	0.0072	0.0092	0.0078

Source: Own elaboration. Notes: ***,** and * indicate that null hypothesis is rejected at 1%, 5% and 10% significance levels.

5.4 Financial Inclusion and GDP growth rate

In this section, I explore the association between financial inclusion and GDP growth rate. Therefore, in this study, I present all significant models where GDP growth rate is considered as a dependent variable. We have run separate models for two different dimensions of financial inclusion: access and usage.

Model 1 is the benchmark model. This model investigates the relationship between GDP growth rate and the difference between monetary aggregates M0 and M1, monetary aggregate M0, inflation, and GDP growth rate. Inflation confirms a positive and a significant association at 10% with GDP measured in growth rate. This evidence is weak to confirm that the current GDP growth rate is influenced by past values of inflation.

Models 2 and 3 explore the relation between GDP growth rate and number of ATMs and POS terminals per 10,000 adults. Also, monetary aggregate with two lags confirms a positive and significant association with inflation measured in growth rate. Also, the number of ATMs and POS do not exhibit any statistically significant association with the current value of GDP growth rate.

Models 4-7 allows us to investigate the association between inflation and banking services: credit cards, debit cards, banking transfers and internet transfers. Results indicate a positive relationship between GDP growth rate and credit cards and debit cards but do not exhibit any statistically significant association. This evidence is weak to confirm that there is a positive nexus between the demographic outreach of credit cards and debit cards and Mexican economy.

Finally, the results of the VAR model with geographical variables of financial inclusion are shown in models 8 and 9. Results indicate a positive and significant association at 10% between inflation and number of ATMs and POS terminals per 1,000 km^2. Apergis (2007) shows a bi-directional causality between financial inclusion and economic growth. However, this evidence is weak to confirm Sharma (2016) theory about that the geographic penetration of banking services, in terms of the availability of ATMs, drives the wheels of an economy by providing easy financial access to borrowers and savers.

Table 4. VAR Models For GDP Growt Rate

	Dependent variable: GDP growth rate (Y)								
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	0.576**	0.005**	0.563**	0.564**	0.587**	0.595**	0.652**	0.582**	0.573**
Y (t-1)	-0.352*	-0.010**	-0.357**	-0.499	-0.333**	-0.097**	0.001**	-0.436**	-0.340**
Y (t-2)	-2.270*	-2.327*	-2.232*	-2.494*	-2.294*	-2.120*	-2.080*	-2.275*	-2.332*
Y (t-3)	-0.379	-0.349	-0.424	-0.348	-0.343	-0.018	-0.159	-0.167	-0.349
Y (t-4)	0.048	0.096	0.039	0.237	0.058	0.000	-0.159	0.197	0.101
π (t-1)	0.413	0.427	0.413	0.431	0.424	0.189	0.401	0.426	0.428
π (t-2)	-0.276*	-0.288*	-0.274*	-0.284*	-0.287*	0.140*	-0.326*	-0.285*	-0.289*
π (t-3)	-0.082	-0.070	-0.083	-0.058	-0.075	0.194	-0.057	-0.065	-0.069
π (t-4)	0.117	0.117	0.121	0.129	0.117	0.031	0.047	0.106	0.117
m0 (t-1)	-2.527	-2.673	-2.311	-2.249	-2.729	-2.175	-2.792	-2.865	-2.690
m0 (t-2)	-1.203	-1.41	-1.16	-1.119	-1.356	-1.169	-1.194	-1.152	-1.179
m0 (t-3)	-1.04	-1.16	-1.88	-1.098	-1.395	-1.227	-1.75	-1.219	-1.33
m0 (t-4)	-1.130	-1.160	-2.910	-1.301	-1.017	-2.460	-1.910	-2.412	-1.461
(Δm) = m1-m0	0.0009	-0.0001	0.0001	0.0001	0.0011	0.0005	0.0002	0.0002	0.0010
ΔmXln (ATM´s per adults)		-0.0011							
ΔmXLn (POS per adults)			0.0047						
ΔmXln (credit cards)				0.005					
ΔmXLn (debit cards)					0.001				
ΔmXln (transfer bank)						-0.008			
ΔmXLn (transfer internet)							-0.006		
ΔmXln (POS per km^2)								0.0035*	
ΔmXLn (ATM´s per km^2)									0.0015*
R^2	0.320	0.317	0.325	0.332	0.317	0.393	0.369	0.326	0.317
Adjusted R^2	0.189	0.185	0.195	0.201	0.183	0.276	0.245	0.191	0.185
F-statistic	2.449	2.408	2.503	2.534	2.370	3.368	2.983	2.418	2.410
p-value	0.018	0.020	0.015	0.015	0.022	0.002	0.005	0.020	0.019

