

Foreign Exchange in Argentina: a seemingly equilibrium relationship?*

by Osvaldo E. Baccino

It is the object of this article to enquire whether the weakness of the peso has actually been removed and there was a movement towards equilibrium or not if one takes into account the experience from the end of February 2002 to mid-April 2003.

When the "Convertibilidad" (currency board system) was through in Argentina in the early days of 2002, a new era of continuous depreciations of the peso seemed to have initiated. In the first months a peculiar and unstable behaviour was observed in the foreign exchange market. The exchange rate started to rise and there was a run against the peso in favour of the US dollar.

The behaviour of the economic agents in the foreign exchange market revealed some serious weaknesses of the domestic currency to perform efficiently the functions of money. The perils of continuous depreciation of the peso plus inflationary escalation were threatening the economy in the course of the first half of 2002.¹

However, at a certain moment the situation was reversed. The peso slowly started to appreciate. Many economic agents recovered their confidence on the banking institutions within narrow limits. Then the economy moved to a quieter situation though most of the relevant economic problems were not solved.

Therefore, the modelling of a previous paper (Baccino 2002) were applied to an extended sample with new data to see how expectations behave upon the basis of forward and spot foreign exchange rate basis. The aim was to see whether present conditions imply a return to stability or a new form of instability.²

Finally, a new attempt to model the spot market in the short run was made to evaluate the main determinants in the period of peso appreciation. This was done through a simultaneous equation model of weekly demand and supply for US\$.

* I am very grateful to Juan Carlos de Pablo for helpful comments.

¹ See Osvaldo E. Baccino (2002), "Foreign Exchange Rate and Risk in Argentina 2002", Asociación Argentina de Economía Política (AAEP); Annals of the 37th Annual Meeting in Tucumán, Argentina (http://www.aaep.org.ar/espa/anales/PDF_2/baccino.pdf). The paper analyses the behaviour of the US\$ market in Argentina for the period extending from December 31, 1997 to the end of March, 2002. The role of expectations in the foreign exchange market was observed through the evolution of the volatility of the forward-to-spot rate ratio. The analysis showed an upward trend in volatility detected long before the currency board system was abandoned. Summing up, there was a clear flight from AR\$ to the US dollar which put in evidence the weakness of the domestic currency.

² The study of the risk components was based on the dynamic performance of the volatility of the ratio of the forward exchange rate to the spot rate. The work followed the steps defined in Baccino (2002). This was done through a GARCH-M model. In addition, one of E. F. Fama's models was borrowed to evaluate the relative weights of the covered interest parity and the expectations about the future spot exchange rate.

In this paper the use of models were directed to describe a changing context rather than forecasting future behaviour. Their predictive power is limited to to a very short time horizon.

The Facts

When the abandonment of the currency board system in Argentina took place in the first week of the year 2002 there was an initial depreciation of the peso in 29% (or what is the same, the price of the dollar in domerstic currency increased in 40%). In this paper the foreign exchange rate is defined as the spot price of the US dollar in terms of Argentine pesos. Later on, the exchange rate mainly experienced two broad kinds of movements. First, the exchange rate fluctuated with an upward trend until mid 2002. Then the trend was reversed and the exchange rate moved downwards with ups and downs.

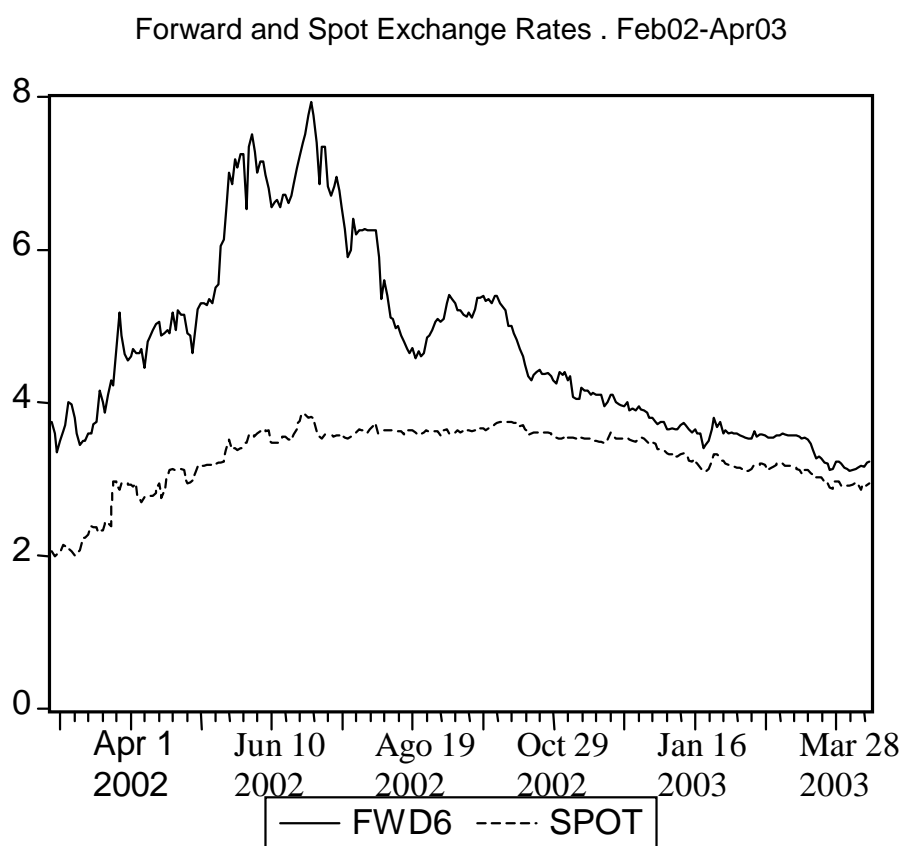


Fig. 1

The figure 1 depicts the forward foreign exchange for contracts with a maturity of six months and the spot rate. The gap between both daily prices was significantly reduced after mid-2002. At first sight, this created the idea that some sort of equilibrium was near and that the Argentine peso was strengthening. This belief was especially expressed by Government officials. This movement contrasted with the previous experience of the market and it became apparent that in the market there was a recovery of confidence,

however other relevant variables in the economy did not react positively in terms of investment and output expansion with lasting prospects.

