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Understanding Money Demand of Argentina: 1935-2000
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UNDERSTANDING MONEY DEMAND OF ARGENTINA: 1935-2000

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Abstract

This paper investigates whether or not a simple –Cagan like – econometric model of demand for currency can be developed for Argentina based on more than sixty years of data (1935- 2000). For such a long period the presence of structural breaks cannot be ignored given the variety of economic regimes this country has experienced. The purpose is to understand from an “ex-post” perspective how money holdings have reacted to the two main determinants of their demand: a transaction variable and an opportunity cost after suitable approximations for both concepts could be obtained. Transaction elasticity estimates matter for the distribution effects of inflation tax and for measuring the size of the shadow economy. Besides, a comparative analysis of the effect of inflation, interest rates and exchange rates could clarify about the relevant opportunity cost of holding money. Once two values of the transaction elasticity were taken for the long run relationship (1 and 0.5) and inflation and interest rates alternatively measured the opportunity cost of holding money, a stable money demand – a satisfactory approximation to the data generating process – was obtained for the Argentina case .

Preliminary Version. Comments Welcome.

Understanding Money Demand of Argentina: 1935- 2000*

The behaviour of real cash balances of Argentina during the XX century could be considered as a “curiosity” in monetary economics. After having notorious experiences of deep intervention as well as ones of financial and economic liberalisation, varieties of exchange-rate and capital-inflows regimes, periods of high and hyper inflation followed by a decade of price stability, even a long negative trend in output, it appears that a stable and well defined domestic money demand for a long period would be impossible to assume. For the case of the narrowest definition of money there are even more difficulties than in broader aggregates since there are many substitutes of currency. They elude – at least partially – the inflation tax, so recurrent in the seventies and eighties in this country. Besides currency is also affected by the still ongoing world-wide process of financial innovation that has reduced non-banking money holdings everywhere but particularly in cases in which the same inflation tax has given the incentives to accelerate such a process. In spite of these issues this paper investigates whether or not a simple – Cagan like – econometric model of demand for currency can be developed for an economy like Argentina based on more than sixty years of data – starting from the year of the Central Bank creation (1935) until 2000 – where the presence of structural breaks cannot be ignored.

The purpose of the econometric exercise is to understand from an “ex-post” perspective how money holdings have reacted to the two main determinants of their demand: a transaction variable and an opportunity cost after suitable approximations for both concepts could be obtained. Apart from being the aggregate with the longest official record, the importance of studying the demand for currency is twofold, as far as the transaction effect is concerned: the distribution effects of inflation tax and the size of the shadow economy.

* This paper is dedicated to the memory of a great economist, Elias Salama, who devoted his life to monetary economics both theoretical and applied to the day-to day- Central Bank issues and also to them from a historical perspective.

The negative effect on income distribution of financing public deficit with money is based on the different capabilities of individuals to substitute money. Higher income people are in better conditions for accessing to “substitution technologies”. The appropriate definition of money to measure this effect has been discussed in the literature (see Ahumada, et. al., 1993). Although there is no a unique answer regarding all purposes of computing the inflation tax, it is clear that the narrower the definition of money the more exposed money holdings are to this tax. For money paying interest, instead “private” gains and losses (say between banks and deposit holders) would be likely taken place – at least in the short run- depending on outcomes of the expected inflation embodied in interest rates. For the distribution effect, there is also an empirical question: if when income increases real cash holding also do so but less than proportionally. In a way, income elasticity or transaction elasticity (transaction tied to income) should be less than one (see, Sturzenegger (1992))¹. Empirical analysis of cash-holdings during more than sixty years could help about this elasticity conjecture, in particular when inflation as a way of deficit financing is again under discussion in the Argentine “arena”.

Measuring the extent of the shadow economy has been for long in the literature, both in Argentina and elsewhere ². One of the most common technique is the monetary method based on the parameter estimates of money demand models and inspired on the idea that “cash leaves no tracks” (B. Friedman, *The Economist*, 22-07-00, p.76)). Ahumada et.al. (2000) discussed the assumptions behind the measure of the shadow economy employing such a method, and in particular called attention about the needs of adjustment of the usual computation when the income elasticity of money demand is different from one. The recent experience of Argentina revealed the necessity to improve these measures: underestimation of the size of the shadow economy could explain the so strong opposition to the financial reforms, which try to substitute currency by money within the banking system.

¹ Although it is indeed a cross section question no data is available. However, it is difficult to assume such elasticity values when aggregate time series evidence rejects them.

² See for a recent survey the special issue of the *Economic Journal*, 109 (1999) and for the Argentine case, *FIEL* (2000).

Regarding the opportunity cost, the question is whether inflation, interest rates and exchange rates are alternative or complement definitions for measuring the cost of holding money and, besides, how dependent on the sample period is the answer to this question.

Next section analyses real money behaviour from a historical perspective. Section 3 presents a discussion about the economic theory of money demand and its application to the Argentine data. Section 4 reports the results of a first model estimated for the whole sample. Based on these results, section 5 discusses the transaction effects and section 6, the opportunity cost. Then, section 7 reformulates the econometric model to obtain an equilibrium correction for the whole sample. Section 8 analyses these results. Section 9 concludes.