Source: Own elaboration. Notes: ***,** and * indicate that null hypothesis is rejected at 1%, 5% and 10% significance levels.

5.5 Forecast analysis

Then I make a forecast analysis to observe how financial inclusion variables and monetary aggregates adds better information to the benchmark model. Following Horvarth and Komarek (2011) some models containing money improve the inflation forecasts in certain periods. Therefore, I compare VAR models forecast estimates with additional variables of financial inclusion and monetary aggregates. Then I test their performance with MAPE, Mean Absolute Percentage Error, criteria. Evidence in Table 10 confirms that some variables of financial inclusion are correlated with better forecasts. Models 2-8 generate a better forecast for inflation. Models 7 and 8 improve the forecasts for GDP growth. The forecasting strategy was to perform a forecast within the sample and evaluate the forecast performance against the real.

Table 10. Forecast of GDP growth rate and inflation

Dependent Variable:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Inflation									
quarter 1	0.05	0.20	0.15	0.25	0.20	-0.08	0.12	-0.11	0.17
quarter 2	0.28	0.24	0.17	0.24	0.16	0.19	-0.02	0.21	0.29
quarter 3	0.17	0.08	0.08	-2.98	0.07	0.09	-0.09	0.10	0.12
quarter 4	0.12	0.09	0.10	0.05	0.15	0.07	-0.08	0.03	0.10
MAPE	1.12	0.72	0.51	0.35	0.77	0.74	0.19	0.93	1.36
GDP									
quarter 1	-1.49	-2.02	-1.58	-0.67	0.31	-2.47	-0.97	-2.60	-2.09
quarter 2	-1.66	-2.20	-2.68	-2.27	-0.06	-2.46	-1.46	-2.32	-1.98
quarter 3	-2.16	-2.29	-2.65	-2.98	-0.43	-1.38	-0.77	-1.47	-1.96
quarter 4	-0.66	-0.85	-0.40	-1.20	0.20	0.47	1.19	0.71	-0.93
MAPE	0.76	0.83	0.77	0.90	0.82	0.85	0.12	0.46	1.18

Source: Own elaboration. Note: The criteria used to test the performance forecast was MAPE, Mean Absolute Percentage Error

6. Concluding remarks

This paper uses a VAR model to study the relationship between financial inclusion variables, inflation and GDP growth rate in Mexico for the period 2002 - 2018. Previously, time series were assessed individually to demonstrate stationarity using ADF, and Phillip-Perron criteria. Then, inflation and GDP growth rate were predicted to test the improvements in forecast by employing financial inclusion variables over a vanilla VAR model.

In the first section, I introduce the motivation of this paper by stablishing that effects of financial inclusion on money aggregates and inflation remained relevant to public policy making in Mexican case since recent developments showed an increased credit cards, debit cards, ATMs and POS. In Section 1, I reviewed the theoretical framework motivated by the quantitative theory of money, and McCandless and Weber discussion. I discussed how financial inclusion and cashless societies have level effects over money and velocity of money. In Section 2, I reviewed the literature motivated by McCandless and Weber discussion, who first empirically demonstrated the relationship between money and prices. I discuss how this finding were updated and confirmed by Ramos-Francia, Rodríguez-Pérez and Noriega (2015) for the Mexican case. I also showed the theoretical mechanism proposed by Geanakoplos (2009) to stablish a relationship between credit cards and inflation. In Section 3.1, I described the time series used on this work and the approximation method to compare both sources, Banxico and CNVB. In Section 3.2, I analyzed the stochastic trending of variables using ADF and Philips Perron test. In Section 4.3 and 4.4 I demonstrated that monetary aggregate m0, debit cards and ATMs per 1, 000 km^2 statistically significant at 10% explaining inflation. I also demonstrated that ATMs and POS per 1,000 km^2 are statistically significant at 10% explaining economic growth. In Section 4.5, I demonstrated how the use of some financial inclusion variables are correlated with better forecasts.