The financial system was in bankrupt, bank deposit holders were unable to recover the full value of their foreign currency deposits, the “asymmetrical pesoification” implied a direct loss over the banks since they had to recover less than the value previously lent. Some debtors were benefited by this but a new indexation system led to increases in their debts while their incomes were reduced by the depressed economic activity. The tremendous disequilibrium has torn away the system of transactions and the Government only attempted to do patchwork policy. This resulted in increased confusion and lack of confidence in the future of the economy both in the domestic and foreign spheres.

However, the persistence of this gradual movement in closing the gap between forward and spot exchange rates brought forth new doubts about a true convergence to equilibrium. It is clear that the covered interest parity should not converge to unity since there must be a gap between domestic and foreign interest rates. By the time, there was no clear riskless interest rate in Argentina and an estimate for that rate should be considerably higher than the Federal funds Rate used as a foreign riskless rate. The premium had to be considerable. Therefore, the vanishing gap between forward and spot exchange rates became a matter of concern to the observer rather than something to be happy about. It reflected the insignificant operation of the forward market and a decline in the role of risk expectations.

In the second quarter of 2002 there was a slow down in the rythm of peso depreciation. The leak in bank deposits due to the demand for US dollars ended as the deposit freeze regulation was partially removed. People started to accept their circumstances. Although with the discontent of the bank deposit holders since they could not get back the original amounts in foreign currency. There was a lot of legal proceedings initiated to recover their holdings.

From the beginning the economic measures like depreciation of the currency and asymmetrical pesoification worked in absolute disregard of the property rights. Later, the economic economic mesaures that followed from mid 2002 were directed to maintain the current state of affairs, just postponing the solution of the big problems without describing concrete future action to solve them.

In addition, differential export taxes and regulations to force exporters to sell foreign exchange were introduced. Those actions limited the freedom to sell foreign exchange derived from exporting activities. Thus the Government established periods to bring to the foreign exchange market the foreign currency associated with earlier shipments.

The exchange rate seemed to be quiet and people became used to keep cash balances in pesos. In October 2002 the rate of exchange started to move the way down with a definite declining trend. Then the domestic currency started a slow but continuous appreciation process. Then the Government became worried by the gradual appreciation of the peso and induced the central bank to change the direction of its intervention in the market.

Even when there was no clear economic program announced it was clear that the Government was decided to maintain the gap obtained by earlier successive depreciations of the currency. However this aim was very difficult to be fulfilled since the market forces pushed in the opposite direction.

The low level of economic activity implied a strong curtailment of imports and even when exports did not respond much to the exchange rate inducement, the trade balance was positive and remained so for the following months.

Nevertheless, the Argentine economy remained in default of the external and internal debts. Lack of agreement with the IMF implied postponing any attempt to restructure the external debt, while the domestic prices did not catch up with the price of foreign currency. In the meantime debt payments were essentially restricted to operations with the multilateral international financial institutions.

At the end of 2002 in Argentina prevailed two opposite considerations about the current situation. One was the official interpretation of having a successful economic policy which prevented further important depreciation of the peso and the possibility of starting a hyper-inflationary process in Argentina. The other view considered that the little progress towards stability attained by the Government was at the cost of keeping the economy stuck in the depression and in a regulated and arbitrary policy framework even when some slight recovery might take place.

In sum, both approaches were concentrated on different aspects and they did not go very far to settle the question. In fact those views remained mainly in the realm of political controversy. Nonetheless, the results of asymmetrical pesofication remained unsolved. Bankruptcies of different kinds were postponed by law and the economy was still in default with a foreign debt that surpassed the gross domestic product.

Generally speaking when issues of economic policy are discussed the stress usually rests on the flow analysis. This is so when wealth and stock effects are negligible. However, matters of economic policy in Argentina since the beginnings of 2002 must not be treated without direct account of stock problems. The traumatic change produced by the abandonment of the currency board system altered the equity values of the economic agents. Asymmetrical revaluations of assets and liabilities created a tremendous transfer of wealth which by action of the Government were postponed in their results. The legal devices to postpone bankruptcies and the government efforts to solve unpaid sums with new bonds introduced more confusion into the system.

Meanwhile, there was no clear indication about what the final effects of such transfers of wealth were. Income distribution was also altered significantly since depreciation of the peso reduced the incomes of a large part of the population. Creditors do not know if they are going to be paid, debtors also do not know whether they will be able to pay, and many of them do not know how much they will have to pay. Many firms and the financial system also face serious problems with respect to the future.

This lack of definitions affecting stock of wealth, assets and liabilities, are the main determinants of uncertainty and preclude any relevant investment activity.

On the other hand, the responsibility of economic policy kept only concentrated in trade measures and searching ways to tax exporting activities in order to maintain the government expenditures. As a consequence the financial aspects of the economy, particularly those concerned with the external debt did not have much progress.

The sustainable economic program expected by the IMF and foreign creditors was not produced by the Government. The only variable that mainly seemed to call the government's attention was the exchange rate. The economic interpretation of growth in governmental circles seemed to be strictly mercantilist and attached to the idea of allocation of subsidies. This made harder to reach a relevant agreement with the international financial institutions.

The foreign exchange market was never completely left on its own. The central bank sold US dollars in the first stage to prevent the escalation of the exchange rate and later bought foreign exchange in the second stage to curtail the appreciation of the domestic currency. However, the fall in the price of the American currency was not entirely eliminated. The central bank sold dollars during the first half of the year and then it reversed the direction of its operations. Table 1 presents the net sales of foreign exchange of the central bank. Negative numbers express net purchases.

Table 1. Central Bank of Argentina Monthly Net Sales of US\$

Month/Year	Net Sales of forex M. US\$	Month/Year	Net Sales of forex M. US\$
Feb. 2002	611	Oct. 2002	-1710
Mar. 2002	2153	Nov. 2002	-1583
Apr. 2002	1019	Dec. 2002	-1934
May. 2002	2664	Jan. 2003	-1680
Jun. 2002	875	Feb. 2003	-906
Jul. 2002	-433	Mar. 2003	-519
Ago. 2002	-1302	Apr. 2003	-998
Sep. 2002	-218	May. 2003	-2332

Source: Central Bank of the Argentine Republic

In fact, the strong impact that the depreciation of the AR\$ had on the economy at flow and stock levels contradicted the government's view that the country needed a sharp depreciation in the domestic currency to make grow the economy through the expansion of exporting activities. In fact, the exporting sector did not react as much as Government officials expected.

