Putting the Pieces Together: The Moldovan Exchange Rate Policy Puzzle

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Abstract

This paper explores the Moldovan exchange rate policy puzzle: why the country has pursued a soft peg to the US dollar, despite the virtual absence of direct trade with the United States, increasing "euroisation" of the economy, and an inflation-targeting monetary policy regime. In an attempt to assess Moldovan exchange rate policy, the paper finds that while changes in both the US dollar exchange rate and the import-weighted exchange rate affect import prices, consumer prices are determined primarily by changes in the dollar exchange rate. It also finds that the Moldovan monetary authorities use the US dollar exchange rate as an instrument for responding to domestic price developments. Thus, the sensitivity of consumer prices to the dollar exchange rate, and systematic use of the dollar exchange rate as an instrument of monetary policy, constitute an important setting against which the dollar peg policy has been maintained.

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1. Introduction

This paper explores the Moldovan exchange rate policy puzzle: why a small, open economy on the eastern fringe of Europe manages the external value of its currency against the US dollar. We view this as a puzzle to be confronted within the context of Moldova. First, the country, which is nestled between the Russian Federation to the east and the eurozone to the west, conducts virtually no direct trade with the United States; Moldova almost exclusively trades with neighboring and eurozone countries.[1] Second, the Moldovan economy has become increasingly "euroised." From its introduction in 2001 until May 2012, the euro's share of total local exchange market turnover rose to 40.94 percent (32.77 percent for wholesale transactions and 54.5 percent for retail (cash) transactions), and had reached 69.7 percent of total foreign currency bank deposits and 55.2 percent of total foreign currency bank loans by the end of 2011.[2] Third, the National Bank of Moldova (NBM) has, since 2006, defined its monetary policy in terms of an inflation-targeting framework. At first sight, a soft peg to the dollar does not seem compatible with inflation targeting, to the extent that such a policy implies the existence of competing nominal anchors.

In fact, the uniqueness of Moldova, among the transition economies of Central and Eastern Europe (CEE), lies in the endurance of its dollar peg policy.[3] At the beginning of the transition, almost all CEE countries used the US dollar exchange rate as a nominal anchor as the national currencies were introduced, which helped them achieve substantial price stability. As capital inflows picked up and financial markets deepened, however, country after country introduced greater exchange rate flexibility (Crespo-Cuaresma et al., 2005; Frommel and Schobert, 2006). Over time, price stability, not exchange rate targeting, appears to have taken center stage in monetary policy, even in some prospective eurozone participants (Frommel et al., 2011).[4] Ukraine is another country that pursued a soft peg to the US dollar during the 2000s (Conway, 2012), but the peg came under attack during the global financial crisis of 2008; the country subsequently became committed to a gradual transition to a more flexible exchange rate regime (IMF, 2012b).

Frieden, Leblang and Valey (2010), in a political economy model of exchange rate regime choice by Moldova and 20 other transition economies during 1992–2004, show that preference for exchange rate fixity increases with democracy, the size of external debt, and trade openness, while preference for flexibility increases with financial development and as the share of tradable sector employment becomes larger. In this framework, Moldova's relatively large external debt, substantial trade openness, and lack of financial development may explain its preference for exchange rate stability. Frommel and Schobert (2006), in their analysis of the divergence between de jure and de facto exchange rate regimes among six

[1] In 2010, for example, Russia accounted for 26 percent, Romania 16 percent, Italy 10 percent, and Ukraine 6 percent of total exports; on the import side, Romania accounted for 17 percent, Ukraine 16 percent, Russia 15 percent, and Germany 7 percent.

[2] The foreign exchange turnover data come from the website of the National Bank of Moldova (www.bnm.md) and the deposit and loan data from the National Bank's latest annual report.

[3] In this respect, Moldova is similar to some of the Commonwealth of Independent States (CIS) countries in Central Asia (Keller and Richardson 2003; Bauer and Herz 2007). Importantly, these countries depend heavily on the export of commodities whose prices are quoted in US dollars and their trade integration with the eurozone is not as substantial as Moldova's; nor do they explicitly pursue inflation targeting. The Moldovan regime thus remains unique.

[4] Prospective eurozone participants continue to enjoy considerable latitude as ERM-2 allows a 15 percent band.

CEE countries during 1994–2004, document the increasing use of inflation targeting as a nominal anchor but find that the exchange rates often remained managed; Josifides, Allegret and Pucar (2011) explain the incentives faced by the region's countries to combine "hard managed floating" (relative to the euro) with "light inflation targeting" by appealing to exchange rate pass-through and financial euroisation. Amato and Gerlach (2002), noting that the practice of inflation targeting combined with some exchange rate targeting is prevalent in emerging market and transition economies, argue that it can be explained by thin financial markets, sensitivity of domestic prices to exchange rate changes, and foreign currency borrowing. The foregoing discussion suggests that Moldova is unique, not necessarily because it pursues inflation targeting combined with a soft peg, but because its anchor currency choice is the US dollar, not the euro or some euro–dollar basket.

An important part of the empirical literature on transition and other emerging market economies concerns the extent to which monetary policy reacts to exchange rate developments, whether the monetary policy framework in place is inflation targeting or a standard Taylor rule type. Svensson (2000), for example, notes that the exchange rate is part of two transmission channels of monetary policy in an open economy, one working through domestic and foreign demand for domestic goods and the other through the domestic currency prices of imported goods; he then argues that inflation targeting in an open economy would require monetary policy to respond, not only to the deviations of actual inflation and output from target, but also to foreign disturbances. Focusing on seven CEE transition economies during 1994–2006, Ghatak and Moore (2011) find that monetary policy responded significantly to exchange rate movements, suggesting that exchange rate stability was an important component of price stability in an open economy. In the context of Moldova, where money markets are underdeveloped and the transmission channel of monetary policy is weak (e.g., NBM's 2009 Annual Report, p. 27), it is possible that the monetary authorities directly use the exchange rate as an instrument for achieving price stability, a hypothesis we will test later in the paper.

