Working Paper No. 06/01

Exchange Rate Fluctuations in Armenia: Exploring the Role of Macroeconomic Policies

Aghassi Mkrtchyan [1]
UNDP Armenia
aghassi.mkrtchyan@undp.org

January 2006

Abstract

This paper tries to illustrate the possible impact of macroeconomic policies on exchange rate fluctuations of the recent years in Armenia. In particular, it speculates that the rapid appreciation of 2004-2005 came as a reaction to earlier policy-driven undervaluation of the exchange rate. Undervaluation of the exchange rate in 2002-2003 may have been caused by policies that deviated from its inflation objective and by massive government savings, which contributed to excessive foreign reserve accumulation. The following shift in policies back to low inflation objective and less ambitious fiscal saving scenario could have triggered rapid adjustments of the exchange rates.

Keywords: exchange rate, monetary policy, policy objectives
JEL Classification: E3, E52, E61

[1] The view expressed in the paper do not necessarily represent those of the UNDP.

1. Introduction

While exchange rate appreciation seems a rational response to the dynamics of economic fundamentals, the scope and the speed of the appreciation in 2004-2005 still raises many questions. If economic fundamentals were driving the development of the exchange rate than it is not clear why appreciation did not start earlier and why it was so drastic.

This paper examines whether economic policies or the inter-temporal policy choices could have affected the dynamics of the exchange rate. It speculates that both nominal and real appreciation could have started earlier but were prevented by the mix of policies leading to undervalued exchange rate. Two policy factors were identified that could contribute to excessive foreign exchange accommodation and nominal and, perhaps, real undervaluation: (i) changing priorities and higher tolerance of the Central Bank to inflation in 2002-2003 and (ii) lower Government deficit and resulting massive deposit accumulation that stimulated Central Bank's foreign exchange accommodation above projections. Subsequently, the following reversal of this unusual policy behavior to its traditional stance, i.e. low inflation preferences and less fiscal savings caused adjustment in exchange rate toward appreciation.

The paper is build into the following logic. First, the problem is formulated by describing the relationship between policy stance and exchange rate, concluding that the beginning of appreciation was triggered by the reversal in foreign exchange policy. Then, the changes in foreign exchange accommodation are discussed in the under the assumptions of Central Bank's changing tolerance to inflation and volatile dynamics of Government surpluses. The paper considers that the higher inflation of 2003 / 2004 as driven not only by the external shock, but also as an outcome of expansionary monetary policy and resulting undervalued exchange rate. The undervaluation of exchange rate could have also been provoked by massive deposit accumulation by the Government and associated rapid reserve accumulation by the Central Bank.

The third section tests the hypotheses about the effectively changing monetary policy objectives and claims that acceleration of inflation in 2003 and the later disinflation were policy driven phenomena. It also analyzes the link between inflation and exchange rate, arguing that acceleration of inflation is associated with undervalued exchange rate while disinflation was associated with exchange rate appreciation. The following section discusses the impact of the wheat price shock on inflation by drawing on analysis of CPI dynamics and relative price developments. Further, possible reasons for varying policies are discussed. The final section looks at the possible future developments of the exchange rate in the framework of inter-temporal fiscal policy choice.

2. Policy context for the exchange rate fluctuations

The dynamics of economic fundamentals, in particular productivity growth and external environment suggest that Armenia should be experiencing real exchange rate appreciation. Since inflation is usually at low one digit, the real exchange rate is likely to appreciate through nominal appreciation. While it is widely recognized that economic fundamentals should have led to real and nominal appreciation, there are still open questions about the volatility of the exchange rate and the timing of the appreciation: the exchange rate appreciation was not smooth as could have been expected from the dynamic of the economic fundamentals.

There is certain ambiguity about the dynamics of nominal exchange rate and particularly about when the recent nominal appreciation started. This is mainly due to the volatility of USD/EURO exchange rates in international markets and the large diversion in USD/AMD and EURO/AMD exchange rate trends in recent years (Chart 1). The effective nominal exchange rate[2], however, shows that exchange rate appreciation started in early 2004.

The reasons why nominal exchange rate was depreciating before 2004 are not conspicuous. One explanation for the real exchange rate depreciation in this period is that it was caused by the appreciation of Russian Ruble, or, in other words, higher inflation in Russia drove AMD real depreciation[3]. Similarly, the drastic appreciation that begun in 2004 is difficult to interpret in terms of macroeconomic environment. Although BoP inflows, mainly private transfers, accelerated in the second half of 2004, they could not be the reason for the appreciation, which begun two quarters earlier (Chart 6).

To explore the possible policy impact on the exchange rate we need to consider the monetary policy stance in terms of accommodation of foreign flows by examining the foreign exchange interventions of the Central Bank. Unfortunately, the interpretation of these data is not straightforward. The term “foreign exchange interventions” in official literature[4] describes Central Bank’s intervention in inter-bank market only (presented in Chart 2). Still, this indicator only partly describes the scope of Central Bank’s participation in foreign exchange market as it excludes Government related foreign exchange accommodation. Therefore, the “foreign exchange interventions” data cannot be used for accurately describing the full scope of absorption of the BoP flows and their liquidity impact.

[2] IMF, Regional Economic Outlook, Middle East and Central Asia, 2005.

[3] Ibid.

[4] Central Bank of Armenia, Annual Reports.

To fully capture the impact of Central Bank's foreign exchange operations on the liquidity and BoP flows, a modified indicator for the foreign exchange operations is introduced, which includes transactions with the Government as well. Namely, in addition to inter-bank operations, this indicator accounts for net Government related foreign exchange purchases defined in official literature as "conversions" of Government related foreign exchange receipts minus change in Treasury deposits in the Central Bank (quarterly data presented in Chart 3 and quarterly annualized – in Chart 4). The advantage of this indicator is that it shows the scope of reserve accumulation with direct liquidity impact.

As the data indicate, the shift from aggressive intervention scenario to less intervention scenario coincides with the beginning of exchange rate appreciation (Charts 3 and 4). The exchange rate seems to be very sensitive to changes in foreign exchange intervention. This can be explained by the fact that BoP flows were relatively stable in this period[5] (Chart 6) and fluctuations in the exchange rate can be attributed to the changes in policy parameters. It can be speculated that had the Central Bank changed its policy earlier, the exchange rate appreciation would have started earlier, and the opposite[6].

The reminder of the paper will try to analyze two possible reasons for instability in foreign exchange interventions: (i) changing tolerance to inflation and resulting changing monetary targets; and (ii) Government surpluses that might have affected foreign exchange accommodation potential of the Central Bank. These factors are described in the reminder of this section and further analyzed in the following section.

Changing tolerance to inflation: The scope of foreign exchange operations is a direct function of the money supply, since foreign exchange operations have traditionally been the main monetary instrument (Chart 5). At the same time the growth pattern of the money supply[7] has been very unstable in the recent years: while in 2002-2003, growth rate of money supply was very high, exceeding 40 percent, in 2004 it was low one digit (Chart 7). Is the varying dynamics of money and foreign exchange interventions an indication that the Central Bank had different objectives in different time-periods? The stated objective of the Central Bank of maintaining 3 percent CPI inflation has remained unchanged in the recent years. Nor

[5] It is interesting that even the end of the flows from Lincy foundations in the Q4 of 2003 did not cause major fluctuations in BoP as they were fully compensated by an increase in private transfers.

[6] Unfortunately this relationship could not be illustrated quantitatively since the data on interventions is in quarterly frequency, thus not allowing a sufficient number of observations for a regression model.

