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Abhandlungen

Offsetting and Sterilization Mechanisms in Argentina (1992–2014)

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Abstract

We test the existence and extent of capital flows as an offset to monetary policy in Argentina from 1992–2014. After providing an analysis of Argentina's past and current economic conditions, a theoretical framework of the offset and sterilization mechanisms will be provided. Then, with the use of VAR and IRF analysis, it is shown that a one standard deviation shock to monetary policy (measured by changes in net domestic assets) is offset between 27 %–32 % by responsive capital flows (measured by changes in net foreign assets). Furthermore, the results indicate that the Argentine government more than sterilizes shocks to capital flows through compensation of expansionary monetary policy.

Offsetting- und Sterilisationsmechanismen in Argentinien (1992–2014)

Zusammenfassung

Wir testen die Existenz und das Ausmaß von Kapitalflüssen, welche in Reaktion auf Änderungen der argentinischen Geldpolitik der Jahre 1992–2014 entstanden sind und diese konterkariert haben. Nach einer kurzen Analyse der aktuellen und vergangenen ökonomischen Situation in Argentinien stellen wir ein theoretisches Modell zu Offsetting- und Sterilisationsmechanismen vor. Im Anschluss zeigen wir mit Hilfe einer IRF Analyse und einem VAR-Modell, dass eine Veränderung der Geldpolitik um eine Standardabweichung (gemessen als die Veränderung des inländischen Nettovermögens) durch entgegenwirkende Kapitalflüsse (gemessen als die Veränderung des Nettoauslandsvermögens) um 27 %–32 % abgeschwächt wird. Des Weiteren zeigen die Ergebnisse, dass die argentinische Regierung Kapitalverkehrsschocks durch expansive Geldpolitik nicht nur ausgeglichen sondern überkompensiert hat.

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I. Introduction

In this paper we study the Argentine offset and sterilization mechanisms between 1992 and 2014. There are two reasons why this study is of interest. First, as far as we can tell, there are no studies on this subject for Argentina. The only exception we can point out is *Aizenman* and *Glick* (2009); different to their study, we use a vector autoregression (VAR) model to produce impulse response functions (IRF). Second, our time period covers a number of years before and after the 2001 Argentine financial crisis and therefore we can compare the monetary policy before and after the crisis. Both before and after the crisis we see the effects of a de facto versus de jure monetary policy. Particularly, during the 1990's Argentina had a heterodox currency board. After the 2001 financial crisis, Argentina moved to a dirty floating exchange rate regime.

As an approach to balance of payments, monetary policy understood as changes in money supply is effective inasmuch as the amount of monetary expansion that is not offset by capital outflow. We find that a change in Net Domestic Assets (*NDA*) is offset in the first two quarters by 27 %–32 % through movements in Net Foreign Assets (*NFA)*, and that the central bank more than sterilizes to compensate. We argue that these results are consistent with Argentine monetary policy between 1992 and 2014.

In the next section we lay out key aspects of the recent economic history of Argentina to contextualize our research. In the third section we offer a literature review of the offsetting mechanism and sterilization policies. In the fourth section we explain and show our empirical approach. Section five concludes.

II. Recent Historical Events in Argentina

When Carlos Menem became President in 1989, he inherited an economy with hyperinflation, closed to international trade, and limited access to international financial markets. Probably more due to necessity than conviction, Menem carried out reform policies to achieve economic stability. Among many reforms, the privatization of many public service utilities and the creation of a more open economy stand out. Another reform, most relevant to this topic, was the switch to a currency board in 1991 enacted by the "Ley de Convertibilidad" [convertibility law].

An orthodox currency board arrangement is an extreme form of an exchange rate peg where the nation fixes the exchange rate of its currency to a foreign cur-

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rency. But it requires that the nation's money supply be 100 percent backed by foreign reserves to ensure unlimited convertibility.[1] In the case of Argentina, the Menem administration created a one-to-one pegged exchange rate to the U.S. dollar that lasted until the end of 2001. However, the currency board of Argentina was *not* an orthodox currency board arrangement because it did not observe the 100 percent backing in foreign reserves and because the pass through of monetary policy, change of monetary base over change in reserves, was not as required as in an orthodox currency board arrangement (*Cachanosky* & *Ravier*, 2015; S. *Hanke*, 2002). This second condition is the one that limits the possibility to perform monetary policy by the central bank. By deviating from this requirement, the central bank of Argentina (BCRA) had some discretionary authority to perform monetary policy to a limited extent. S. *Hanke* (2002) points out that it was when Argentina deviated from the rules of an orthodox currency board, for instance after Mexico devalued its currency in December 1994, that it suffered speculative attacks against the Argentine Peso.