The rest of the paper assesses Moldova's soft dollar peg policy pursued against the background of inflation targeting, in the following sequence. First, Section 2 presents an overview of Moldova's relevant economic characteristics and policy frameworks. Second, Section 3 explores the connection between exchange rates and domestic prices by estimating the pass-through of import-weighted and US dollar exchange rate changes on Moldova's consumer and import prices. Third, Section 4 analyses the conduct of exchange rate and monetary policies in response to macroeconomic developments by estimating alternative versions of Moldova's monetary policy rule—one in which the US dollar exchange rate is used as an instrument and the other in which the short-term interbank interest rate is used. Following these sections, Section 5 completes the paper by concluding that Moldova's soft dollar peg policy can be understood as a monetary policy device in an environment where changes in the US dollar exchange rate significantly influence consumer prices and the transmission channel of monetary policy is weak and unpredictable.

2. Relevant Economic Characteristics and Policy Frameworks

The Republic of Moldova, one of the region's poorest countries, can be described as a small, open economy primarily based on agriculture and related light industries. The lack of domestic energy resources and raw materials, as well as the limited size of the domestic market, have dictated the heavy dependence of Moldova on foreign trade, principally with EU and CIS member states. The small size of Moldova's economy, relative to its trading partners, has led to a very high degree of openness. For example, according to the 2010 official balance of payments statistics, exports and imports accounted for 27.4 and 65.6 percent, respectively, of GDP. While agricultural products and foodstuffs accounted for 47.5 percent of exports, other important exportables included textiles and textile articles (17.4 percent). On the import side, mineral products, mainly mineral fuels, accounted for 20.9 percent, followed by agricultural products and foodstuffs (15.3 percent) and machinery, mechanical appliances and electrical equipment (15.0 percent).

Moldova experienced negative or anemic growth during the 1990s. While growth picked up in the 2000s, the country was hit hard by adverse economic conditions in Europe in more recent years. Because of the country's agriculture-based economy and heavy dependence on foreign trade and remittances, GDP growth has displayed considerable year-to-year volatility. Likewise, inflation performance has been uneven. After experiencing rapid inflation during the early transition years, Moldova continued to struggle with double-digit inflation throughout the 1990s and sporadically thereafter. Although inflation came down to a single-digit level in 2009 (thanks in part to the deflationary pressure of the recession), it continues to show a large variability reflective of high exchange rate pass-through, the composition of output heavy on agriculture, and volatile energy and food prices that make up nearly half of the consumer price index (CPI). It is possible that, in the presence of pervasive regulation, adjustments in distortionary relative price structure also contribute to the large year-to-year variability of inflation. Coupled with thin and underdeveloped financial markets, the channel linking monetary policy instruments and the price level involves a great deal of uncertainty and unpredictability.

Since the collapse of the USSR and replacement of Soviet money with a national currency (the leu) in 1991, the Moldovan monetary authorities have pursued a policy of achieving price stability while at the same time providing sufficient flexibility to respond to economic developments in its main trading partners. As of April 2012, the International Monetary Fund (IMF 2012a) classified Moldova's de facto exchange rate arrangement and monetary policy framework as "floating" with "inflation targeting." The characterisation of Moldova's de facto exchange rate regime as "floating" probably reflects the fact that the leu–dollar exchange rate does move over time. For example, the exchange rate fluctuated roughly between 10 and 13 leu to the dollar during 2005–2012, a range of approximately 30 percent (Figure 1).

Figure 1. The Average US Dollar Exchange Rate of the Moldovan Leu, Q1 2005–Q2 2012 (leu to the dollar)

Source: National Bank of Moldova.

On closer examination, however, floating is not exactly the way the exchange rate regime is administered in practice. Ciubotaru (2012), estimating the Frankel-Wei (1994) regression using daily data, shows that the weight of the US dollar in Moldova's exchange rate management was close to unity during December 2005–November 2010 regardless of the choice of numeraire;[5] when the Kalman filter was used to allow the weight to vary over time, it consistently remained close to unity (Figure 2). While the estimated Frankel-Wei coefficient of unity is not inconsistent with occasional discrete adjustments in the benchmark exchange rate, it nonetheless suggests that the Moldovan leu is better characterised as a soft peg to the US dollar. This fact is acknowledged by the NBM, whose 2010 Monetary Policy Report (NBM, 2010) stated that its foreign-exchange market intervention was aimed at "smoothing out the excessive fluctuations of the exchange rate of domestic currency vis-à-vis the US dollar."

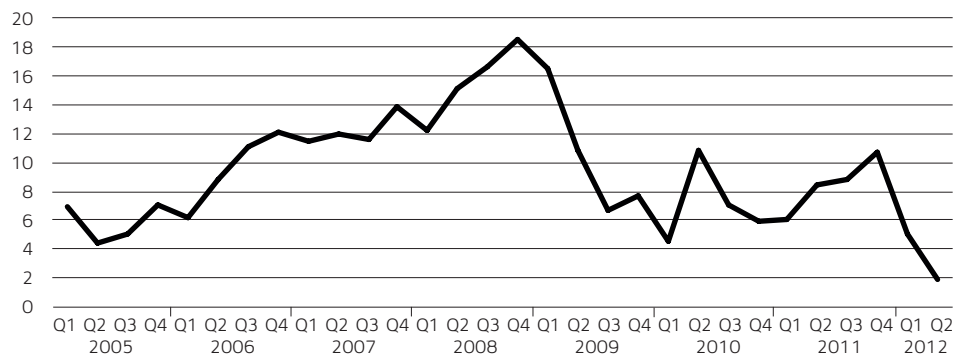
Figure 2. The Time-Varying Weight of the US Dollar in Moldova's Exchange Rate Management, 1 December 2005–30 November 2010 (based on daily data)*

Note:* The Swiss franc is used as the numeraire.
Source: Ciubotaru (2012).

[5] Ciubotaru (2012) used, as alternative numeraires, the Australian dollar, the Swiss franc, the Japanese yen and the special drawing right (SDR); the other currencies included in the regression were the euro, the Romanian leu, the Russian rouble, and the Ukrainian hryvna.