The evolution of the Balance of Payments main accounts shows the improvements in the current account due to trade changes and the decline in the outflow of funds of the Capital account with the resulting increase in foreign reserves of the country. See the Quarterly Balance of Payments for the year 2002 in the appendix A. In the second half of 2002 there was a persistent excess supply of US\$ in the foreign exchange market which pushed the exchange rate downwards. These conditions have been maintained in the following year. The central bank attempted to compensate the flows and continuously made operations in the foreign currency market.

Table 2. Quarterly Changes in International Reserves

Year.Quarter	Change in International Reserves US\$ M	Foreign Exchange Rate. Average \$/US\$	Wholesale Price Index
2001 I	-3886.0	1.00	101.99
2001 II	-1439.1	1.00	101.49
2001 III	-261.5	1.00	100.31
2001 IV	-6496.8	1.00	96.85
2002 I	-2186.6	2.03	120.38
2002 II	-3128.0	3.30	180.10
2002 III	-215.2	3.64	214.93

2002 IV	1014.2	3.57	220.26
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Source: Ministry of Economy of Argentina.

Table 2 shows the quarterly change in international reserves during the years 2001 and 2002. The lower half of the table corresponds to the flexible exchange rate system but also to the Argentina's default of international financial commitments. The wholesale price index moved up but at a lower speed than the exchange rate.

The intense activity of the central bank to compensate markets pressures was not as successful as the Government expected. Nobody could have an idea of mid-term or long-term level for the exchange rate. The responsible for the economic policy presumably thought they could cope with maintaining a "desired" real exchange rate, which seemed to be their goal in determining the changes of domestic monetary system. They entertained the ideas of "over-shooting" and "inflation-targeting". However, the markets' reactions left them without clear ideas about how much command of the situation the Ministry of the Economy really has got.

Forward and Spot Exchange Rates and Risk

The behavioural equations obtained in this study are valid only in the short term and describe features derived from conditions prevailing in a short period of time. Therefore, there is no use to look for specifications that could last for longer periods. The reason is that the conditions (expressed by stock variables) that make the Argentinian economy very unstable are still present and there is no hope that functions valid in the long term could be computed from present data.³

Out of forecasting purposes, the estimates of functions were only valid in a small domain of time are justified because of their descriptive merits. Some characteristic of the moment were reflected by the figures and the model was useful to shed light over the interconnections between variables. A first step in the analysis was to replicate the computation of the specifications of the models of the previous paper with the additional data reaching 15th April 2003.

Here volatility was used as an appropriate indicator to detect noise in the forward-spot differentials as a probable consequence of changes in expectations. As it was said above the forward contract lasts 6 months.

$$\frac{F_t}{S_t} = \frac{[(1+i)(1+\rho)]}{(1+i^*)}$$

³ Regarding the conclusions of last-year paper, it is interesting to look at the whole process with the inclusion of additional recent data. This was done to know if the closer experience modifies the volatility model result. At this stage of the analysis it must be taken into account that the models computed were built for descriptive purposes within the scope of the sample used. By the way, there were no attempts to forecasting. Even when the last-year-paper model of daily spot exchange rate proved to be a very good forecasting instrument for data outside the sample.

where, F_t = forward exchange rate; S_t = spot exchange rate; i_t and i_t^* = interest rates on nominal bonds both domestic and foreign; and ρ_t = risk-premium rate; all variables at time t .

ρ_t describes a rate that reflects the impact of subjective modifications produced in the ratio of forward to spot rates by variables other than those involved in the covered interest parity. Those subjective influences derive mainly from the state of expectations.

(a) Covered Interest Parity and Expectations for the whole extended sample.

According to the previous definition the volatility model reflects changes in the interest rates and in the state of expectations on daily data for the period running from 31Dec97 to 15Apr03.

The distinctive aspect of the analysis of volatilities in $f - s$ (measured these variables in logs) is that volatility here measures the continuous rate ρ_t . This rate ρ_t was considered to vary through time. Sometimes it was high, sometimes it was low. Therefore, this process was supposed to behave like a GARCH model with autoregressive conditional heteroscedasticity. These models are weighted averages of squared ρ_t (measured as continuous rates) and of long term ρ_t -variance. The generalised autoregressive conditional heteroscedasticity model includes in the average a lagged value of the variance.

The parameters obtained are those which maximise the likelihood of the observed outcome. In a GARCH model the variance is usually mean reverting. The variance tends to the long run variance through time if the sum of alpha and beta coefficients is less than one. This condition implies that the model is stable.

In this section, a new model GARCH-M was estimated for $(f_t - s_t)$. Lower case letters for forward and spot rates denotes logs. The data used includes the sample of the previous study plus the information completing the year 2002 and the three month and a half of 2003.

Now the sample consists of 1312 business days. The source was Bloomberg. The forward exchange rate was measured in logs of AR peso per US dollar for 6-month period contract. The forward price was calculated as the log of the average of "bid" and "ask" quotations. The remaining series are provided by the same source and are expressed in their levels.

Foreign and domestic interest rates were described by two proxy variables: the Annual Rate for Investments in Federal Funds), which played the role of the six-month foreign interest rate, and the risk indicator of J.P.Morgan (EMBI), which occupied the place of the domestic interest rate for six-month period. These variables were expected to capture the changes in the foreign and domestic riskless interest rates of USA and the Argentine Republic. It is important to be aware that mainly from 2002 onwards there is no clear indicator of a riskless interest rate in the Argentine economy.

The volatility was measured by the standard deviation varying through time. Like in the previous paper, a model of generalised autoregressive conditional heteroscedasticity seemed appropriate to describe its dynamic behaviour.