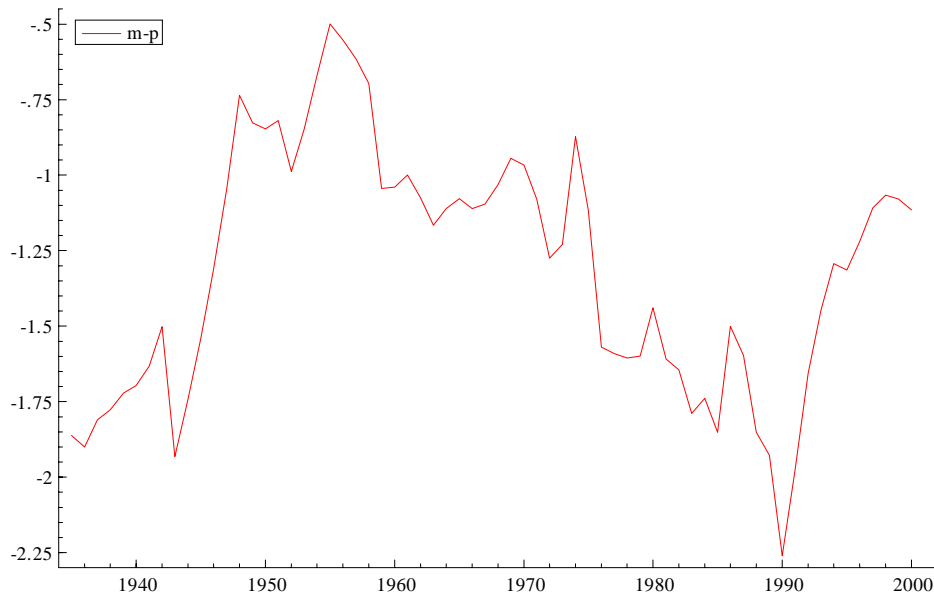
2. A historical perspective

Since 1930 until 1983 Argentina oscillated between democracy and military regimes, changing one for another when not only the political situation but also the economic performance deteriorated. Even the transition between two democratic governments in 1989 took place in the middle of a hyperinflation process. Therefore a brief summary of such changes could help to understand dates of structural breaks.

Cottely (1985) divides the first fifty years of the Central Bank's life (1935-1985) – according to the economic framework – in the following periods: a) 1935-1945, stabilisation policies under the crisis of the thirties and the Second World War; b) 1945-1955, development efforts under government intervention, c) 1956-1967, economic restructuring under markets law; d) 1968-1972, efforts on stabilisation and recovery; e) 1973-1975, new attempts for development under intervention; f) 1976-1981, attempts to transform the economic structure under monetarist concepts; g) 1982-1984, “fighting for normalisation” (both from economic and political perspective). We add two periods to them, both under democracy: h) 1985-1990, coping with hyperinflation and i) 1991-2000,

market-oriented economic reforms under Convertibility regime. These periods have been useful to reflect the zigzag development of monetary institutions and policies in Argentina, but what do they mean in terms of real cash holdings of money? Figure 1 could help us to answer this question.

Figure 1



Visual inspection of figure 1 shows three periods according to the underlying trend of currency holding. An up-ward behaviour until the mid-fifties is followed by a long period of a negative trend, which change the direction again since 1990, although some short-run reversals are also observed.

The first period of growing real cash holdings corresponds to a) and b). Monetary stability characterised the first years of the Central Bank, being stable both domestic prices and exchange rate when monetary expansion was mainly originated in international reserves (increasing particularly during the war), money was defined almost exclusively as currency in private hands and banks. The financial reform from 1946 onwards that nationalised deposits (and the Central bank too) reduced the participation of

currency in relation to deposits but it still increased in real terms following the level of activity.

From 1956 to 1990, real holdings of currency decline about 80 % between the maximum and minimum value of the sample. As can be noticed the Argentine economy experienced a variety of economic regimes, from c) to e). Although, financial free-market reforms (like that of 1957 or 1977) could open alternatives to holding currency, which could explained a decreasing behaviour, this period is characterised as a whole by an upward trend in inflation (see Figure 2) that accelerates in the mid-seventies when consumer prices passed the 50% annual rate and becomes a hyperinflation process in 1989 and 1990.

The last up-ward trend in real cash holdings re-started after the Convertibility regime that backed the money base on external reserves to guarantee the one-peso to one-dollar rate of exchange. This monetary regime was undertaken at the same time that deep reforms move the economy towards free market and the largest growing in activity within the sample was experienced. This trend -both in real activity and real money- has been interrupted in the late nineties walking to a reversal to the earlier periods. Understanding the behaviour of money demand in such long period could be a fruitful experience to learn for the near future.

3. Economic Theory and the Argentine Data

This work econometrically studies the demand for currency (on annual basis). Therefore, the demand for this definition of money would be more related to a transaction motive rather seeing money holdings as an asset that preserve exchange value, see Baumol (1952), Tobin (1956) and Friedman (1956)³. In this case, real money holdings would depend on a measure of the volume of real transactions and the opportunity cost of cash holdings. In addition, given the persistence of high inflation as well as hyperinflation

³ However both reasons for holding money could be supposed -at least for short periods- when income is generated in the shadow economy.

outbreaks in the sample period a formulation as that proposed by Cagan (1956) could be taken as the long run specification,

$$m-p = \alpha + \beta y + \gamma \pi$$

where $m-p$ are logs of the real cash holdings: m , nominal money and p , the price level, both in logs; y denotes a scale variable (income or transactions in logs) and π is inflation ($\pi_t - \pi_{t-1}$).

The scale elasticity β is anticipated positive, taking values of 1 or .5, according to the Cambridge interpretation of the Quantity Theory as a demand function and the Baumol- Tobin hypothesis, respectively. As earlier discussed the estimation of this elasticity could give empirical support to a necessary condition for a negative effect on income distribution of the inflation tax ($\beta < 1$). This estimation could also indicate needs of adjustment of a traditional measure of the shadow economy (if β different from 1). In the case of Argentina, transaction's proxies – available for the long period analysed – are: GDP and aggregate supply (GDP plus imports).

Regarding the opportunity cost, the classical Cagan demand anticipates a negative effect of π (γ is β times the elasticity of money with respect to inflation). In this model for high and hyperinflation cases, inflation is the dominant opportunity cost. However, two other alternatives for this cost should be taken into account: the exchange rate and the domestic interest rate, in particular when at least one of the others is subject to policy control as in a fixed exchange regime, regulated interest rates or price controls as observed in certain periods of the sample. The issue is whether or not they are acting as substitutes or complement measures of the opportunity cost of holding money. In the case of the interest rate it is worth noting that it embodies an expected rate of inflation, which could be – in some periods – quite different from actual ones reflected in π . Next section comments about the results of employing the different alternatives (see data sources in the appendix).