As to monetary policy, the revised National Bank of Moldova Law of 2006 states that the "fundamental objective of the National Bank is to ensure and maintain price stability," although ensuring economic growth and full employment is also mentioned as part of the mandate as long as it does not interfere with attaining the primary objective. The NBM defines price stability in terms of the CPI, computed and published by the National Bureau of Statistics, thus avoiding any conflict of interests. The NBM publishes annual inflation targets, "medium-term strategy" papers, and annual reports on its past performance. The law protects the NBM's legal autonomy and makes the NBM accountable to Parliament in its conduct of monetary policy. In view of the empirically weak link between monetary aggregates and inflation, in 2008, the NBM abandoned monetary aggregates as the intermediate target of monetary policy in favor of short-term interest rates, which they have used rather actively for monetary policy purposes; given capital controls, Moldova appears to retain a considerable degree of monetary policy autonomy despite the tight management of the leu with respect to the US dollar (Figure 3). On this basis, the Moldovan monetary policy framework appears to satisfy most, if not all, of the criteria for inflation targeting proposed by Mishkin (2008).[6] As noted, under inflation targeting, Moldova has seen a fall in the historically high rate of inflation.

Figure 3. The Average Short-term Interest Rate in Moldova, Q1 2005–Q2 2012 (12-month CHIBOR; in percent)



Source: National Bank of Moldova.

3. Exchange Rates and Domestic Prices

Because the value of imports is large relative to GDP, and a large portion of them are energy and agricultural products that are typically invoiced in US dollars, it is possible that Moldova's domestic prices are significantly influenced by changes in the US dollar exchange rate. As noted in the introduction, high exchange rate pass-through is frequently used to explain the practice of inflation targeting combined with a soft exchange rate peg (Amato

[6] According to Mishkin (2008), inflation targeting must possess all of the following five elements: (i) public announcement of numerical targets for inflation; (ii) institutional commitment to price stability; (iii) strategy relating variables to policy instruments; (iv) transparency concerning the plans, objectives, and decisions; and (v) accountability for attaining inflation objectives.

and Gerlach, 2002; Josifides et al., 2011). But, in the case of Moldova, the question remains as to whether it is the dollar exchange rate or the import-weighted exchange rate that matters. This is the issue we explore in this section.

The framework we use is given by the large exchange rate pass-through literature (e.g., Goldberg and Knetter, 1996; Devereux and Yetman, 2010). The term pass-through could mean different things, including how firms set prices in response to exchange rate changes. We focus instead on how exchange rate changes affect aggregate price indices, although to motivate the discussion we start from the following profit function of a representative exporter of goods to Moldova:

$$TR_t - TC_t = \frac{1}{S_t} P_t Q_t(P_t, P_t^*, Y_t) - TC(Q(P_t, P_t^*, Y_t), W_t^*) \quad (1)$$

where: t is a time subscript; $TR(.)$ is the exporter's total revenue function; $TC(.)$ is the exporter's total cost function; S is the bilateral exchange rate (units of Moldova's currency per unit of the exporting country's currency); P is the exporter's price in the exporting country's currency; $Q(.)$ is Moldova's demand function; P^* is the export price in units of Moldova's currency; Y is Moldova's real income; and W^* is the exporter's unit labor costs.

By maximising *TR-TC* given in equation (1) with respect to Q, we obtain the following first-order condition:

$$P_t = S_t MC_t(.)N(P_t, Y_t) \quad (2)$$

where *MC* stands for marginal cost and N is the ratio of price to marginal cost (i.e., markup over cost). A testable form of equation (2) can be obtained by taking logarithmic differences and expressing it as the following regression equation:

$$\pi_t = \alpha_1(s_t + \pi_t^*) + \alpha_2 y_t + \alpha_3 z_t + \varepsilon_t \quad (3)$$

where: π is the log difference of Moldova's price level (i.e., the rate of inflation); π^* is the log difference of the exporting country's price level; s is the rate of depreciation of Moldova's currency; y is the log difference of Moldova's real income; z is the log difference of the exporter's productivity; ε is a random error term; and α_1, α_2 and α_3 are coefficients to be estimated. In particular, α_1 is the parameter of central interest, which indicates the degree of exchange rate pass-through on to domestic prices. When a change in the exporter-price-adjusted exchange rate is passed one-for-one on to domestic prices, α_1 is equal to unity.

In practice, we estimate equation (3) by treating the exporter as an import-weighted average of Moldova's ten largest source countries.[7] Because Moldovan real income and its trading partners' productivities are not available on a quarterly basis, we assume that their quarterly changes are sufficiently small relative to the quarterly exchange rate and price-level changes. In order to include a majority of Moldova's source countries and, at the same time, to isolate the influence of changes in the US dollar exchange rate, we include two exchange rate terms: (i) the effective (import-weighted) exchange rate of the Moldovan leu,

[7] The country weights, based on Moldova's total imports during 2005–10, are as follows: Ukraine (24.22); Romania (21.48); the Russian Federation (18.21); Germany (9.36); Italy (6.97); Turkey (5.41); Belarus (4.42); China (4.53); Poland (4.00), and the United Kingdom (1.39).

adjusted by the import-weighted average price level of Moldova's main source countries, and (ii) the nominal exchange rate of the Moldovan leu against the US dollar, adjusted by the US price level.

Then, equation (3) is transformed as:

$$\pi_t = \alpha_{11} s^{iwe}_{t-1} + \alpha_{12} s^{usd}_{t-1} + \varepsilon_t \qquad (4)$$

where s^{iwe} is the log difference of the price-level-adjusted import-weighted exchange rate; s^{usd} is the log difference of the price-level-adjusted US dollar exchange rate; α_{11} and α_{12} are the separate pass-through coefficients relating to the import-weighted exchange rate and the US dollar exchange rate; and, in view of the likely speed of price adjustment, we have lagged both s^{iwe} and s^{usd} by one period (i.e., by three months).[8] The conventional approach in the empirical literature is to use either bilateral exchange rates in a panel framework (e.g., Takagi and Yoshida, 2001) or an effective (trade- or import-weighted) exchange rate index (e.g., Campa and Goldberg, 2005; Ito and Sato, 2008) for the exchange rate term. The novel feature of equation (4) is that it uses both the bilateral exchange rate against the US dollar and the import-weighted effective exchange rate. This can be interpreted essentially as a setup in which the US bilateral exchange rate term is separated out of the effective exchange rate term and is allowed to have a different coefficient.