The purpose of the pegged exchange rate was to create a strong currency that reduced inflation, and encouraged exports and capital inflows. As it turned out, the currency board did help combat inflation, bringing it from a rate of 3,000 % in 1989 to 10.6 % in 1993. Also, GDP grew by 36 % from 1991 to 1995. Even though exports of goods and services also grew during this period, imports increased faster creating large current account deficits (*Beker*, 2012). As for capital flows in the 1990's, there appeared to be a significant relationship between Argentina's GDP growth and capital inflows, as both variables moved in the same pattern. After a disruption from the Mexican Tequila crisis of 1995, both capital inflows and GDP quickly recovered and increased further up until 1999 when both started to decline rapidly at the onset of an economic crisis (*Lacoste*, 2005). The economic crisis of 1999–2002 was the largest recession ever recorded in Argentine history, causing the abandonment of the currency board arrangement and a $132 billion default on foreign debt.[2]

After abandoning the currency board in 2002 caused a 236 % devaluation rate of the Peso against the US dollar, Argentina switched to a managed floating exchange rate system in order to control the depreciation by making imports seem artificially cheaper than their real value, and exports artificially more expensive.

[1] More precisely, the reserves backing the domestic currency could be between 90 % and 110 %.

[2] There are different explanations to the 2001 Argentine crisis and default. Structural fiscal deficits (*Cachanosky* & *Ravier*, 2015; *Guido* & *Lazzari*, 2003); an overvalued Peso that harmed exports and therefore produced a shortage of reserves to pay government debt (*Kulkarni* & *James*, 2009); and the BCRA's contractionary monetary policy that began in 1998 coupled with tax increases in 2000 that failed to reduce the fiscal deficit (*S. H. Hanke* & *Schuler*, 2002; *Kaminsky*, *Mati*, & *Choueri*, 2009). It should also be noted that Argentina was also affected by the Russian and Brazilian crisis in the late 1990s.

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Despite what looks like a surprising recovery after the 2001 crisis, Argentina is now again in a delicate economic situation, arguably in stagflation since 2013. Since Néstor Kirchner became President in 2003, and replaced in office by his wife, Cristina Fernández de Kirchner, in 2007, the exchange rate has depreciated less than the rate of Argentine inflation minus U.S. inflation by means of a dirty floating exchange rate system. A misalignment between official and estimated exchange rates begins as inflation rises in 2007. The exchange rate spread between the official and black markets was about 65 % in August 2015 (*Thomas* & *Cachanosky*, 2015). Contributing to high inflation, monetary policy was expansionary, especially since 2007, but to monetize the fiscal deficit, not as a means to stimulate the economy.

Starting in 2009, there was evidence of capital flight and a run on foreign reserves. To fight depleting foreign reserves, the Argentine central bank would buy incoming USD but issue only the depreciating currency. In 2011, the administration of Cristina Kirchner prohibited access to US dollars by controlling imports and restricting foreign investment by domestic residents. There was no official law ever passed in 2011, but Argentines were required to ask permission to the tax agency to buy USD and were only granted certain amounts based on their income. The capital controls were ineffective, as shown by the continuation of dwindling foreign reserves, because of a lack of incoming USD from foreign investors. By examining the offset and sterilization mechanisms we evaluate the effectiveness of Argentina's *de facto* monetary policy as an approach to balance of payments.

III. Offsetting and Sterilization: Literature Review

The offset mechanism can be defined as the extent to which capital flows cause an offset to monetary policy by changing foreign reserves. A monetary authority's decision to change money supply is accompanied by a change in domestic interest rates, which impacts domestic and foreign investment, and therefore foreign reserves. The extent of the offset mechanism depends on the country's level of capital mobility. With high capital mobility, the likelihood of repatriation of assets is higher and therefore more likely to stem capital flows. Lower domestic interest rates in comparison to foreign interest rates would stem capital outflows from the domestic nation, as investment in foreign nations would give better returns. The offset coefficient can be interpreted as the amount of decline in foreign reserves (measured by changes in net foreign assets–*NFA*) due to an increase in domestic reserves (measured by changes in net domestic assets–*NDA*). One important responsibility of central banks is to observe fluctuations in foreign reserves because the effectiveness of monetary policy in an open economy setting severely depends upon its offsetting forces. The offset mechanism can be expressed in the following way:

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$$\Delta NFA = \alpha_1 \cdot \Delta NDA + \alpha_2 \cdot X$$

where α_1 is the offsetting coefficient and X is a set of other economic variables that affect the interaction between ΔNFA and ΔNDA.

The sterilization process is the deliberate policy response or action by monetary authorities to mitigate foreign reserve oscillations. Sterilization can be used when there is a threat of depreciation to the domestic currency. In such a case, the central bank will use foreign exchange intervention to sell their foreign assets and sterilize its effect of a reduction in foreign reserves by purchasing domestic assets in order to expand the domestic reserves. In effect this will protect the price of the domestic currency by replacing the high-yield assets with low-yield assets. Conversely, the government may try to reduce the value of their appreciating domestic currency by purchasing foreign assets and selling domestic assets. The effectiveness of monetary policy is determined by the offsetting effect of capital flows on foreign reserves, and the sterilization process is a foreign exchange intervention that attempts to uphold the effectiveness of monetary policy. The degree of sterilization can be represented with the following expression:

$$\Delta NDA = \beta_1 \cdot \Delta NFA + \beta_2 \cdot Z$$

where β_1 is the degree of sterilization and Z is a set of economic variables that have an effect on the interaction between ΔNDA and ΔNFA.

