Dollarization in Transition Economies: New Evidence from Georgia

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Abstract

This paper provides new evidence for dollarization in Georgia during the period from 1996 to 2007 using implications of dynamic money-in-utility-function models. Partial effects of foreign and domestic inflation, exchange rate, and foreign and domestic currency deposits' interest rates on dollarization are considered. The US dollar is a strong substitute for domestic currency and has a significant share in producing domestic liquidity services. The actual dollarization in Georgia is well explained by the exchange rate partial effects model.

Keywords: Dollarization, Georgia, Money-in-utility-function
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1 Introduction

The phenomenon of dollarization[1] was a very popular topic in the academic literature in the 1970s and 1980s. After stabilization policies in Latin America were implemented it became silent. Recently, this issue has gained increasing attention mostly due to the high degree of dollarization in a number of former Soviet market economies. In these economies, large amounts of the US dollar are held by the public. De-dollarization has not occurred in these countries despite recent progress in macroeconomic stabilization. Georgia is one of these economies, in which moderate inflation and stability of the exchange rate do not provide enough incentives to switch to the domestic currency, the lari.

It is well known that dollarization influences monetary independence of a country. Significant dollarization leads to decreasing control over the exchange rate, to reducing the results of inflation stabilization and monetary policies, and to stimulating the growth of the shadow sector of an economy. Thus, dollarization should be taken into account by authorities in determining the exchange rate regime, in conducting policies, and in intervening on the foreign exchange market. This paper studies the significance and degree of dollarization in Georgia, and addresses the issue of the persistence in the use of the US dollars.[2]

A large stream of literature focuses on the study of dollarization using various approaches. The demand for domestic currency with respect to foreign currency is usually empirically analyzed based on a theoretical model. Several categories of theoretical models can be identified. The first type are sequential portfolio balance models (Miles, 1978). In these models agents choose an optimal mix of monetary and non-monetary assets, and then decide how much of each currency to hold. The elasticity of currency substitution is then estimated

[1] The paper uses dollarization to refer to the unofficial process when the national currency, as means of circulation and wealth accumulation, is substituted with a more stable foreign currency or several currencies (Calvo & Vegh, 1996).

[2] In Georgia, the US dollar has the largest share (85-90%) in total foreign currency holdings.

as a parameter in the foreign currency demand equation. The classical optimization model (Thomas, 1985) implies that the ratio of domestic to foreign money is negatively related to the domestic nominal interest rate and positively to the foreign nominal interest rate. Another type of model is a two-period portfolio balance model, in which agents allocate wealth among domestic and foreign money and bonds (for example, Cuddington, 1983). The demand for domestic real money balances is as a function of domestic real income, interest rates on domestic and foreign bonds, and the expected rate of depreciation.

Recent models of dollarization deal with the agent's dynamic optimization. These models usually follow the money-in-utility-function (MIUF, Sidrauski, 1967) approach. The demand for foreign currency is based on the first order conditions for MIUF model optimization. This demand equation is estimated rather than an *ad hoc* money demand function. The parameters of consumer preferences are jointly or separately estimated by the generalized method of moments (GMM, Hansen, 1982). Imrohoroglu (1994) estimates currency substitution between the Canadian and the US dollars. Selcuk (1997) applies the same model for the Turkish case. Friedman and Verbetsky (2001) consider dollarization in Russia. Mulligan and Nijsse (2001) examine currency substitution in Bulgaria, Hungary, Poland, and Romania. A study on Bolivia can be found in Cuddington, Garcia, and Westbrook (2002). Selcuk (2003) provides empirical evidence for the Czech Republic, Hungary, Israel, Jordan, Poland, and Slovak Republic.

Models with ratchet effect of dollarization (also known as hysteresis) refer to the persistence in foreign currency use despite improvement in macroeconomic fundamentals. In order to explain the ratchet effect of dollarization these models usually assume that the reaction of the money demand is asymmetric to the key explanatory variables. In empirical studies, this effect is captured by adding past maximum of inflation rate as an explanatory variable. The main finding of these studies is that the elasticity of money demand is higher

when inflation rises than when inflation is falling. In theoretical models, this asymmetry results from costs of consideration of households. These can be costs of learning, developing, or applying financial innovation strategies. In these models, only a highly significant decline in inflation or domestic currency appreciation can provide enough incentives to switch to domestic money. Uribe (1997) builds a cash-in-advance model with a network externality with money as a medium of exchange. There are transaction costs for using foreign currency. The positive network externality reduces the transaction costs of foreign currency.

This papers uses the implications of a dynamic money-in-utility-function model to investigate the phenomenon of dollarization in the context of the Georgian transition economy. First, significance of dollarization is addressed. The model is used to estimate the elasticity of currency substitution between the US dollar and the lari as well as their shares in the production of money services. In the model, both currencies are useful in reducing transaction costs. Money services are produced using CES technology with two currencies as inputs. Influence of dollarization learning on the elasticity of currency substitution is studied. This aims to capture not just the role of the fundamentals but all possible factors that influenced the dollarization process in the past. Second, the MIUF framework is used to study dynamics of dollarization. Evolution of actual dollarization is compared to the model's optimal dollarization level.

The results show that dollarization is of significant importance in Georgia. The GMM estimates indicate that the US dollar is a good substitute for the domestic currency in terms of reduction of transaction costs. Foreign money balances have 0.57-0.8 significant share in producing liquidity services. Dollarization persistence in Georgia can be explained by trends in exchange rate, in domestic versus foreign inflation, as well as in interest rates differential between domestic and foreign currency deposits. The exchange rate model predicts dollarization the closest to actual one comparative to the inflation and the interest

rate models.

The paper is structured as follows. Section 2 presents the model of an economy. Section 3 describes the data. Empirical findings are presented in Section 4. The dynamics of dollarization is studied in Section 5. Section 6 concludes.

2 Benchmark Model

The economy consists of infinitely lived identical agents. Let N be population that is constant over time $N_t = N_{t-1}$, P_t is the price of the consumption good in terms of the domestic currency, and P_t^* is foreign price. At the beginning of each period, each agent decides how much to consume $c_t = \frac{C_t}{NP_t}$, how much to hold in the form of domestic real balances $m_t = \frac{M_t}{NP_t}$ and foreign real balances $m_t^* = \dfrac{M_t^*}{NP_t^*}$ (domestic and foreign personal accounts and demand deposits), and how much to save in certificates of deposits (domestic and foreign term deposits) $cd_t = \dfrac{CD_t}{NP_t}$ and $cd_t^* = \dfrac{CD_t^*}{NP_t^*}$ that earn nominal interest rates i_t and i_t^*. Each individual receives an exogenous endowment $\frac{Y_t}{NP_t}$.