Equation (4) should be independent of the policy regime in place, so that we estimate the equation by using the longest possible sample, i.e., Q2 1995–Q4 2011; the starting and ending points were dictated by data availability.[9] No unit roots were detected when the data were log-first differenced; however, seasonality was detected, necessitating use of year-on-year changes (HAC standard errors are reported below, given the likely serial correlation). Two alternative dependent variables are used: consumer price inflation and import price inflation (Table 1).

Two observations immediately emerge, when the full sample is utilised (see the left half of the table). First, in terms of the impact on consumer prices, the coefficient of the US dollar exchange rate is positive and statistically significant at the 1 percent level, while the coefficient of the import-weighted exchange rate is negative and statistically not significant at conventional levels. Second, in terms of the impact on import prices, the estimated coefficients are positive and statistically significant at the 5 percent and 1 percent levels, respectively, for the dollar exchange rate and the import-weighted exchange rate. As a robustness check, we have repeated the same procedure by eliminating the post-global financial crisis observations from the sample, to verify if the asymmetry remains with respect to the impacts of the dollar exchange rate and the import-weighted exchange rate on consumer and import prices (see the right half of the table). With the restricted sample, we

[8] When the additional lags for t-2 and t-3 were included, their coefficients turned out to be not statistically significant.

[9] Monthly series of exchange rates and consumer prices were obtained from the official websites of the National Bank of Moldova as well as of the central banks of Belarus, China, Germany, Italy, Poland, Romania, Russia, Turkey, Ukraine, and the United Kingdom; annual series of merchandise imports (cif) for Moldova were obtained from the National Bank of Moldova, *Balance of Payments for 2009* and *Balance of Payments for 2010*; monthly series of the 12-month Chisinau Interbank Offered Rate (CHIBOR) were obtained from the website of the National Bank of Moldova; and quarterly series of import prices (unit value of imports) and output (seasonally adjusted gross domestic product) for Moldova were obtained from the online database of the Moldovan National Bureau of Statistics.

obtain better overall results in terms of statistical fit and the strength of the impact of changes in the dollar exchange rate on both consumer and import prices. The main conclusion remains the same in either case: the dollar exchange rate affects both consumer and import prices, while the import-weighted exchange rate only influences import prices.

Table 1. OLS Estimates of Exchange Rate Pass-Through on to Domestic Prices

Sample period	Q2 1995–Q4 2011 (full sample)		Q2 1995–Q2 2008 (excluding the post-global financial crisis period)	
	Coefficient	HAC std. error	Coefficient	HAC std. error
The impact on consumer prices:				
Constant	0.101***	0.013	0.115***	0.012
Import-weighted exchange rate	-0.064	0.063	-0.091	0.033
US dollar exchange rate	0.339***	0.054	0.347***	0.043
R^2 (adjusted R^2)	0.50 (0.49)		0.61 (0.59)	
The impact on import prices:				
Constant	0.044**	0.021	0.048***	0.021
Import-weighted exchange rate	0.238***	0.069	0.203**	0.060
US dollar exchange rate	0.314**	0.132	0.367***	0.112
R^2 (adjusted R^2)	0.43 (0.41)		0.52 (0.50)	

Note: There are 67 and 53 observations, respectively, in the full and restricted samples; *** (**) denotes statistical significance at the 1 (5) percent level.

Next, let us uncover the intertemporal relationships among the four variables by means of a vector autoregression (VAR) model. Lag length was selected by comparing different information criteria. Under the assumption that the maximum lag length is 4, the Schwarz Bayesian criteria suggests a lag length of 1, the Hannan-Quinn criteria a lag length of 1, and the Akaike criterion the maximum length of 4. In order to avoid forecast errors due to over-fitting (selecting a higher lag length than the true length) and, at the same time, to avoid autocorrelated errors that arise from under-fitting, we have settled on a lag length of 1. Thus, the four-dimensional VAR (1) model can be specified by the following equations:

$$s_t^{usd} = \beta_{10} + \beta_{11} s_{t-1}^{usd} + \beta_{12} s_{t-1}^{iwe} + \beta_{13} \pi_{t-1}^{imp} + \beta_{14} \pi_{t-1}^{cpi} + \varepsilon_{1,t} \quad (5)$$

$$s_t^{iwe} = \beta_{20} + \beta_{21} s_{t-1}^{usd} + \beta_{22} s_{t-1}^{iwe} + \beta_{23} \pi_{t-1}^{imp} + \beta_{24} \pi_{t-1}^{cpi} + \varepsilon_{2,t} \quad (6)$$

$$\pi_t^{imp} = \beta_{30} + \beta_{31} s_{t-1}^{usd} + \beta_{32} s_{t-1}^{iwe} + \beta_{33} \pi_{t-1}^{imp} + \beta_{34} \pi_{t-1}^{cpi} + \varepsilon_{3,t} \quad (7)$$

$$\pi_t^{cpi} = \beta_{40} + \beta_{41} s_{t-1}^{usd} + \beta_{42} s_{t-1}^{iwe} + \beta_{43} \pi_{t-1}^{imp} + \beta_{44} \pi_{t-1}^{cpi} + \varepsilon_{4,t} \quad (8)$$

where π^{imp} is import price inflation; π^{cpi} is consumer price inflation; ε_1, ε_2, ε_3, and ε_4 are the corresponding error terms for the equations; and β_{ij} (i=1,4; j=0,4) are the respective parameters to be estimated.