The new model has the following mean equation,

$$(f_t - s_t) = 0.129942 - 0.021830 i_t^* + 2.083E-06 EMBI_t + 0.483332 \sigma_t + \varepsilon_t$$

$$\begin{array}{cccc} [10.63261] & [-10.65969] & [326.8291] & [10.93243] \end{array}$$

ε_t is the error with zero mean and variable conditional variance. $\varepsilon_t \sim N(0, \sigma_t^2)$

On the other hand, the variance equation is as follows:

$$\sigma_t^2 = -8.12E-05 + 0.268181 \varepsilon_{t-1}^2 + 0.650952 \sigma_{t-1}^2 + 2.61E-06 t$$

$$\begin{array}{cccc} [-19.71836] & [12.21189] & [63.23990] & [30.14874] \end{array}$$

The coefficients of both mean and variance equations are highly significant and their signs are the expected ones excepting the intercept of the variance equation. The latter has an interconnection with the trend component that in the computation of the model it was not possible to set apart.

This model gave similar results to those provided with identical specification in last-year-analysis (Baccino(2002)). The inclusion of data corresponding to the period Feb02-Apr03 did not alter the main results. Later on, a similar model was computed to capture the particular movements of the exchange rate since mid 2002 until the end of the sampling period.

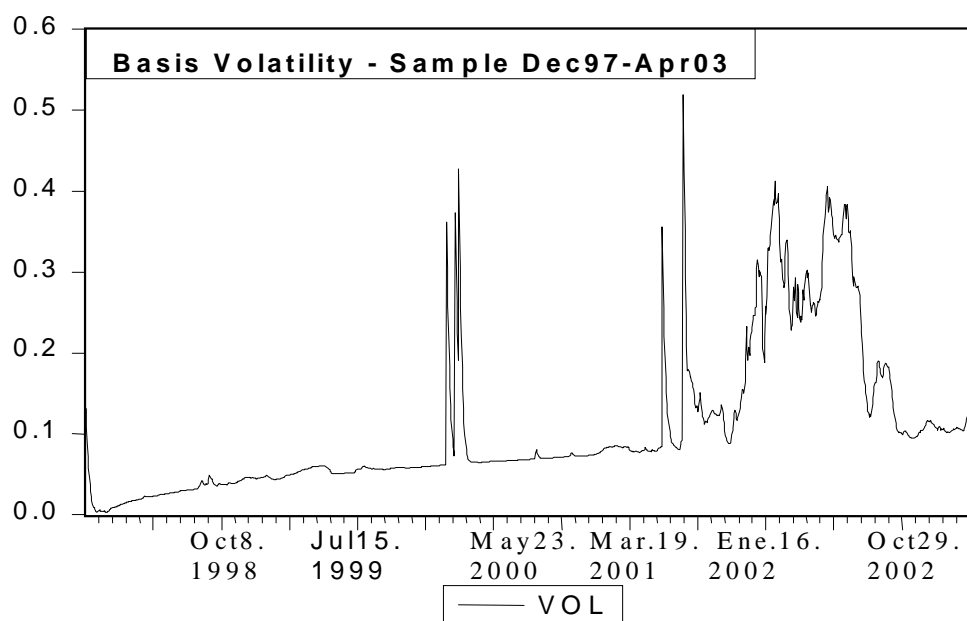


Fig. 2

The volatility of the Covered Interest Parity ratio (in logs) still presents an upward trend for the whole period (see figure 2). The trend now has a lower slope than before. The addition

of new data pushed the coefficient down. In this equation trend and intercepts have opposite meanings. In a GARCH model the constant usually reflects a weight times a long-term-variance and the trend implies that there is no definite long-term-variance. In the last-year-paper the trend coefficient was significant and the constant was not significantly different from zero, then the model chose the trend. In the present case the distinction is not clear. Both effects are mixed and the model could not choose properly. However, a negative intercept though significantly different from zero is meaningless. The trend with a reduced coefficient becomes the relevant parameter though the value of the coefficient may have lost influences attached to the intercepts..

In the table 3 the coefficients of the new and old models can be compared. In almost all cases, the new model have bigger and more significant coefficients in than in the old model. The exception is the trend in the variance equation. .

The model retains its features when the sample was expanded. The inclusion of new data loosened the upward trend in the volatility of the forward and spot exchange differentials but the general characteristics of the process are retained.

Table 3. Comparison of parameters between present model and previous models

Mean Equation	Present Model (Dec97/97-Apr03))		Previous Model (Dec97/97-Feb02)	
Variable	Coefficient	z statistic	Coefficient	z statistic
σ_t	0.483332	10.93243	0.279310	2.259401
$EMBI_t$	2.08E-06	326.8291	0.000142	13.39110
i^*_t	-0.021830	-10.65969	-0.022207	-2.881515
constant	0.129942	10.63621	0.032739	0.667478
Variable	Coefficient	z statistic	Coefficient	z statistic
Variance Equation				
constant	-8.12E-06	-19.71836	0.000154	0.864008
ε^2_{t-1}	0.268181	12.21189	0.150008	4.073765
σ^2_{t-1}	0.650952	63.23990	0.600012	13.84428
trend	2,62E-06	30.14874	4.79E-06	7.855760

So far, the model exposes the dynamic aspects of expectations in a long run process where the departures from the interest covered parity reflects changes of mind regarding the future events in the foreign exchange markets. The risk components kept an increasing trend for volatility through time though it underwent several shocks in any

direction. Even when the new data included corresponded to a process of reversing trends and amplitude of shocks on the forward-t- spot differentials the unstable features of the process remains as a long term characteristic. The fast convergence of forward and spot rates did not alter the existence of a positive trend in volatility though small it shows potential instability in the market.

(b) What about the weights of fundamentals and expected spot rates?

So far, the model described the evolution of volatility through time. Next, it is required to know about how much of the variation corresponds to the relative influence of the covered interest parity elements and of the expectations about the future spot foreign exchange rate.

Like in the previous paper, the relative influences were measured by means of some aspects of Eugene Fama's model (1984).