[7] Dram broad money, defined as Broad Money minus foreign exchange deposits

is the unusual acceleration of inflation in 2003 a direct indication of the Central Bank's deviation from its policy objectives as, according to the Central Bank, the 2003 price hikes were caused by the drastic increase in international wheat prices that contributed almost 6 percentage points to inflation bringing it to around 9 percent in late 2003-mid 2004[8].

The claim about changing policy objectives would be valid if there were indications that the monetary policy was in fact expansionary in 2003 and it would cause higher than 3 percent inflation without the wheat price shock. The following section will argue that the monetary expansion was crucial in transforming the shock to the CPI inflation. This implies that would there be no supply shock, money expansion would lead to higher than projected inflation.

Government surpluses: The underlying approach is that the scope of foreign exchange operations and their impact on the exchange rate is not limited by quantitative monetary targets only but it also depends on the fiscal position[9]. In particular, because of lower than projected fiscal deficits, the Government was experiencing "surprise surpluses"[10] since 2002 that were resulting in massive deposit accumulation in the Central Bank. These fiscal developments significantly contributed to the stabilization of macro-environment by restraining inflation and economic growth rates and thus helping to prevent overheating in the period of double-digit economic growth. On the other hand, the accumulated fiscal savings became important tools that could be used to stimulate aggregate demand when the external environment would be less positive and growth would slow down. In other words these savings may play a role of stabilization funds through which extra benefits from good years could be used at less favorable times in the future.

From monetary management perspective, these fiscal developments helped the Central Bank to accumulate reserves, as unexpected liquidity drainage by the Government and decline in the Central Bank's Net Domestic Assets had to be substituted by liquidity injections through reserve accumulation (Chart 11). Thus, in 2002 and 2003, instead of planned net interventions, the Central Bank ended up with huge reserve accumulation. If the Government were as expansionary as it was

[8] Central Bank of Armenia, 2004 annual report.

[9] The phenomenon of fiscal surpluses contributing to exchange rate undervaluation and reserve accumulation is also discussed in the literature (e.g., V. Polterovich and V. Popov, *Accumulation of Foreign Exchange Reserves and Long Term Growth*).

[10] The term "surpluses" is used for the budget excluding PIUs.

planned, the Central Bank would have to sterilize the fiscal expenditures through massive foreign exchange sales thus leading to appreciation. In other words, the "surprise" fiscal savings prevented large scale foreign exchange sales and thus might have contributed to undervaluation of the exchange rate.

In 2004, however, after two years of massive deposit accumulation the Government saved very little. (bold line in Chart 11). This fiscal shift affected the Central Bank's ability to accommodate foreign exchange inflows: the Central Bank could not afford to be expansionary as the Government itself became expansionary. These changes in the Government's fiscal stance and resulting reaction from the Central Bank may have increased the costs associated with keeping exchange rate undervalued.

Retrospective estimates for 2002-2003 show that, assuming "no surprise surplus" scenario, foreign reserve accumulation would be by around cumulative AMD 40 billion lower than the actual level. In other words, in such a scenario the Central Bank would need to sell extra USD 70 millions in the course of two years to observe its quantitative monetary targets. This would undoubtedly lead to appreciation of the exchange rate. In 2004, on the other hand, when the Government's deposit accumulation practice was reversed the Government stopped helping the Central Bank in preventing exchange rate appreciation.

3. Analysis of macroeconomic policies

This section first analyzes the importance of the monetary policy for price dynamics with the view of making the case for effectively changing monetary policy objectives and claims that acceleration of inflation in 2003 and the later disinflation were policy phenomena. Second, the link between inflation and exchange rate will be analyzed, arguing that acceleration of inflation is associated with undervalued exchange rate while disinflation was associated with exchange rate appreciation.

To test the importance of the monetary factor for inflation in the context of exogenous shocks the relationship between money and inflation was estimated for three time periods: the period preceding the wheat price shock, the period when the shock was affecting the economy and the period after the impact of the shock had died out. The regression results (Appendix 1) suggest a quite stable link between inflation (defined as CPI) and money (defined as Dram, or Domestic Currency Broad Money) over the three time periods as well as over the entire time period. The coefficient for dram broad money is significant at the 5% level and is almost the same for all three equations. Both CPI and dram broad

money were differenced to ensure stationarity and a seasonal moving average term was included to account for the seasonality of prices.

These results suggest that inflation was largely a monetary phenomenon over the entire period regardless of the presence of external shocks. This supports the argument that the monetary stance between Q3 2002 and Q3 2003 was not consistent with an inflation target of 3 percent. Still, capturing and quantitatively estimating the impact of the wheat price shock on inflation is complicated by several factors. Most importantly, the shock was followed by rapid adjustments in the exchange rate in 2004 which changed the cost structure of inflation. Unfortunately this does not allow to come up with a quantitative estimate as to what inflation would be in 2003 if there were no shock. The following section uses CPI and relative price variability analysis to estimate the inflation caused by monetary factors.

Further examining the link between inflation and the exchange rate requires establishing a relationship between the two variables. Cointegration and Vector Error Correction were used to test the hypothesis that high inflation was associated with undervaluation of the exchange rate and disinflation was associated with exchange rate appreciation. This exercise put together CPI, money and the exchange rate (defined as USD/AMD nominal exchange rate).

Prices, exchange rate and money are non-stationary in levels but are stationary in first differences (see table 2 of the appendix). As the results of the Johansen test indicate, these three variables are co-integrated. (See table 5 of the appendix). The co-integration test indicates one co-integrating equation with a lags interval of 1 in first differences and a linear deterministic trend. This allows to estimate the long term relationship between inflation, money and exchange rate through a Vector Error Correction model. The results of the VEC are reported in table 6 of the appendix. The first column represents the equation for d(cpi). The coefficients are in line with the above discussed logic: the coefficients of both money and exchange rate are significant. The second and third equations are irrelevant for this analysis due to the use of lagged values of money and exchange rate.

4. Observations on CPI, Relative Prices and Money Velocity

Using disaggregated monthly data of CPI components the impact of wheat price shock can be traced across the time. The "mechanical impact"[11] of the shock on CPI can be traced back to June 2003, and this impact is felt until end - November 2004, as the last price hike in bread and cereals category caused by the international wheat price shock was observed in December 2003 (Table 7). It is important to note that data in column 4 do not constitute non-shock inflation, as they are derived simply by subtracting the contribution of bread inflation from CPI. These numbers do not account for changes in relative prices due to the shock. After the "mechanical" impact of bread inflation gradually is coming to its end, (in the second half of 2004), we see non-shock inflation from time to time exceeding 6 percent. Moreover, inflation is high, reaching around 5 percent, even after the impact of the shock is exhausted, i.e. after November 2004 (Chart 8 and 9).

The annualized average non-shock inflation for the second half of 2004 (compared to the same period of 2003) is 4.5 percent. This is an indication that in the time of rapid appreciation and disinflation, the non-shock inflation is still well above the Central Bank objective. Unfortunately this exercise cannot be used for estimating non-shock or non-bread inflation for earlier periods, to see what inflation would be in 2003 without the supply shock. However, since it can be safely assumed that inflation was on decline throughout 2004, we can speculate that non-shock inflation at end-2003, early 2004 was probably higher than 4.5 percent.

The second observation is related to relative price developments. The underlying idea is that when supply shocks affect the price of certain goods, then the behavior of the other goods' prices depends on the extent to which monetary policy is flexible in terms of adjusting its targets. The impact of monetary policy on relative prices at times of external shocks can be viewed in the framework of the Cukeirman – Leiderman model (Cukierman and Leiderman, 1982). This model shows that relative price variability[12] depends positively on the "lack of synchronization" between monetary policy and exogenous price shocks.

