On Monetary Dynamics in Argentina

A Study on Real Money Demand Behavior (2004-2016)\textsuperscript{1}

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ABSTRACT

This work is an empirical study on real money demand in Argentina using data from the period 2004-2016, the “K Administration”, acknowledging that studies of demand for real balances constitute a fundamental factor of central banking management to achieve an optimal monetary dynamic with price stability. This study aims to find, through co-integration techniques, a long run, explanatory model of real money demand. For that, it tests three models, using different specifications, incorporating stylized facts of Argentina. Finally, the work analyzes the short-run dynamics through error-correction models. In particular, this work aspires to help monetary and economic policymakers to learn from the Argentine recent past, and also to contribute with a scientific approach necessary -among others- to give Argentina the means to reach monetary stability, economic growth and social progress\textsuperscript{5}.

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I. Introduction

A stable money demand function is crucial to formulate and execute sound monetary policy, that’s why the study and estimation of the demand for (real) money is a central piece of any Central Bank management and its monetary policy strategy. This fact takes special emphasis in a country like Argentina because of two reasons: Firstly, because of Argentina has an intense and explosive monetary background in terms of inflation rate, interest rates and exchange rate volatilities which triggered several financial and macroeconomic crises in the last decades. This sole factor could affect expectations of agents making them much more sensitive than in other countries without such a history. Secondly, because of the current economic and monetary situation in Argentina, with a new Administration which has appointed new authorities to the Central Bank of Argentina (BCRA) who have declared war on a 35% inflation which started to escalate almost a decade ago. To pursue this goal, in September 2016 the BCRA has communicated inflation targets and, in this way, initiating the “Journey to an Inflation Targeting (IT) Regime” which relies on scientific estimations of money demand and make them a center piece of this Central Banking managerial framework.

Empirical evidence has shown that Inflation Targeting schemes need “as-acute-as-possible” money demand estimations to do fine-tuning on money supply and therefore inflation expectations using a reference interest rate (Mishkin and Posen, 1997). The Monetary Authority needs to make an assessment on the differences between expected inflation and their targets and, at the same time, the gap between actual output and potential output.

Miscalculations of money demand could lead to either monetary oversupply or undersupply. The former might cause a Central Bank’s failure on its price stability main objective, whereas the latter could stop the Argentine, much-needed economic growth come-back. Therefore, scientific, updated studies on


7 “La prioridad absoluta en obtener, en un plazo razonable, una moneda con poder de compra estable implicará dejar de lado objetivos que han sido característicos del manejo monetario del país (…)”. Objetivos y Planes Respecto del Desarrollo de la Política Monetaria, Cambiaria, Financiera y Crediticia para el año 2016’. Banco Central de la República Argentina. December 2015.

8 No reliable official data was available on December 2015. The most prestigious, private economic consulting firms publicly agreed that inflation, at that moment, was rampant and well above 32%, depending on the basket and geographical location of the sample. The Presidential Inauguration was on December 10th, 2015.

9 As stated by Laurens, Eckhold, King, Maehle, Naseer and Durre (IMF, 2015): “Countries with evolving monetary regimes that decide to embark on The Journey to Inflation Targeting may not be able to adopt a full-fledged inflation targeting regime immediately”. In “The Journey to Inflation Targeting: Easier Said than Done. The Case for Transitional Arrangements along the Road”. International Monetary Fund. Working paper 15/136. Abstract.

10 For further understanding of the effects of over-emission see Friedman and Schwartz (1963), Phelps (1967), Lucas (1972), Kydland and Prescott (1977), Calvo (1978), Barro and Gordon (1983), Mishkin (2007).

11 For historical examples of crisis and depression after monetary under-supply see Friedman and Schwartz (1963b) and Bernanke (2000).
money demand would contribute to the Argentine new economic times of sound, inflation-targeting monetary policy (Bernanke et al., 1999; 2004).

This paper investigates whether there is, as the monetary theory holds, a long run, co-integrated relationship between real money demand, real income and the opportunity cost of holding money in Argentina during years of maximum monetary distortions like the Kirchner Administration (May 2003-December 2015). We also test new elements, different from the text book-like equations, which believe apply to Argentina. We use long run cointegration and short run perturbations error-correction techniques of estimation, using the methodology proposed by Engle and Granger (1987).

The work is structured as follows: Part II briefly reviews on mainstream Theory of Money Demand; Part III goes over existent, specific literature on money demand estimations for Argentina; Part IV inspects recent history and conditions of Argentine monetary and macro variables; Part V describes data, stylized facts and methodology; Part VI presents econometric analysis for long and short run with results interpretation; and finally, Part VII concludes and proposes further research.

II. Brief Theoretical Background on Money Demand

For centuries, economic science has been trying to explain what money is and why economic agents demand it. In Smith’s classic work (Smith, 1776) money is defined after the reasons to hold it: medium of exchange, store of value and unit of account. Mill (1848), Wicksell (1906) and Walras (1909) made the first modern approaches. Fisher (1911) developed the classical quantitative identity of money, explaining the relationship between quantity of the circulating money-mass and the nominal value of transactions is the velocity of circulation of money, like a flow in a closed system. As volume of transactions and velocity of circulation depend on relatively constant technological and institutional aspects, then variations in level of prices are proportional to variations in quantity of this money-mass.

\[ M \cdot V \equiv P \cdot Y \] (1)

Where \( M \) is nominal quantity of money, or money-mass, \( V \) velocity of circulation of monetary mass, \( P \) price level and \( Y \) national output (real income). The quantity of money times its velocity of circulation necessarily needs to be equal to national real income multiplied by level of prices. This relationship is transactional, and its shortcoming is not taking into account effects of demanding money as a store of value, ignoring the effects of the interest rate.