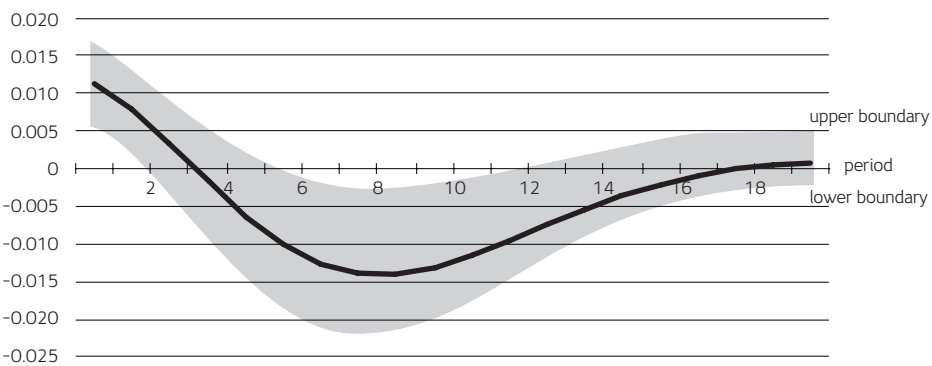
Equations (5)–(8) follow the order we assume for deriving the impulse response functions:

$$s^{usd} => s^{iwe} => \pi^{imp} => \pi^{cpi}$$

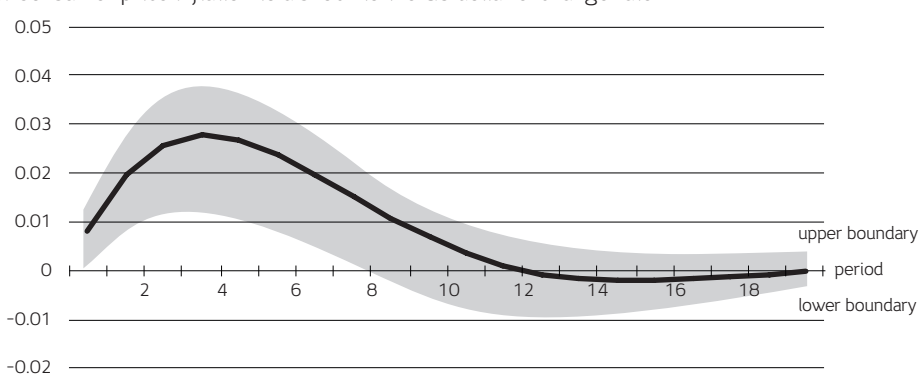
Specifically, this ordering assumes that (i) the US dollar exchange rate is exogenous in the contemporaneous time horizon, (ii) the import-weighted exchange rate is influenced only by the US dollar exchange rate, (iii) import prices are influenced by both of the exchange rate terms, and (iv) consumer prices are influenced by all four variables. As a robustness check, we later switch the order of the first two variables, although the order we assume here appears to be the most economically sensible one. Focusing on the impulse responses of consumer and import price inflation to one standard deviation shock to the import-weighted and US dollar exchange rates, Figure 4 depicts how Moldovan inflation responds to exchange rate shocks over 20 quarters.

Figure 4. The Estimated Impulse Responses of Consumer and Import Price Inflation to One Standard Deviation Shock to the Import-Weighted and US Dollar Exchange Rates

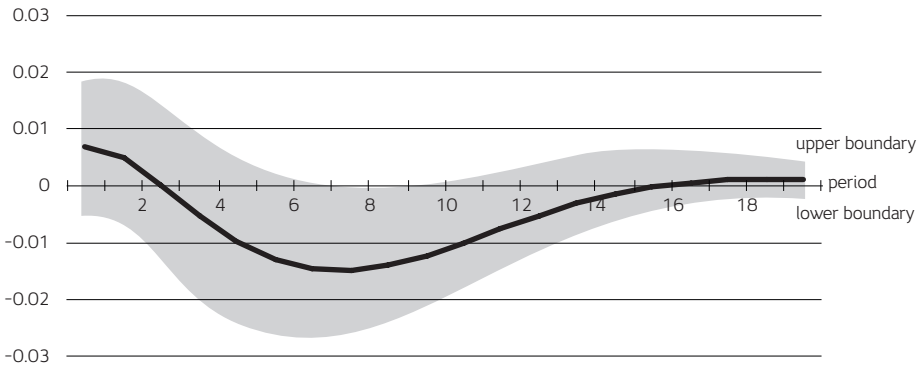
a. Consumer price inflation to a shock to the import-weighted exchange rate



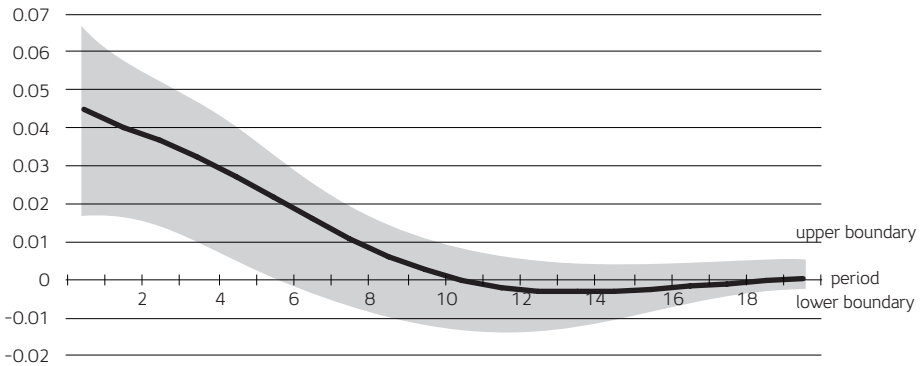
b. Consumer price inflation to a shock to the US dollar exchange rate



c. Import price inflation to a shock to the import-weighted exchange rate



d. Import price inflation to a shock to the US dollar exchange rate



For convenience, the impulse responses of consumer and import price inflation to one standard deviation shocks to the import-weighted and US dollar exchange rate are summarised at three-month, six-month and one-year time horizons (Table 2). Positive numbers mean that a depreciation of domestic currency leads to a rise in inflation, which is a consistent result that obtains in all possible exchange rate–price combinations, at least at a shorter time horizon. The impact of a shock to the import-weighted exchange rate, however, appears to dissipate quickly. The stronger and more persistent effect of a shock to the US dollar exchange rate is consistent with the results from the single-equation estimates, where consumer prices were shown to respond only to a shock to the US dollar exchange rate, although import prices respond to both types of exchange rate shocks (see Table 1 above).