In other words, if supply shocks are not accommodated by monetary expansion, the variability of other prices (prices of shock-free goods) increases, while in case of full monetary accommodation of the shocks increased variability of other goods' prices is prevented. This model has been applied to the case of Armenia for the period of 1998-

[11] Assuming no change in bread and cereals prices.

[12] Relative price variability is measured by the variance of CPI components

2002 and was found effective in explaining sharp relative price fluctuations (Mkrtchyan, 2004).

Table 1 compares different monetary reactions to supply shocks in Armenia in the period of 1998-2004 and relative price variability. It illustrates the impact of "synchronization" between the shocks and monetary policy on price variability in different periods.

Table 1

	Shocks, percentage in headline inflation	Nature of shocks	Headline inflation	Variability of non-shock goods' prices (based on Their variances)	Growth rate of Reserve Money[13]
1998	2.6	introduction of VAT on bread	-1.3	75.2	3.3
1999	6.6	electricity tariffs, taxes on gasoline, tobacco	2	74.4	2.8
2000	0.8	Gasoline	0.4	40.1	11.9
2001	not identified	-	2	60.6	23.3
2002	not identified	-	3	40.8	12.4
2003	5.7	Increase in international price of wheat	8.6	33.1	28.6
2004	not identified	-	2.3	43.7	10.4

In 1999 the supply shock caused dramatic changes in relative prices and resulted in high relative price variability within the group of shock-free goods. In 2003, on the other hand, a shock of almost the same magnitude had a very different impact on relative prices, resulting in very low price variability. In the context of the described model this can be interpreted as a different policy response to the shocks and different tolerance to headline inflation. While in 1999 the Central Bank was firm on its low inflation target, in 2003 monetary policy seemed to be loose enough to accommodate the shock and to prevent the growth of relative price variability. In other words, on the top of regular 3 percent inflation, quantitative monetary targets allowed to fully accommodate 6 percentage point supply-shock inflation, preventing any major relative price variability (Chart 10).

On thing to note at this point is that the international wheat price shock was not anticipated at the time of monetary policy design. Monetary targets were set to achieve the objective of 3 percent inflation without any assumptions about possible shocks. In this respect the Central Bank's objectives did not include preventing price variability and unnecessary

[13] To capture the lagged impact of money on the CPI, Q4(t-1) through Q3(t) is used instead of calendar year.

short-term relative price changes. In this context, we can speculate that would there be no supply shock, inflation rate would be higher than projected 3 percent.

The final observation is related to the developments in money velocity. Large supply shocks not accommodated by monetary expansion, should generally lead not only to higher price variability and relative price changes but also to higher velocity. In other words, since the external price shocks normally cannot be fully neutralized by adjustments in relative prices, certain increase in money velocity would be expected. However, what we observed in 2003 was a decline in money velocity, not an increase. This suggests that that money supply was large enough to accommodate the shock.

4. Possible reasons for varying policies

What could be the reasons behind possible changes in macroeconomic policies that could have caused exchange rate undervaluation in 2002-2003 and rapid appreciation since 2004? Below three models of changing behavior of the monetary authority are discussed: inflation bias followed by disinflation, core inflation targeting to manage supply shocks, and information bias toward "official sources".

The years 2002 and 2003 were of high political importance as two general elections were held in highly competitive political environment of 2003. "Would be elected" incumbent authorities would want to prevent nominal appreciation and the resulting negative BoP and economic growth effects. Lincy foundation was another important component in the political landscape and could have played a crucial role for motivating the authorities to push for undervalued exchange rate or to prevent exchange rate from appreciating. A stable exchange rate was most likely a crucial factor for success in highly politicized Lincy project implementation. In this context, the fact that the exchange rate appreciations began right after the completion of Lincy Projects supports the argument for the "inflation bias" model.

However, it would not be accurate to classify the Central Bank's behavior as "dynamic inconsistency" as this term is used in the literature, since the Central Bank did not deviate a lot from its rules (in terms of intermediate quantitative quarterly targets) but it deviated significantly from its main objective, 3 percent CPI inflation. In this respect, "inconsistency" would apply to policy design, when targets at different times were based on different levels of tolerance to deviation of inflation from the stated objective.

The Central Bank's behavior can also be interpreted in terms core inflation targeting: namely, it can be argued that the Central Bank adjusted its policy to manage the external shock and to prevent changes in relative prices thus avoiding unnecessary price variability.

This would resemble the practice in countries with core inflation targeting, where central banks do allow shocks of certain magnitude to transform into headline inflation. Looking at the Central Bank's historical performance, tight headline inflation targeting did not allow to mitigate large scale supply shocks of 1999 that were driven by adjustments of electricity tariffs and heavy taxes levied on gasoline and tobacco. In 2003, on the other hand, the international wheat price shocks, that were of similar magnitude as the shocks in 1999 were handled was completely differently. While in 1999 the Central Bank's reaction was monetary contraction that caused increased relative price variability, in 2003 the shocks were accommodated by expansionary monetary policy and relative prices were not affected. Thus, the Central Bank's policy in 2003 can be described as opting for core inflation targeting instead of traditional headline inflation targeting[14].

However, if core inflation targeting was indeed the best model to describe the policy-makers' motivation in 2003, it would be difficult to explain the 2004 monetary program. If the Central Bank willingly accommodated a supply shock of 5.5 percentage point magnitude bringing headline inflation to just a little below of 9 percentages, 3 percentage headline inflation targeting for the next year would mean a radical disinflation. As the experience of most of core inflation targeting countries suggests Central Banks usually accommodate no more than around 2 percentage supply shocks, which allow them to come back to their headline inflations easily when the shock expires. In case of Armenia, a radical shift from 9 percent headline inflation to 3 percent would mean a very aggressive and thus very costly disinflation.

Lastly, the policies could be affected by the information bias, namely relying only on official sources of information. As it was already mentioned, the Central Bank did not depart significantly from its quantitative monetary targets in 2003. However, these targets were generous, envisaging more than 25 percent money growth. At the time the 2003 monetary policy program was being developed full information was available about the expected inflows from the Lincy foundations and therefore the risk of exchange rate appreciation was clearly recognized. Having this information about the expected flows and risks, the policymakers decided to set expansionary quantitative targets for money supply. In contrast, in the following year, when the Lincy foundation projects were over, policy makers could have felt little need to project accommodative monetary scenario, as they

[14] This assumption can be supported by the following statement from 2003 Central Bank report: "…The Central Bank of Armenia refrained from measures that would completely absorb the impact of "bread products" group of commodities on inflation because it treated price stability as long term of objective (in view of possible decline of prices in the bread product group due to expectation of wheat supply in international markets growing back to the levels of previous years)", page 8, 2003 Annual Report, CBA

believed that appreciation pressures will diminish once the Lincy flows are over. Obviously, what they may have overlooked was the potential for private inflows that soon proved to be as significant as the Lincy flows of previous year. If accurate, this explanation illustrates a high degree of dependence of monetary and macroeconomic programming on so called "official" information that could put the authorities in a position where they might overlook signals from more ambiguous private sector.

5. Is the exchange rate still undervalued? A fiscal policy perspective

Have the significant adjustment of 2004 and 2005 brought the Armenian Dram to its long run equilibrium, or does it still remain undervalued and more appreciation is yet to come[15]? This issue can be looked at from the point of view of Government's inter-temporal fiscal stance and its implication on the exchange rate.