Cambridge economists Marshall (1890) and Pigou (1917) focused on the choice of individual economic agents instead of analyzing the monetary market equilibrium, meaning how much money would the agents want to hold under different circumstances considering money as a store of value. Here, volume of transactions is not the only motive for demanding money anymore, including now wealth of agents and interest rate. As wealth of agents grow, the desire for holding bigger quantities of money will grow too, additionally, as interest rate grows the opportunity cost of having cash holdings grows too, lowering the
demand for money. With this new approach from Cambridge, the velocity of circulation would only be relevant for those amounts of money demanded for transactional motives.

Consequence of the Great Depression and the slump of velocity of circulation of money, economists started to look for alternative explanations for money demand. Keynes (1930; 1936) distrusted on this, allegedly, constant velocity and studied the role of interest rates, re-thinking on factors by which agents not only demand money but also hold it. Keynes recognized transactional motives linked to income, but he also pointed out precautionary-motives related to level of income, and speculative-motives, where the role of interest rate is the main driver for deciding on cash holdings, as interest rate is a cost of opportunity for holding cash. Keynes also stated that the value of money is in its purchasing power, therefore, the demand for money is a demand for real value, or real balances, using a deflator for the money mass.

\[ \frac{M}{p} = f (+Y; -r) \] (2)

Demand for money \( M \) deflated by the level of prices \( p \) is a demand for real balances or purchasing power, positively linked to the level of real income \( Y \) and negatively linked to interest rate \( r \).

Fisher (1930), Hicks (1935), Patinkin (1956) and Sidrauski (1967) developed the marginalist approach explaining money as one of the elements of the utility function of the agents, formalizing the wealth-effect of real balances as the propensity-to-consume of agents would depend not only from their nominal income but also from the real value of their wealth.

Baumol (1952) and Tobin (1956) proposed similar theoretical models of demand for money based on the Theory of Stocks Optimization, showing that monetary holdings for transactions are not only positively affected by income and negatively affected by interest rates as an opportunity cost, but also positively affected by the transactional costs of getting cash.

\[ M^d = \frac{2bY}{\sqrt{2r}} \] (3)

Being \( b \) cost of getting cash, \( Y \) nominal income and \( r \) interest rate. The bigger the income and/or costs of getting cash, the bigger the demand for cash, conversely, the higher the interest rate, the lower the money demand. Miller and Orr (1966) developed a model of money demand based on the latter theory of stocks optimality in stochastic version, later developed by Akerlof and Milbourne (1980).

Friedman (1956) reformulates the quantitative theory based on the Portfolio Theory of demand for assets, where economic agents have an available vector of financial assets in which money holdings is one of them. The demand for these assets depends directly on real income \( Y \) and inversely on the differential of returns between money and bonds, stocks and expected inflation, as increases in prices would affect real value of assets.

\[ \frac{M^d}{p} = f (+Y, -[r_b - r_m]; -[r_s - r_m]; -[\pi^e - r_m]) \] (4)

Where \( r_b, r_s, r_m \) are returns on bonds, stocks and money respectively, and \( \pi^e \) expected inflation. Cagan (1956) formalizes this concept with special emphasis on what happens with money demand under
hyperinflation, determining that its parameters generally satisfy the condition of dynamic stability preventing inflations from being self-generated. Cagan’s model was extended by Barro (1970), Sargent and Wallace (1973) and Salemi (1979).

In the last decades, dynamic-stochastic, general-equilibrium macroeconomic models (DSGE) based on microeconomic foundations have been developed, being money included into the utility function of the agents with several, diverse arguments generating alternative models like Patinkin (1956), Lucas (1980), McCallum (1983), Svensson (1985), Feenstra (1986), and Obstfeld and Rogoff (1995). Nonetheless, this analysis has been seriously criticized by several mainstream and not-mainstream economists12.

Finally, some modern, non-mainstream monetary theorists like Schmitt (1972; 2003), Cencini (1988; 2005), Rossi (2003) and Gnos (2017) sustain that macroeconomics in general, and monetary economics in particular, follow their own systemic-laws independently from agent’s behaviors, and conclude that it is not acceptable to derive macroeconomic phenomena from microeconomic foundations.13

III. Money Demand in Argentina

The literature on money demand analysis for Argentina is comparatively scarce. In addition, given the many changes in monetary regimes and macroeconomic conditions in the last decades, empirical studies from some years ago may not have explanatory power, and perhaps even lower forecasting capabilities.

Another important fact is the correct, complete model specification. Extrapolated models from developed countries and/or theoretical text book-like, closed economy models are not necessarily acute since the Argentine economy presents some particular features and stylized facts. Argentina is a medium-size, open economy, and global main exporter of soft commodities, with a significant propensity to currency substitution to U.S. dollar and therefore, her money demand estimations should test additional variables related with these facts.

Disequilibria in Argentine money demand not only seem to be related to a scale variable, like GDP, and cost opportunity of holding cash, like interest rate, but also changes in terms of trade (international prices of soft commodities in the case of Argentina) and depreciation/appreciation of real exchange rate, which is a multi-causal variable14. These relationships, in turn, would have effects on i) the internal balance of the production allocation to tradable/non-tradable, ii) the wealth/poverty effect as a consequence of

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13 This macroeconomic analysis is called Quantum Monetary Macroeconomics or the Theory of Monetary Emissions.

14 Sustainable GDP growth, policy decision (currency board), capital inflows, sovereign debt issuing, inflation spiral, positive external shocks (terms of trade), etc.
massive U.S. dollar holdings in hands of Argentine families and firms inside borders and offshore\textsuperscript{15}. That’s why closed-economy, text book-like money demand models would be incomplete to explain the Argentine case, presenting, therefore, a research gap thought-provoking for academia and practitioners.

Melnick (1990), Ahumada (1992), Kamin and Ericsson (1993; 2008) and Choudhry (1995) provide first analysis and econometric estimations for different sample-periods within the range 1935 (foundation of Central Bank) to 1990’s with focus on high inflation and hyper-inflation episodes during the 1980’s using co-integration tests with error-correction modeling. They show that, even in periods with high volatile inflation, it seems to be a stationary long run demand function where real income is exogenous.