4. A First Model for the Whole Sample

As presented in the previous section, a basic model of the demand for money should include transactions and a measure of the opportunity cost of holding real cash balances as explanatory variables. Given this model and the time properties of the series, real money balances are hypothesized to be cointegrated with the volume of real transactions and inflation, the first proxy employed as the opportunity cost of holding money. This section presents the results of estimating this first model of money demand for Argentina for the whole sample 1935-2000⁴.

In order to jointly model the dynamic and the long run relationship, an unrestricted autoregressive distributed lag model of m-p (real cash holdings) on y (transactions: measured as the log of gross domestic product plus imports) and π (inflation: calculated as the first difference of the consumer prices index) is presented in Equation 1. It includes 1 lag and a set of annual dummies. The residuals can be considered homocedastic white-noise and normal⁵.

Equation 1

(m-p) _t	=	+0.0543	+0.872 (m-p) _{t-1}	-0.2706 π_t
SE		(0.1802)	(0.02979)	(0.03364)
		+0.1151 π_{t-1}	+0.3291 y _t	-0.3461 y _{t-1}
		(0.02952)	(0.09166)	(0.09301)
		-0.4876 d43	+0.2969 d48	+0.2958 d74
		(0.08416)	(0.0803)	(0.08026)
		+0.2878 d84	+0.6046 d89	
		(0.8624)	(0.1098)	
R ² =0.967666 F(10,53)=158.62 [0.0000] σ =0.0791878				

Residuals tests

AR 1- 2	F(2, 51) =	2.3796 [0.1028]
ARCH 1	F(1, 51) =	3.3434 [0.0733]
Normality	Chi ² (2)=	0.4306 [0.8063]
Xi ²	F(15, 37) =	0.64251 [0.8203]

From Equation 1 the following long run solution can be derived,

⁴Similar approaches have been followed in Ahumada (1992); Baba et.al. (1992); Ericsson (1998) and Ericsson et.al. (1998).

⁵ Similar results were found working with a three-variable system, which also indicates the validity of the conditional model, as that of Equation 1. See section 5 and 6 for further discussion.

(m-p) =	+0.4243	-0.1323 γ	-1.215 π
SE	(1.431)	(0.1515)	(0.2668)
	-3.809 d43	+2.319 d48	+4.724 d89
	(1.029)	(0.8058)	(1.504)
	+2.249 d84	+2.311 d74	
	(0.8979)	(0.8126)	

The same solution could be obtained from a model in differences with the levels of (m-p), γ and π in the first lag added as explanatory variables. This parameterization, proposed by Bardsen (see Banerjee et. al. (1993)), could be less collinear than the first one⁶. It is reported in Equation 2 for later comparisons with other specifications. The residual tests show similarly that they could be considered homocedatic white- noise and normal.

Equation 2

D(m-p)net _t =	+0.03192	+0.3466 Dy _t	-0.2672 D π_t
SE	(0.1775)	(0.08882)	(0.03328)
	-0.1247 (m-p) _{t-1}	-0.01436 γ _{t-1}	-0.1533 π_{t-1}
	(0.02942)	(0.01862)	(0.01909)
	+0.2988 d48	+0.2968 d74	+0.2861 d84
	(0.08001)	(0.08)	(0.08594)
	+0.6008 d89		
	(0.1094)		
R ² =0.80415 F(9,54)=24.636 [0.0000] σ =0.0789392			

Residuals tests

AR 1- 2	F(2, 52) =	1.9491 [0.1527]
ARCH 1	F(1, 52) =	3.0463 [0.0868]
Normality	Chi ² (2)=	0.64323 [0.7250]
Xi ²	F(14, 39) =	0.62496 [0.8277]
RESET	F(1, 53) =	2.2166 [0.1425]

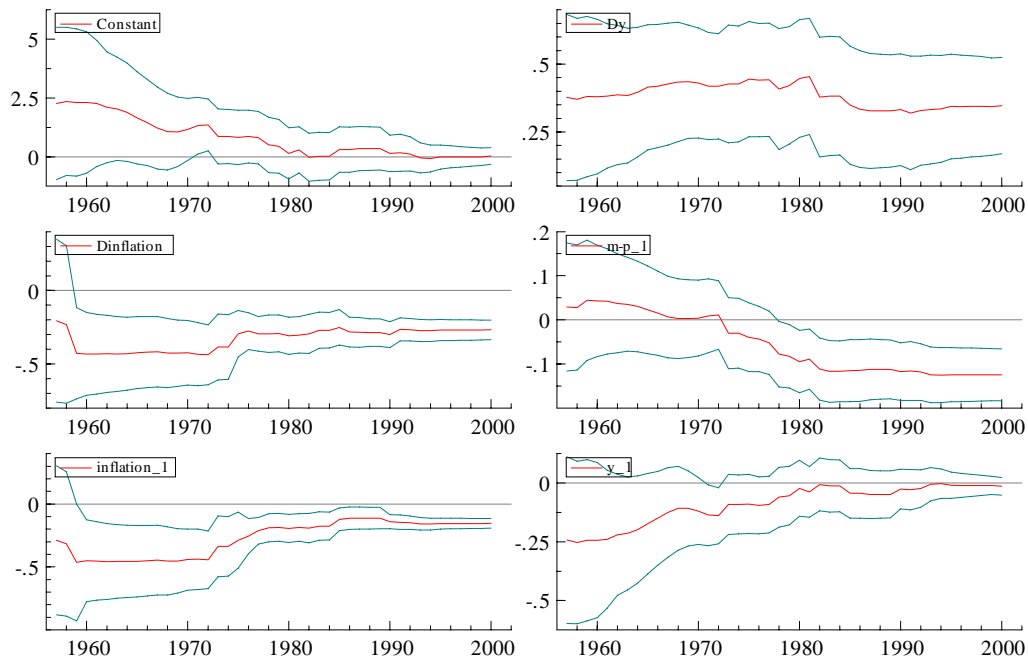
According to the estimates of both equations, real cash holdings are determined by inflation in the long run ($\gamma=-1.215$) but they have no significant long run relationship

⁶ The dependent variable was transformed as the real cash balances net of the effect of the dummy of the year 1943 (D(m-p)net). This transformation has been maintained for the rest of the model.

with transactions. In the short run, transactions affect the demand for real holdings of money: a 10% increase in the rate of growth of transactions increases the rate of growth of real holdings in 3.5%. The inflation has a negative and significant short run effect, a 10% rise in the inflation rate would reduce real holdings in 2.7%.