As it was argued above, the accumulation of fiscal deposits helped to prevent potential inflation, thus preventing more real appreciation. In other words if the fiscal savings are to be used as "stabilization" funds and will be spent when GDP is below its potential and external environment is unfavorable this is unlikely to cause major instability. One possible scenario is that the savings will be used sometimes in the distant medium-term as new Lincy and MCA funds as well as estimated expansion of regional economies will keep foreign exchange flowing to Armenia for another couple of years. However, if the Government will decide to use of these funds in an economic environment similar to the current one (high growth rate, favorable external environment) a surge in inflation may be the result in case if Central Bank deviates from its target or, there will be another wave of nominal appreciation in case the Central Bank stay firm about its target. In both cases rapid fiscal expansion will lead to real appreciation.

Inter-temporal fiscal impact on the exchange rate, however, will become less relevant, if due to changing expectations and decline in dollarization, money demand will increase, and the Central Bank will be able to further monetize the economy without inflationary pressures. In fact, recent monetary data indicates that monetization is deepening[16]. Deepening monetization that follows rapid appreciation is observed in other transition countries as well.

[15] According to IMF estimates the real exchange rate misalignment is still in magnitude of about 30 percent (IMF, MCD Regional Economic Outlook 2005)

[16] After money contraction of 2004, the Central Bank of Armenia is expansionary again with more than 50 percent annualized money growth rate as of Q4, 2005. This expansion is believed to be non-inflationary due to high growth of money demand.

6. Conclusion

The central conclusion of this paper is that economic policies or the inter-temporal policy choices could have affected the dynamics of the exchange rate. In particular, in 2002-2003 exchange rate appreciation was prevented by a mix of policies leading to undervalued exchange rate while the following policy reversal lead to rapid exchange rate appreciation.

The paper finds that in 2002 and 2003 the Central Bank attached less priority to its inflation target as it was trying to be more accommodative of international flows. Monetary expansion, driven by large foreign exchange interventions prevented the appreciation and led to undervalued exchange rate in 2002 and 2003, meanwhile contributing to higher inflation. This behavior could have been the result of an inflation bias / short term prioritization of the economic growth, the attempt to manage large external price shocks or an information bias toward official sources. The period of interventionist monetary policy was followed by a period of "pay-off" with rapid disinflation measures that became inevitable when the Central Bank felt that inflation pressure were particularly strong.

The paper also concludes that Central Bank's active build-up of foreign reserves and the associated exchange rate undervaluation was also driven by Government surpluses that played a sterilization role for the Central Bank's foreign exchange accumulation and delayed its inflationary pressure.

Appendix

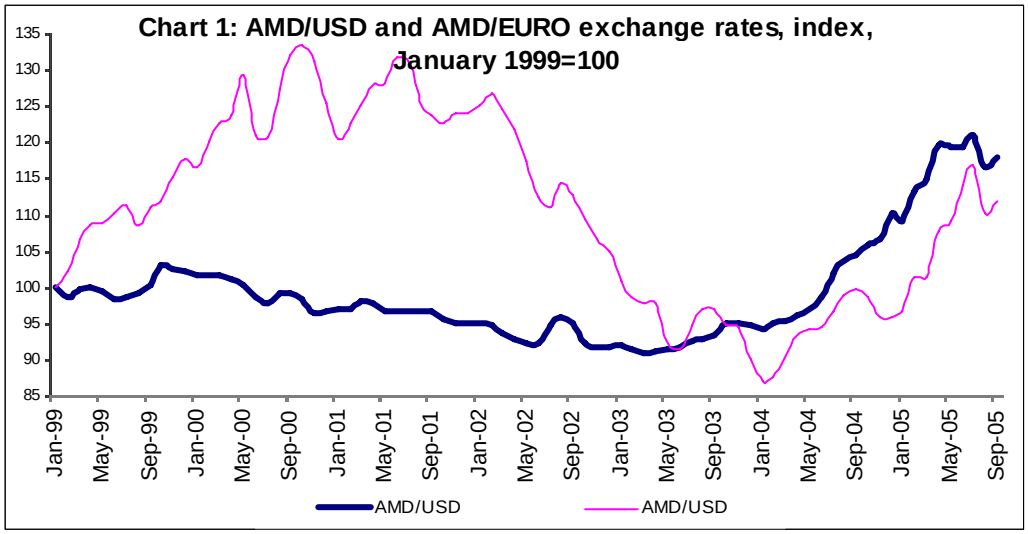
Chart 1: AMD/USD and AMD/EURO exchange rates, index, January 1999=100
135
130
125
120
115
110
105
100
95
90
85
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
May-05
Sep-05
AMD/USD
AMD/USD

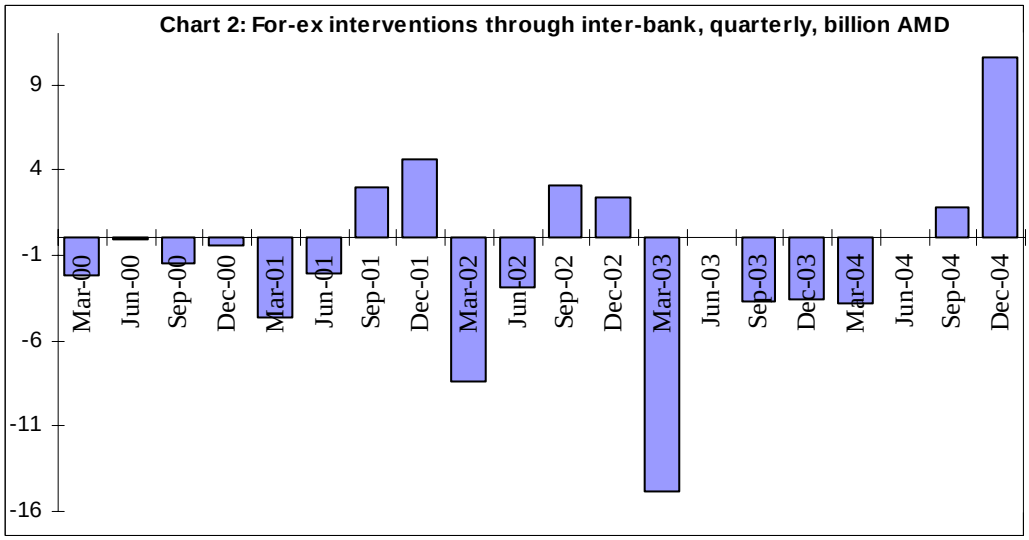
Chart 2: For-ex interventions through inter-bank, quarterly, billion AMD
9
4
-1
-6
-11
-16
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04