Ahumada and Garegnani (2002) and Gay (2005) were focused on the long-term money demand behavior and its determinants, taking long samples 1935-2000 and 1932-2002 respectively, and highlighting structural breaks after changes in governments, exchange rates regimes and monetary policy strategies. According to the former, money demand seems to be determined by inflation in the long run and by transactions level only in the short run. Same authors develop a new study for the period 1977- 2008, emphasizing the role of real exchange rate as driver for money demand and advising NEER, and not CPI, as money deflator, as appears to be a proper deflator not only for hyperinflation experiences but also for economies prone to suffer chronic inflation like Argentina (Ahumada and Garegnani, 2010). Gay (2005) takes series from 1932-2002, and introduces a model for Argentina as an open economy, which, as previously described, it is a \textit{sine qua non conditio} for having a realistic model of money demand for Argentina.

Finally works like Grubisic and Manteiga (2000), Utrera (2002) and Aguirre, Burdisso and Grillo (2006) address estimations for forecast purposes, analyzing different responses to changes in monetary aggregates.

\textbf{IV. The Argentine Case}

Argentina has been experiencing inflation and monetary volatility since mid-1950’s\textsuperscript{16}. In the last decades, the country has gone through several two-digit inflations (even currently, in 2017) and two hyperinflations (1989 and 1990) with considerable volatility in exchange and interest rates which could have provided grounds for instability in the real money demand function.

\textsuperscript{15} As these USD holdings are out of the system they are not easy to estimate. Nonetheless, the Federal Agency of Statistics (INDEC) made an estimation of USD 190,676 MM, as of December 31st 2014, which was more than six times the Central Bank reserves - more than 40% of GDP- at that time.

\textsuperscript{16} For a detailed analysis see Laura Randell “An Economic History of Argentina in the Twentieth Century”. Columbia University Press, 1978; and, most recently, Domingo Cavallo and Sonia Cavallo Runde “Argentina’s Economic Reforms of the 1990’s in Contemporary and Historical Perspective”. Routledge, 2017.
Before the crisis of the Convertibility Regime (AR peso pegged to U.S. dollar 1 to 1) in December 2001, real demand holdings started to decrease\(^\text{17}\). After the collapse in January 2002, the Government defaulted on the sovereign debt and abandoned the currency board, provoking a 300% devaluation, partially containing the pass-through to inflation by freezing all utility and public transportation tariffs, in part compensating service providers with growing subsidies. Nevertheless, after a few years, and as a consequence of growing needs of cash for these public expenditures, fiscal deficit started to spiral, and the Administration progressively started to monetize this deficit through monetary emission. Real money demand started to increase continuously at the beginning of this process in 2002, as the economy rebounded from the collapse, strongly helped with historically benign terms of trade. Even though the economy grew steadily from 2002 to 2007, by 2007 inflation started to spiral exponentially (graph 1) as a consequence of an unsounded monetary policy and unsustainable macro distortions.

\[\text{Graph 1. Consumer Price Index started to grow exponentially from 2007 onwards, as it shows the corrected-series by MIT professors Roberto Rigobon and Alberto Cavallo (The Billion Prices Project; Sloan School of Management, Massachusetts Institute of Technology).}\]

The policy of freezing domestic tariffs by providing economic subsidies contained inflation for a short period of time, yet inflation retook its upward path by 2004 caused by an aggressive, expansionary monetary policy needed to cover a growing fiscal deficit, which, in turn, reinforced inflation by its monetization. Inflation rate spiral to almost 35% in 2015\(^\text{18}\) (graph 2).

\(^{17}\) Over appreciation of Peso and massive, growing fiscal deficit was cornering the Government. This situation had a correlate in economic activity and money demand (fly to quality). See Ahumada and Garegnani (2010), based on Central Bank (BCRA) official statistics.

\(^{18}\) In 2007, the National Agency of Statistics (INDEC) was intervened and its statistical data falsified systematically. On December 10th 2015, the new Administration of President Mauricio Macri took office, and on January 7th 2016 it was announced the Statistical Emergency by the Presidential Decree 55/2016 until December 31st 2016, suspending any statistical publication -at least- until June 2016 in order to internally reform the Agency.
Inflation rate had an initial peak after the three-hundred percent devaluation, just right after the economic collapse in December 2001, and throughout the first half 2002. Then, it dropped to a level lower than five-percent, accelerating its upward path again from 2004 to 2015/16. The Government failed in trying to artificially control it by declaring a stop-payment in every public debt and freezing tariffs of all utilities and transportation services (2002-2016).

The rate of money creation started to grow at an exponential speed in January 2010 (graph 3) after the necessity of monetization for a fast-pace growing fiscal deficit due to increasingly expanding public sector expenses, as well as utilities and public transport subsidies.

On December 10th 2015, the new Administration appointed new senior management of the Central Bank which had to face delicate conditions left behind by the former Administration. The Argentine economy ostensibly\(^\text{19}\) had at that moment (December 2015) a gigantic monetary overhang of more than 4% of GDP (AR$ 200Bn) after a year (2015) in which the money supply grew 45%.

The new Central Bank had to face a monetary time-bomb made of last minute dollar future contracts, launched at an official price of around AR$10 per dollar, with at least 50% price-gap comparing to prices at the informal market, which was floating at around AR$ 15. These dollar future-contracts were poisoned pills at the moment of “sincere” the exchange rate by removing the so-called “Exchange Clamp”\(^\text{20}\) which threatened to potentially explode the monetary mass to a growth rate of 65% at once, which would have ended up in a hyper-inflation with a collapse of the money demand with a catastrophic political crisis. The new Central Bank reacted promptly, re-negotiating those poisoned-pill forward contracts and liberalizing the exchange restrictions, letting float the exchange rate, which immediately floated around the former “blue-value” (parallel market). At the same time, the Central Bank started to issue, on a weekly basis, Central Bank Notes (called “Lebacs”) with interest rates at a 35-37.5% range in order to absorb the overhanging monetary mass, sterilizing it, and providing disincentives to currency substitution (demand for U.S dollars). As of May 2016, the correct tightening of monetary policy had absorbed around AR$ 140Bn out of 200Bn with an annualized monetary mass growth rate of 25% (coming down from a growth rate of 45% in 2015).