Some studies that test sterilization are interested in not only its level of effectiveness to mitigate capital offsets, but also in its relationship to capital mobility and interest rate differentials across regions. Specifically, (*Cavoli* & *Rajan*, 2006; *Moreno*, 1996) study Asian economies prior to the financial crisis of 1997–1998 and found almost complete sterilization intervention and perfect capital mobility in each of the economies. This tells us that even with complete sterilization, the monetary authorities' intervention over domestic credit may not be sufficient to prevent crises caused by changes in foreign assets.

Offset and sterilization coefficients are between (0) and (–1). An offset coefficient closer to (–1) indicates higher capital mobility and less effective monetary policy because an increase in domestic money supply would be completely offset by decease in foreign reserves. The closer the sterilization coefficient is to (–1) the more effective is monetary policy in correcting capital offsets and balance of payments. Oppositely, if the sterilization coefficient were (0), then the consequence of capital outflows and reserve decline would put upward pressure on interest rates and allow less control over monetary policy (*Cavoli* & *Rajan*, 2006).

The offset mechanism has been tested in several cases with an offset coefficient value typically fluctuating between (–.3) and (–.8), showing that expan-

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sionary monetary policy is offset by 30 % to 80 % due to a reduction in foreign reserves. *Kouri* and *Porter* (1974) find coefficients between (–.43) and (–.77) for Germany, Australia, Italy, and the Netherlands between the years 1960–1972. Other authors have further examined India, the Netherlands, and the case of Germany during the Bretton Woods system (*Brissimis*, *Gibson*, & *Tsakalotos*, 2002; *Kouri*, 1975; *Kulkarni* & *Pradhan*, 1988; *Kulkarni*, 1985; *Neumann*, 1978).

Different approaches have been used to estimate the offset coefficient. *Gulfason* and *Helliwell* (1983) use a synthesis of a Keynesian, monetarist, and portfolio approaches to exchange rate determination. From the Keynesian approach a change in foreign reserves is measured by a change in net domestic credit, government deficit, exchange rate, foreign price level, foreign GNP, foreign capital accounts, and domestic interest rates. From the monetarist approach the change in foreign reserves is a function of net domestic credit assuming income, price level, interest rate, and wages to be exogenous variables multiplied by the money multiplier. And the portfolio balance approach assumes an exogenous commodity market, and measures net capital flows as a function of change in net domestic assets. Domestic assets are derived by demand for domestic and foreign bonds, and demand and supply of domestic money reserves at the central bank.[3]

Other estimates of the offset coefficient have been found using mainly two different approaches. One way is to use structural estimates of asset demand functions and capital flow equations, similar to the Portfolio Balance model already mentioned. Another way is to use a reduced-form equation which a change in foreign reserves is equated to changes in total capital flows (see *Kouri*, 1975; *Neumann*, 1978). In this case capital flows are a function of net domestic assets, current account balance, domestic and foreign income, domestic and foreign interest rate, risk premium, expected change in exchange rate, and domestic and foreign wealth.

The sterilization coefficient can be computed separately from the offset coefficient using a monetary reaction function. The reaction function reflects the monetary authority’s decision to adjust reserve money depending upon the loss of foreign reserves. Different control variables are included in a monetary reaction function depending on the authors’ discretion. *Herring* and *Marston* (1977) include inflation and output differences as control variables, whereas *Ljubaj*, *Martinis*, & *Mrkalj* (2010) include the money multiplier, industrial production, and interest rate on Treasury Bills as control variables for Croatia.

The problem with using a reduced-form OLS approach to compute the offset and sterilization coefficients is that it does not account for the endogeneity of

[3] See also *Herring* and *Marston* (1977).

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the explanatory variables that occurs because of the mutually dependent behavior of *NDA* and *NFA* (*Kouri* & *Porter*, 1974; *Obstfeld*, 1980; *Roubini*, 1988). If the monetary authority decides to buy or sell foreign assets in response to capital flow oscillations, then the offset coefficient may be correlated to the residuals of the expected *NFA* values. Or in the case that domestic credit is changed in response to foreign asset fluctuations, then a large sterilization coefficient is likely to be a reflection of a high offset coefficient. Furthermore, the more effective that the offset and sterilization mechanisms both are, then their results may hypothetically cancel each other out; in which case reduced form equations would compute inaccurate coefficients.

Due to the fact that changes in *NFA* and *NDA* are dependent upon each other, some studies will use either a two-stage least squares (*2SLS*) method or a vector autoregression (VAR) model. In both cases time lags are used and the offset coefficient and the sterilization coefficient are jointly determined. *Roubini* (1988) argues that OLS and 2SLS inaccurately determine the offset and sterilization coefficients because of not only the endogeneity problem in a typical sterilization reaction function, but also because offset and sterilization coefficients cannot stay consistent. That is because a monetary authority will choose its intervention method depending on disturbances hitting the economy such as a foreign interest rate shock, a current account shock, an increase in domestic bonds, or a domestic output shock (*Roubini*, 1988). One advantage of using VAR models is the ability to use IRF analysis. *Christensen* (2004), for example, studied the responses of domestic credit, domestic interest rates, and foreign reserves to a positive one standard deviation shock to each of the variables. In this paper, we use a VAR model to overcome the problem of endogeneity and make use of impulse response analysis.