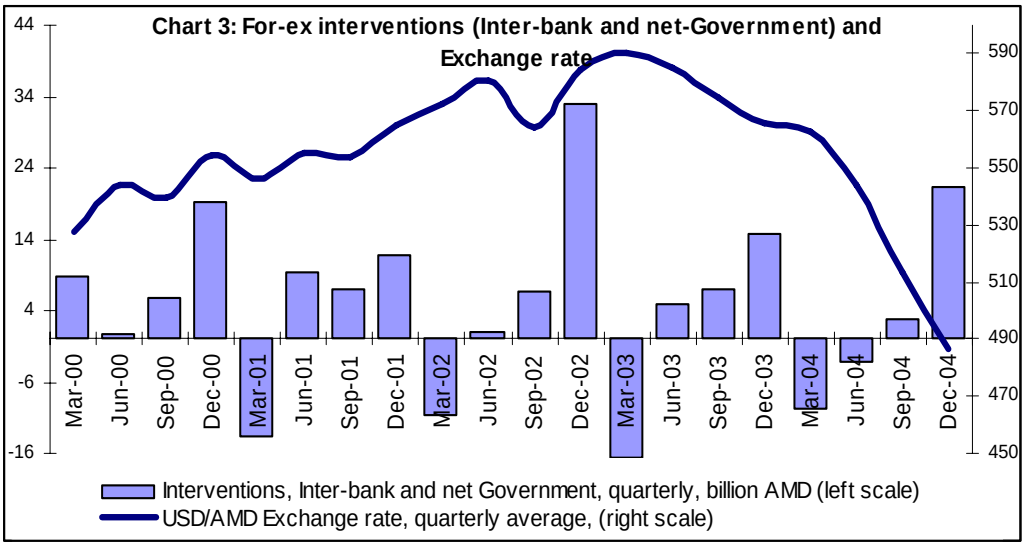
Chart 3: For-ex interventions (Inter-bank and net-Government) and Exchange rate
44
34
24
14
4
-6
-16
590
570
550
530
510
490
470
450
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Interventions, Inter-bank and net Government, quarterly, billion AMD (left scale)
USD/AMD Exchange rate, quarterly average, (right scale)

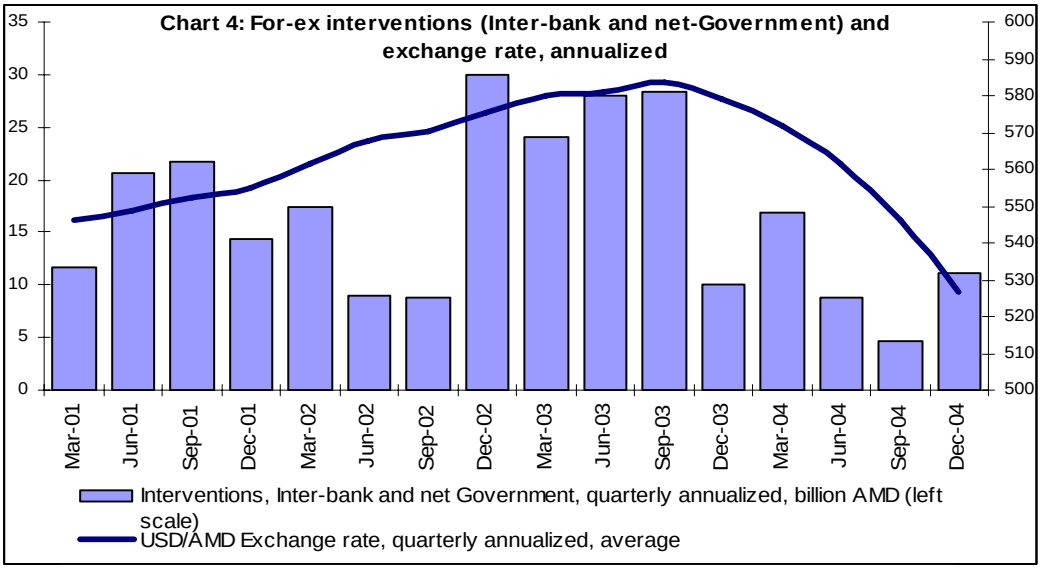
Chart 4: For-ex interventions (Inter-bank and net-Government) and exchange rate, annualized
35
30
25
20
15
10
5
0
600
590
580
570
560
550
540
530
520
510
500
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Interventions, Inter-bank and net Government, quarterly annualized, billion AMD (left scale)
USD/AMD Exchange rate, quarterly annualized, average

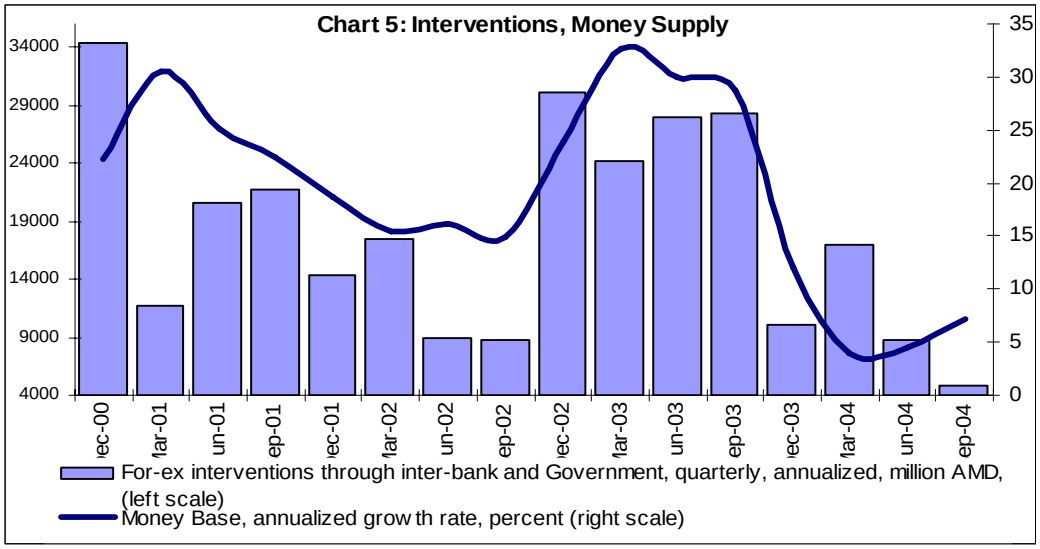
Chart 5: Interventions, Money Supply
34000
29000
24000
19000
14000
9000
4000
35
30
25
20
15
10
5
0
ec-00
ar-01
un-01
ep-01
ec-01
ar-02
un-02
ep-02
ec-02
ar-03
un-03
ep-03
ec-03
ar-04
un-04
ep-04
For-ex interventions through inter-bank and Government, quarterly, annualized, million AMD, (left scale)
Money Base, annualized grow th rate, percent (right scale)

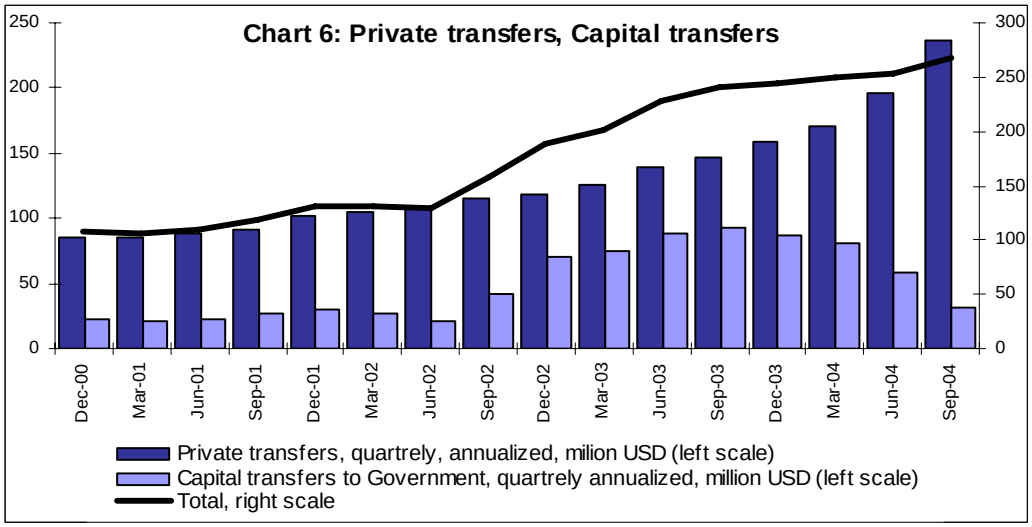
Chart 6: Private transfers, Capital transfers
250
200
150
100
50
0
300
250
200
150
100
50
0
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Private transfers, quartrely, annualized, milion USD (left scale)
Capital transfers to Government, quartrely annualized, million USD (left scale)
Total, right scale