Table 2. The Estimated Impulse Responses of Domestic Inflation to a One Standard Deviation Exchange Rate Shock, Q2 1995 and Q4 2011

Domestic inflation	After three months	After six months	After one year
A shock to the import-weighted exchange rate:			
Consumer prices	0.011	0.008	-0.001
Import prices	0.007	-0.005	-0.005
A shock to the US dollar exchange rate:			
Consumer prices	0.008	0.020	0.028
Import prices	0.045	0.040	0.032

In order to check the robustness of these VAR results, we have first changed the order of Cholesky decomposition by switching the first two variables, the US dollar exchange rate and the import-weighted exchange rate. We have found that the shapes of the impulse response functions remain the same, except that consumer prices respond more vigorously to the import-weighted exchange rate during the initial two quarters; the overall impact of the dollar exchange rate also becomes somewhat weaker. Second, we have next excluded the post-global financial crisis period from the sample and repeated the same procedure (with the original ordering). The shapes of the impulse response functions again remain the same, with the estimated responses to shocks having the same signs, although the response of import prices to the import-weighted exchange becomes less pronounced. Otherwise, it is difficult to argue that the overall VAR results are sensitive to changes in ordering or the sample period.

4. The Exchange Rate as an Instrument of Monetary Policy

The high domestic price pass-through of changes in the US dollar exchange rate may to some extent explain why the Moldovan authorities have found it convenient to maintain a soft peg to the US dollar but, given their commitment to price stability, exchange rate policy may still be subordinate to monetary policy. If so, a peg must be systematically adjusted with respect to domestic price developments. To verify this hypothesis, we now turn to investigating whether the National Bank of Moldova has systematically adjusted the level of the benchmark exchange rate vis-à-vis the US dollar in the light of price and possibly other domestic considerations.

The framework we use is offered by the empirical literature on the Taylor rule, which refers to a set of monetary policy rules that stipulate how much the central banks should change their instruments (usually, the policy interest rate) in response to changes in inflation, output, and other macroeconomic variables (Taylor, 1993). Normally, the set of factors that influence the central bank's decision include: (i) the level of the interest rate that would prevail under full employment; (ii) the actual (or forecast) rate of inflation relative to the "target"; and (iii) the actual level of production relative to its potential level.

A Taylor rule, relating the policy interest rate as a linear function of inflation and output gap, is given by:

$$r_t = \phi_0 + \phi_1 \pi_{t-1} + \phi_2 g_{t-1} + \eta_t \qquad (9)$$

where t is a time subscript; r is a change in the policy interest rate; and π_{t-1} and g_{t-1} stand for one period lagged consumer price inflation (a proxy for the deviation of actual inflation from the target) and output gap (e.g., deviation of real GDP from the full employment level), respectively; η is a random error term; ϕ_0, ϕ_1 and ϕ_2 are coefficients to be estimated. In the context of Moldova, we use the average short-term interbank interest rate in obtaining r. The parameters ϕ_1 and ϕ_2 represent the preferences of the central bank with respect to price and output stability, respectively. A number of existing studies demonstrate that the response of many central banks to macroeconomic shocks can be explained reasonably well by predefined rules of this type (e.g., Taylor, 1993).[10]

While the literature on the Taylor rule is extensive, perhaps more relevant to Moldova may be a modest literature that highlights the role of the exchange rate in a modified Taylor rule framework (see Cavoli, 2008). For example, Ball (1999) found that a Taylor rule augmented by the exchange rate better explained the monetary policy management of highly open economies (see also Svensson, 2000). Singapore goes even further by using periodic adjustments in the trade-weighted exchange rate as an instrument of monetary policy in responding to domestic price and output developments. Given the empirically weak transmission channel of monetary policy, this may also characterise Moldova's monetary policy management.

Following Parrado (2004) and McCallum (2007), consider the alternative version of equation (9), in which the interest rate on the left-hand side is replaced by the exchange rate:

$$e_t = \phi_0 + \phi_1 \pi_{t-1} + \phi_2 g_{t-1} + \phi_3 e_{t-1} + \eta_t \qquad (10)$$

where e is a change in the policy exchange rate (where an increase denotes an appreciation or revaluation of domestic currency); e_{t-1} is a lagged change in the policy exchange rate; ϕ's are coefficients to be estimated, of which the first two are made analogous to those in equation (9) (note that there is no lagged interest-rate term in equation (9)). According to equation (10), a positive shock to output (a positive output gap) or a higher rate of inflation would prompt the monetary authorities to intervene by allowing the domestic currency to appreciate. It should be noted that, to preserve symmetry with equation (9), the exchange rate variable here (e) is defined such that a positive number represents appreciation, whereas the exchange rate term (s) in the previous section was defined such that an increase or positive number represented depreciation.

In what follows, we estimate equation (10) by using quarterly Moldovan data, with the US dollar exchange rate, rather than the import-weighted exchange rate, used in obtaining e because, as observed in Section 2, the US dollar exchange rate is one of the stated operating targets of monetary policy. We will then compare the results so obtained to those derived from estimating the conventional Taylor rule (equation (9)), in which the interest rate is used in place of the exchange rate.

We have estimated equation (10), along with equation (9), for the sample period Q2 2000–Q4 2011. In estimating equation (10), in the absence of quarterly official expected inflation series, we have used one-quarter lagged inflation as a proxy, as noted above. This

[10] Taylor (1993), setting the target inflation at 2 percent per annum with equal weights on inflation and output gap, shows that the model explains reasonably well the monetary policy practice of the Federal Reserve in the 1980s and early 1990s.

also helps avoid simultaneity with the dependent variable. In order to remove seasonality, the rate of inflation is the year-on-year rate of change in consumer prices. In obtaining output gap, we have followed Clarida et al. (1998) in operationally defining it as the deviation of actual output from its polynomial trend, calculated from a longer sample period that goes back to Q2 1995.[11]