IV. Empirical Estimation

Inflation data for Argentina is of questionable quality since 2007. To deal with this issue we use a combination of official and private estimations. The private estimation is a CPI-C (CPI-Congress) informed by the National Congress which is a composite of different private estimations. Table 1 shows a summary statistics of the economic series and their sources.

The changes in net foreign and domestic assets in Argentina mirror each other for the whole time period before and after the 2001 financial crisis and abandonment of the Convertibility Law. Figures 1 and 2 show the changes in domestic currency of *NFA* and *NDA* and their ratio, respectively. There are a few characteristics to point out. First, there is an increase in magnitude for both series after the crisis in 2001, the abandonment of the currency peg, and harsh devaluation. Second, there is an increase in the variation of changes in *NDA* after the

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Table 1

Summary Statistics and Sources

	(1)ΔNFA	(2)ΔNDA	(3)ΔGNI	(4)π	(5)$(i^D - i^F)$
Mean	2,378.8	2,351.8	46.212.0	12.6470	9.8925
Median	1,356.3	–326.3	6,556.8	10.3540	5.8459
Minimum	–15,951.0	–45,754.0	–88,940.0	–1.7908	–0.7400
Maximum	21,837.0	74,112.0	$6.29\ 10^5$	47.000	85.8550
Standard deviation	6,542.9	13.839.0	$1.03\ 10^5$	12.1220	12.7460
C.V.	2.7505	5.8841	2.2312	0.9585	1.2885
Skewness	0.2264	1.8445	2.28411	0.6442	3.1665
Ex. Kurtosis	1.0668	9.6695	11.1600	–0.4701	14.0150
Observations	90	90	90	90	90
Missing observations	0	0	0	0	0
Sources	IMF's IFS database	IMF's IFS database	IMF's IFS database	Until 2006 Q4: Official data (INDEC) Since 2007 Q1: Private estimations as published by the National Congress	IMF's IFS database.

(1) Change in net foreign assets
(2) Change in net domestic assets
(3) Change in Gross National Income (GNI)
(4) 12-month inflation rate
(5) Interest rate spread; Argentine lending rate minus U.S. lending rate

2008 global financial crisis while *NFA* does not show as significant of changes in its behavior. Third, there is no visible structural break in the slope nor intercept of either series after the crisis in 2001, or the 2008 global financial crisis. Finally, as seen in figure 2, there are 5 outliers.

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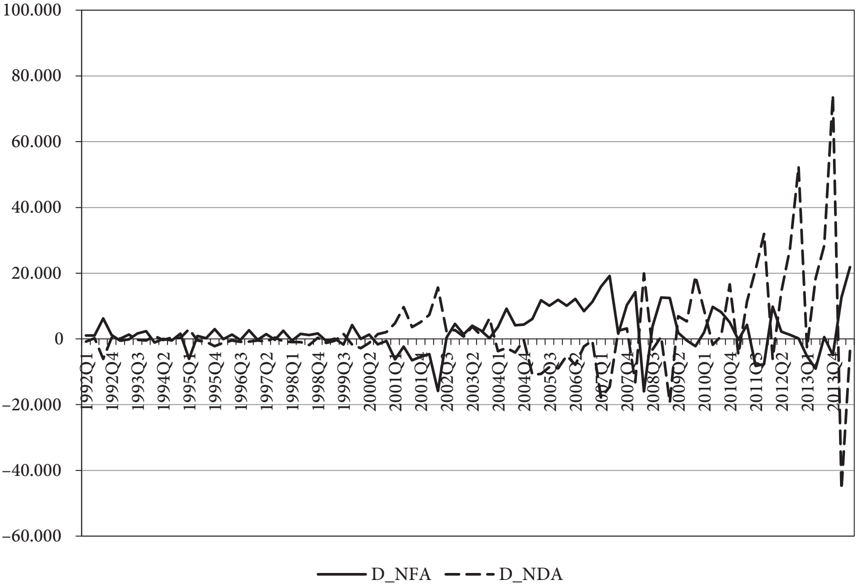

Figure 1: Absolute Change in NFA and NDA (in Millions of ARS)

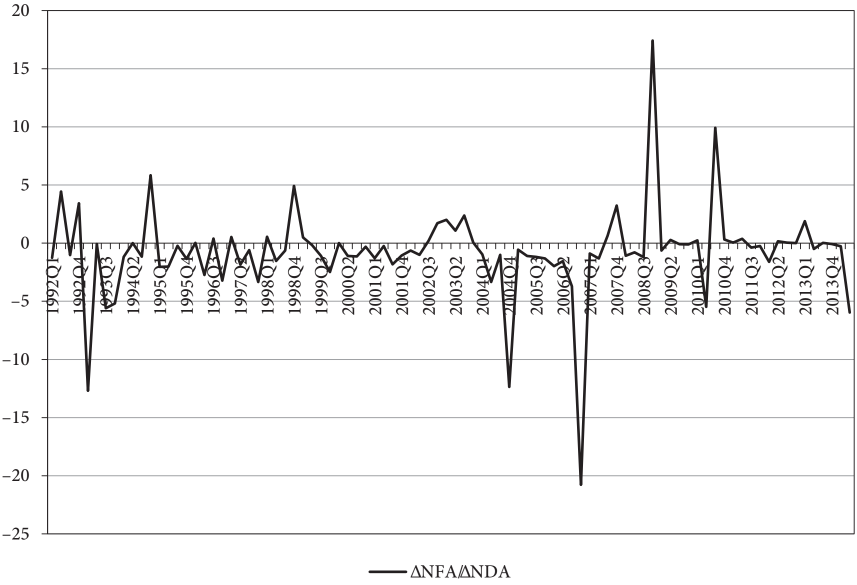

Figure 2: Ratio of ΔNFA/ΔNDA

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To measure the economic significance of the offsetting and sterilization mechanisms in Argentina we run a VAR model where *NFA* and *NDA* interact with each other. The IRF of these two variables measure the extent of the offsetting and sterilization mechanisms. The model is defined as follows:

$$\Delta NFA_t = \alpha_0 + \alpha_1 \cdot t + \alpha_2 \cdot D + \alpha_3 \cdot tD + \alpha_4 \cdot \Delta NFA_{t-1} + \alpha_5 \cdot NDA_{t-1} + \alpha_6 \cdot \Delta GNI_t + \alpha_7 \cdot \pi_t + \alpha_8 \cdot \left(i_t^D - i_t^F\right) + e_{1,t}$$

$$\Delta NDA_t = \beta_0 + \beta_1 \cdot t + \beta_2 \cdot D + \beta_3 \cdot tD + \beta_4 \cdot \Delta NDA_{t-1} + \beta_5 \cdot NFA_{t-1} + \beta_6 \cdot \Delta GNI_t + \beta_7 \cdot \pi_t + \beta_8 \cdot \left(i_t^D - i_t^F\right) + e_{2,t}$$

Where t is the time trend, D is a dummy for before (1) and after (0) year 2001, *GNI* is gross national income, π is inflation, $(i^D - i^F)$ is the spread between the domestic nominal interest rate (D) and the foreign domestic interest rate (F), and e is the error term for equations 1 and 2 respectively.[4] We consider that one lag in the *NFA* and *NDA* variables is enough to account for lags in movements and adjustments in financial flows.

As we said above, quality and diversity of economic indicators for Argentina are lacking. Since 2007 the government has tampered with the official inflation. Therefore, we replace the series after 2007 with private estimations of inflation as provided by the National Congress. The ratio of debt over GDP is also unreliable, for two reasons. First, the debt value of the bondholders from before 2001 crisis that did not accept Argentina's offer to swap the debt (the *holdouts*) after the crisis is ignored in official records. In 2014 the ruling by the South District New York of Law judge Thomas Griesa where Argentina was mandated to recognize and pay the outstanding debt to the *holdouts* became final. Argentina defaulted again in 2014 and continued to refuse to observe this ruling up until 2016 with a change in administrations. Second, Argentina moved from relying on foreign creditors to domestic creditors like the national pension funds (ANSES) and the national Central Bank of the Argentine Republic (BCRA). This debt does not appear in the *foreign* debt variables. Because of these problems we think it is better to not include the debt/GDP series than to add such a non-representative variable to the model.

We run the VAR model two times. Model 1 includes all observations (1991Q2–2014Q2). Model 2 drops the five identified outliers.[5] There is no clear evidence that the dummy for the 2001 crisis is statistically significant neither on the intercept nor on the slope of the trend. This suggests that offsetting and sterilization

[4] 1992 GNI quarterly is interpolated with a polynomial fit.

[5] 1993 Q1, 2004 Q4, 2006 Q4, 2008 Q4, 2010Q3. Along with visual aid, certain diagnostics were used to identify particular observatiions that were the most influential on the fitted values of both *NFA* and *NDA*.

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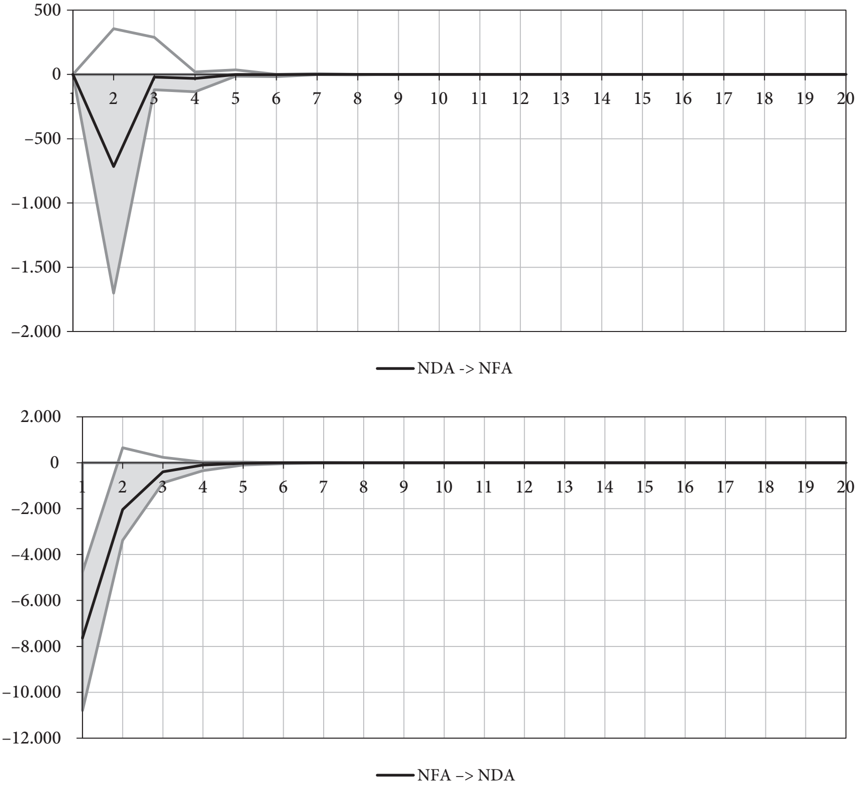