On the exchange rate side, in 2011 the government imposed, and progressively started to tight, the “exchange-clamp”, manipulating, in this way, the nominal exchange rate and making it, artificially, a quasi-fixed exchange rate (de facto) with the objective of stopping monetary substitution peso-dollar. M1 grew more than 1,500% from 50.1 Bn AR$ in January 2004 to 804.7 Bn in December 2015, more than fifteen times over in almost 12 years, an astounding average of around 125% per year (if taken as arithmetic average).

Real Effective Exchange Rate

Graph 4. The domestic price level started to strongly grow in dollars, after inflation rate spiraled and nominal exchange rate artificially manipulated. As a consequence, the real exchange rate started to progressively appreciate, hampering, in this way, the tradable sector, the inflow of foreign currency and, finally, provoking a drip drain of reserves from the Central Bank.

\(^{20}\)The so-called “Exchange Clamp” started in October 2011 and finished with the inauguration of the new Federal Administration and the new BCRA senior management, on December 2015. It was the impossibility of free purchasing foreign currency (mostly U.S Dollars) within Argentine borders without a bureaucratic and arbitrary governmental, administrative procedure purposed to refrain currency substitution, mostly because of escalating inflation and losses of purchasing power. The gap between the official exchange rate (very hard to obtain) and the un-official free market (so-called “Blue Exchange Rate”) started from 2011 to escalate, until its end. It reached gaps up to 60%. 
Only some micro-devaluations were allowed, managed by the Central Bank which was trying to use the nominal exchange rate as nominal anchor for inflation. An overvalued exchange rate, wrongly used as an instrument for inflation anchoring, distorts the relative prices in favor of non-tradable goods, in which the productivity growth is lower. As a result, the overvaluation of the exchange rate takes a reinforcing dynamic, favoring an inward-oriented economy with import substitution, making the economy less efficient and competitive, increasingly deteriorating its current account and, therefore, accumulating sovereign debt after commercial deficits, on the top of the inflationary process (in case of fiscal deficit monetization) or accelerating even more sovereign debt formation (in case of fiscal gap financed by foreign currency debt). This dynamic inevitability ends up in crisis (Conesa, 2002).

In our period of study, as inflation continued spiral at a much higher rate than these micro-devaluations of nominal exchange rate, domestic price level started to strongly grow in dollars (overpassing micro-devaluations). As a consequence, the real exchange rate started to progressively go down (graph 4), making domestic peso stronger overtime (appreciated) and hampering, in this way, the tradable sector. Artificially lower exchange rate is not a new disequilibrium in Argentina. Monetary history shows that, previously to each balance of payment crisis, the real exchange rate is characterized by an overvaluation, with an open or a semi-closed economy, like in 2001 and 2015\(^{21}\) respectively. With the sovereign default and a massive devaluation, in 2002 a new set of relative prices in favor of tradable was combined with very favorable exogenous conditions in terms of trade (graph 6), as a consequence GDP rebounded from 2003 to 2007 (graph 5). However, as we described, very unsound macroeconomic policy implemented by the Treasury and the Central Bank caused multiple and very serious macro and micro economic distortions. This fiscal dominance under an import-substitution model led to a significant distortion and, later reversion, of relative prices, twin deficits and a two digits’ annual inflation.

![Graph 5](image1.png) ![Graph 6](image2.png)

**Graph 5.** After the collapse of 2001, Argentina enjoyed a technical rebound of its GDP. However, and as a consequence of unsound, distorted macroeconomic and monetary policy, GDP stagnated around a very low growth rate from 2007 onwards.

**Graph 6.** The Terms of trade were favorable to Argentine main exports during the last fifteen years, specially from 2007 to 2012. Unfortunately, these exceptional conditions of high terms of trade, weak U.S. dollar and all times’ low international interest rates were not combined with sound macroeconomic policy.

\(^{21}\) In 2015 the macroeconomic crisis was avoided by the new Administration measures. Consensus among independent, Argentine economists is that this crisis was prevented just at very last minute.
As a consequence of this two-digit inflationary spiral, real interest rate turned negative (graph 8) throughout the period 2004 to 2016, that is, term deposits returns could not beat inflation during the whole period in spite of upward trending nominal interest rates (graph 7).

Graph 7. The nominal interest rate was upward trending during the whole period 2004-2016. Graph 8. The real interest rate was negative during the same, whole period of study, 2004-2016. In the graph, 30 to 59 days term deposit interest rate with high volatility throughout the period, but always in negative territory.

V. Data, Stylized Facts and Methodology

As we already saw in Part II, there is consensus on the direct role of wealth and the inverse role of opportunity cost of holding money, as determinants of the demand for real balances. Since calculation and aggregation of real wealth could be difficult, income is typically the scale variable proxied through real GDP commonly used in studies for Latin America22. Regarding the definition of money23 applied, which varies depending on the study, we use M2 because it represents a broad definition that includes not only transactional purposes but also reserve of value24. As the money demand that we intend to estimate is a

22 For economies with recurrent high inflation periods, like Argentina, real GDP is appropriate, but nominal GDP is also used. For different examples see, for Chile: Ewing and Payne (1999), Calani, Fuentes and Schmidt-Hebbel (2013), and Ferrada and Tagle (2014); for Mexico: Noriega, Ramos-Francia and Rodriguez-Perez (2015); Additionally, in the case of Argentina, Ahumada and Garegnani (2002, 2010) have used total supply (nominal GDP + imports), and Choundry (1995) real net national income.

23 M= cash; M1 = cash + demand deposits/checking accounts; M2 = M1+ savings deposits, money markets (retail) and time deposits (short-run); and M3 = M2 + money markets (institutional), time deposits (long-run), repurchase agreements (short-term).