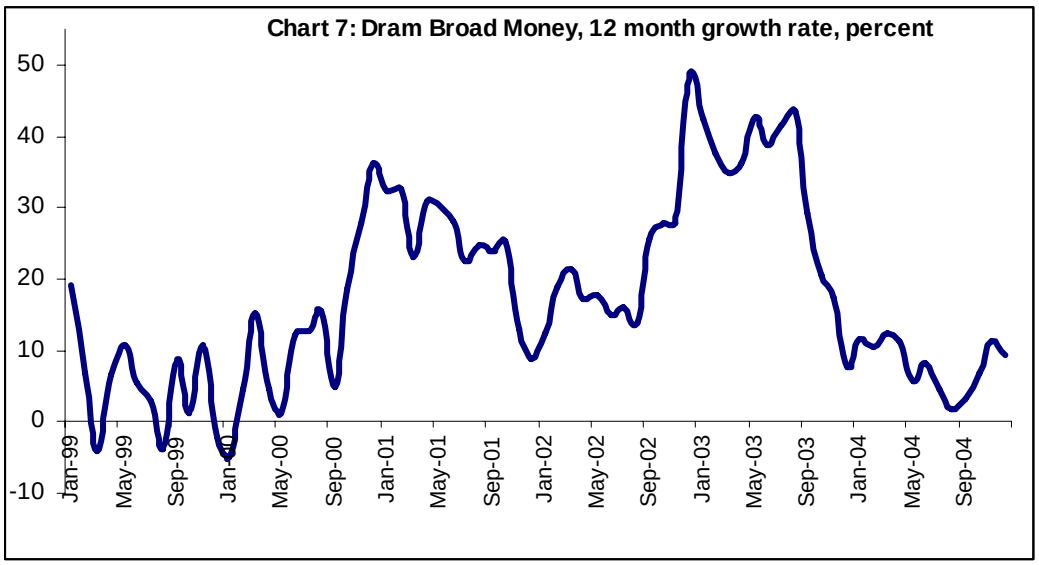
Chart 7: Dram Broad Money, 12 month growth rate, percent
50
40
30
20
10
0
-10
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04

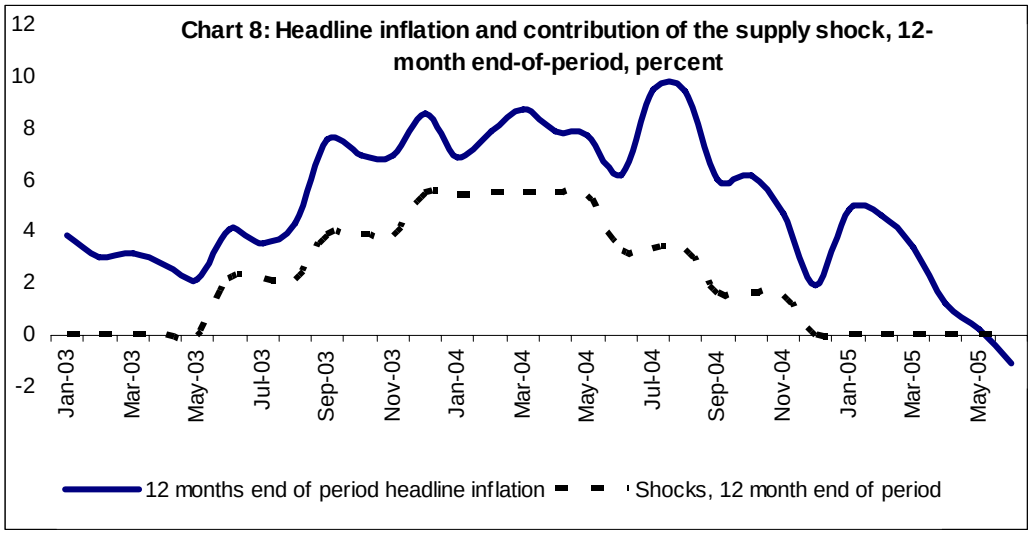
Chart 8: Headline inflation and contribution of the supply shock, 12-month end-of-period, percent
12
10
8
6
4
2
0
-2
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
12 months end of period headline inflation
Shocks, 12 month end of period

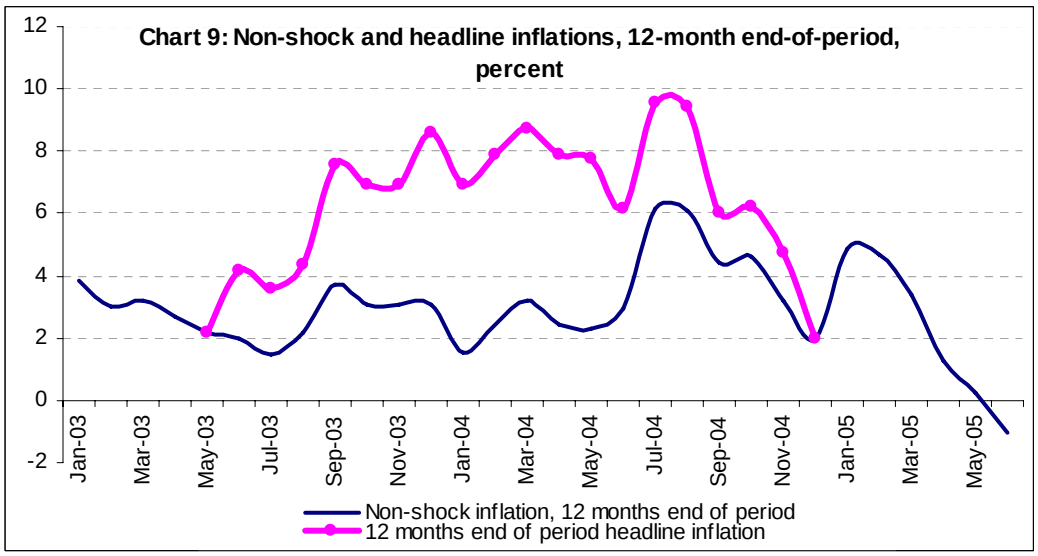
Chart 9: Non-shock and headline inflations, 12-month end-of-period, percent
12
10
8
6
4
2
0
-2
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Non-shock inflation, 12 months end of period
12 months end of period headline inflation