Figure 3: Model 1 IRF with 10 % Confidence Interval. Quarters 1 to 20. In Millions of ARS

mechanisms show no significant difference in behavior before and after the 2001 crisis. Figures 3 and 4 show the IRF for models 1 and 2 respectively. The horizontal axis shows the number of quarters since a one standard deviation in quarter zero. The vertical axis shows the response of *NFA* when the shock occurs in *NDA* first and the other way around second. Figure 5 shows the difference between the IRF of each model (IRF of model 2 *minus* IRF of model 1).[6]

In both cases, a positive shock to either *NDA* or *NFA* produces a negative reaction to *NFA* or *NDA* signaling the presence of offsetting and sterilization mechanisms that counteract the effects of monetary policy and inflow of foreign assets. Both effects last for around 6 quarters. Note also that the difference in the IRFs with and without the outliers is significant only in quarter numbers 0 and 1.

[6] Model output tables can be found in the appendix.

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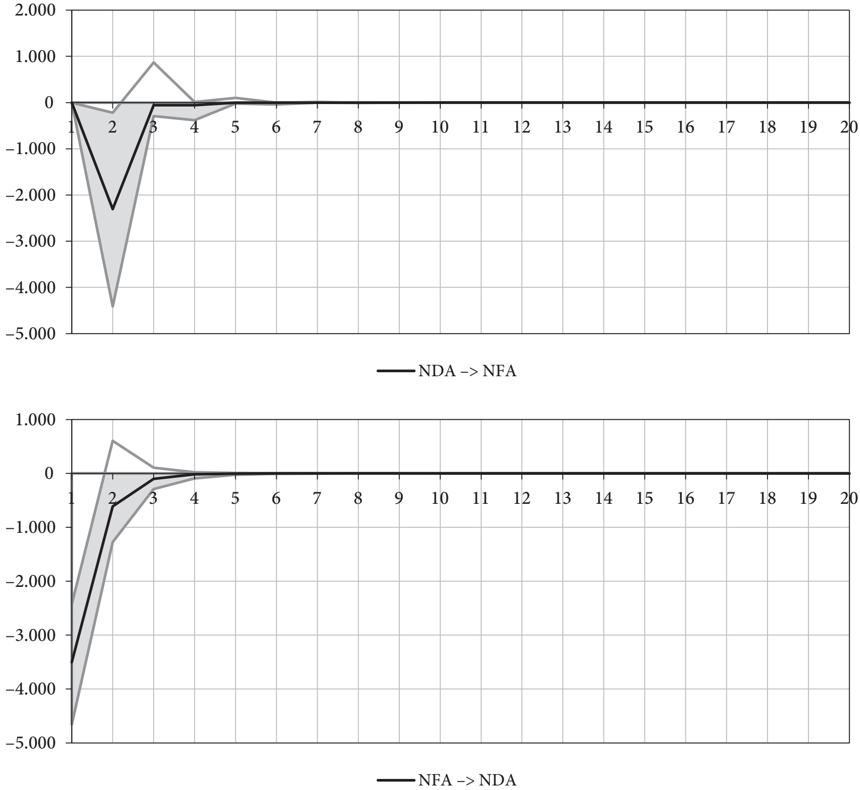

Figure 4: Model 2 IRF with 10 % Confidence Interval.
Quarters 1 to 20. In Millions of ARS

One of the shortcomings of a VAR model is that the IRF estimation needs to assume no contemporaneous effects in one of the variables. To deal with issue we run the IRF calculation twice, assuming no contemporaneous effect in each variable (*NDA* and *NFA*) in turn. Tables 2 and 3 show, for models 1 and 2 respectively, how much of a one standard deviation to *NDA* and *NFA* is offset and sterilized through the IRF reaction of the other variable for 6 quarters after the initial shock. The first (third) column shows a one standard deviation to *NDA* (*NFA*) minus the accumulated *NFA* (*NDA*) reaction. Columns two and four show the *NFA* and *NDA* response to a one standard deviation shock to *NDA* and *NFA* respectively.