Each household maximizes the discounted utility stream $\sum_{t=0}^{\infty} \beta^t U(c_t, m_t, m_t^*)$, with discount factor $\beta < 1$. The utility function is a reduced form of a more complex problem, in which households can shop more efficiently and increase leisure time by holding more money.

Household's budget constraint is given as

$$\frac{C_t}{NP_t} + \frac{M_t}{NP_t} + \frac{M_t^*}{NP_t^*} + \frac{CD_t}{NP_t} + \frac{CD_t^*}{NP_t^*} = \frac{M_{t-1}}{NP_t} + \frac{M_{t-1}^*}{NP_t^*} + (1+i_t)\frac{CD_{t-1}}{NP_t} + (1+i_t^*)\frac{CD_{t-1}^*}{NP_t^*} + \frac{Y_t}{NP_t}.$$

In real per capita terms the budget constraint is

$$c_t + m_t + m_t^* + cd_t + cd_t^* = m_{t-1}\frac{P_{t-1}}{P_t} + m_{t-1}^*\frac{P_{t-1}^*}{P_t^*} + (1+i_t)\frac{P_{t-1}}{P_t}cd_{t-1} + (1+i_t^*)\frac{P_{t-1}^*}{P_t^*}cd_{t-1}^* + y_t.$$

The FOCs for the problem are

$$U_c(t) = \beta(1+i_{t+1})\frac{P_t}{P_{t+1}}U_c(t+1) \tag{2.1}$$

$$U_c(t) = \beta(1+i_{t+1}^*)\frac{P_t^*}{P_{t+1}^*}U_c(t+1) \tag{2.2}$$

$$U_c(t) = U_m(t) + \beta\frac{P_t}{P_{t+1}}U_c(t+1), \tag{2.3}$$

$$U_c(t) = U_{m^*}(t) + \beta\frac{P_t^*}{P_{t+1}^*}U_c(t+1). \tag{2.4}$$

The term $U_x(t)$ denotes the marginal utility of x at time t. Marginal utilities $U_m(t)$ and $U_{m^*}(t)$ show a transaction cost reducing role of the real money balances at period t in domestic and foreign currencies, respectively. In Eq. 2.3 and Eq. 2.4, the marginal utility of holding one unit of real money balances plus the discounted next period marginal utility afforded by the real balances at time t are balanced by the marginal utility loss at time t.

The utility function follows Kydland and Prescott (1982) non-separable in consumption and money services:

$$U(c_{t,}\Psi_t) = \frac{(c^\gamma \Psi_t^{1-\gamma})^{1-\sigma} - 1}{1-\sigma}.$$

This function is a constant relative risk aversion in the consumption and money services function. The parameter $\sigma > 0$ is the coefficient of relative risk aversion, and $\frac{1}{\sigma}$ is the elasticity of intertemporal substitution; γ reflects the transaction requirement of money in a broad sense. This form of the utility function reflects the motive for holding money: to reduce transaction costs in implementing efficient consumption plans. It highlights the link

between the liquidity services and efficient consumption. The additive in consumption and the money services utility function, in contrast, would break this linkage.

The liquidity services function is the CES function as in Imrohoroglu (1994)

$$\Psi_t(m_t, m_t^*) = \left[(1-\varphi)m_t^{-\rho} + \varphi(m_t^*)^{-\rho}\right]^{-\frac{1}{\rho}}.$$

This functional form separates the elasticity of currency substitution $\frac{1}{1+\rho}$ from the share of foreign currency in the production of domestic liquidity services $\varphi \in (0,1)$.

With these functional forms the marginal utilities are given by

$$U_c = \gamma c_t^{a-1}\left[(1-\varphi)m_t^{-\rho} + \varphi(m_t^*)^{-\rho}\right]^b,$$

$$U_m = (1-\varphi)(1-\gamma)c_t^a\left[(1-\varphi)m_t^{-\rho} + \varphi(m_t^*)^{-\rho}\right]^{b-1} m_t^{-\rho-1},$$

$$U_{m^*} = \varphi(1-\gamma)c_t^a\left[(1-\varphi)m_t^{-\rho} + \varphi(m_t^*)^{-\rho}\right]^{b-1} (m_t^*)^{-\rho-1},$$

where $a = \gamma(1-\sigma), b = \frac{(1-\gamma)(1-\sigma)}{-\rho}$.

2.1 Three Model Specifications

Partial effects on the degree of dollarization (domestic to foreign money ratio) are studied: the effect of inflation differential (foreign and domestic), of the changes in the exchange rate, and of the interest rate differential (foreign and domestic currency deposits interest rates). These three different model specifications allow us to look at dollarization under alternative assumptions.

First model specification will be referred to as the inflation model 1.1. Intuitively, lower expected domestic inflation with respect to expected foreign inflation should pro-

vide incentives to substitute foreign currency with domestic currency. Inflation is defined as $\pi_t = \dfrac{P_t - P_{t-1}}{P_{t-1}}$ and $\pi_t^* = \dfrac{P_t^* - P_{t-1}^*}{P_{t-1}^*}$. First order conditions of the problem (Eq. 2.3 and Eq. 2.4) become

$$\gamma c_t^{a-1}\left[(1-\varphi)m_t^{-\rho}+\varphi m_t^{*-\rho}\right]^b = (1-\varphi)(1-\gamma)c_t^a\left[(1-\varphi)m_t^{-\rho}+\varphi m_t^{*-\rho}\right]^{b-1} m_t^{-\rho-1} + \\ + \beta\gamma\frac{1}{(1+\pi_{t+1})}c_{t+1}^{a-1}\left[(1-\varphi)m_{t+1}^{-\rho}+\varphi {m_{t+1}^*}^{-\rho}\right]^b,$$

$$\gamma c_t^{a-1}\left[(1-\varphi)m_t^{-\rho}+\varphi m_t^{*-\rho}\right]^b = \varphi(1-\gamma)c_t^a\left[(1-\varphi_t)m_t^{-\rho}+\varphi_t m_t^{*-\rho}\right]^{b-1} m_t^{*-\rho-1} + \\ + \beta\gamma\frac{1}{(1+\pi_{t+1}^*)}c_{t+1}^{a-1}\left[(1-\varphi)m_{t+1}^{-\rho}+\varphi {m_{t+1}^*}^{-\rho}\right]^b.$$