The method derived from Fama permits to conclude about the importance of covered interest parity and the expectations about the future spot rate under assumptions of rational expectations.⁴

$$F_t = \frac{(1 + r_t)}{(1 + r_t^*)} S_t \frac{(1 + p_t)}{(1 + p_t^*)}$$

Using that method implies decomposing the nominal rates of interest into rates of inflation and real rates, and introduce the assumption of purchasing parity theory to link inflation to exchange rates. The above expression becomes,

$$F_t = \frac{(1 + r_t)}{(1 + r_t^*)} S_{t+k}^f$$

where the rational and efficient forecast made by the market about the future spot exchange rate at time t+k is denoted by S_{t+k}^f .

Fama considered the variables in logarithms in order to overcome problems of monetary definitions of the exchange rates. His equations are

$$\begin{aligned} f_t &= E(S_{t+k}) + P_t \\ f_t - s_t &= P_t + E(s_{t+k} - s_t) \end{aligned}$$

Fama used two regression equations. One relates the forward-spot differential at

⁴ Fama constructed a model to measure the role of interest rate differentials and the error of forecast in the variation of the gap between forward and spot exchange rates. He decomposed the f – s (in logs) variance through the estimation of two regression lines. The latter meets the condition that the sum of regression coefficients equals 1 and the sum of the corresponding intercepts equals zero. The sum of the respective residuals equals zero for any t.

maturity ($f_t - s_{t+1}$) to the current forward-spot differential, ($f_t - s_t$); and the other associates the future change in the spot rate, ($s_{t+1} - s_t$) to the current forward-spot differential.

The application of Fama's model to the data base used in this study provides the following results

$$f_{t-180} - s_t = -0.111596 + 0.313735 (f_{t-180} - s_{t-180})$$

[-8.212654] [5.500444]

R2 = 0.026976 F = 30.25488
N obs. = 1132

$$s_t - s_{t-180} = 0.111596 + 0.686265 (f_{t-180} - s_{t-180})$$

[8.212654] [12.03168]

R2 = 0.113560 F = 144.7613
N obs. = 1132

Fama's equations gave evidence that expectations about the future spot exchange rates from the market is more important when the new data is added to the sample used in the previous paper. For the whole period under analysis a 69% of the variance of $f_t - s_t$ (in logs) corresponds to the expectation of future spot exchange rate. Before, the participation of that variable was the 42%.⁵

Both the GARCH-M model and the Fama's regressions show that the general features observed in the previous analysis hold on in the present analysis with the expanded sample. The evolution of the forward-spot differential still reflects the weakness of the domestic currency and the absence of a long run equilibrium in the foreign exchange market in spite of the recent convergence between forward and spot exchange rates. The disturbance factors still rests on the expectations of the future spot rate. As a consequence of that there is no stable prospect about what an equilibrium level for the exchange rate will be in the future.

The Analysis of the Sub-Period 19 Feb 2002-15 Apr 2003

Now it has been decided to detach the new data from the past and to focus on the behaviour of ($f_t - s_t$) in the period 19 February 2002 to 15 April 2003, by using similar tools as it was done for the whole extended sample.

This analysis cannot be considered as a part of the one made above because the sample is considerable shorter. The purpose is to analyse the dynamic behaviour in a shorter period. Therefore, the specifications of the model might be fundamentally different. Then it will be useful to consider a behaviour in isolation of the links with the past that brings the former model GARCH-M.

By the way, in order to focus the problem in a shorter period a new model was specified on the basis of an exponentially weighted moving average (EWMA)⁶ of the form,

⁵ Fama defined $\beta_1 = [\text{var}(P_t) + \text{cov}(P_t, E(S_{t+1} - S_t))] / [\text{var}(P_t) + \text{var}(E(S_{t+1} - S_t)) + 2\text{cov}(P_t, E(S_{t+1} - S_t))]$. On the other hand, $\beta_2 = 1 - \beta_1$. See Fama (1984).

⁶ Hull, John C., (1999).

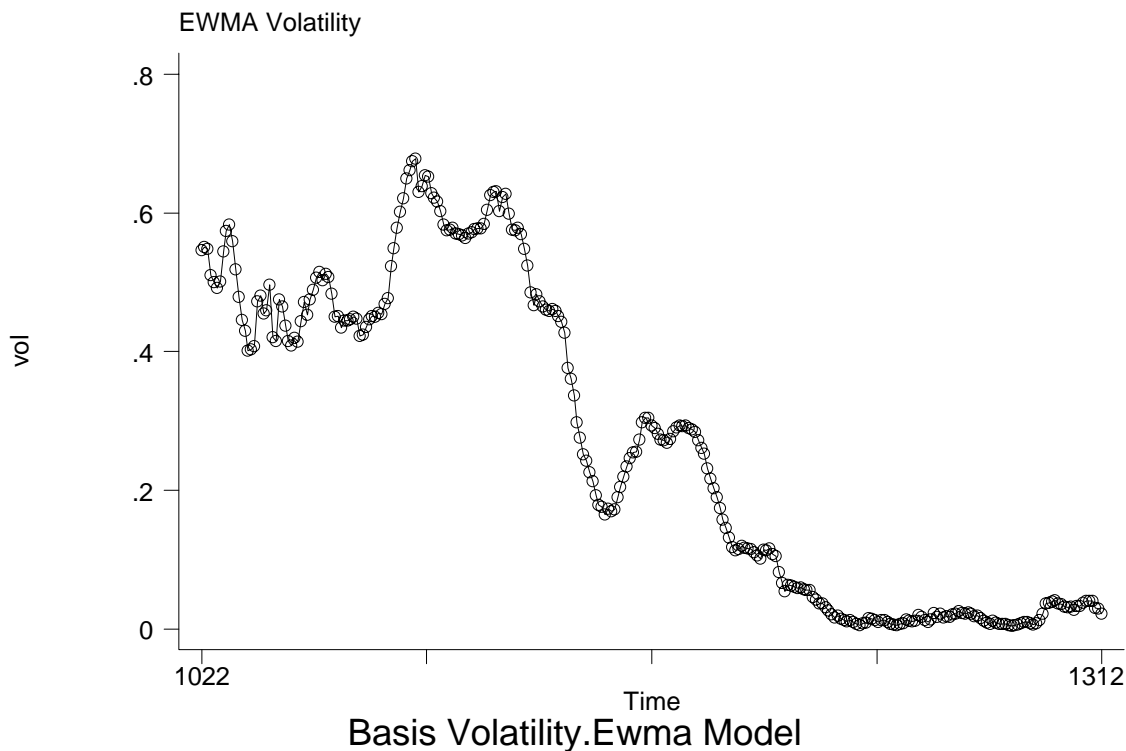


Fig. 3

The exchange rate market underwent a period where its main sources of demand and supply were partially inactive. As it was mentioned before, most of the normal demand for foreign exchange to meet imports and to make payments of financial commitments abroad was lacking. The persistent economic depression under default conditions and lack of definition on part of the government to generate a feasible economic program had negative influence in investment and this also was reflected in the performance of the foreign exchange market. As a consequence of this situation the forward market became meaningless.