Furthermore, parameters constancy of the model was evaluated and rejected by recursive estimation as it can be observed in the next graphics (the recursive estimates of the main coefficients are not inside the previous 2 times standard errors intervals).

Recursive graphics



The absence of parameter constancy (in particular lagged inflation and real money holdings) and the lack of a positive (significantly different from zero) long run relationship between (m-p) and y, motivated a further analysis as explained in the following two sections concentrating firstly, on transactions and secondly, on the opportunity cost.

5. Discussing the transaction effects

The absence of a long run relationship between real cash balances and the transaction variable was very difficult to understand not only from the theoretical point of view but also from the historical behaviour of the data. An inappropriate definition for transactions and/or a not unique relationship are suspected to be responsible for such result.

A first issue to investigate is the sensitiveness of the long run results to the definition of the transaction or scale variable since economic theory nothing says about it. In the previous section the log of the sum of the gross domestic product and imports was taken as a proxy. In this section an equally suitable approximation for the concept and often used in empirical studies, the GDP (gross domestic product), is tried. The same results are maintained for the whole sample with this alternative definition of the transaction variable, as could be observed in the next equation and the long run solution.

Equation 3

$(m-p)_t =$	-0.1427	+0.8756 $(m-p)_{t-1}$	+1.047 $Lgdpt_t$
<i>SE</i>	(0.2159)	(0.03031)	(0.2872)
	-1.045 $Lgdpt_{t-1}$	-0.2618 π_t	+0.1191 π_{t-1}
	(0.2868)	(0.03521)	(0.0294)
	-0.5059 $D43$	+0.2591 $d48$	+0.263 $d74$
	(0.08291)	(0.08137)	(0.08111)
	+0.273 $d84$	+0.6172 $d89$	
	(0.08709)	(0.1099)	

$R^2=0.967369$ $F(10,53)=157.12$ [0.0000] $\sigma=0.0795516$

Long Run Solution

$(m-p) =$	-1.147	+0.01985 $Lgdpt$	-1.147 π
<i>SE</i>	(1.682)	(0.1926)	(0.2634)
	-4.067 $D43$	+2.083 $d48$	+4.961 $d89$
	(1.133)	(0.7924)	(1.61)
	+2.114 $d74$	+2.194 $d84$	
	(0.8154)	(0.9227)	

Again real holdings are determined by inflation in the long run but there is no long run relationship with transactions. Because of a slight advantage in terms of goodness of fit of the regressions and a clearer behaviour within sample, the log of gross

domestic product plus imports, i.e. total supply, was considered a better approximation than the GDP for transactions.

A priori it was also suspected that the long run relationship with transactions could be dependent on the sample period chosen. So, a second point of analysis was to investigate the relationship between real cash balances and transactions for subsamples of the Argentine economic history.

Apart from the visual inspection, we analyse cointegration of these series, using the system-based procedure from Johansen (1988) and Johansen and Juselius (1990) for different periods of the sample. After several divisions in subsamples, two periods could be differentiated: 1935-1955 and 1956-2000 (Appendix 3 reports the results for the bivariate case). Although the very short sample, the simplicity of the bivariate analysis and the effect of outliers had reduced the confidence of these results, they brought some conjectures about the long run values of transaction elasticity which were later evaluated in an equilibrium correction model

During the first period analysed, the income elasticity would be supposed as being one⁷ derived from the Cambridge interpretation of the Quantity Theory as a demand function. In the second period the income elasticity would be 0.5 like the Baumol-Tobin income elasticity, which transforms the deviation from the long run relationship between real cash holdings and transactions into a pseudo velocity measure $(m-p-0.5y)$ ⁸.

Thus, the long run relationship between $(m-p)$ and y appears to be dependent on the sample chosen. The transaction variable would enter with a different coefficient in both periods so explaining the lack of a significant relationship between both variables for the whole sample. These different long run relationships are tested in a multivariate framework parameterised as Bardsen, controlling for other determinants. These results are discussed in section 7 after discussing the relevant opportunity cost.

⁷ The deviation from the long run relationship $(m-p-y)$, in the regression analysis, is called $mpyd$.

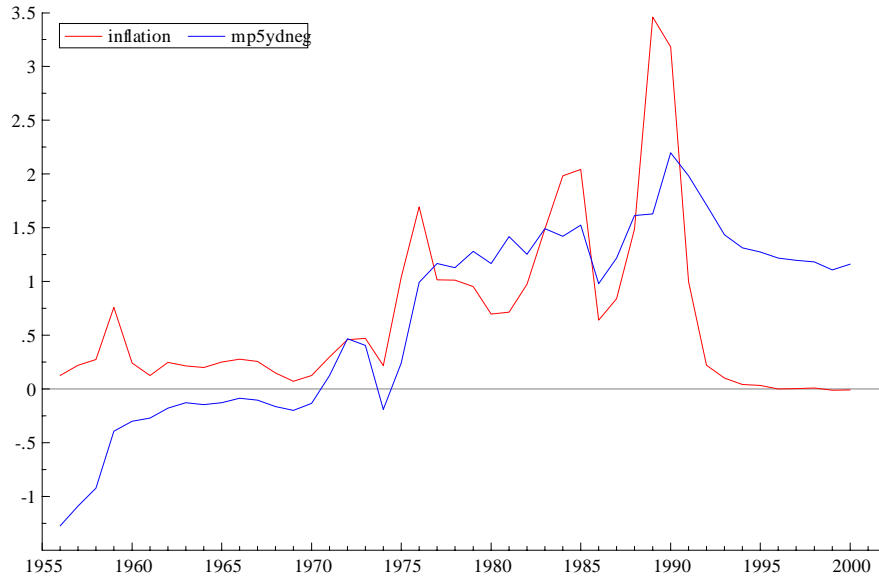
⁸ Its name is $mp5yd$.