These equations are rearranged in such a way that the variables enter the modified equations as ratios and one minus growth rate form indicating the lack of significant trends.[3]

$$\beta\gamma\frac{1}{(1+\pi_{t+1})}\left(\frac{c_{t+1}}{c_t}\right)^{a-1}\left[\frac{(1-\varphi)(\frac{m_{t+1}}{m_{t+1}^*})^{-\rho}+\varphi}{(1-\varphi)(\frac{m_t}{m_t^*})^{-\rho}+\varphi}\right]^b\left(\frac{m_{t+1}^*}{m_t^*}\right)^{-\rho b} = \\ = \gamma - (1-\varphi)(1-\gamma)\left(\frac{m_t}{m_t^*}\right)^{-\rho}\left[(1-\varphi)\left(\frac{m_t}{m_t^*}\right)^{-\rho}+\varphi\right]^{-1}\frac{c_t}{m_t},$$

$$\beta\gamma\frac{1}{(1+\pi_{t+1}^*)}\left(\frac{c_{t+1}}{c_t}\right)^{a-1}\left[\frac{(1-\varphi)(\frac{m_{t+1}}{m_{t+1}^*})^{-\rho}+\varphi}{(1-\varphi)(\frac{m_t}{m_t^*})^{-\rho}+\varphi}\right]^b\left(\frac{m_{t+1}^*}{m_t^*}\right)^{-\rho b} = \\ = \gamma - \varphi(1-\gamma)\left[(1-\varphi)\left(\frac{m_t}{m_t^*}\right)^{-\rho}+\varphi\right]^{-1}\frac{c_t}{m_t^*}.$$

From these, the optimality condition that will be used in GMM estimation for the inflation

[3] The stationarity issue is one of the important aasumptions for GMM estimation (Hansen,1982).

model 1.1 with the share parameter φ is

$$(\pi^*_{t+1} - \pi_{t+1})\gamma = (1-\gamma)[(1-\varphi)(\frac{m_t}{m^*_t})^{-\rho} + \varphi]^{-1} * \\ \{(1+\pi^*_{t+1})\varphi\frac{c_t}{m^*_t} - (1+\pi_{t+1})(1-\varphi)(\frac{m_t}{m^*_t})^{-\rho}\frac{c_t}{m_t}\}. \tag{2.5}$$

The optimal money ratio in the economy at the period t for the inflation model 1.1 is

$$\frac{m_t}{m^*_t} = (\frac{\varphi(1-\gamma)\frac{c_t}{m^*_t} - \gamma\varphi(1 - \frac{(1+\pi_{t+1})}{(1+\pi^*_{t+1})})}{(1-\varphi)(1-\gamma)\frac{c_t}{m_t} + (1-\varphi)\gamma(1 - \frac{(1+\pi_{t+1})}{(1+\pi^*_{t+1})})})^{-1/\rho}. \tag{2.6}$$

The money ratio in the period t is a function of the consumption-money ratios $\frac{c_t}{m^*_t}$, $\frac{c_t}{m_t}$, and domestic and foreign inflation in the next period π_{t+1}, π^*_{t+1}. The parameters are the share of foreign currency in the production of domestic liquidity services φ, the transaction requirement of money in broad sense parameter γ, and ρ that implies the elasticity of currency substitution $\frac{1}{1+\rho}$.

Dollarization can be encouraged when the domestic currency is expected to depreciate. Optimality condition for the exchange rate model 2.1 is obtained in similar way using Eq. 2.3 and Eq. 2.4 as for the inflation model 1.1 using purchasing power parity condition $P_t = e_t P^*_t$. The optimality condition is

$$\gamma(1 - \frac{e_{t+1}}{e_t}) = (1-\gamma)[(1-\varphi)(\frac{m_t}{m^*_t})^{-\rho} + \varphi]^{-1} * \\ \{\varphi\frac{c_t}{m^*_t} - \frac{e_{t+1}}{e_t}(1-\varphi)(\frac{m_t}{m^*_t})^{-\rho}\frac{c_t}{m_t}\}. \tag{2.7}$$

The optimal money ratio for the model 2.1 at the period t is

$$\frac{m_t}{m_t^*} = (\frac{\varphi(1-\gamma)\frac{c_t}{m_t^*} - \gamma\varphi(1-\frac{e_{t+1}}{e_t})}{(1-\varphi)(1-\gamma)\frac{c_t}{m_t} + (1-\varphi)\gamma(1-\frac{e_{t+1}}{e_t})})^{-1/\rho}. \tag{2.8}$$

In this case, money ratio depends on the depreciation rate $\frac{e_{t+1}}{e_t}$ in addition to consumption-money ratios and parameters.

Dollarization ratio should also respond to differences in rates of returns between domestic and foreign currency denominated deposits. The higher real return on domestic currency denominated assets would result in lower dollarization. In contrast to models 1.1 and 2.1, the interest rates model 3.1 divides money into current accounts and demand deposits (more liquid money) m_t and m_t^*, and certificates of deposits (term deposits) cd_t and cd_t^* that earn interest rates. From Eq. 2.1 and Eq. 2.2

$$\frac{e_{t+1}}{e_t} = \frac{1+i_{t+1}}{1+i_{t+1}^*}.$$

The optimality condition for the interest rate model 3.1 is

$$\begin{aligned}\gamma(1-\frac{1+i_{t+1}}{1+i_{t+1}^*}) &= (1-\gamma)[(1-\varphi)(\frac{m_t}{m_t^*})^{-\rho}+\varphi]^{-1} * \\ &\quad \{\varphi\frac{c_t}{m_t^*} - \frac{1+i_{t+1}}{1+i_{t+1}^*}(1-\varphi)(\frac{m_t}{m_t^*})^{-\rho}\frac{c_t}{m_t}\},\end{aligned} \tag{2.9}$$

and the optimal money ratio at the period t is now a function of consumption-money ratios, parameters, and foreign and domestic next period interest rates i_{t+1} and i_{t+1}^*:

$$\frac{m_t}{m_t^*} = (\frac{\varphi(1-\gamma)\frac{c_t}{m_t^*} - \gamma\varphi(1-\frac{1+i_{t+1}}{1+i_{t+1}^*})}{(1-\varphi)(1-\gamma)\frac{c_t}{m_t} + (1-\varphi)\gamma(1-\frac{1+i_{t+1}}{1+i_{t+1}^*})})^{-1/\rho}. \tag{2.10}$$

2.2 Modified Versions of the Models

In the first version of each model, the share of foreign currency in domestic liquidity services φ is a fixed parameter. In modified two versions, the assumption of the fixed parameter is relaxed.