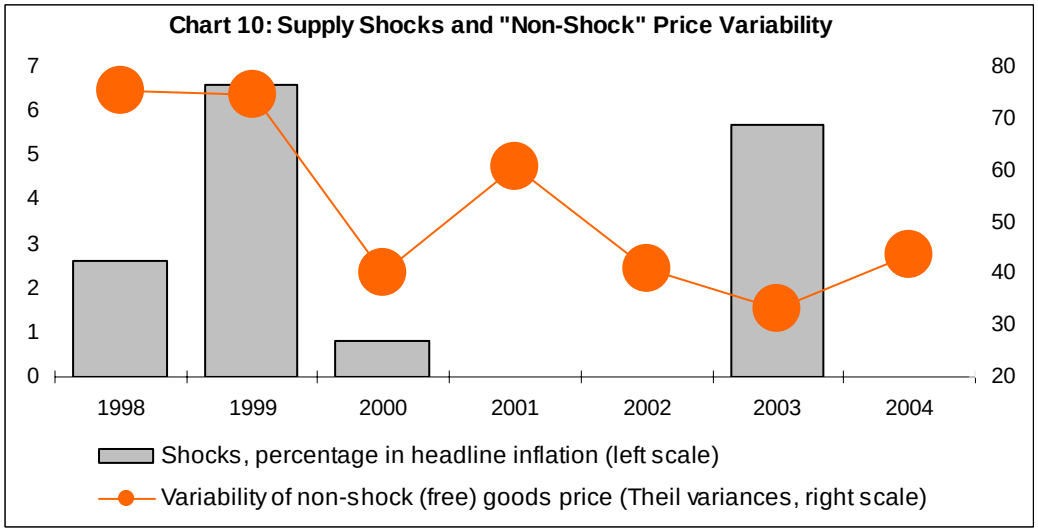
Chart 10: Supply Shocks and "Non-Shock" Price Variability
7
6
5
4
3
2
1
0
80
70
60
50
40
30
20
1998
1999
2000
2001
2002
2003
2004
Shocks, percentage in headline inflation (left scale)
Variability of non-shock (free) goods price (Theil variances, right scale)

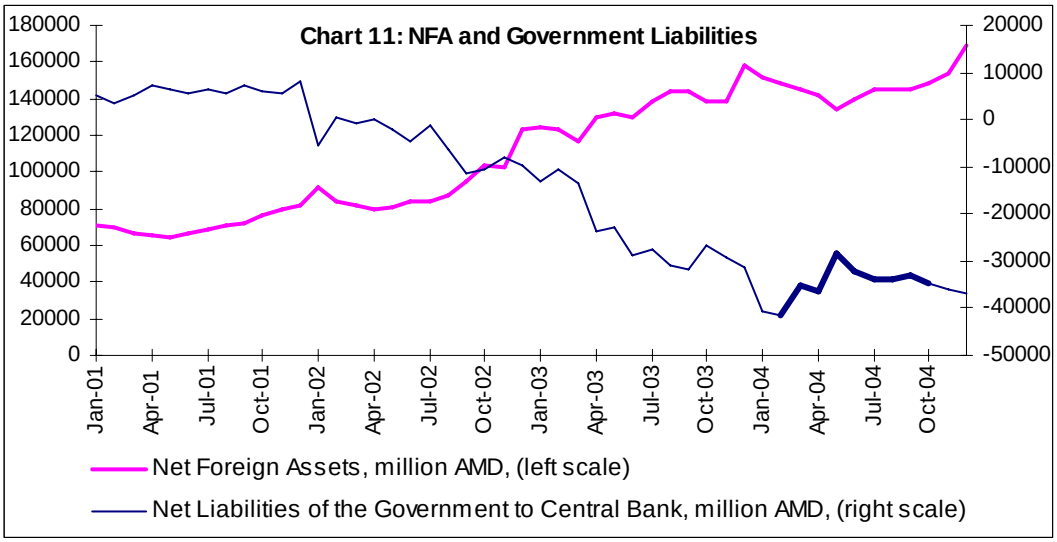

Table 2. Stationarity Tests

	Levels		First Differences	
	T-statistics	P-values	T-statistics	P-values
CPI	2.16	0.99	-1.73	0.08
DRAMMONEY	-1.10	0.92	-11.98	0.00
USD	0.26	0.99	-7.94	0.00

Table 3: Regression: CPI before the shock

Dependent Variable: D(CPI)
Method: Least Squares
Sample (adjusted): 1998M08 2003M05
Included observations: 58 after adjustments
Convergence achieved after 8 iterations
Backcast: 1997M08 1998M07

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.022654	0.317027	-0.071457	0.9433
DDRAMMONEY(-6)	0.000133	5.67E-05	2.338152	0.0230
MA(12)	0.859689	0.023033	37.32360	0.0000

R-squared	0.562991	Mean dependent var	0.263793
Adjusted R-squared	0.547099	S.D. dependent var	1.899741
S.E. of regression	1.278486	Akaike info criterion	3.379568
Sum squared resid	89.89893	Schwarz criterion	3.486143
Log likelihood	-95.00748	F-statistic	35.42771
Durbin-Watson stat	1.390924	Prob(F-statistic)	0.000000

Inverted MA Roots	.95+.26i	.95-.26i	.70-.70i	.70+.70i
	.26+.95i	.26-.95i	-.26+.95i	-.26-.95i
	-.70-.70i	-.70-.70i	-.95-.26i	-.95+.26i

Table 4: Regression: CPI at the time of shock

Dependent Variable: D(CPI)
Method: Least Squares
Sample: 2002M01 2003M12
Included observations: 24
Convergence achieved after 10 iterations
Backcast: 2001M01 2001M12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.238828	0.605184	0.394637	0.6971
DDRAMMONEY(-6)	0.000170	7.75E-05	2.190706	0.0399
MA(12)	0.825120	0.094694	8.713519	0.0000

R-squared	0.623259	Mean dependent var	0.466667
Adjusted R-squared	0.587379	S.D. dependent var	2.878053
S.E. of regression	1.848734	Akaike info criterion	4.183348
Sum squared resid	71.77419	Schwarz criterion	4.330605
Log likelihood	-47.20018	F-statistic	17.37061
Durbin-Watson stat	1.323078	Prob(F-statistic)	0.000035

Inverted MA Roots	.95-.25i	.95+.25i	.70+.70i	.70-.70i
	.25+.95i	.25-.95i	-.25-.95i	-.25+.95i
	-.70+.70i	-.70+.70i	-.95+.25i	-.95-.25i

Table 5. Regression CPI for the entire period, 1998-2004

Dependent Variable: D(CPI)
Method: Least Squares
Sample (adjusted): 1998M08 2004M12
Included observations: 77 after adjustments
Convergence achieved after 9 iterations
Backcast: 1997M08 1998M07

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.147923	0.281145	0.526144	0.6004
DDRAMMONEY(-6)	6.94E-05	3.71E-05	1.872422	0.0651
MA(12)	0.895964	0.021744	41.20458	0.0000

R-squared	0.588612	Mean dependent var	0.272727
Adjusted R-squared	0.577493	S.D. dependent var	2.098598
S.E. of regression	1.364100	Akaike info criterion	3.497049
Sum squared resid	137.6969	Schwarz criterion	3.588366
Log likelihood	-131.6364	F-statistic	52.93934

Durbin-Watson stat	1.477645	Prob(F-statistic)		0.000000

Inverted MA Roots	.96+.26i	.96-.26i	.70+.70i	.70-.70i
	.26-.96i	.26+.96i	-.26+.96i	-.26-.96i
	-.70-.70i	-.70-.70i	-.96-.26i	-.96+.26i

Table 6: Johansen Cointegration Test

Sample (adjusted): 1998M08 2004M12

Included observations: 77 after adjustments

Trend assumption: Linear deterministic trend (restricted)

Series: CPI DRAMMONEYL5 USDL2

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.344157	45.03049	42.91525	0.0302
At most 1	0.087995	12.54927	25.87211	0.7725
At most 2	0.068415	5.456789	12.51798	0.5321

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.344157	32.48122	25.82321	0.0057
At most 1	0.087995	7.092478	19.38704	0.8944
At most 2	0.068415	5.456789	12.51798	0.5321

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

CPI	DRAMMONEYL5	USDL2	@TREND(98M02)
-0.348827	6.34E-05	-0.032251	0.037628
-0.021196	0.000106	-0.013978	-0.083224
-0.055384	-1.87E-05	0.014881	0.064834

Unrestricted Adjustment Coefficients (alpha):