6. Discussing the opportunity cost

Usual theories of the demand for money include either the interest rate or the rate of inflation as measures of opportunity cost. Friedman (1956) and Cagan (1956) had called attention of the effect of inflation on real cash balances when the inflation is high. This effect could be detected not only in hyperinflation contexts (defined usually in the literature as periods in which the rate of inflation is over 50%) but also in periods of high and volatile inflation. In the long run, inflation and interest rates are supposed to move together in a relationship similar to the Fisher hypothesis, particularly at high inflation rates when its variations dominate over those of the real interest rates. However, deviations between both variables could be substantial in the short run, current interest rates having also information about expected rates of inflation. In a country like Argentina it is likely that people adopt different variables as opportunity cost of holding money.

A visual inspection of the behaviour of the coefficient of pseudo velocity with the opposite sign ($mp5ydneg$) and the rate of inflation ($inflation$) (Figure 2) shows that when the inflation is persistent over the value of 50% (since 1973), exists a clear relationship between the rate of inflation and the pseudo velocity.

Figure 2



In order to further analyse this relationship, the cointegration analysis between $(m-p-0.5y)$ and the inflation variable for the period, where a clearest relationship between them is observed (1973-1991), is presented in the following table.

$(m-p-0.5y)$ and π system

1973 to 1991 (2 lags and d86,d88,d89,d91 and constant unrestricted)

λ_i	$H_0: r=p$	$\text{Max}\lambda_i$	Tr
0.560	$p=0$	15.64*	18.35*
0.132	$p<=1$	2.71	2.71

MAX λ_i is the maximum eigenvalue statistic $(-T \ln \lambda_i)$ and Tr is the Trace statistic $(-T \ln \Sigma(1-\lambda_i))$ for each statistic the second column presents the adjusted by degree of freedom and the third the 95% (Osterwald-Lenum, 1992) critical values (See Hendry and Doornik (1997)).

	α	β'
$\Delta(m-p-0.5y)$	-0.23507	1.0000
$\Delta\pi$	-0.42058	7.1400

α is the matrix of standardised weight coefficients and β' the matrix of eigenvectors (cointegration vectors and their weights in bold)

LR test ($r=1$)

$H_0: \alpha_0=0; \quad \text{Chi}^2(1) = 4.2609 [0.0390] *$
 $H_0: \alpha_1=0; \quad \text{Chi}^2(1) = 2.6244 [0.1052]$

LR is the likelihood ratio statistics assuming rank =1

These results indicate that between 1973 and 1991, the rate of inflation could be considered as a long run opportunity cost of holding money. A rank equal to zero is rejected in favour of one, that is there is one cointegration vector. Thus, the bivariate system gives $(m-p-0.5y)$ and π having a long-run (cointegration) relationship with coefficient of $(1, 0.87)$. LR tests also indicate the validity of the conditional model of money demand (rejecting $\alpha_0=0$ and not rejecting $\alpha_1=0$); the disequilibria from the cointegration relationship entering only in the real money equation⁹.

For those periods in which the relationship between the real money holdings and the inflation rate would not be so clear, other opportunity costs were studied. Several empirical problems had been found for including the interest rate. In periods of regulated interest rates, no records were found for the differential paid in the shadow economy, which probably has varied with the levels of restrictions. For the period when an appropriate interest rate is available, it shows no significant long run relationship with the real cash balances, but a significant one for short run until 1973. After the Convertibility Plan, the rate of interest is again relevant as a long run explanatory variable.

Another variable usually considered as a proxy for the opportunity cost of holding money is the rate of depreciation (the first difference of the nominal exchange rate), since it could contain information about expected inflation. The additional effect of this variable was also tested and rejected as explained in the next section.

⁹ See Johansen (1992) and Urbain (1992) and Ericsson (1994).

7. An Equilibrium Correction for the Whole Sample

In this section an equilibrium correction model for the whole sample is developed from a Bardsen parameterisation. The model of section 4 has been reformulated in order to take into account the results discussed in the previous sections.

The model is the same of Equation 2 but two disequilibrium terms respect to the transactions are included mpyd (1935-1955) and mp5yd (1956-2000), that is assuming a long run elasticity of transaction equal to 1 and 0.5, respectively for both periods. In addition, the rate of interest but not the exchange rate has been incorporated. After several trials, the following model resulted in which the opportunity cost has changed in different periods. The analysis from the residuals tests indicates that they appear to be homocedastic white- noise and normal.

Equation 4

D(m-p)net _t =	-1.082	+0.5223 Dy _t	-0.0142 Dintrate3573 _t
SE	(0.2184)	(0.09896)	(0.004129)
	-0.2376 Dπ7391 _t	-0.09783intrate9100 _t	-0.115 mpyd _{t-1}
	(0.0447)	(0.03467)	(0.02171)
	-0.1861 mp5yd _{t-1}	-0.1361 π7391 _{t-1}	+0.5097 d89
	(0.03748)	(0.02392)	(0.1287)

R²=0.730252 F(8,55)=18.612[0.0000] σ=0.0917965

Residuals tests

AR 1- 2	F(2, 53) =	0.30592 [0.7377]
ARCH 1	F(1, 53) =	0.10045 [0.7525]
Normality	Chi ² (2)=	0.79316 [0.6726]
Xi ²	F(15, 39) =	0.69504 [0.7735]
Xi*Xj	F(30, 24) =	0.81105 [0.7094]
RESET	F(1, 54) =	0.84147 [0.3631]