For the second version, assume that the share of foreign currency in the production of domestic liquidity services φ changes over time. The agents make decisions over consumption and money holdings knowing lagged dollarization share in the economy in the previous period $DR_t = \dfrac{m^*_{t-1}}{m^*_{t-1} + m_{t-1}}$. This is the share of foreign currency in the production of money services. Using the actual data on dollarization shares DR_t is calculated using dollarization ratios. For example, version 1.2 of the inflation model is

$$\begin{aligned} \gamma(1 - \frac{(1+\pi_{t+1})}{(1+\pi^*_{t+1})}) &= [(1-DR_t)(\frac{m_t}{m^*_t})^{-\rho} + DR_t]^{-1}(1-\gamma) * \\ &\quad \{DR_t \frac{c_t}{m^*_t} + \frac{(1+\pi_{t+1})}{(1+\pi^*_{t+1})}(1-DR_t)(\frac{m_t}{m^*_t})^{-\rho}\frac{c_t}{m_t}\}. \end{aligned} \tag{2.11}$$

In the third version, individuals act as econometricians by learning share of foreign currency in the production of money services using previous period's data on dollarization shares. This is aimed to capture inertia in the agents' foreign currency holdings. Knowledge is accumulated through the use of foreign currency by domestic agents in previous periods. A proxy for such knowledge at time t is fitted value of dollarization ratio obtained by regression on its lags. The idea behind this proxy is that knowledge of foreign currency is proportional to the amounts of foreign currency previously used.[4] That is, dollarization in the economy persists because agents constantly utilize accumulated knowledge on the foreign currency use. Each individual runs regression

$$DR_t = \alpha + DR_{t-1}\lambda_1 + .. + DR_{t-p}\lambda_p + \varepsilon_t,$$

[4]It is assumed that knowledge accumulates equally from all foreign deposits.

with p being number of lags. One-step-ahead forecast $\widehat{DR}_{t/t-1}$ is obtained OLS estimation under general assumptions. Fitted values are the share of foreign currency in the money services.

For example, version 1.3 of the inflation model is

$$\begin{aligned}\gamma(1-\frac{(1+\pi_{t+1})}{(1+\pi^*_{t+1})}) &= [(1-\widehat{DR}_t)(\frac{m_t}{m^*_t})^{-\rho}+\widehat{DR}_t]^{-1}(1-\gamma)* \\ &\quad \{\widehat{DR}_t\frac{c_t}{m^*_t}+\frac{(1+\pi_{t+1})}{(1+\pi^*_{t+1})}(1-\widehat{DR}_t)(\frac{m_t}{m^*_t})^{-\rho}\frac{c_t}{m_t}\}. \qquad (2.12)\end{aligned}$$

Modified versions for the exchange rate and the interest rate models are expressed in a similar way.

3 Data

The sample period considered in this paper is January 1996 - November 2007. Foreign nominal money balances are measured by the sum of the foreign currency denominated personal accounts and demand deposits. Both accounts and deposits are held in Georgian banks by nonofficial, nonbank residents. The domestic nominal money balances are measured as the sum of the lari denominated personal accounts and demand deposits in local banks. As a proxy for consumption seasonally adjusted pure energy consumption is used.[5] This series are taken from the Georgian electricity distribution company Telasi's statistics. Both foreign and domestic money balances and consumption are converted to real per capita terms by dividing by population and domestic prices. The domestic price is seasonally adjusted consumer price index. The civilian population is obtained from the World Population record.

[5]Monthly consumption of goods and services and the share of electricity consumption by households data are not available for Georgia. Quarterly goods and services consumption is correlated with electricity consumption series and have similar trends.

Seasonally adjusted observations on the GEL/USD exchange rate are used.[6] The interest rates are domestic and foreign currency denominated term deposits' interest rates. All these series are taken from the National Bank of Georgia statistical bulletins. Foreign price index is the US consumer price index obtained from the Federal Reserve Bank of St. Louis.

Figure 1 shows total dollarization share (foreign currencies share), inflation and depreciation rates for the Georgian economy for the period 1996-2007. The dollarization share is calculated as real per capita sum of the foreign currency denominated personal accounts and demand deposits over the sum of the domestic and foreign currency deposits. The increases/decreases of the share can be partly explained by the lari appreciation/depreciation and inflation rate. However, the ratios remain high despite low inflation and depreciation rates.

Figure 2 shows the shares of the US dollar and Euro in the total dollarization share in the economy in recent years. These are the main foreign currencies in the total ratio. The shares of other currencies deposits (RUB, GBP and CHF) are less than 1%. The US dollar holdings are significantly larger in amount comparatively to the Euro.

Table 1 provides summary statistics, and the stationarity and structural break tests for the ratios $\frac{e_{t+1}}{e_t}, \frac{1+\pi_t}{1+\pi_t^*}, \frac{1+i_t}{1+i_t^*}, \frac{m_t}{m_t^*}, \frac{m_t^*}{m_t^*+m_t}, \frac{c_t}{m_t}$, and $\frac{c_t}{m_t^*}$. All the ratios are stationary or broken trend stationary series (the exchange rate and inflation ratios have a structural break).

4 Evidence on Dollarization: Empirical Findings

The estimation results for the models 1, 2 and 3 (Eq. 2.5, Eq. 2.7, and Eq 2.9) and their versions (Eq. 2.11 and Eq. 2.12) are obtained using the GMM procedure robust to

[6] Weighted average of the GEL/USD and the GEL/EUR exchange rates is close to the GEL/USD exchange rate as the US dollar has the main share in the total ratio.