This conduct in the short term was not sufficient as to change the long term behaviour depicted before for the whole sample.

Summing up, this part of the analysis states that in the appreciation-of - the-peso period there is a minor role of expectations regarding the future level of the exchange rate. This seems rather obvious. The convergence between forward and spot prices gives an idea of the loss of relevance particularly of the forward market.

The Spot Exchange Rate: Demand and Supply

Once discarded the influence of expectations about the future level of the spot exchange rate, one has to concentrate on the spot market itself. The aim was to identify both demand and supply of US\$ in the short run (say a week).

So that a model of simultaneous equations was built for the period running from June 2002 to mid-Apr 2003 to estimate the weekly demand and supply of US dollars in Argentina.

The objective was to consider the period of continuous appreciation of the peso. The endogenous variables were the spot exchange rate and the volume of weekly transactions taken from the central bank's operations.

The experience of the foreign exchange market from the start of 2002 until the end of February of that year was already described in Baccino(2002). Then, the determinant other than the exchange rate was the current bank deposits in domestic currency. The model showed a clear trade-off between banks deposits and demand for US dollars.⁷

Since June 2002 the roles of determinants of demand and supply of foreign exchange were modified in a more normal way. So, the specifications had to be changed. The perverse relationship between bank deposits and demand for US dollars almost disappeared and a different scheme prevailed. Demand was receiving influence from the exchange rate, the level of economic activity, and also from the bank deposits in domestic currency. On the other hand, supply was influenced by the exchange rate and the revenue obtained by exporters.

A new 3SLS model was constructed to determine linear weekly demand and supply for foreign exchange.⁸ The exogenous variables were: index of economic activity, Bank deposits in AR\$, trend, and sales of foreign currency from lagged exports. The sample included data from the start of the second week of June 2002 to the end of the fourth week of March 2003.

The new model had a completely different specification from the old one owing to the change in the conditions of the market. It included the impact of current monthly economic activity and other factors that were grouped in a trend variable. There were also changes in the way to treat the data since the compensations policy of the central bank offset the private sector behaviour. That is why in the new version of the model the volume of transactions had to exclude the central bank both as a buyer and as a seller otherwise the private behaviour could not be clearly detected.

The volumes of foreign exchange being transacted in the week were captured from the purchases and sales from the central bank. In the previous paper demand and supply included the central bank as another participant of the market because it did not obliterate the private transactions. In the present model the only transactors considered exclude the central bank. As a consequence the behaviour observed cannot be applied to the central bank.

Therefore to exclude the central bank from the transactions then the lower magnitude had to be chosen between its purchase and sale of foreign currency per week. In this way the

⁷ The model for the spot exchange rate constructed in Baccino(2002) was relevant in the first quarter of 2002. That was a short-term model that described the anomalous behaviour of economic agents trying to run from domestic currency to foreign currency. In the following months the exchange market operated under different conditions determined in part by economic policies and in part by reaction of the economic agents. Therefore, the new model described the new conditions ruling in the period running from the second week of June 2002 till the end of March 2003.

⁸ The model's structural parameters were estimated simultaneously applying generalised least squares to the set of relations. This method has similarities with the method of full information maximum likelihood to the extent that the structural disturbances matrix is not diagonal. Zellner and Theil (1962). The parameters are more efficient than those estimated by two-stage least squares.

compensatory operations of the central bank were kept out of the model.

Three-stage least squares regression equations were computed to get more efficient estimators.

The first equation, shown below, corresponds to the demand function and the second equation refers to the supply price of foreign exchange function - the inverse supply function.

$$D_t = -558.8179 \pi_t + 9.447478 Y_t - .0118015 DEP_t - 8.47726 \text{ trend} + 2400.962 + \varepsilon_t$$

[-2.75] [2.45] [-0.93] [-2.79] [1.93]

$$\pi_t = .0032385 S_t + .0019544 X\text{revenue}_t - 2.082776 + \eta_t$$

[2.97] [3.52] [-1.39]

$$D_t = S_t$$

The three-stage least squares regression fit had the following features:

Equation	Observations	Parameters	RMSE	Chi ²	p
$D_t = S_t$	39	4	76.3593	17.36079	0.0016
π_t	39	2	.290097	13.91059	0.0010

where,

D_t = Demand for US dollars

S_t = Supply of US dollars

π_t = Exchange rate (AR\$/US\$)

Y_t = Index of economic activity

DEP_t = Bank deposits in AR\$

trend = trend (from 18 = June.2nd week; to 56 = March.fourth week)

$X\text{revenue}_t$ = exporters' revenue in foreign exchange for shipments made three months before.

ε_t , η_t are stochastic terms. The figures between brackets are z-statistics corresponding to each coefficient.

The volume of foreign exchange transacted in a week was denoted by $D_t = S_t$. This variable was measured in millions of US\$. The price of the US\$ was the weekly average of daily components.

The influence of economic activity was captured by Y_t and it was represented by the monthly index of economic activity published by the Board of Statistics and Census (INDEC). The value of this monthly variable was repeated in each week of the month. The reason of this treatment rests on that any way of distributing the index on a per-week basis seemed equally artificial.