24 As did it, e.g., Choudhry (1995), and Ahumada and Garegnani (2010). Other studies have used M like Ahumada and Garegnani (2002); M1 Gay (2005), and Choudhry (1995); or M3 Utrera (2002), and Ericsson and Kamin (2008).
demand for real balances, it is needed to use a deflator\textsuperscript{25}, in our case we use CPI\textsuperscript{26}. The cost of opportunity of holding money balances could be proxied by different variables\textsuperscript{27}, in our case we use the average, local currency 30-59 days term-deposit interest rate.

Additionally, to data typically seen on money demand estimations there are some other data correspondent to stylized facts from Argentina which are mostly ignored in model specifications. One of them is the fact that Argentina has an economic structure mostly based on exporting soft commodities, and therefore, terms of trade, productivity differentials tradable/non-tradable sectors and real exchange rate may have an important role in real money demand\textsuperscript{28}. Also, due to such an inflationary history, Argentines hold a significant physical amount of U.S. dollars, therefore depreciations/devaluations of Argentine Peso might also produce substantial wealth/poverty effects with their correlate on the demand for money. Consequently, our base working-hypothesis was a combination of the already long tested relationship between real money demand, a scale variable (real income related) and the opportunity cost of holding money, and the mentioned stylized facts of Argentina, namely an open economy, agricultural exporter, with a currency substitution propensity and income disequilibria due to tradable/non-tradable productivity differentials.

Our first conjecture (base model) to explain Argentine money demand was built out of four explanatory variables: i) real gross domestic product (rGDP) which would capture the scale effect on real money demand as the real income grows, ii) opportunity costs of holding money given by the term deposit interest rate \(\left(\frac{r}{1+r}\right)\) in Argentine pesos up to 59 days, iii) terms of trade \(\left(\frac{P_x}{P_m}\right)\) used as a proxy to capture the wealth affect produced by the monetization of foreign currency inflow after current account surpluses (export price effect related to REER). iv) real effective exchange rate (REER) which would set the tradable/non-tradable allocation. The demand for money would grow as the internal allocation of resources turns to tradable sector favoring foreign currency inflow and its monetization. We, finally, dismissed this last variable for having high positive correlation with terms of trade. \(\beta_2, \beta_3\) and \(\beta_4\) are income-elasticity, interest-rate elasticity and terms of trade elasticity respectively. We expected, a priori, \(\beta_2\) and \(\beta_4 > 0\); and \(\beta_3 < 0\).

\textsuperscript{25} Typically, CPI is used. Alternatively, we can see WPI (e.g. Choundry, 1995), GDP deflator (e.g. Gay, 2005), or NEER (e.g. Ahumada and Garegnani, 2010).

\textsuperscript{26} As the statistics in that period were unreliable, we use the corrected CPI series from MIT Professors Alberto Cavallo and Roberto Rigobon prepared at the Billion Prices Project. www.thebillionpricesproject.com

\textsuperscript{27} Depending on the definition of money applied (M, M1, M2 or M3).

\textsuperscript{28} Gay (2005) presented -as far as we know- the first money demand estimation based on an open economy model for Argentina, with a specification based on scale variable, opportunity cost, terms of trade, net foreign assets and productivity differentials between tradable/non-tradable sectors (the last three related to REER). Nevertheless, other authors, like Ahumada and Garegnani (2002) did not find a significant influence of the REER to the money demand in the long term.
\[ \ln \left( \frac{M_2}{P} \right) = \eta + \beta_2 \ln (\text{rGDP}) + \beta_3 \ln \left( \frac{r}{1+r} \right) + \beta_4 \ln \left( \frac{P_x}{P_m} \right) + \mu \] Base Model

Data applied are quarterly and obtained from the Argentine official branches (except CPI, as previously indicated). All variables are transformed into logarithmic form. The application of the chosen econometric methodology, cointegration, requires some preliminary statistical analysis of the data to test if the dependent and independent variables are non-stationary (the presence of unit roots). We use the standard Augmented Dickey Fuller or ADF (1979) and Phillips-Perron (1988) tests in order to determine the order of integration of the individual data series\(^{29}\). All variables should be nonstationary at the level, and stationary at the first difference, i.e. integrated of order one: I(1).

Next, we estimate the long-run relationship, which requires a test for the cointegration of the variables, either by the Engle and Granger (1987), or by the Johansen (1988)/Johansen and Juselius (1990) methodology. Co-integration provides an analytical framework through econometrics to assess the long-run relationship between non-stationary economic variables applied to our case of study, such as money, income, interest rates, prices and inflation among others. As sustained by Ericsson (1998) the choice of the appropriate explanatory variables and estimation technique are necessary condition to obtain adjusted-to-reality results. The Johansen procedure assumes the definition and estimation of a well-specified full system of equations, which makes estimations more difficult. Moreover, in applying that technique, we are limited by the size of our sample. As pointed out by Baffes, Elbadawi, and O’Connell (1997), evidence suggests that the Johansen procedure deteriorates dramatically in small samples, generating estimates with “fat tails”. The Engle and Granger procedure -applied in this work- analyzes co-integration, in which residuals from a static regression of integrated variables are tested for having a unit root, then statistic regression is interpreted as a co-integrating relation if the hypothesis of a unit root in the residual is rejected, where tests for a unit root are typically based on the augmented Dickey-Fuller test.\(^{30}\) If variables are co-integrated the residuals of the model can be treated as the equilibrium correction term in subsequent specification of a dynamic model for the variables involved. The first step in the Engle-Granger cointegration method is, therefore, applying Ordinary Least Squares (OLS) to a static regression relating the levels of the real money demand and the variables that, we believe, determine its behavior. We assume that the long-run static relationship provided by theory is a linear composition of the logarithmic transformations of the variables chosen. To finalize this first step of the cointegration test, we shall test the residual (\(\mu\)) from the regression of our models for stationarity. If the residual term is stationary, then we could conclude that our variables are cointegrated.