conditional heteroscedasticity and autocorrelation. Alternative instrument sets are used to check the sensitivity of results to the choice of instruments. The results for the following instrument sets for the three models are presented: [7]

$$I_{t1} = \left\{1, \frac{1+\pi_{t-1}}{1+\pi^*_{t-1}}, \frac{1+\pi_{t-2}}{1+\pi^*_{t-2}}, \frac{m_{t-1}}{m^*_{t-1}}, \frac{m_{t-2}}{m^*_{t-2}}, \frac{c_{t-1}}{m_{t-1}}, \frac{c_{t-2}}{m_{t-2}}, \frac{c_{t-1}}{m^*_{t-1}}, \frac{c_{t-2}}{m^*_{t-2}}\right\},$$

$$I_{t2} = \left\{1, \frac{e_t}{e_{t-1}}, \frac{e_{t-1}}{e_{t-2}}, \frac{m_{t-1}}{m^*_{t-1}}, \frac{m_{t-2}}{m^*_{t-2}}, \frac{c_{t-1}}{m_{t-1}}, \frac{c_{t-2}}{m_{t-2}}, \frac{c_{t-1}}{m^*_{t-1}}, \frac{c_{t-2}}{m^*_{t-2}}\right\},$$

$$I_{t3} = \left\{1, \frac{1+i_{t-1}}{1+i^*_{t-1}}, \frac{1+i_{t-2}}{1+i^*_{t-2}}, \frac{m_{t-1}}{m^*_{t-1}}, \frac{m_{t-2}}{m^*_{t-2}}, \frac{c_{t-1}}{m_{t-1}}, \frac{c_{t-2}}{m_{t-2}}, \frac{c_{t-1}}{m^*_{t-1}}, \frac{c_{t-2}}{m^*_{t-2}}\right\}.$$

The results are given in Tables 2, 3, 4. In each case, the number of orthogonality conditions is greater than the number of parameters. The validity of these overidentifying restrictions is tested using the J-statistics. The test null hypothesis is that the restrictions are satisfied, and the test statistic is distributed assymthotically as χ^2 with degrees of freedom equal to the number of overidentifying restrictions (Hansen, 1982). The Hansen J-statistics are insignificant for all models, thus not rejecting their validity.

In all the models, foreign money balances have significant share φ in producing liquidity services. The economic significance of the role of the US dollar is big since the share estimates range between 0.57 and 0.8. The mean of the actual dollarization share (0.716) and of the forecasted values of the dollarization share (0.699) are close to the estimate of φ. The estimate of the transaction requirement of money in broad sense parameter γ is positively significant and is less then one but is very small in magnitude.

The estimates of ρ imply the elasticity of currency substitution ranging between 1.6 and 5.3 in the model 1 with inflation. Increase in domestic over foreign inflation leads to substitution of the domestic for the foreign currency. In the model 2 with exchange rates, the elasticity is between 1.017 and 11 indicating that the demand for the US dollar is responsive to the fluctuations in the exchange rate. The elasticity of currency substitution drops

[7] The estimation using different instrument sets (number of lags) gives similar results.

significantly in second and third versions of the model. Keeping φ constant (first version of the model) increases elasticity of currency substitution. The hypothesis $1/(1+\rho) = 1$ is rejected at any significance level in favor of $1/(1+\rho) > 1$. In the model 3 with interest rates, the elasticity is between 2.3 and 4.9 but is not significant in the benchmark 3.1 model.

To summarize, using monthly Georgian data gives support to models' overidentifying restrictions. The estimate of the elasticity of currency substitution is more than one, between 1.017 and 11, depending on the model's specification. The US dollar is a good substitute for the lari with the motive for holding money being to reduce transaction costs in purchasing consumption goods. The data supports the money-in-the-utility-function model specification with the transactions cost-reducing role for money. The estimate of the share parameter for foreign real money balance in producing money services is significant and is economically big.

The empirical results of this paper can be compared with findings for other countries based on implications of similar dynamic equilibrium models. Bufman and Leiderman (1991) get the elasticity of currency substitution for Israel greater than one but the share of foreign currency is less than 0.5. Selcuk (2003) finds that elasticity in the Czech Republic is 1.72, in Israel 1.78, in Poland 5, in the Slovak Republic 1.28, and in Turkey 1.4. Foreign balances have a significant share in producing liquidity services: in Turkey (0.53), in Poland (0.50), in the Czech Republic (0.42) and in Israel (0.39). Fiedman and Verbetsky (2001) report the elasticity of currency substitution in Russian between 2 and 3, and estimate of share of the US dollar in liquidity services below 0.5. In a low inflation economy like Canada the US dollar is not a good substitute of domestic currency and, moreover, the share of foreign currency in domestic liquidity services is very small (Imrohorouglu, 1994). Dollarization plays significant role in transition economies like Russia, Czech and Slovak Republics, Poland, Georgia but is insignificant in the developed economies like Canada. Moreover, the share of the US dollar

in producing liquidity services is higher in Georgia than in other transition and developed countries.

5 Dynamics of Dollarization

The optimality conditions of the three versions of the three models are used to calculate the model predicted domestic to foreign money ratios. The optimal money ratio in the economy at period t is a function of economy parameters and consumption-money ratios. In the model 1, the money ratio is also a function of domestic and foreign inflation (Eq. 2.6). In the second and third models, the ratio depends on the changes in the exchange rate and interest rates, respectively (Eq. 2.8 and Eq. 2.10). The actual values of the ratio are compared to the optimal values calculated using the estimated parameter values for Georgia.

Predicted and actual money ratios are shown in Figures 3, 4, 5 for models 1, 2, 3 respectively. These figures show only the versions of the models that predict money ratios closest to the actual ones. The models 1.2, 1.3, and 2.2 that predict money ratios less precisely than the models 1.1 and 2.1, 2.3, respectively, are not shown in the Figures 3 and 4.

The optimal money ratios capture the major movements in the actual data. The volatility of the optimal values is higher than in the actual data for the inflation and interest rates models. In general, the models predict less dollarization in the economy and even de-dollarization in some periods starting from 1999.[8]

[8]When habit persistance is introduced the predicted dollarization is less volatile in some periods. The utility function depends on quasi-difference of consumption $c_t - \alpha c_{t-1}$ rather than only on consumption at period t. The parameter α is the intensity of habit formation between zero and one. The modest (0.2) and strong (0.6) intensity of habit formation were considered. However, on average, the models still predict the same level of dollarization.

The exchange rate model predicts dollarization that is very close to its actual values. The exchange rate model with inertia (model 2.3) performs better until 1999 indicating that agents accumulate knowledge through the use of foreign currency in previous periods. The increased volatility in the inflation model's prediction after 2003 mainly results from decrease in domestic consumption-money ratio over time. The modified versions of the interest rate model predict more volatile dollarization than actual. The interest rate models predict lower and more volatile dollarization. The modified interest rate models predict the actual values better in the period 1997-1999. On average, the interest rate models predict that agents hold equal amounts of domestic and foreign currencies.