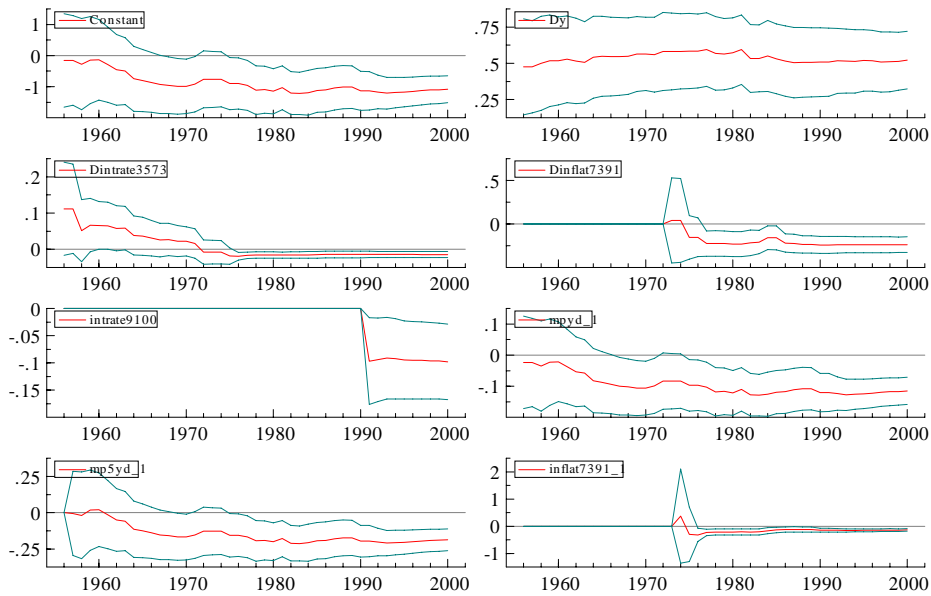
The model of Equation 4 indicates that real holdings are determined in the long run by real transactions but with different values for the elasticity. The impact effect of transactions is approximately 0.50 for the whole sample.

This model also shows the substitution between economic variables that are used as the opportunity cost of holding money: the rate of interest (intrate3573) between 1935-1973, then inflation (π 7391) between 1973-1991 and again, the rate of interest (intrate9100) from the Convertibility Plan up to the end of the sample. It can be noticed that for the first period the rate of interest has only a short run and quite small effect. The long run coefficient of inflation is approximately -0.73 (the γ coefficient for the Cagan equation), whereas the short run effect is -0.24 (an increase of 10% in the inflation variable reduces the real cash balances in 2.4%). For the last period, the long run effect of the interest rate is -0.53 .

8. Analysing the whole sample results

Surveying more than a decade of money demand breakdowns, Goldfeld and Sichel (1990) conclude that a constant parameter money demand function may not exist. For Argentina, in particular, there exists a pervasive view that it is not possible to find constant econometric relationships because of its economic history. This makes extremely necessary the evaluation of parameters constancy. The recursive estimation shows, given the standard error of the regression, that constancy of the parameters of the model are not rejected once the model is redefined taking into account different transaction elasticities and different opportunity cost within the sample.

Recursive graphics



In addition, the assumptions about the long run elasticity and the omission of an extra opportunity cost based on exchange rate were evaluated. In order to test them, two variables were incorporated in turn to the model: the first lag of the transaction variable and the first difference of the nominal exchange rate (devaluation rate).

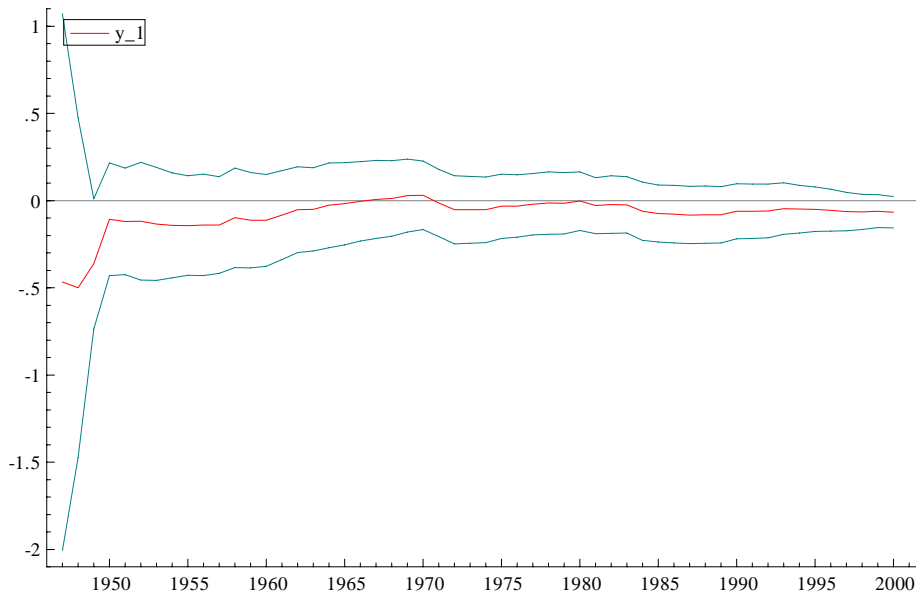
The purpose of adding the first variable is to verify if the transaction variable has got a different long run elasticity from those assumed before (1 between 1935-1955 and 0.5 between 1956-2000), for all or some periods of the sample taking into account the effects of the opportunity costs in a multivariate framework.

Equation 5

D(m-p)net _t	= -0.7468	+0.4788 Dy _t	-0.01459 Dintrate3573 _t
SE	(0.313)	(0.1022)	(0.004093)
	-0.087 intrate9100 _t	-0.1397 mpyd _{t-1}	-0.2369 mp5yd _{t-1}
	(0.03508)	(0.02721)	(0.05054)
	-0.1531 π7391 _{t-1}	-0.2292 Dπ7391 _t	-0.06642 y_{t-1}
	(0.0263)	(0.04458)	(0.04484)
	+0.4767 d89		
	(0.1292)		

R²=0.740783 F(9,54)=17.147 [0.0000] σ=0.0908162

Results from this equation and the next recursive graphic of the coefficient estimates for the first lag of the variable y , show that this coefficient was not statistically different from zero for the whole sample. Thereby evidence does not reject the previous assumptions about transaction elasticity: 1 between 1935-1955 and 0.5 between 1956-2000. This finding suggests that for latest period the necessary condition for a negative effect on income distribution of the inflation tax ($\beta < 1$) is not rejected for the data. It also indicates that the usual computation of the shadow economy size based on money demand should be adjusted.