D(CPI)	0.989399	-0.044415	0.075649
D(DRAMMONEYL5)	328.7204	-1023.148	827.3066
D(USDL2)	0.421481	-0.934873	-1.112508

1 Cointegrating Equation(s): Log likelihood -1129.493

Normalized cointegrating coefficients (standard error in parentheses)			
CPI	DRAMMONEYL5	USDL2	@TREND(98M02)
1.000000	-0.000182	0.092456	-0.107871
	(5.9E-05)	(0.03050)	(0.07967)
Adjustment coefficients (standard error in parentheses)			
D(CPI)	-0.345129		
	(0.05772)		
D(DRAMMONEYL5)	-114.6664		
	(193.288)		
D(USDL2)	-0.147024		
	(0.21893)		
2 Cointegrating Equation(s):		Log likelihood	-1125.947
Normalized cointegrating coefficients (standard error in parentheses)			
CPI	DRAMMONEYL5	USDL2	@TREND(98M02)
1.000000	0.000000	0.071104	-0.259787
		(0.05214)	(0.05875)
0.000000	1.000000	-117.4569	-835.6929
		(233.091)	(262.619)
Adjustment coefficients (standard error in parentheses)			
D(CPI)	-0.344187	5.80E-05	
	(0.05780)	(2.0E-05)	
D(DRAMMONEYL5)	-92.97974	-0.087789	
	(189.004)	(0.06688)	
D(USDL2)	-0.127208	-7.25E-05	
	(0.21593)	(7.6E-05)	

Table 7: Vector Error Correction Estimate

Vector Error Correction Estimates	
Date: 12/16/05 Time: 20:57	
Sample (adjusted): 1998M08 2004M12	
Included observations: 77 after adjustments	
Standard errors in ( ) & t-statistics in [ ]	
Cointegrating Eq:	CointEq1
CPI(-1)	1.000000
DRAMMONEYL5(-1)	-0.000182
	(5.9E-05)
	[-3.10546]
USDL2(-1)	0.092456
	(0.03050)

	[3.03112]		
@TREND(98M01)	-0.107871		
	(0.07967)		
	[-1.35398]		
C	-137.0241		

Error Correction:	D(CPI)	D(DRAMMONEYL5)	D(USDL2)
CointEq1	-0.345129	-114.6664	-0.147024
	(0.05772)	(193.288)	(0.21893)
	[-5.97911]	[-0.59324]	[-0.67155]
D(CPI(-1))	0.474718	438.4691	0.537100
	(0.08208)	(274.835)	(0.31130)
	[5.78393]	[1.59539]	[1.72536]
D(DRAMMONEYL5(-1))	0.000122	-0.347481	-4.49E-05
	(3.4E-05)	(0.11408)	(0.00013)
	[3.58535]	[-3.04604]	[-0.34729]
D(USDL2(-1))	0.056922	-17.82088	0.436023
	(0.02985)	(99.9651)	(0.11323)
	[1.90674]	[-0.17827]	[3.85086]
C	0.054547	1319.639	-0.069516
	(0.16915)	(566.420)	(0.64157)
	[0.32247]	[2.32979]	[-0.10835]
R-squared	0.546454	0.125856	0.214974
Adj. R-squared	0.521257	0.077292	0.171361
Sum sq. resids	151.8076	1.70E+09	2183.839
S.E. equation	1.452046	4862.283	5.507368
F-statistic	21.68728	2.591571	4.929178
Log likelihood	-135.3924	-760.3467	-238.0421
Akaike AIC	3.646555	19.87913	6.312781
Schwarz SC	3.798751	20.03133	6.464976
Mean dependent	0.272727	1042.104	0.042857
S.D. dependent	2.098598	5061.838	6.050085
Determinant resid covariance (dof adj.)		1.35E+09	
Determinant resid covariance		1.11E+09	
Log likelihood		-1129.493	
Akaike information criterion		29.83099	
Schwarz criterion		30.40933	

Table 8, CPI decomposition

1	2	3	4

	12 months end of period headline inflation	Shocks, 12 month end of period	Non-shock inflation, 12 months end of period
January-03	3.88		3.88
February-03	3.04		3.04
March-03	3.19		3.19
April-03	2.69		2.69
May-03	2.19		2.19
June-03	4.14	**2.16**	1.98
July-03	3.59	**2.15**	1.44
August-03	4.34	**2.16**	2.18
September-03	7.59	**3.87**	3.72
October-03	6.95	**3.85**	3.10
November-03	6.95	**3.85**	3.10
December-03	8.60	**5.50**	3.10
January-04	6.93	**5.42**	1.51
February-04	7.91	**5.47**	2.44
March-04	8.72	**5.51**	3.21
April-04	7.87	**5.46**	2.40
May-04	7.76	**5.46**	2.30
June-04	6.17	**3.25**	2.92
July-04	9.54	**3.35**	**6.19**
August-04	9.43	**3.35**	**6.08**
September-04	6.01	**1.61**	**4.40**
October-04	6.22	**1.62**	**4.61**
November-04	4.77	**1.59**	**3.17**
December-04	1.98		**1.98**
January-05	4.86		**4.86**
February-05	4.65		**4.65**
March-05	3.40		3.40
April-05	1.25		1.25
May-05	0.25		0.25
June-05	-1.05		-1.05

References

Central Bank of Armenia, Annual Reports, 2002, 2003 and 2004.

Central Bank of Armenia, Monetary Policy Programs, 2002, 2003 and 2004.

Coorey, S., M. Mecagni, and E. Offerdal (1997), *Designing Disinflation programs in Transition Economies: The Implications of Relative Price Adjustment,* PPAA/97/1, (Washington, International Monetary Fund).

Cukierman, Alex, (1983), *Relative Price Variability and Inflation: A Survey and Further Results*, Carnegie-Rochester Conference Series on Public Policy 19 pp. 103-158.

Cukierman, A. and L. Leiderman (1994), *Price Controls and the Variability of Relative Prices,* Money, Credit and Banking 16, No. 3.

Gelbard, E., J. McHugh, G. Iradian, C. Beddies, and L. Redifer (2004), Growth and Poverty Reduction in Armenia, International Monetary Fund.

Ghilijyan H. *Armenian Currency Appreciation, Reasons and Consequences,* mimeo, University of Nebraska at Omaha.

Ghosh, A. and S. Phillips (1998), *Inflation, Disinflation, and Growth,* WP/98/68, (Washington, International Monetary Fund, May, 1998).

Grigorian, D., A. Khachatryan and G. Sargsyan (2004), *Exchange Rate, Money, And Wages: What is Driving Prices in Armenia?* Armenian Journal of Public Policy 1, No. 2, and also International Monetary Fund Working Paper No. 04/229, Washington, DC.

Mkrtchyan, A. (2004), *Impact of Regulated Price Adjustments on Price Variability in a Very Low Inflation Transition Economy: Case of Armenia*, WP 732, William Davidson Institute (2004).

Mkrtchyan, A. (2004), *Several Observations on AMD Appreciation*, Economic Development Research Center, Newsletter, December 2004.

Siklos, L. P. (2004), Central Bank Behavior, *The Institutional Framework, And Policy Regimes: Inflation Versus Noninflation Targeting Countries,* Contemporary Economic Policy.

Wozniak, P. (1998) Relative *Price Adjustments in Poland, Hungary and the Czech Republic. Comparison of the Size and Impact on Inflation,* Center for Social and Economic Research, Working Paper No.12, 1998 (Warsaw, August 1998)

International Monetary Fund, Regional Economic Outlook 2005, Middle East and Central Asia .