Given recent improvements in macroeconomic fundamentals, dollarization is persistent in Georgia. The simple basic models are able to explain this pattern. The models predict that significant exchange rate and domestic inflation stabilization, as well as increase in interest rate on the domestic currency deposits, reduce dollarization in the economy. When the domestic currency depreciates and there is high domestic inflation the models 1 and 2 predict high dollarization close to actual. According to the model 3, increase in the interest rate on the domestic currency deposits provides additional incentive to switch to domestic currency.

Clearly, the main factor that influences the decision over foreign currency holdings is the exchange rate. The exchange rate model predicts dollarization very close to the actual one. Inflation is the second factor that influences foreign currency holdings. However, the inflation model predicts that dollarization ratio should be more volatile as a response to the changes in domestic inflation. The interest rates differential between domestic and foreign currency deposits should provide incentives to significantly reduce the US dollar holdings according to the interest rate model. Inertia in the agent's behavior partly explains high dollarization in the period from 1997 to 1999. Once switched to foreign currency as a response to

macroeconomic instability, there is hedging against future uncertainty. Possible explanation for excessive dollarization predicted by the interest rate model is portfolio diversification motive. The agents hold foreign currency in the form of currency deposits and cash as alternative to savings in the form of domestic currency.

6 Conclusion

This paper presents new evidence for dollarization in the highly dollarized Georgian economy based on a money-in-utility-function model. First, the economic and statistical significance of dollarization is studied based on implications of the model. The elasticity of substitution between the US dollar and the lari and their shares in producing money services are estimated using the GMM procedure. The impact of learning behavior on the elasticity of currency substitution is studied. Second, the paper studies the optimal and actual dynamics of dollarization.

The main empirical findings reveal that dollarization is of first-order importance in Georgia. The US dollar provides a good substitute for domestic currency when money is held to reduce transaction costs. The implied elasticity of currency substitution is significantly greater than one. Foreign currency has significant 0.57-0.8 share in producing liquidity money services. When behavioral aspects are introduced, the demand for the foreign currency becomes less responsive to the fluctuations in the exchange rate due to learning adjustment.

The benchmark simple model with the exchange rate predicts dollarization closest to its actual values among partial effect models. The inflation and the interest rate models predict more volatile dollarization than the actual one. The interest rate models predict less dollarization than the actual one in the economy. According to the exchange rate and

the interest rate models, inertia in foreign currency holdings takes place until 1999. Agents are looking at previous period's dollarization in the economy when deciding how much of each currency to hold. Thus, once switched to foreign currency as a response to macroeconomic instability, there was hedging against future uncertainty even with macroeconomic improvement during this period.

As the US dollar is a good substitute for the lari, changes in domestic inflation over foreign inflation or in the exchange rate lead to substitution between currencies. Given the observed ratchet effect, only the inflation and the exchange rate stabilization policies will eventually reduce dollarization. For now, dollarization is present, should be taken into account, and can not be completely removed in the near future.

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Table 1. Data statistics

	$\frac{e_{t+1}}{e_t}$	$\frac{1+\pi_t}{1+\pi_t^*}$	$\frac{1+i_t}{1+i_t^*}$	$\frac{c_t}{m_t}$	$\frac{c_t}{m_t^*}$	$\frac{m_t}{m_t^*}$	$\frac{m_t^*}{m_t^*+m_t}$
Obs	142	142	142	142	142	142	142
Mean	0.995	1.505	0.975	0.008	0.009	0.671	0.716
Median	1	1.370	0.986	0.008	0.002	0.275	0.784
Maximum	1.211	13.627	1.053	0.022	0.191	8.579	0.886
Minimum	0.949	-1.247	0.874	0.001	0.000	0.128	0.104
Std. Dev.	0.029	1.716	0.034	0.006	0.023	1.208	0.185
Skewness	4.554	3.662	-0.389	0.319	5.006	3.878	-1.801
Kurtosis	29.100	21.956	-0.245	-1.068	31.032	17.013	2.559
UR/break tests result[a]	broken trend stationary	broken trend stationary	stationary	stationary	stationary	stationary	stationary

[a]The decision is based on the results of ADF, PP, KPSS, Vogelsang and Perron tests at 5% significance level.

Table 2. Estimation results for the model 1

parameter	inflation model 1.1	inflation model 1.2	inflation model 1.3
φ	0.566***(0.099)	-	-
γ	6.41E-04**(3.37E-04)	1.08E-03**(5.61E-04)	2.91E-03***(6.66E-04)
ρ	-1.464**(0.767)	-0.811**(0.382)	-1.618***(0.329)
$\lvert 1/(1+\rho)\rvert$	2.153	5.300	1.617
J	6.949[0.542]	5.291[0.808]	14.302[0.074]

Sample: 01/01/1996-01/11/2007; estimation method: GMM; *=significance at 10%;**=significance at 1%;***=significance at 1%. Standard errors of coefficient estimates are in parenthesis. P-values for J-test are in square brackets.

Table 3. Estimation results for the model 2

parameter	exchange rate model 2.1	exchange rate model 2.2	exchange rate model 2.3
φ	0.591***(0.161)	-	-
γ	1.06E-03*(5.74E-04)	0.068***(0.024)	6.58E-04***(1.76E-04)
ρ	-1.091***(0.466)	-0.017**(8.52E-03)	-1.647**(0.833)
$\lvert 1/(1+\rho)\rvert$	10.980	1.017{0.00}[a]	1.545
J	12.293[0.504]	7.322[0.885]	4.929[0.977]

Sample: 01/01/1996-01/11/2007; estimation method: GMM; *=significance at 10%;**=significance at 1%;***=significance at 1%. Standard errors of coefficient estimates are in parenthesis. P-values for J-test are in square brackets. [a] p-values of the equality to unity test are in curly brackets.

Table 4. Estimation results for the model 3

parameter	interest rates model 3.1	interest rates model 3.2	interest rates model 3.3
φ	0.800***(0.253)	-	-
γ	9.44E-04***(3.26E-04)	1.40E-03***(3.80E-04)	3.68E-03***(8.06E-04)
ρ	-2.49509(2.232)	-0.797*(.531)	-1.426***(0.459)
$\lvert 1/(1+\rho)\rvert$	-	4.916	2.346
J	4.776[0.853]	3.106[0.96]	15.622[0.058]

Sample: 01/01/1996-01/11/2007; estimation method: GMM; *=significance at 10%;**=significance at 1%;***=significance at 1%. Standard errors of coefficient estimates are in parenthesis. P-values for J-test are in square brackets.