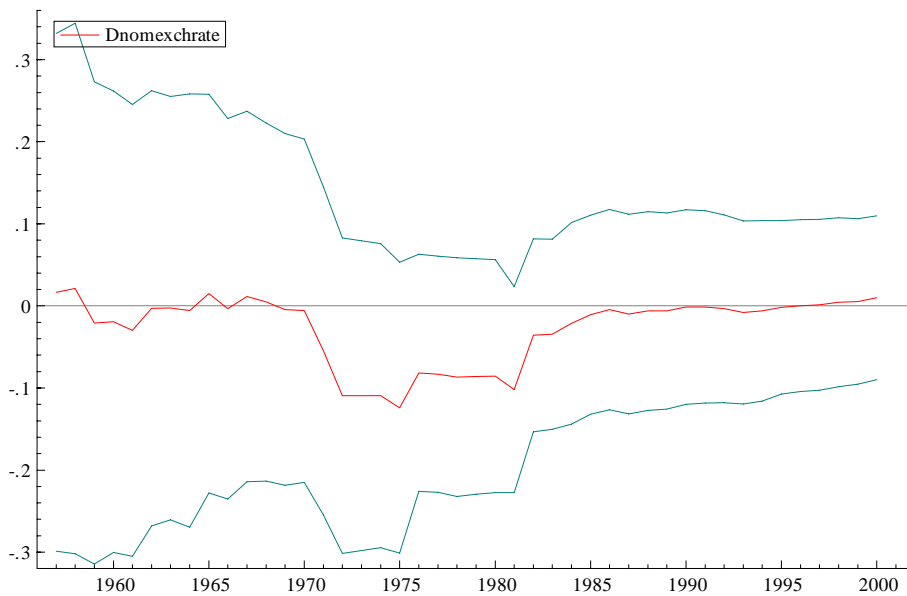
Then the devaluation rate was re-introduced to detect if it could be considered as an extra opportunity cost of holding money, given that inflation and interest rate are included in the model.

Equation 6

D(m-p)net =	-1.095	-0.01422 Dintrate3573 _t	-0.09993 intrate9100 _t
SE	(0.2294)	(0.004166)	(0.03656)
	-0.2462 Dinflat7391 _t	+0.529 Dy _t	-0.1161 mpyd _{t-1}
	(0.0628)	(0.1053)	(0.02263)
	-0.1879 mp5yd _{t-1}	-0.1442 inflat7391 _{t-1}	+0.5013 d89
	(0.039)	(0.04743)	(0.1365)
	+0.009844 Dnomexchrates_t		
	(0.04992)		

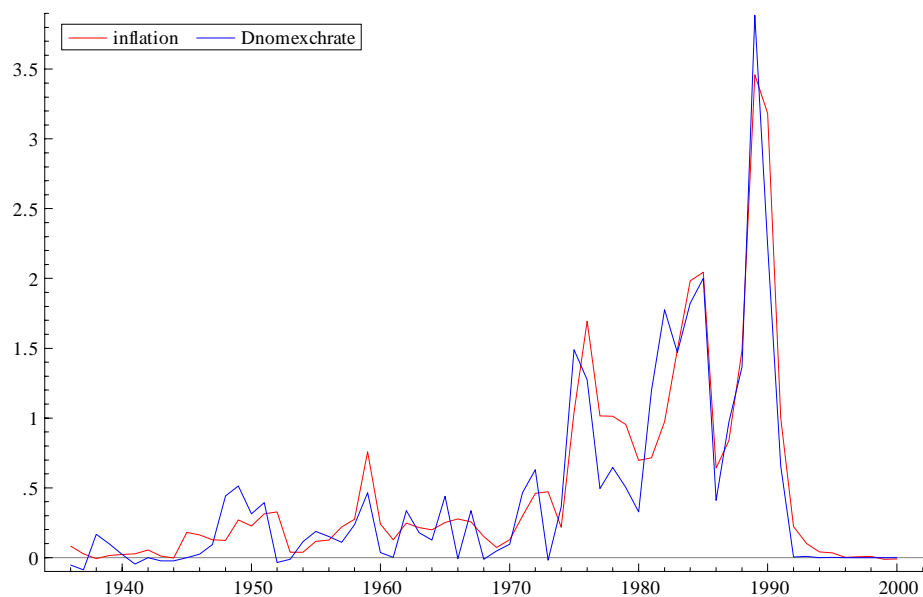
R²=0.730446 F(9,54)=16.259 [0.0000] σ=0.0926093

From these results and the next following recursive graphic it could be concluded that there is no effect of the devaluation rate on real money holdings once the rate of interest and the rate of inflation are alternatively included as opportunity cost. Inflation is the clearest opportunity cost for high and hyperinflation period and the effect of interest rate is detected for stable ones.



Inspection of the next figure also gives similar evidence. For annual data there are no substantial differences in the behaviour of the devaluation and the inflation rates.

Figure 3



As a whole the results show that the model selected appears to be a satisfactory representation of money demand, including being empirically constant over such a long period (1935-2000), during which there were so different economic regimes.

9. Conclusions

This work presented an econometric model of the money demand for Argentina between 1935-2000 based on a simple Cagan like relationship in which real holdings depend on a transaction variable and an opportunity cost. Such a long period for a country with so many different experiences about economic regimes makes that any attempt to look for a stable money demand be a big challenge.

The analysis was focussed on two issues. The first one was to find suitable proxies for both explanatory variables defining money in the narrowest way (as currency). The second one was to study their effects within the sample, in particular given that no long run relationship with transaction could be detected for the whole sample and no constant parameters were found.

A model, which can be considered as a satisfactory approximation to the underlying data generating process of real cash holdings was obtained with the following characteristics. Regarding the transaction or scale variable, it was approximated as total supply of goods, GDP plus imports (although the traditional measure as GDP was also evaluated). For this transaction variable two different long run elasticities were conjectured and not rejected by the data: one for a first period between 1935-1955 and 0.5 for the second, 1956-2000. They can be interpreted as the values from the Cambridge equation and the Baumol-Tobin model, respectively. From the mid-fifties, the period in which Argentina faced the acceleration of inflation until reaching hyperinflation rates, the long run elasticity of transaction would be less than one and therefore, satisfying a necessary condition for a negative distribution effect of the inflationary taxation. Moreover, given such estimates the traditional measure of the shadow economy based on the monetary method needs to be adjusted to take into account such elasticity.