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Annex I: CNBV Data for Financial Inclusion variables

Period No.	Period (quarter)	Bank branches	correspondents	ATM´s	POS Terminals	Debit cards	Credit cards
1	2009/04	1.52	NA	4.41	58.27	692.71	336.06
2	2010/01	1.77	NA	4.53	57.73	719.61	306.90
3	2010/02	1.80	NA	4.58	60.05	753.11	302.19
4	2010/03	1.83	NA	4.63	60.33	7691.42	2868.89
5	2010/04	1.82	1.19	4.66	61.91	8196.71	3067.64
6	2011/01	1.81	1.20	4.56	61.76	8057.66	3019.65
7	2011/02	1.80	1.22	4.53	62.44	9017.20	3285.67
8	2011/03	1.82	1.56	4.53	62.68	9483.87	3360.52
9	2011/04	1.83	2.64	4.61	65.41	9720.51	3455.83
10	2012/01	1.88	2.74	4.83	68.06	10269.46	3485.37
11	2012/02	1.92	2.81	4.92	70.93	10543.55	3154.58
12	2012/03	1.98	2.85	5.03	67.42	11497.99	3260.13
13	2012/04	1.93	2.83	4.89	66.81	11304.86	3107.54
14	2013/01	1.94	2.90	4.77	69.16	10952.25	3064.88
15	2013/02	1.92	2.99	4.76	71.24	11794.37	3188.68
16	2013/03	1.95	3.02	4.83	73.19	12640.80	3112.69
17	2013/04	1.97	3.06	4.89	73.95	12928.73	3174.69
18	2014/01	1.93	3.06	4.84	71.93	13061.46	3139.46
19	2014/02	1.94	3.09	4.87	74.78	13378.65	3255.24
20	2014/03	1.95	3.11	4.95	80.83	13664.55	3173.51
21	2014/04	1.94	3.12	5.07	84.82	13297.31	3249.15
22	2015/01	1.90	3.10	5.00	83.90	13207.19	3139.15
23	2015/02	1.87	3.13	5.07	85.85	13150.68	3167.96
24	2015/03	1.86	3.84	5.20	90.82	13289.62	2793.25
25	2015/04	1.86	4.01	5.33	97.21	13230.98	2800.47
26	2016/01	1.84	4.10	5.30	98.36	12880.98	2796.41
27	2016/02	1.86	4.31	5.37	100.48	12717.94	2919.58
28	2016/03	1.87	4.42	5.44	100.40	12760.00	2920.62
29	2016/04	1.89	4.57	5.51	101.16	12947.34	2964.94
30	2017/01	1.86	4.60	5.41	100.03	12755.16	2937.38
31	2017/02	1.88	4.68	5.45	102.04	11915.53	2985.66
32	2017/03	1.88	4.77	5.50	98.71	13215.64	3001.41
33	2017/04	1.90	4.93	5.62	107.73	13015.56	2983.46
34	2018/01	1.86	4.97	5.58	104.17	12618.43	2939.33
35	2018/02	1.88	5.06	5.68	102.36	13217.54	3016.79
36	2018/03	1.88	5.14	5.77	110.37	13364.44	3022.28

Note: Data sourced from CNBV (National Banking and Securities Commission) website https://www.gob.mx/cnbv) in February 2019.