\(^{29}\) However, the ADF and PP tests can be less robust in the presence of breaks in the level or in the slope of the trend function. In some cases, when graphic observations and correlograms indicate that the series are not stationary in their levels but ADF and PP tests indicate the contrary, we also could apply other tests as Kwiatkowski-Phillips-Schmidt-Shin, the Ng-Perron and the Dickey Fuller-GLS and use the most recurrent outcomes as our unit root results.


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VI. Study and Results

a. Unit Root Tests

As mentioned, firstly it is required statistical analysis of the data to test if variables are non-stationary (presence of unit roots) using the standard Augmented Dickey Fuller (1979) and Phillips-Perron (1988) tests to determine order of integration of the individual data series. All variables need to be nonstationary at the level, and stationary at the first difference (integrated of order one: I[1]).

<table>
<thead>
<tr>
<th>Table I: Unit Root Tests Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real Money Demand</strong></td>
</tr>
<tr>
<td>M2RCPI</td>
</tr>
<tr>
<td>D(M2RCPI)</td>
</tr>
<tr>
<td>LI</td>
</tr>
<tr>
<td>D(LI)</td>
</tr>
<tr>
<td>LGDPRPC</td>
</tr>
<tr>
<td>D(LGDPRPC)</td>
</tr>
<tr>
<td>LGDPR</td>
</tr>
<tr>
<td>D(LGDPR)</td>
</tr>
<tr>
<td>LTOT</td>
</tr>
<tr>
<td>D(LTOT)</td>
</tr>
<tr>
<td>LCG_GDP</td>
</tr>
<tr>
<td>D(LCG_GDP)</td>
</tr>
</tbody>
</table>

*** (resp. ** and *) denotes that H0 is rejected at the 1% (resp. 5% and 10%) significance level.

b. Co-Integration Analysis

As stated, our first hypothesis (base model) was built on three explanatory variables: real GDP, nominal interest rate and terms of trade. However, after our first model-run, we verified a very serious distortion, namely a positive relationship between nominal interest rate and money demand, contrary to monetary theory. We analyzed that the most plausible explanation was the negative real interest rate and a significant monetary overhang created by an entrapped monetary flow, enforced by the exchange clamp. This entrapped overhang, with low level of leaking, was channeled mainly to consumption, spiraling inflation. As a result, we decided to hypothesize and test three different alternative models to study such rare behavior.

[1] We started our set of estimations of real money demand replacing from our base model terms of trade for real GDP per capita (rGDP/cap) calling it Model 1, in which we aim to explain money demand as a function of real GDP (rGDP) as scale variable, real GDP per capita (rGDP/cap) as a proxy of productivity related to real exchange rate, and nominal interest rate \( \left( \frac{r}{1+i} \right) \) as opportunity cost. We expected positive effects (coefficients) from rGDP/cap as a proxy of country productivity (differential tradable/non-tradable
in the case of Argentina) and also from rGDP as proxy of national income. On the contrary, as economic theory suggests, negative effect was expected from nominal interest rate as opportunity cost of holding money.

\[ \ln \left( \frac{M_2}{P} \right) = \eta + \beta_2 \ln (rGDP/cap) + \beta_3 \ln \left( \frac{r}{1+r} \right) + \beta_4 \ln (rGDP) + \mu \quad \text{Model [1]} \]

Substituting estimated coefficient in our Model [1] we present a Real Money Demand Equation [1]:

\[ \ln \left( \frac{M_2}{P} \right) = 0.216 \ln (rGDP/cap) + 0.090 \ln \left( \frac{r}{1+r} \right) + 0.083 \ln rGDP + \mu \quad \text{Md Equation [1]} \]

[2] The second model we regressed, may explain money demand as a function of real GDP per capita (rGDP/cap) and nominal interest rate \( \left( \frac{r}{1+r} \right) \) like Model [1] but incorporating the expected positive effect on real money demand as a consequence of increasing monetization of foreign currency inflows after positive, exogeneous shocks in the Argentine terms of trade. A country like Argentina, mostly based on agricultural exports, shall verify a direct relationship between terms of trade and real money demand, as better international prices of agricultural exports historically caused a wealth affect due to monetization of foreign currency inflows. We suspected, ex-ante, that the partial closing of the external sector, the “Exchange Clamp”, a heavy tax burden on agricultural exports and the negative nominal interest rate will neutralized, in part, this effect.

\[ \ln \left( \frac{M_2}{P} \right) = \eta + \beta_2 \ln (rGDP/cap) + \beta_3 \ln \left( \frac{r}{1+r} \right) + \beta_4 \ln \left( \frac{P_X}{P_m} \right) + \mu \quad \text{Model [2]} \]

Substituting estimated coefficient in our Model [2] we present a Real Money Demand Equation [2]:

\[ \ln \left( \frac{M_2}{P} \right) = 0.134 \ln (rGDP/cap) + 0.089 \ln \left( \frac{r}{1+r} \right) + 0.160 \ln \left( \frac{P_X}{P_m} \right) + \mu \quad \text{Md Equation [2]} \]

[3] After running the second model we verified that macroeconomic conditions in Argentina, during that period, reverted the relationship between nominal interest rate and money demand, then we reformulated our specification. In our third model we hypothesized that the over-supply of money flow mostly was going to monetize an ever-expanding public spending, therefore, in our last estimation we test a model of money demand as a function of real GDP per capita and nominal interest rate, like Model [1] but now adding real government consumption as a percentage of GDP (GOVcon). With this new variable, GOVcon, we intended to test whether government spending was a main driver impacting, and pushing up, real money demand. This conjecture made sense a priori, since government increased its relative weight in the economy during the whole period of study, fueled by monetary emission, making us suspicious about the role of GOVcon as an “engine” for money demand.
\[
\ln \frac{M_2}{P} = \eta + \beta_2 \ln (r\text{GDPCap}) + \beta_3 \ln \left(\frac{r}{1 + r}\right) + \beta_4 \ln \left[\frac{\text{GOVcon/GDP}}{\text{GDP}}\right] + \mu
\]

Model [3]

Substituting estimated coefficient in our Model [3] we present a Real Money Demand Equation [3]:

\[
\ln \frac{M_2}{P} = 0.157 \ln (r\text{GDPCap}) + 0.077 \ln \left(\frac{r}{1 + r}\right) + 0.362 \ln \left[\frac{\text{GOVcon/GDP}}{\text{GDP}}\right] + \mu
\]

Md Equation [3]

Our three models show that, during the period 2004-2016, in Argentina, the textbook-like negative relationship between real money demand and nominal interest rate got inverted to a positive relationship. Real interest rates were, even volatile, negative across the period, and real money demand grew despite a growing nominal interest rate.