Another newly introduced variable in the model is the estimate of export values to be

converted in peso, $X_{revenue_t}$, (measured in millions of US\$). This variable was constructed by lagging the monthly value of total exports in US\$ for a period of three months. The Government compelled the exporters to exchange their export revenues for AR\$ within a given time period. Otherwise penalties were applied. The "obligation to sell foreign currency" periods had different lengths according to the productive sector. After several tests the average period was 90 days was assumed to collect the whole revenue of a month's exports. This figure was considered to define $X_{revenue}$ variable. The application to weekly data was similar to the treatment of the economic activity variable.⁹

The coefficients of the demand function show that economic activity has a positive impact on the demand of foreign exchange. This is so because an increase in economic activity produces an increase in imports. Bank deposits in domestic currency has a negative coefficient thus showing a trade off between deposits and demand for foreign currency. However, this coefficient is not significantly different from zero, so that this variable has no relevant influence on demand of foreign exchange. There is also a negative trend in demand which might represent the influences other variables, presumably indicating the postponing of transfers abroad under default conditions. Finally, the coefficient of the foreign exchange rate is negative and very significant thus showing the inverse relationship existing between demand and the price of the US dollar.

On the side of supply, the coefficient of the spot rate is positive as expected and also very significant. The surprising result is the sign of the coefficient of $X_{revenue}$. A positive coefficient with respect to the foreign exchange rate implies a negative coefficient with respect to the quantity of dollars supplied. The variable $X_{revenue}$ describes the average revenue expected to be transformed into pesos in the current month according to the average time limit imposed by the government. At first sight a negative coefficient would be expected just meaning that the bigger revenue to be exchanged for pesos the larger the current supply of dollars and the lower the price of foreign currency. However, a positive coefficient is consistent with a particular behaviour on the part of the exporters.

The highly significant coefficient of $X_{revenue}$ expresses a very important relationship. The positive coefficient also admits a very interesting explanation in theoretical terms. When exports' revenue rises the exporter do not send all US dollars to the market. He decides to retain a part of it for himself for a time. This attitude implies to offer dollars at a higher supply price. On the other hand, when the revenue is small the exporters get rid of their holdings thus expanding the foreign currency supply.

This behaviour implies a particular demand for liquidity in foreign exchange for precautionary purposes. Under this scheme, the exporters cover themselves against the uncertainty surrounding the future value of the domestic currency. In fact, the Government has explicitly forced the exporters to convert their foreign currency receipts into AR\$ during the second quarter of 2002. Later on, the Government extended the time limits of that conversion to offset the appreciation of the peso.

⁹ Different alternatives were computed upon the basis of different lags applied to current exports. The case where most variables have significant coefficients - and also the coefficient for $X_{revenue}$ is also highly significant - corresponds to lag = 3. Larger lags imply positive coefficients for $X_{revenue}$ in the model. No lags lead to a negative coefficient. These extremes blur the role of other variables' coefficients which become not significant.

The positive sign of the coefficient in the foreign exchange supply function cannot be used as a proof of this point but the interpretation looks plausible and states the need of further study outside the scope of the present model. The reluctance to undersell the foreign currency obtained is always present in the course of 2002 and 2003. However, these aspects coexist with a persistent excess supply that generates a continuous and slow appreciation of the peso.

Under demand and supply conditions prevailing in the market the impact of exogenous variables on the endogenous ones can be seen through the coefficients of the reduced system of equations of the model.

Table 4. Reduced Matrix of the D-S model of Weekly Foreign Exchange

	Y_t	DEP_t	trend	$Xrevenue_t$	Constant
$D_t = S_t$	3,362446127	-0,004200268	-3,01713637	-0,3887038	1268,765185
π_t	0,010889114	-1,36024E-05	-0,00977085	0,000695582	2,026056813

The values of the endogenous variables -both observed and fitted- and the residuals are shown in the Appendix B.

In order to close the picture it is interesting to see the type of operations involved in both demand and supply of dollars in the years 2002 and 2003. The figures of Table 5 though they compare two years with different numbers of months are useful to describe the factors underlying demand and supply of foreign exchange.

Table 5.a Main Determinants of the Weekly Demand for US\$

Year	Goods	Services	Income	Transfers
2002	46.3%	13.1%	5%	35.6%
2003	49.5%	14.5%	11.2%	24.7%

Table 5.b Main Determinants of the Weekly Supply of US\$

Year	Goods	Services	Income	Other Transfers
2002	91.3%	7.7%		1.0%
2003	88.8%	10.5%		0.1%

Source: Central Bank of the Argentine Republic (website).

Looking from the side of demand for foreign exchange, the year 2003 showed an increased participation in the total demand for foreign currency the motives of purchasing goods and services and income payments abroad. On the contrary transfers for capital decreased relatively due to default intensification.

On the supply side, exports of goods lost importance in the relative generation of foreign exchange supply. Services increase its share while other transfers declined very sharply.

These observed characteristics were consistent with the behaviour described by the model.

The period of slow appreciation of the peso was characterised by the a period where the shrink in demand prevailed over the limited availability of foreign currency produced by current exports. The rate of appreciation, which could not be offset by an increasing participation of the central bank as a buyer of US dollars was kept low by the transitory recovery of economic activity.

This experience looks like a mirror image of the process observed in the first months of 2002 studied in Baccino (2002). However, it shares with the latter the unstable character regarding the future. No trend to equilibrium can be detected. Only adjustments to the current conditions. Uncertainty prevails. The short-term speculative actions were replaced with increasing precautionary attitudes of those who bring foreign currency to the country.

The model computed is also valid only in the short run as it is mainly determined by existing conditions in the economy. Those conditions are not likely to be maintained in the long run. These models are used for describing different conditions of operation of the market. The conditions are defined by changes in the relevant variables influencing demand and supply.

Conclusions

There is no way to imagine the future without clear answers about the payment strategy of external debt and this is not possible in as much a sustainable economic program is not defined. The relationship with the rest of the world is essential to attain a picture of what the future will mean for Argentina. In the meantime, disequilibrium will persist and so uncertainty.

As far as the exchange rate is concerned, the main conclusions about the process that started in the middle of 2002 are not very different than those derived from the older model constructed for the period ending in the first quarter of 2002. Moreover, the foreign exchange rate did not seem to move towards a stable equilibrium. The economic depression plus the results of economic policy – the latter did not eliminate the remaining state of uncertainty - continued affecting negatively the economic decisions.