Annex II.a: Banxico Data for Financial Inclusion variables

Period	Period (quarter)	POS (Geographical)	ATM´s (Geographical)	POS (Demographic)	ATM´s (Demographic)	Credit cards	Debit cards	Baking Trans Pers	Internet Tranfers
1	2002/01	58.91	8.50	15.36	2.22	832.89	4235.16	3175.74	267.16
2	2002/02	60.99	8.40	15.90	2.19	920.74	4215.04	3193.73	645.17
3	2002/03	62.20	8.42	16.22	2.19	967.66	4162.78	3201.45	817.93
4	2002/04	65.00	8.51	16.95	2.22	1020.15	4223.21	3349.81	1077.87
5	2003/01	66.76	8.60	17.41	2.24	1049.07	4117.32	3309.13	919.78
6	2003/02	66.85	8.63	17.43	2.25	1076.24	4229.02	3377.07	934.62
7	2003/03	67.58	8.72	17.62	2.27	1146.63	4124.55	3683.02	954.22
8	2003/04	73.03	8.88	19.04	2.32	1226.31	4197.58	3321.06	971.65
9	2004/01	69.93	9.06	18.24	2.36	1316.22	4190.49	3305.86	1260.53
10	2004/02	72.98	9.14	19.03	2.38	1358.79	4359.03	3505.56	1526.02
11	2004/03	76.43	9.85	19.93	2.57	1413.47	4011.59	2907.32	1635.42
12	2004/04	80.16	10.21	20.90	2.66	1519.27	4144.85	3519.21	1720.78
13	2005/01	86.42	10.56	22.54	2.75	1593.11	4066.99	5899.34	4396.88
14	2005/02	86.56	10.77	22.57	2.81	1698.97	3990.53	6298.08	4727.12
15	2005/03	94.11	11.07	24.54	2.89	1794.35	4308.76	6469.09	4697.12
16	2005/04	100.95	11.45	26.32	2.99	1917.16	4704.34	6830.40	5310.05
17	2006/01	111.91	11.86	29.18	3.09	2503.23	5881.49	7798.05	8275.77
18	2006/02	120.39	12.18	31.40	3.18	2744.24	6280.28	8475.51	8722.36
19	2006/03	133.52	12.46	34.82	3.25	3005.40	6538.01	8560.86	9065.16
20	2006/04	152.60	12.85	39.80	3.35	3201.99	6747.62	9225.69	10044.36
21	2007/01	169.62	13.15	44.23	3.43	3355.87	6103.27	8952.32	9149.92
22	2007/02	186.46	13.60	48.62	3.55	3420.56	6619.88	9188.07	9774.66
23	2007/03	196.27	14.05	51.18	3.66	3440.22	6684.42	9423.89	10244.09
24	2007/04	209.11	14.67	54.53	3.83	3851.85	6764.79	10255.71	11780.64
25	2008/01	209.95	15.11	54.75	3.94	4038.64	6760.07	9658.77	11436.82
26	2008/02	211.86	15.48	55.25	4.04	3455.48	7133.84	10082.88	12521.25
27	2008/03	219.76	15.86	57.31	4.14	3408.97	7389.72	9679.74	12725.19
28	2008/04	223.06	15.97	58.17	4.16	3291.84	7425.28	10674.01	13937.26
29	2009/01	227.36	15.99	59.29	4.17	3196.15	7611.81	9506.12	13210.83
30	2009/02	213.69	16.15	55.73	4.21	3004.38	7810.82	10029.14	14560.25
31	2009/03	220.60	16.38	57.53	4.27	2905.79	8150.56	9321.22	14663.78
32	2009/04	223.44	16.96	58.27	4.42	2881.75	7932.87	10355.51	15828.64
33	2010/01	227.01	17.23	59.20	4.49	2850.57	8383.35	9353.28	15451.53