Both the exchange rate-based monetary policy rule and the conventional Taylor rule have yielded coefficients with an expected positive sign for lagged inflation for the full sample; they are also statistically significant at the 1 percent level (see the upper half of Table 3). In contrast, the coefficient of output gap is not significant for either rule. A rather high estimate of ϕ_3 (0.724, not reported in the table) in the exchange rate rule suggests considerable inertia in exchange rate adjustment. This is consistent with the soft dollar peg policy pursued by the authorities over this period. In order to check the robustness of these results, we have deleted the post-global financial crisis observations from the sample (see the lower half of the table). The results remain substantially the same, confirming that the authorities likely used both the dollar exchange rate and the short-term interest rate as independent instruments to achieve price stability. Although not formally reported, we have also found weak evidence to suggest that the interest rate was the primary instrument for output developments when the sample was restricted to more recent years.[12]

Table 3. OLS Estimates of Modified versus Conventional Taylor Rules in Moldova

Monetary policy instrument	ϕ_1 (lagged inflation)	ϕ_2 (output gap)	R^2 (adjusted- R^2)
Q2 2000–Q4 2011 (full sample)			
The dollar exchange rate	0.351 (0.088)***	0.358 (0.271)	0.80 (0.78)
The short-term interbank interest rate	0.186 (0.065)***	0.174 (0.141)	0.73 (0.71)
Q2 2000–Q2 2008 (excluding the post-global financial crisis period)			
The dollar exchange rate	0.361 (0.100)***	-0.074 (0.412)	0.81 (0.79)
The short-term interbank interest rate	0.231 (0.092)**	0.156 (0.216)	0.76 (0.74)

Note: There are 48 and 33 observations, respectively, in the full and restricted samples; *** (**) denotes statistical significance at the 1 (5) percent level; standard errors are in parentheses.

In order to see the interactions between the interest rate and the exchange rate as two instruments of monetary policy, we employ the following VAR model where, on the basis of the Schwarz Bayesian information criterion, we selected the lag length of one:

$$g_t = \gamma_{10} + \gamma_{11} g_{t-1} + \gamma_{12} \pi_{t-1} + \gamma_{13} r_{t-1} + \gamma_{14} e_{t-1} + \eta_{1,t} \quad (11)$$

$$\pi_t = \gamma_{20} + \gamma_{21} g_{t-1} + \gamma_{22} \pi_{t-1} + \gamma_{23} r_{t-1} + \gamma_{24} e_{t-1} + \eta_{2,t} \quad (12)$$

[11] That is to say, the trend is calculated by using $c_0+c_1t_1+c_2t_2+c_3t_3$, where c's are coefficients and t is time. Our approach differs from Clarida et al. (1998) in two respects: (i) because quarterly data on Moldovan industrial production are not available, we use seasonally adjusted real gross domestic product; (ii) because our primary data cover more than 15 years, we use a third-order polynomial trend instead of the original second-order trend. The output gap is calculated as a difference between actual GDP and its potential level, divided by potential GDP.

[12] When we estimate the interest-rate equation for Q4 2006–Q4 2011, the estimated coefficient of the output gap is positive and significant, but numerically nearly zero.

$$r_t = \gamma_{30} + \gamma_{31} g_{t-1} + \gamma_{32} \pi_{t-1} + \gamma_{33} r_{t-1} + \gamma_{34} e_{t-1} + \eta_{3,t} \quad (13)$$

$$e_t = \gamma_{40} + \gamma_{41} g_{t-1} + \gamma_{42} \pi_{t-1} + \gamma_{43} r_{t-1} + \gamma_{44} e_{t-1} + \eta_{4,t} \quad (14)$$

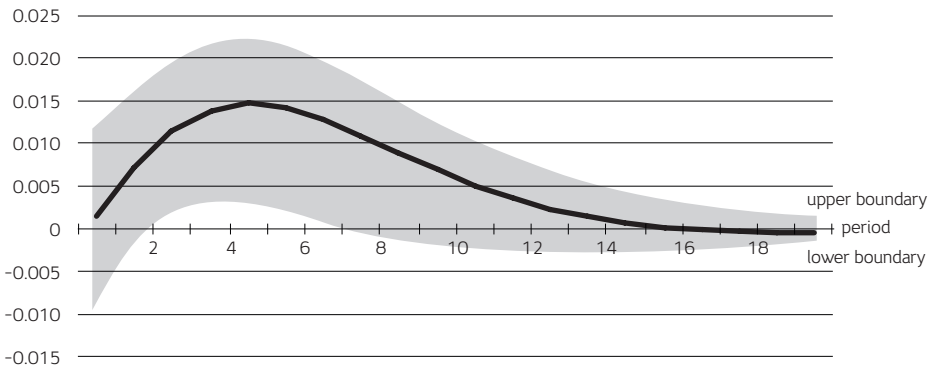
where η_1, η_2, η_3, and η_4 are the error terms for the corresponding equations; and γ_{ij} (i=1, 4; j=0,4) are the respective parameters to be estimated. Equations (11)–(14) follow the order we assume for deriving the impulse response functions:

$g \Rightarrow \pi \Rightarrow r \Rightarrow e$

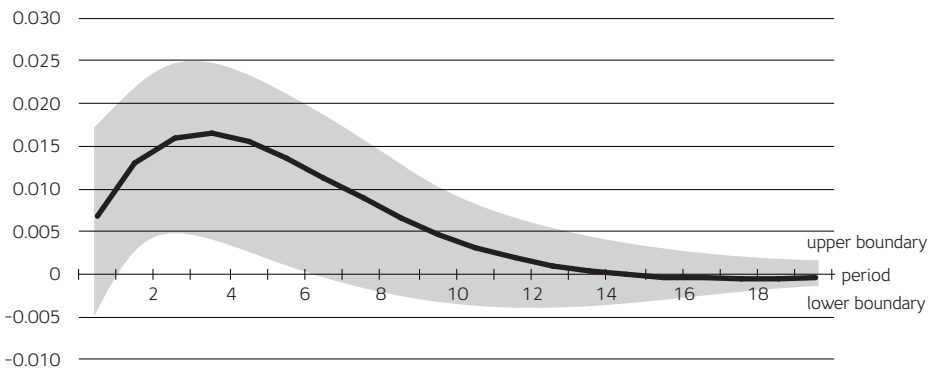
This ordering assumes that real output is exogenous in the contemporaneous time horizon, while inflation is influenced by real output only; although the interest rate and the exchange rate are both policy instruments, the exchange rate has a greater endogenous component as it is subject to greater market forces, including interest-rate adjustments (although the link between the exchange rate and the interest rate is less than perfect, given the capital controls). Focusing on the behavior of the two instruments of monetary policy, Figure 5 depicts the impulse responses of the US dollar exchange rate and the 12-month Chisinau Interbank Offered Rate (CHIBOR) to one standard deviation shock to inflation and output gap.