The main characteristic of the foreign exchange market in Argentina was the risk component which developed from the beginnings of 1998 until now. The ratio between forward and spot exchange rates kept a rising trend. This is so even with the ups and downs of the evolution of the market. The risk component in the long run has an important memory. This was more visible in so far the economic depression goes on, the lack of adequate economic policy creates more problems, and the inability to meet financial commitments abroad persists.

Looking at the process in the absolute short-period occurrence, the risk elements seem to disappear but the relationship between forward and spot exchange rates also become artificial too. However, uncertainty mainly reappears in the behaviour of demand and suppliers withholding dollars.

In the second semester of 2002 the forward market lost significance since the intervention of the Government maintained the exchange rate within narrow limits. The market was far from functioning freely and the exchange rate showed the impact of the active policy to counteract the appreciation of the peso.

The narrowing of the differential between forward and spot rates looked excessive. Also implied a departure from the fundamentals. The role of the latter reappeared in an ambiguous form since there was no clear idea about what a risk-less interest rate was for Argentina.

The weakness of the Argentine peso came out under the form of precautionary motives to keep monetary balances in foreign currency. The continuous decline in imports based in the higher costs of imported goods was understood as a step towards import-substitution. However, the postponement of spending on imported goods, together with a sluggish investment reflected uncertainty in the market.

The evolution of flow variables were still dependent upon the solution of serious stock problems related to indebtedness and inability to pay. The financial system is an example of structural weaknesses yet unsolved.

Under these conditions, it is very hard to say what will be the future path of the exchange rate. The ghosts of inflation and a rising price for the US dollar are threatening the economy again,

Appendix A:

Balance of Payments (millions of US\$)

	Year 2002			
	I Quarter	II Quarter	III Quarter	IV Quarter
Average Spot Rate of Exchange (AR\$/US\$)	2.04	3.28	3.62	3.56
Current Account	1,589	2,682	2,520	2,163
Goods	3,736	4,670	4,450	4,027
Exports (fob)	5,684	6,701	6,612	6,355
Imports (fob)	1,948	2,031	2,162	2,328
Services	-549	-386	-320	-248
Income	-1,664	-1,688	-1,694	-1,776
Current Transfers	67	85	84	160
Capital y Financial Account	-3,024	-4,944	-2,210	-1,261
Capital Account	3	17	19	9
Financial Account	-3,027	-4,961	-2,229	-1,270
Net Errors and Omissions	-752	-866	-525	112

Change in International Reserves (-)	-2,187	-3,128	-215	1,014
International Reserves in the BCRA	-2,133	-3,150	-226	1,072
Adjustment for exchange rate changes(-)	54	-22	-11	58

Source: Ministry of Economy of Argentina

Appendix B

Values of the Endogenous Variables of the Weekly Spot Exchange Market. Observed and Fitted (M US\$ for $D_t = S_t$, and AR\$ for π_t)

Week	Observed		Fitted		Residuals	
	$D_t = S_t$	π_t	$D_t = S_t$	π_t	$D_t = S_t$	π_t
Jun.II	511,00	3,49	516,47	3,62	-5,47	-0,12
Jun.III	393,69	3,57	513,45	3,61	-119,76	-0,04
Jun.IV	583,16	3,82	510,44	3,60	72,72	0,22
Jul.I	465,40	3,62	482,99	3,67	-17,59	-0,06
Jul.II	529,37	3,57	479,97	3,66	49,39	-0,09
Jul.III	623,39	3,57	476,96	3,65	146,44	-0,09
Jul.IV	546,77	3,66	473,94	3,65	72,83	0,01
Ago.I	385,71	3,63	384,21	3,74	1,50	-0,11
Ago.II	403,01	3,62	381,19	3,73	21,82	-0,11
Ago.III	389,84	3,62	378,17	3,72	11,66	-0,10
Ago.IV	386,42	3,62	375,16	3,71	11,27	-0,10
Sep.I	414,41	3,62	420,49	3,60	-6,07	0,01
Sep.II	282,93	3,63	417,47	3,59	-134,54	0,03
Sep.III	380,31	3,65	414,45	3,58	-34,14	0,06
Sep.IV	392,94	3,68	411,43	3,57	-18,49	0,11
Oct.I	377,12	3,75	409,94	3,57	-32,82	0,18
Oct.II	290,29	3,71	406,92	3,56	-116,63	0,16
Oct.III	417,88	3,61	403,90	3,55	13,97	0,07
Oct.IV	380,73	3,59	400,89	3,54	-20,16	0,05
Nov.I	282,00	3,54	410,44	3,45	-128,44	0,09
Nov.II	416,81	3,54	407,43	3,44	9,39	0,10
Nov.III	308,79	3,52	404,41	3,43	-95,62	0,09
Nov.IV	339,32	3,51	401,39	3,42	-62,07	0,09
Dic.I	369,24	3,54	358,88	3,48	10,36	0,06
Dic.II	393,80	3,51	355,86	3,47	37,94	0,05
Dic.III	374,37	3,50	352,84	3,46	21,53	0,04
Dic.IV	236,79	3,41	349,83	3,45	-113,03	-0,04
Ene.I	174,84	3,32	321,53	3,31	-146,69	0,01
Ene.II	426,75	3,31	318,51	3,31	108,24	0,00
Ene.III	437,37	3,19	315,50	3,30	121,88	-0,11
Ene.IV	497,75	3,23	312,48	3,29	185,27	-0,05
Feb.I	322,14	3,16	333,82	3,22	-11,68	-0,06
Feb.II	356,22	3,13	330,80	3,21	25,42	-0,08

Feb.III	333,96	3,19	327,79	3,20	6,17	-0,01
Feb.IV	416,68	3,17	324,77	3,19	91,92	-0,02
Mar.I	380,74	3,18	432,40	3,15	-51,66	0,03
Mar.II	456,09	3,11	429,39	3,14	26,71	-0,03
Mar.III	441,97	3,04	426,37	3,13	15,60	-0,09
Mar.IV	470,32	2,94	423,35	3,12	46,97	-0,18

Note: Built with Data from Central Bank and Ministry Of Economy of the Argentine Republic

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