Annex II.b: Banxico Data for Financial Inclusion variables

Period	Period (quarter)	POS (Geographical)	ATM´s (Geographical)	POS (Demographic)	ATM´s (Demographic)	Credit cards	Debit cards	Baking Trans Pers	Internet Tranfers
34	2010/02	230.29	17.45	60.05	4.55	2852.29	8846.43	9309.66	16490.07
35	2010/03	233.78	17.72	60.96	4.62	2844.84	9329.78	9498.60	16935.71
36	2010/04	241.20	17.97	62.90	4.69	2920.89	9802.57	10478.36	19169.74
37	2011/01	246.42	18.15	61.73	4.55	2812.15	9501.28	9085.44	17106.54
38	2011/02	258.90	17.95	64.86	4.50	2911.75	10028.27	9858.81	18115.63
39	2011/03	267.69	17.94	67.06	4.49	3014.04	10503.73	9773.91	18858.10
40	2011/04	273.91	18.23	68.62	4.57	3088.21	10724.39	10476.48	20720.01
41	2012/01	280.37	19.22	67.25	4.61	2968.18	11119.08	9610.20	18726.71
42	2012/02	288.45	19.73	69.18	4.73	2973.39	11585.38	8990.52	19327.52
43	2012/03	295.62	20.04	70.90	4.81	3022.13	13045.05	8586.52	19193.40
44	2012/04	310.88	20.27	74.56	4.86	3043.02	13516.61	9654.06	21368.86
45	2013/01	315.15	20.12	74.32	4.74	2959.44	13695.06	8404.48	19675.67
46	2013/02	321.32	20.00	75.78	4.72	3014.68	13975.59	9059.29	20743.66
47	2013/03	324.49	19.87	76.53	4.69	3022.91	14428.14	8818.66	20578.24
48	2013/04	341.11	20.10	80.45	4.74	3053.23	14861.59	9460.60	23635.18
49	2014/01	346.39	20.60	80.36	4.78	3156.66	14859.01	8536.58	26192.60
50	2014/02	358.32	20.75	83.13	4.81	3339.43	15250.71	8811.31	21895.21
51	2014/03	371.44	21.24	86.17	4.93	3350.55	15345.85	7088.66	22232.63
52	2014/04	382.68	21.51	88.78	4.99	3312.41	15621.60	7834.37	24597.51
53	2015/01	383.69	21.53	87.62	4.92	3395.46	15267.00	7363.85	22145.52
54	2015/02	396.09	21.81	90.46	4.98	3398.61	15955.44	7324.03	22213.99
55	2015/03	417.95	22.47	95.45	5.13	3386.88	16343.44	7334.25	21909.07
56	2015/04	432.46	22.95	98.76	5.24	3384.79	16197.86	7892.98	24185.40
57	2016/01	434.32	23.19	97.69	5.22	3371.86	15895.93	7171.41	21757.64
58	2016/02	446.62	23.67	100.46	5.32	3428.45	15148.83	7504.51	21808.91
59	2016/03	443.13	23.93	99.67	5.38	3472.86	15486.46	8326.67	22042.32
60	2016/04	447.79	24.06	100.72	5.41	3512.62	15424.89	8673.86	23354.34
61	2017/01	452.29	24.47	100.25	5.42	3651.54	15264.62	7964.75	21416.85
62	2017/02	456.78	24.76	101.24	5.49	3628.43	15400.90	6514.69	25061.85
63	2017/03	468.35	25.28	103.81	5.60	3566.16	15410.88	6694.32	24782.01
64	2017/04	481.07	25.72	106.63	5.70	3629.20	15995.74	6811.75	27884.80
65	2018/01	488.33	26.57	106.71	5.81	2876.85	15139.32	6460.95	24926.57
66	2018/02	488.90	26.99	106.84	5.90	2941.93	15795.30	6836.79	26877.72
67	2018/03	500.09	25.90	109.28	5.66	2972.10	16153.84	6772.20	25849.91
68	2018/04	454.51	25.99	99.32	5.68	3000.61	15312.58	7588.77	27494.93

Note: Data sourced from Banxico (Mexico´s National Bank) website (http://www.banxico.org.mx/) in February 2019.