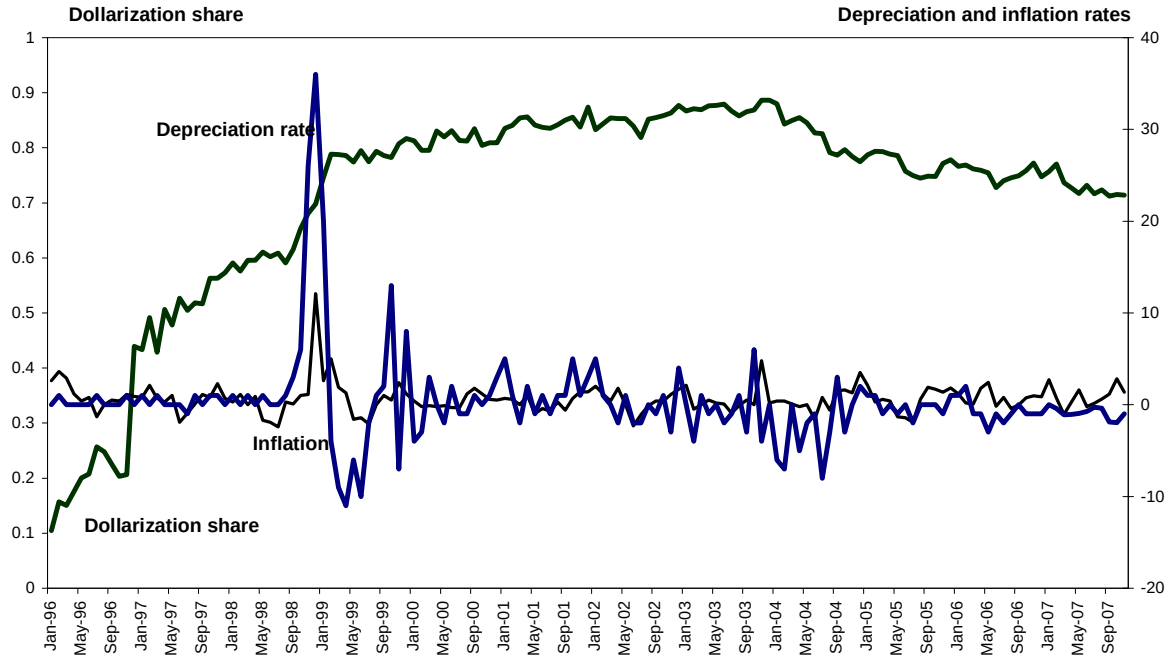

Figure 1: Dollarization share, depreciation, and inflation in Georgia , 1996-2007