Government spending, as we expected, played a strong “pull-up” factor to money demand in Argentina, overpassing the income scale variable (real GDP) and terms of trade, which, represents a serious macroeconomic distortion. The proxy of productivity shows an impact on money demand with a higher relative weight than textbook-like variables, income and interest rate, showing that Argentine stylized facts like internal balance tradable/non-tradable, terms of trade and variables related to real exchange should not be ignored at estimating money demand, in other words, extrapolating textbook-like models is, in the best case, incomplete, even if the model is econometrically sophisticated.

**Table II: Coefficients of Cointegration Vector Models [1], [2] and [3]**

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lc)</td>
<td>0.090***</td>
<td>0.090**</td>
<td>0.078***</td>
</tr>
<tr>
<td>((3.403))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(LGDPRPC)</td>
<td>0.216**</td>
<td>0.135*</td>
<td>0.157**</td>
</tr>
<tr>
<td>((2.068))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(LGDPR)</td>
<td>0.083**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>((2.409))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(LTOT)</td>
<td>0.161**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>((2.67))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(LCG_GDP)</td>
<td>0.362**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2.576)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations 52 52 52
R-squared 0.588 0.580 0.597
Adjusted R-squared 0.571 0.563 0.581
Durbin-Watson stat 1.610 1.617 1.325
ADF -3.874*** -3.407*** -3.572***

Note: Data in brackets indicate the t-Student.

***, ** and * denote a significance of the coefficient at the 1%, 5% and 10% levels.

The ADF test in the last row refers to the t-statistic of the residual series from each regression. t-statistics are compared to the McKinnon critical values table (1991).
Despite the presence of negative real interest rates, which by itself is a significant anomaly in macroeconomics, this would not explain by itself the positive correlation between nominal interest rate and real money demand. In order to understand this incongruity, it is needed to add to the analysis a major macroeconomic distortion, the so-called “Exchange Clamp” (mentioned before) which was a de-facto prohibition of exchanging currency, working as a closed hydraulic system (economy), in which was injected fluid (money) systematically without any possibility of leaking, unless at a high cost (parallel market) with consumption as the only forward-way out. This virtual-forced consumption of the agents explains growing money demand with growing nominal interest rates (and negative real interest rates). This combination caused growing inflation overtime, reinforced by growing monetary emission from the Central Bank, which was coopted by the Government to finance (monetize) a growing fiscal deficit. With saving possibilities closed, either in domestic currency (negative real interest rates) or foreign currency (“Exchange Clamp”) then consumption was the only partial drainage for the monetary flow. Yet, it was not enough, growth in money supply started to overpass consumption possibilities, and without a way out, it started to get stuck and get accumulated, as a stagnant flow in a closed-end system, pushing up even more inflation. These harmful monetary and exchange policies produced an enormous quantity of stagnant money, or monetary overhang, which is a very rare macroeconomic pathology seen in some Soviet economies before the 1990’s in 2011-2016 in Argentina.

c. Short Run Perturbations and The Error Correction

Having estimated our three models of money demand, and having found long run co-integration relationships, the following stage is estimating dynamic models with short run adjustments to the deviation (perturbations) from the long run equilibrium (path). We continue with the second and last part of Engle and Granger method, which estimates a dynamic version for each of our three models in order to verify the short-run effects of our variables on the money demand. Models are being run again, with their variables in first differences of logarithm of each variable, and include their first lag of residuals. We verified for the three cases that variables are significant, especially significance of first lag of residuals and that coefficients are lower than zero. Using this technique, we compare the already obtained long term path of money demand with its short-term perturbations in order to visualize convergence or divergence with the long-term trajectory (path) of the money demand. Once the second step of our cointegration validates the specifications of our long-term models, we calculate our estimated money demand of the three models, and compare them with the observed money supply. We proceed first by removing the short-term disturbance in our explanatory variables applying the Hodrick-Prescott filter to keep only the long-term components of each variable, which we multiply by its respective coefficient we obtained from our long-term regression.
Table III. Error Correction Results

OLS Estimations of the Short-run Determinants of the Real Money Demand (Error-Correction Model)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESID(-1)</td>
<td>-0.903</td>
<td>***</td>
<td>-0.948</td>
</tr>
<tr>
<td></td>
<td>(-5.780)</td>
<td>(0.152)</td>
<td>(-3.798)</td>
</tr>
<tr>
<td>D(LI)</td>
<td>0.140</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D(LGDPRPC)</td>
<td>0.311</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.692)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D(LGDPR)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D(TOT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D(LCG_GDP)</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.451</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.852</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Data in brackets indicate the t-Student. *** and ** denote a significance of the coefficient at the 1%, 5% and 10% levels.