From the analysis of the opportunity cost, it is clear the effect of inflation on real money –both in the long run and the dynamics– since 1973 until 1990. Only for periods of calm in inflation, the interest rate has a significant effect, before the acceleration

process (having only a short run impact) and after the Convertibility regime (only a long run relationship). No additional effect of the depreciation rate was detected, at least using data on annual basis.

Once the two values of the transaction elasticity were taken for the long run relationship and inflation and interest rates alternatively measured the opportunity cost of holding money, the hypothesis of constant parameters are not rejected and therefore a stable money demand can be ex-post obtained for the Argentina case.

Appendix 1: Data definitions and sources

M: nominal currency holdings. Argentine Historical Statistics: 1873-1973, Institute of Applied Economic and ECLAC Bs.As.

P: the price level. General level of consumer prices. INDEC.

Y: real aggregate transactions. Gross Domestic Product plus Imports. ECLAC Bs.As.

Intrate: Interest Rate. Argentine Historical Statistics: 1873-1973, Institute of Applied Economic and ECLAC Bs.As.

Exchrates: nominal exchange rate, US Dollar/\$. ECLAC Bs.As.

Appendix 2: Unit-Root Tests

Serie	ADF(j)
m-p	ADF(1)=-2.291
m-p (1935-1955)	ADF(1)=-0.414
m-p (1956-2000)	ADF(1)=-2.373
y (log(GDP+Imports))	ADF(1)=-0.6332
y(1935-1955)	ADF(1)=-2.413
y(1956-2000)	ADF(1)=-0.4382
π (1973-2000)	ADF(1)=-1.655

All cases include the constant and j indicates the lags of the Augmented Dickey-Fuller (ADF) test. In all cases the null hypothesis of order of integration equal to one cannot be rejected at traditional levels of 1% and 5%.

Appendix 3: The bivariate relationships

Period 1935-1955

The bivariate cointegration analysis between real money holdings¹⁰ and the transaction variable for the period 1935-1955 is presented in the next Table.

(m-p) and y system

1936 to 1955 (1 lag and d48, d4955 and constant unrestricted)

λ_i	Ho:r=p	Max λ_i			Tr		
0.591	p=0	17.9*	16.11	14.1	20.33**	18.03*	15.4
0.101	p<=1	2.13	1.97	3.8	2.13	1.97	3.8

MAX λ_i is the maximum eigenvalue statistic(-Tln λ_i)and Tr is the Trace statistic(-Tln $\Sigma(1-\lambda_i)$) for each statistic the second column presents the adjusted by degree of freedom and the third the 95% (Osterwald-Lenum,1992)critical values (See Hendry and Doornik (1997)).

	α		β'	
$\Delta(m-p)$	-0.89963	-0.70536	1.0000	-0.9377
Δy	0.13084	-0.33669	-0.0003	1.0000

α is the matrix of standardised weight coefficients and β' the matrix of eigenvectors (cointegration vectors and their weights in bold)

LR test(r=1)

Ho: $\alpha_0=0$; Chi²(1) = 7.1552 [0.0075] **

Ho: $\alpha_1=0$; Chi²(1) = 1.1496 [0.2836]

Ho: $\alpha_3=-1$; Chi²(1) = 0.0210 [0.8847]

LR is the likelihood ratio statistics assuming rank =1

Although the long run relationship is clear until 1948, after this year it could appear a transition period, so it was necessary to include the dummies (entering unrestricted in the system): for the year 1948 and a permanent change in the constant term between 1949 and 1955¹¹.

Inspecting the eigenvalues and their associated statistics (Maximun and Trace) for this first period, it can be rejected that the rank is zero in favor of one. Thus, the bivariate

¹⁰ Real cash holdings are net from the dummy variable for the year 1943.

¹¹ A learning function between this period and the following one will be investigated in future versions of the model.

system gives evidence that (m-p) and y have a long-run (cointegration) relationship with coefficient of (1 , -0.94). LR tests also indicate the validity of the conditional demand model.

Period 1956-2000

The bivariate cointegration analysis between real money holdings and the transaction variable for the period 1956-2000 is presented in the following table were several dummies were necessary.

(m-p) and y system

1956 to 2000 (1 lag and d5673,d74,d76,d86,d88,d90 and const unrestricted)

λ_i	Ho:r=p	Max λ_i			Tr		
0.395	p=0	22.64**	21.63**	14.1	24.52**	23.43**	15.4
0.041	p<=1	1.885	1.801	3.8	1.885	1.801	3.8

MAX λ_i is the maximum eigenvalue statistic(-Tln λ_i)and Tr is the Trace statistic(-Tln $\Sigma(1-\lambda_i)$) for each statistic the second column presents the adjusted by degree of freedom and the third the 95% (Osterwald-Lenum,1992)critical values (See Hendry and Doornik (1997)).

	α		β'	
$\Delta(m-p)$	-0.26415	-0.028078	1.0000	-0.63817
Δy	-0.08970	-0.057400	0.52746	1.0000

α is the matrix of standardised weight coefficients and β' the matrix of eigenvectors (cointegration vectors and their weights in bold)

LR test(r=1)

Ho: $\alpha_0=0$; Chi²(1) = 15.732 [0.0001] **
 Ho: $\alpha_1=0$; Chi²(1) = 1.6698 [0.1963]
 Ho: $\alpha_3=-0.5$;Chi²(1) = 0.7052 [0.4010]

LR is the likelihood ratio statistics assuming rank =1

As in the previous system, it can be rejected that the rank is zero in favour of one. Thus, the bivariate system gives evidence again that (m-p) and y have a long-run (cointegration) relationship with coefficient of (1 , -0.64). The estimates of the transaction elasticity can be considered as 0.5. A valid conditional model of demand can be also supposed according to the LR statistics.

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