Figure 5. The Estimated Impulse Responses of the US Dollar Exchange Rate and the Policy Interest Rate to One Standard Deviation Shock to Inflation and Output Gap

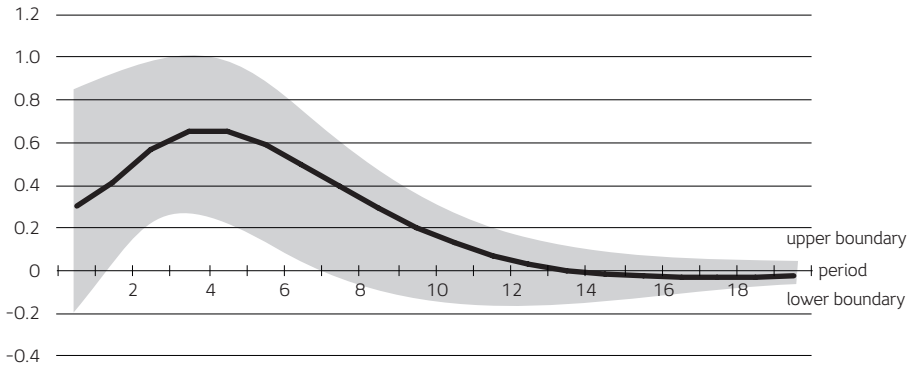
a. The US dollar exchange rate to inflation



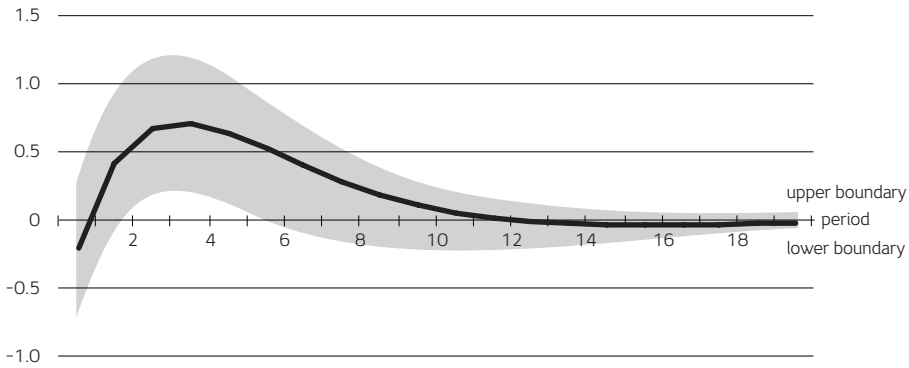
b. The US dollar exchange rate to output gap



c. The policy rate to inflation



d. The policy rate to output gap



The estimated impulse response functions suggest that the immediate response of both the exchange rate and the policy interest rate to inflation is positive and statistically significant; numerically, the response of the exchange rate is considerably larger. In both cases, the impact dissipates in about four quarters. In contrast, the immediate response of the exchange rate and the interest rate to output gap is positive but statistically not significant. In short, the Moldovan monetary authorities appear to use both the exchange rate and the interest rate as instruments for achieving price stability, possibly with the former used as a more dominant tool. These patterns are broadly consistent with the single-equation estimates of the exchange rate-based Taylor rule and the conventional Taylor rule, where the response to inflation was found to be statistically significant but the response to output gap was statistically not significant.

In order to check the robustness of these VAR results, we have first changed the order of Cholesky decomposition by switching the first two variables, output gap and CPI. We have found that the shapes of the impulse response functions substantially remain the same, but the effect of output gap on both instruments becomes much weaker. We then excluded the post-global financial crisis period from the sample. In this case, there is a significant difference. The initial impact of the CPI on the interest rate becomes more pronounced, while the initial impact on the US dollar exchange rate becomes weaker. In contrast, the impact of the output gap on both instruments persists for a long time, although the initial

impact is smaller. None of the conclusions we had reached earlier would need to change, however, especially regarding the broad qualitative responses of both the exchange rate and the interest rate to inflation and output shocks.

5. Conclusion

The paper has explored the Moldovan exchange rate puzzle: why a small, open economy nestled between the eurozone and the Russian Federation has pursued a soft peg to the US dollar, even though it conducts virtually no direct trade with the United States, its economy has become increasingly "euroised," and the monetary policy regime is best characterised as inflation targeting. In particular, the paper has assessed Moldova's soft dollar peg policy pursued against the background of inflation targeting, in two stages. First, using the framework offered by the empirical literature on exchange rate pass-through, we have found that while changes in both the US dollar exchange rate and the import-weighted exchange rate affect import prices, it is primarily the changes in the US dollar exchange rate that affect consumer prices. Second, within the framework of the literature on the Taylor rule, we have shown that the Moldovan monetary authorities use the US dollar exchange rate as a dominant instrument to deal with domestic price developments.

The sensitivity of consumer prices to changes in the US dollar exchange rate, coupled with the systematic use of the US dollar exchange rate as an instrument of achieving price stability, constitute an important setting against which Moldova's soft dollar peg policy has been maintained. The endurance of the regime, however, does not mean that it is necessarily the best option for the country. First, our analysis of dynamic relationships between exchange rates and prices by means of vector autoregression has suggested that consumer prices also respond to changes in the import-weighted exchange rate (although the impact may dissipate more quickly). Second, the statistical sensitivity of consumer prices to the dollar exchange rate may in part be an artifact of the use of the US dollar as a monetary policy instrument. As Moldova further liberalises its foreign exchange and capital account regime over time, its economic integration with neighboring countries is bound to deepen. Moldova may therefore need to give greater attention to exchange rate stability in terms of broader import-weighted terms as a means of achieving price stability. It is even possible that, given the increasingly binding impossible trinity, the country may need to accept greater exchange rate flexibility if it desires to retain monetary policy independence.

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