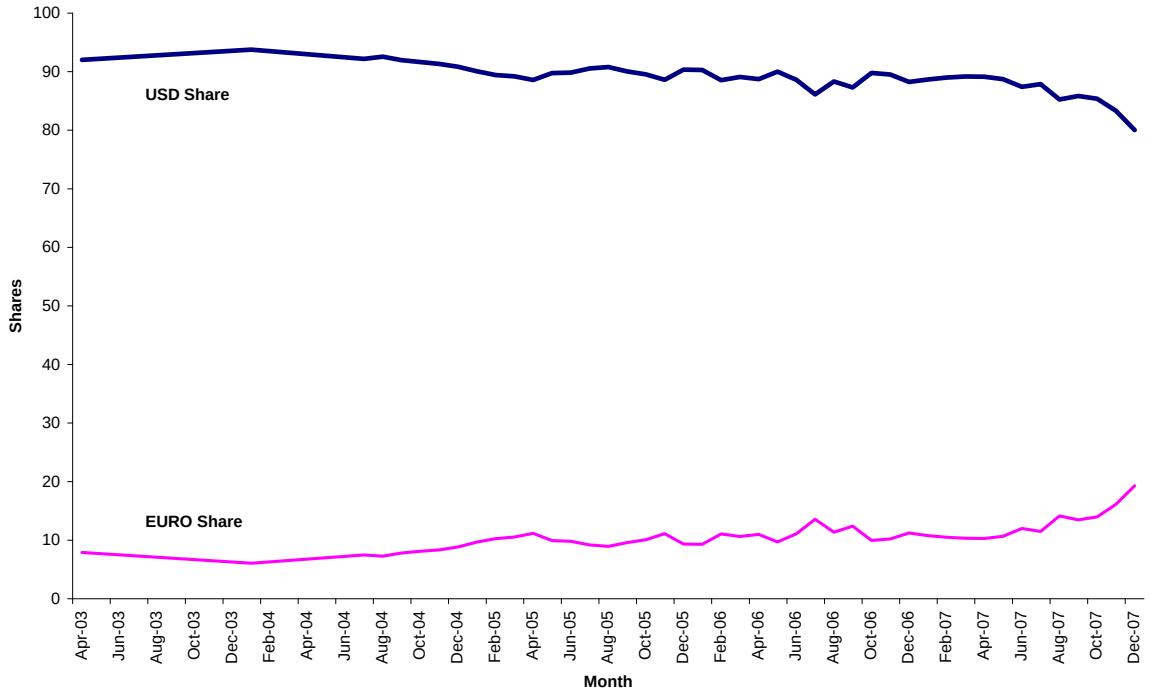

Figure 2: USD and EURO Shares in Dollarization Ratio in Georgia, 2003-2007

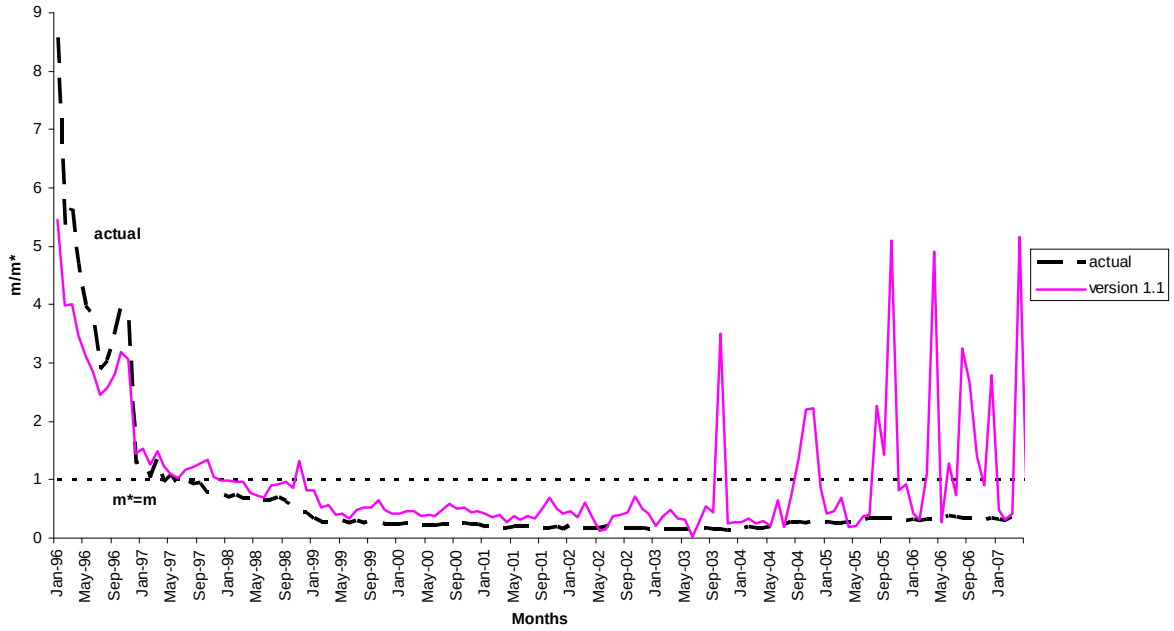

Figure 3: Money ratio: actual and inflaion model 1

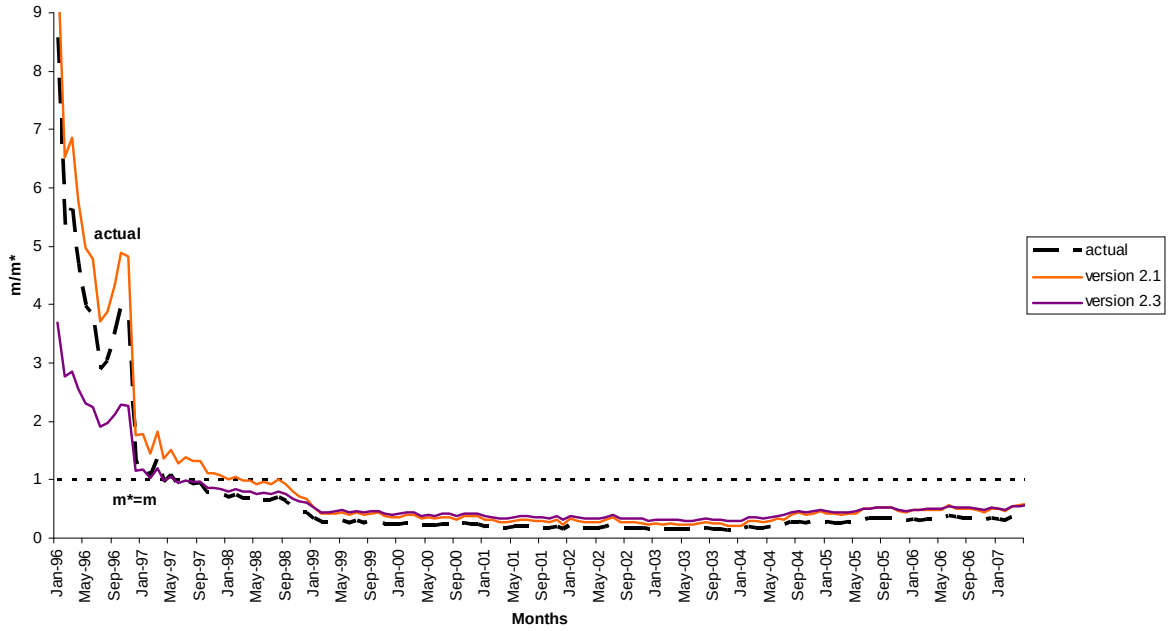

Figure 4: Money ratio: actual and exchange rate model 2

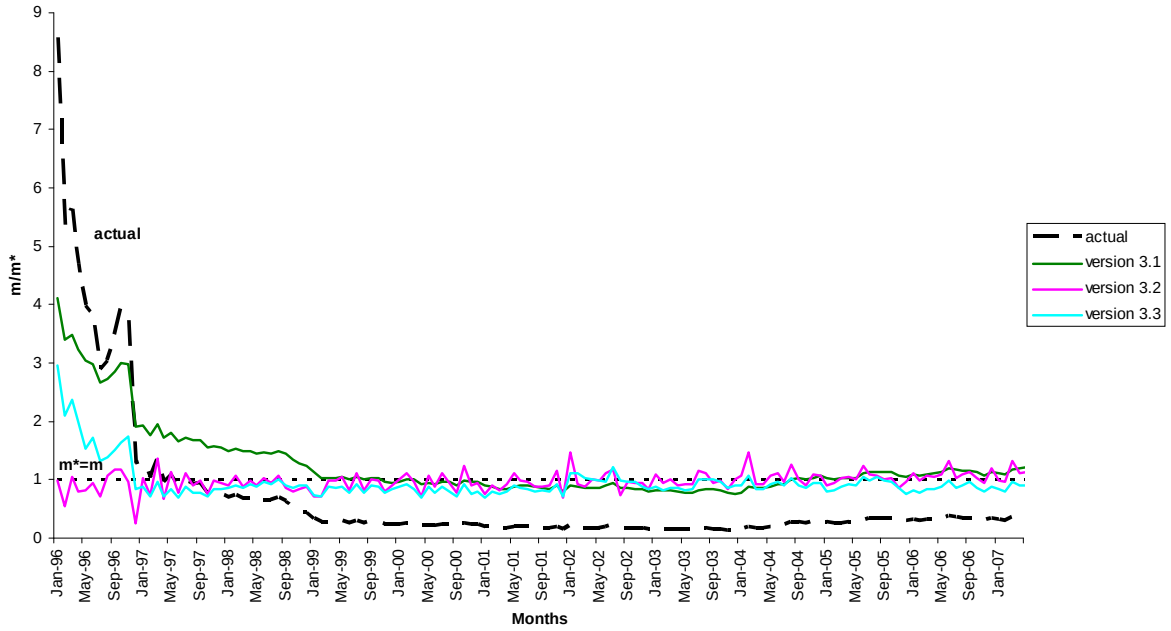

Figure 5: Money ratio: actual and interest rates model 3