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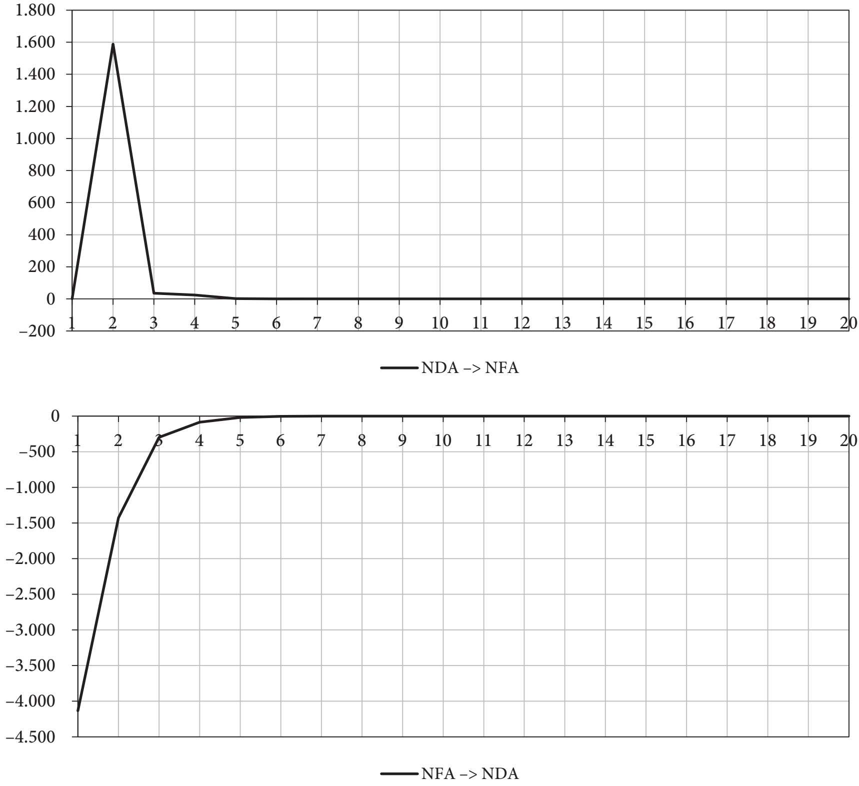

Figure 5: Model 2 IRF Minus Model 1 IRF.
Quarters 1 to 20. In Millions of ARS

Table 2

Model 1: *NDA* Offsetting and *NFA* Sterilization, Eight Quarters

	$\sigma(\Delta NDA)$ – *IRF*	*IRF*(ΔNFA)	$\sigma(\Delta NFA)$ – *IRF*	*IRF*(ΔNDA)
1	10,332.5	–3,506.5	–1,093.0	–7,635.9
2	9,045.9	–1,286.6	–3,127.9	–2,034.9
3	8,854.2	–191.7	–3,523.3	–395.4
4	8,791.9	–62.3	–3,624.4	–101.1
5	8,781.7	–10.2	–3,644.8	–20.4
6	8,778.7	–3.0	–3,649.8	–5.0

$\sigma(\Delta NFA)$ = 6,542.9
$\sigma(\Delta NDA)$ = 13,389.0

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Table 3

Model 2: *NDA* Offsetting and *NFA* Sterilization, Eight Quarters

	$\sigma(\Delta NDA) - IRF$	$IRF(\Delta NFA)$	$\sigma(\Delta NFA) - IRF$	$IRF(\Delta NDA)$
1	10,337.2	−3,501.8	−1,062.8	−7,605.7
2	9,728.2	−609.0	−2,978.8	−1,916.0
3	9,629.5	−98.7	−3,207.4	−228.6
4	9,612.5	−17.0	−3,258.9	−51.5
5	9,609.7	−2.8	−3,265.6	−6.7
6	9,609.2	−0.5	−3,267.0	−1.4

$\sigma(\Delta NFA) = 6{,}542.9$
$\sigma(\Delta NDA) = 13{,}389.0$

According to these numbers, between 32 % (model 1) and 27 % (model 2) of a one standard deviation shock to *NDA* is offset by *NFA* in the first two quarters. Both tables also show an immediate sterilization reaction of *NDA* that is larger than the shock to *NFA* (note that we are looking at the IRF and not an estimated coefficient). This means that in the presence of a change in foreign capital flows the monetary authority in Argentina on average more than sterilizes the inflow (or outflow) of foreign assets. That is, accumulation of net domestic assets occurs regardless of the change in net foreign assets.

V. Conclusions

We use a VAR model to estimate offsetting and sterilization IRFs for Argentina between 1992 and 2014. The results show that a shock to *NDA* is offset by 27 %-32 % in the first two quarters. We also find that the central bank tends to more than sterilize by expanding *NDA* more than the inflow of *NFA*. There is no significant difference in the offsetting and sterilization mechanisms before and after the 2001 crisis, which indicates that the relationship between domestic money supply and foreign reserves is determined by capital mobility, regardless of exchange rate system in place.

The results imply active interventionist monetary policy carried both before and after the crisis of 2001. During the 1990's Argentina did not have an orthodox currency board, but a heterodox one, where the monetary authority enjoys some monetary policy freedom. The reserves pass-through ratio (change in monetary base divided by change in net reserves) was greater than one in several occasions. By deviating from the requirements of a currency board, the central bank thereby allowed the influences of the offsetting and sterilization mechanisms to take effect. After the 2001 crisis the central bank would expand its

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money supply not just to keep the nominal exchange rate stable (especially before 2007), but also to monetize the fiscal deficit (especially after 2007). This further expanded the *NDA* in the balance sheet of the central bank absent an inflow of USD.