Annex III.a: CNBV and Banxico Data

Period No.	Period (quarter)	ATM´s average	POS average	Creditcards average	Debitcards average
1	2002/01	2.216	15.361	832.894	4235.163
2	2002/02	2.190	15.905	920.744	4215.041
3	2002/03	2.195	16.221	967.660	4162.781
4	2002/04	2.218	16.950	1020.145	4223.212
5	2003/01	2.244	17.409	1049.066	4117.324
6	2003/02	2.251	17.432	1076.245	4229.017
7	2003/03	2.274	17.624	1146.627	4124.553
8	2003/04	2.316	19.044	1226.308	4197.579
9	2004/01	2.362	18.236	1316.222	4190.489
10	2004/02	2.384	19.030	1358.786	4359.033
11	2004/03	2.568	19.930	1413.474	4011.589
12	2004/04	2.663	20.904	1519.272	4144.851
13	2005/01	2.753	22.536	1593.114	4066.994
14	2005/02	2.808	22.572	1698.968	3990.529
15	2005/03	2.887	24.542	1794.352	4308.756
16	2005/04	2.986	26.324	1917.164	4704.337
17	2006/01	3.093	29.184	2503.232	5881.487
18	2006/02	3.177	31.395	2744.243	6280.278
19	2006/03	3.249	34.819	3005.399	6538.010
20	2006/04	3.350	39.795	3201.986	6747.624
21	2007/01	3.429	44.231	3355.871	6103.267
22	2007/02	3.546	48.623	3420.564	6619.876
23	2007/03	3.665	51.182	3440.224	6684.419
24	2007/04	3.825	54.530	3851.850	6764.787
25	2008/01	3.939	54.749	4038.639	6760.066
26	2008/02	4.036	55.248	3455.481	7133.837
27	2008/03	4.136	57.308	3408.971	7389.715
28	2008/04	4.164	58.168	3291.844	7425.283
29	2009/01	4.169	59.289	3196.146	7611.808
30	2009/02	4.213	55.725	3004.379	7810.824
31	2009/03	4.272	57.527	2905.795	8150.556
32	2009/04	4.415	58.268	2875.322	7417.791
33	2010/01	4.510	58.463	2859.731	7786.976
34	2010/02	4.567	60.053	2860.592	8188.269

Annex III.b: CNBV and Banxico Data

Period No.	Period (quarter)	ATM´s average	POS average	Creditcards average	Debitcards average
35	2010/03	4.621	60.482	2856.869	8510.601
36	2010/04	4.675	62.403	2994.262	8999.637
37	2011/01	4.548	61.716	2915.574	8779.139
38	2011/02	4.514	63.648	3098.713	9522.739
39	2011/03	4.511	64.868	3187.279	9993.799
40	2011/04	4.589	67.012	3272.018	10222.451
41	2012/01	4.718	67.653	3226.774	10694.272
42	2012/02	4.827	70.059	3063.983	11064.465
43	2012/03	4.919	69.164	3141.129	12271.520
44	2012/04	4.877	70.687	3075.282	12410.731
45	2013/01	4.756	71.742	3012.159	12323.655
46	2013/02	4.740	73.510	3101.681	12884.981
47	2013/03	4.760	74.857	3067.802	13534.469
48	2013/04	4.816	77.198	3113.958	13895.157
49	2014/01	4.810	76.144	3148.062	13960.234
50	2014/02	4.842	78.955	3297.336	14314.682
51	2014/03	4.941	83.503	3262.030	14505.197
52	2014/04	5.031	86.800	3280.779	14459.455
53	2015/01	4.960	85.761	3267.309	14237.099
54	2015/02	5.027	88.151	3283.285	14553.060
55	2015/03	5.166	93.134	3090.065	14816.530
56	2015/04	5.285	97.983	3092.628	14714.424
57	2016/01	5.256	98.026	3084.135	14388.455
58	2016/02	5.347	100.469	3174.011	13933.384
59	2016/03	5.410	100.034	3196.743	14123.231
60	2016/04	5.459	100.939	3238.778	14186.114
61	2017/01	5.416	100.138	3294.458	14009.891
62	2017/02	5.468	101.642	3307.045	13658.214
63	2017/03	5.550	101.258	3283.786	14313.256
64	2017/04	5.661	107.180	3306.331	14505.648
65	2018/01	5.693	105.440	2908.088	13878.874
66	2018/02	5.789	104.599	2979.358	14506.418
67	2018/03	5.713	109.827	2997.190	14759.140
68	2018/04	5.723	104.847	3011.446	14338.512

Note: Data transformed by approximation in the mean. Sourced from Banxico (Mexico´s National Bank) website (http://www.banxico.org.mx/) in February 2019 and from CNBV (National Banking and Securities Commission) website https://www.gob.mx/cnbv) in February 2019.