[rGDP/cap]: As graph 9 shows, short term dynamics of money demand is not significantly distorted from its long-term path by this variable. A convergence took place in 2005 after a short-term under-demand after the 2001/02 crisis when real money demand crashed. From 2005 to 2008 we witnessed a money demand below its long-term path. After 2008 our analysis shows a convergence in the trajectories until 2016. Graphically we can observe that productivity proxied by rGDP/cap did not produce substantial short-term perturbations in real money demand after the recovery from the 2001/02 crisis.

rGDP/cap Short-Run Perturbations on Real Money Demand Long-Run Path

Graph 9. Misalignments between long term path of money demand and its short-term dynamics as a consequence of short-term perturbations on rGDP/cap (proxy of productivity).
Nominal Interest Rate Short-Run Perturbations on Real Money Demand Long-Run Path

![Graph 10](image)

**Graph 10.** Misalignments between long term path of money demand and its short-term dynamics as a consequence of short-term perturbations on nominal interest rate.

\[
LM2RCPI\text{EQ2} = 0.089^*\text{HPLI} + 0.134^*\text{HPLGDP RPC} + 0.160^*\text{HPLTOT}
\]

\[\frac{r}{(1+r)}\]: In graph 10 it is observable short-term dynamics of real money demand as a consequence of nominal interest rate perturbations converge in 2005 to its long-term path after the significant distortion of the crisis 2001/2 with the collapse of the real money demand. From 2005 to 2009 we observe real money demand below its long-term path. After 2009 our analysis shows a convergence in the trajectories until 2016. We observe that nominal interest rate, which presented a counter-intuitive positive relationship with the real demand of money, did not produce substantial short-term perturbations in real money demand after the recovery of 2009.

Government Spending Short-Run Perturbations on Real Money Demand Long-Run Path

![Graph](image)

**Graph**

\[
LM2RCPI\text{EQ3} = 0.157^*\text{HPLGDP RPC} + 0.362^*\text{HPLCG GDP} + 0.077^*\text{HPLI}
\]
Graph 11. Misalignments between long term path of money demand and its short-term dynamics as a consequence of short-term perturbations on government spending as a percentage of GDP.

[Govcon]: Graph 11 shows that short term dynamics of real money demand were significantly distorted from its long-term path as a consequence of real government spending (as a percentage of GDP). After the crash of the money demand in 2001/2 and its ulterior fast recovery, overshooting its long-term path. A convergence took place in 2005. From 2005 to 2013 we witnessed a money demand below its long-term path with the widest gap between 2007 and 2011, converging again in 2013. After 2013 our analysis shows an increasing divergence in money demand trajectory over its long-run path. Graphically, we observe that government expenditures (as a percentage of GDP) did produce significant short-term perturbations in real money demand after the recovery from 2001/02 crisis.

VII. Conclusions and Further Research

This paper studies the real money demand in Argentina during the Kirchner’s years (2004-2015) in which the country witnessed a spiraled inflation and several macroeconomic and monetary distortions and disequilibria. The aim of this study is to understand which are the main drivers and structural relationships of real money demand in Argentina in the long-run and, additionally, which were the monetary distortions and perturbations on real money demand during that period.

We presented a brief theoretical background of money demand, and then we went through a short review of the literature focused on Argentina.

We hypothesized (ex-ante our regressions) that Argentina verifies some stylized facts like imbalances in productivities between tradable/non-tradable sectors, vulnerabilities to terms of trade and real exchange rate volatility and high propensity to currency substitution, therefore, we believe that text book-like equations, only based on real income and interest rate, are incomplete at describing the real money demand behavior. For this reason, we first built a Base Model grounded on a text book-like equation augmented by our first additional variable, terms of trade, as a proxy of wealth affect after changes in price of commodities (exogeneous shocks). We dismissed REER for having correlation issues.

Working with our first hypothesis (Base Model) we discovered a serious distortion in our empiric work, in the relationship between interest rate and real money demand. This relationship, which economic theory vastly showed as negative, was reverted to a positive one. As a consequence of this serious alteration, we decided to split our work and test three different models with different specifications, namely Models [1], [2] and [3]. All of them using rGDP/cap (productivity) and nominal interest rate (nominal opportunity cost), but changing their third variable which are real GDP (income), terms of trade (REER proxy) and government spending, respectively.
Our third model was consequence of hypothesize that, having such a growing public spending and monetary emission, with negative real interest rates, government could be the main “engine” sustaining and fueling real money demand.

Our empiric work shows that productivity plays a role in money demand (as a proxy of the differential between productivity tradable/non-tradable, in a country with the structural characteristics like Argentina), as it also does appreciation/depreciation of real exchange rate, producing wealth/poverty effects which impact on money demand. Terms of trade works as a proxy of these variations on real exchange rate. However, in virtual-closed economies, as Argentina in our period of study (2004-2016), the effects of these two variables could be diluted.

Our last variable, real government spending (as a percentage of GDP), caused a significant effect on real money demand. For the same reason that, in a virtual-closed economy the effects of variables linked to openness (REER-related) can be diluted, conversely, with no possibilities for foreign or domestic saving, government worked as (unsustainable) spurious engine of money demand.

We observed that between 2005 and 2010 real money supply overpassed our estimated real money demand, regardless which of the three models we apply. This fact reinforced an inflationary process which arrived near to 35% as of December 2015, at the moment the new Administration arrived.

Based on these recent past facts, a very cautious approach with money supply, even slightly tight-biased, risking underestimating money demand is mostly advised.

We leave for further research the comparison of these estimations to a previous window of time, applying the same sets of models, [1], [2] and [3], in order to not-falsifying (in Popperian terms) that real money demand in Argentina follows a stable-path regardless short-term perturbations, structural breaks or macroeconomic regimes underneath. Alternatively, in models with a longer sample (e.g. 1975-2015) could be interesting to test whether a stable, long run path for money demand is found in spite of several structural breaks.

Finally, by reviewing the economic history of Argentina of recurrent sovereign debt crisis and rampant inflations it comes up straightforward that fiscal deficits seem to be the mother of all her economic evils of the last decades. This work has not addressed the fiscal origin of monetary over-emissions and the fiscal dominance, i.e. the public deficit, which has roots in the tax structure, federal architecture, politics, welfare and social security. We believe that an independent study on the fiscal configuration of Argentina, and its monetary effects, is a necessary complement of this monetary study.
References


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