It appears that the expansion in *NDA* and contraction in *NFA* after the 2001 crisis may have been intentionally used as a way to reduce foreign influences on the domestic economy. However, it became apparent that the loss of foreign reserves was making it difficult to repay foreign debts. In 2011 when the Kirchner administration attempted to fight the offsetting capital flows by restricting the outflow of USD, they simultaneously continued to expand the money supply. This contributed to stagflation, a greater loss of investor confidence that lead to less international trade, and encouraged further black market activity. The lesson of Argentina tells us that if a central bank wishes to utilize expansionary monetary policy, they must take into consideration the effect that a shock to *NDA* will have on *NFA* in order to discretionarily choose the appropriate sterilization methods and avoid negative economic consequences.

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Appendix

Model 1

All Observations Included

VAR system, lag order 1
OLS estimates, observations 1992:2–2014:2 (T = 89)
Log-likelihood = −1831.0996
Determinant of covariance matrix = 2.5440933e + 015
AIC = 41.5528; BIC = 42.0561; HQC = 41.7557
Portmanteau test: LB(22) = 140.996, df = 84 [0.0001]

Equation 1: D_NFA

	coefficient	std. error	t-ratio	p-value
const	7972.98	5537.88	1.440	0.1538
D_NFA_1	0.101266	0.166283	0.6090	0.5443
D_NDA_1	−0.0779545	0.0801151	−0.9730	0.3335
time	−82.2005	99.6461	−0.8249	0.4119
D	−7612.74	6138.72	−1.240	0.2186
DT	96.1427	157.156	0.6118	0.5424
i_Di_F	−212.662	85.6169	−2.484	0.0151**
Inflation	235.673	130.643	1.804	0.0750*
D_GNI	−0.00422103	0.00977225	−0.4319	0.6669

Mean dependent var	2393.780	S.D. dependent var	6578.406
Sum squared resid	2.68e+09	S.E. of regression	5787.856
R-squared	0.296278	Adjusted R-squared	0.225905
F(8, 80)	4.210151	P-value(F)	0.000302
rho	0.045214	Durbin-Watson	1.840545

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Equation 2: D_NDA

	coefficient	std. error	t-ratio	p-value
const	−20359.1	12059.6	−1.688	0.0953*
D_NFA_1	−0.471747	0.362108	−1.303	0.1964
D_NDA_1	−0.0725221	0.174463	−0.4157	0.6788
time	421.824	216.995	1.944	0.0554*
D	22062.5	13368.0	1.650	0.1028
DT	−507.850	342.232	−1.484	0.1418
i_Di_F	238.112	186.444	1.277	0.2053
Inflation	−368.059	284.496	−1.294	0.1995
D_GNI	0.0372674	0.0212806	1.751	0.0837*

Mean dependent var	2387.658	S.D. dependent var	13912.73
Sum squared resid	1.27e+10	S.E. of regression	12603.98
R-squared	0.253899	Adjusted R-squared	0.179289
F(8, 80)	3.403010	P-value(F)	0.002057
rho	−0.029409	Durbin-Watson	1.970412

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Model 2

Five Outliers Dropped

VAR system, lag order 1
OLS estimates, observations 1992:2–2013:1 (T = 84)
Log-likelihood = −1732.2737
Determinant of covariance matrix = 2.8012927e + 015
AIC = 41.6732; BIC = 42.1941; HQC = 41.8826
Portmanteau test: LB(21) = 154.93, df = 80 [0.0000]

Equation 1: D_NDA

	coefficient	std. error	t-ratio	p-value
const	−21879.3	12142.2	−1.802	0.0756*
D_NDA_1	−0.136892	0.166476	−0.8223	0.4135
D_NFA_1	−0.528910	0.366516	−1.443	0.1532
time	469.133	214.929	2.183	0.0322**
D	23815.3	13526.6	1.761	0.0824*
DT	−562.977	348.595	−1.615	0.1105
i_Di_F	238.522	191.614	1.245	0.2171
Inflation	−386.148	293.768	−1.314	0.1927
D_GNI	0.0326911	0.0208498	1.568	0.1211

Mean dependent var	2527.220	S.D. dependent var	14101.86
Sum squared resid	1.24e+10	S.E. of regression	12851.31
R-squared	0.249544	Adjusted R-squared	0.169495
F(8, 75)	3.117405	P-value(F)	0.004288
rho	−0.034011	Durbin-Watson	1.968631

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Equation 2: D_NFA

	coefficient std.	error	t-ratio	p-value
const	10475.6	5590.50	1.874	0.0649*
D_NDA_1	−0.00374712	0.0766489	−0.04889	0.9611
D_NFA_1	0.160909	0.168751	0.9535	0.3434
time	−140.141	98.9577	−1.416	0.1609
D	−10081.9	6227.92	−1.619	0.1097
DT	153.603	160.500	0.9570	0.3416
i_Di_F	−217.542	88.2229	−2.466	0.0160**
Inflation	239.584	135.257	1.771	0.0806*
D_GNI	0.00296382	0.00959964	0.3087	0.7584

Mean dependent var	2227.885	S.D. dependent var	6592.303
Sum squared resid	2.63e+09	S.E. of regression	5916.998
R-squared	0.272033	Adjusted R-squared	0.194383
F(8, 75)	3.503329	P-value(F)	0.001727
rho	0.016361	Durbin-Watson	1.883887

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