

CURRENCY SUBSTITUTION WHEN DOMESTIC CURRENCY IS A SOLE LEGAL MEANS OF PAYMENT

The paper presents a model of currency substitution in the economy when there is an institutional constraint on usage on foreign currency in every-day transactions, although the desired currency balance could be reached via exchange, and when financial markets are barely developed. Such formulation of the model seems to allow better understanding of currency substitution path in Ukraine.

Currency substitution refers to a situation when foreign currency performs one or several functions of money in a row with domestic currency [1–5]. This phenomenon is tightly connected with people's confidence in domestic government, especially its ability to protect the value of domestic currency versus their confidence in foreign government and, respectively, foreign currency. For instance, in Ukraine currency substitution has spurred since the beginning of 90th. That time domestic prices rocketed, while legal constraints on foreign currency transaction were relaxed. Comparing with other countries, the phenomenon of currency sub-

stitution in Ukraine has several special features [6]. Firstly, since middle of the 90th domestic currency became a sole legal means for payments on domestic market, while the cash foreign exchange was quite available. Secondly, financial markets were poorly developed, and the access to world financial markets was limited.

The paper presents a model of currency substitution in economy that incorporates these peculiarities. The presented model closely corresponds to the model by Uribe [7], but several important distinctions are introduced. As it was said before, we don't allow payments in foreign currency. Next,

we redefine Uribe's "experience in using foreign currency" into "confidence (non-confidence) of households in the government". Finally, we introduce subjective risk evaluation associated with bank holdings ("confidence in banks"). We believe that these amendments allow better analysis of situation, consequently enhancing a formulation of economic policy directed towards reduction of currency substitution.

Consider a perfect-foresight, small open economy populated by a large number of identical infinitely lived consumers with preferences defined over sequence of consumption, and liquidity services $\{C_t, L_t\}_{t=0}^{\infty}$, and described by the utility function:

$$\sum_{t=0}^{\infty} \beta^t U(C_t, L_t); \beta \in \infty(0,1), \quad (1)$$

where the period utility function $U(\cdot)$ is assumed to be strictly increasing, weakly concave, and continuously differentiable; and β is a discount factor.

There are two markets in the economy: financial and goods markets. At the financial market, two currencies circulate in parallel: domestic and foreign. Households can freely choose between cash holdings and bank deposits in either currency. However, only domestic currency can be used as a means of payments. Thus, in contrast to [7], due to institutional constraints foreign currency cannot be used to purchase goods.

At the beginning of each period $t \geq 0$ government sets an exchange rate between domestic and foreign currency E_t and guarantees a convertibility of this currency at this exchange rate. Also, households receive endowment Y_t in domestic currency.

At this point financial market opens, allowing households to form desired balance of domestic cash holdings M_t and foreign cash holdings D_t . The

acquisition of desired foreign balance is costly: buying one unit of foreign currency (one dollar) is associated with transactions costs μ_t . It is further assumed that the decision to acquire and keep foreign cash holding is determined by non-confidence of households in domestic government $k_t(\varepsilon_t)$, which in turn is the function of domestic currency devaluation. Thus, $D_t = D_t(\mu_t, k_t)$, and it is assumed that $D'_t(\mu_t) < 0$ and $D'_t(k_t) > 0$. In other words, higher expenditures associated with exchange (transaction costs) will cause decrease in demand for foreign cash, while higher non-confidence in the government actions will increase an attractiveness of foreign cash holdings. Moreover, domestic cash holdings M_t are also a function of $k_t(\varepsilon_t)$, and $M'_t(k_t) < 0$.

In addition, households can make or withdraw foreign currency deposits in commercial banks B_t that pay an interest rate $r^* > 0$ in period $t + 1$. Alternatively, they can choose domestic currency deposits H_t with $r > 0$ in period $t + 1$. There is a risk associated with holding money in domestic banking system due to its poor development and, consequently, instability. We introduce variable $\kappa_t(s_t)$ to measure the households' confidence in banking system. Thus, both deposits in foreign and domestic currencies are function of κ_t : $B'_t(\kappa_t) > 0$ and $H'_t(\kappa_t) > 0$. Both demand for deposits in domestic and foreign currency depends on non-confidence in government, but with different signs: $H'_t(k_t) < 0$ while $B'_t(k_t) > 0$. Also $B'_t(\mu_t) < 0$.

The summary of functional relations of four types of financial assets (domestic cash, foreign cash, domestic-currency denominated deposits, and foreign currency denominated deposits) with respect to institutional variables (transaction costs, non-confidence in the government, and confidence in banks) is presented in Table 1.

Table 1. Summary of functional relations of financial assets

Types of assets		μ_t	$k_t(\varepsilon_t)$	$\kappa_t(s_t)$
Domestic currency cash holdings	$M_t = M_t(k_t)$	—	$M'_t(k_t) < 0$	—
Foreign currency cash holdings	$D_t = D_t(\mu_t, k_t)$	$D'_t(\mu_t) < 0$	—	$D'_t(k_t) > 0$
Domestic currency bank deposits	$H_t = H_t(k_t, \kappa_t)$	—	$H'_t(k_t) < 0$	$H'_t(\kappa_t) > 0$
Foreign currency bank deposits	$B_t = B_t(k_t, \kappa_t, \mu_t)$	$B'_t(\mu_t) < 0$	$B'_t(k_t) > 0$	$B'_t(\kappa_t) > 0$

No goods are traded at financial market. Households enter this market with received endowment Y_t and wealth remained from the previous period W_t . Let's express all domestic currency variables

in dollar terms:

$$w_t \equiv \frac{W_t}{E_t}, m_t \equiv \frac{M_t}{E_t}, y_t \equiv \frac{Y_t}{E_t}, b_t \equiv \frac{B_t}{E_t}, h_t \equiv \frac{H_t}{E_t}, c_t \equiv \frac{C_t}{E_t}.$$

When households' budget constraint at the finan-

cial market could be presented as follows:

$$b_t + h_t + m_t + d_t \leq w_t + y_t, \quad (2)$$

After financial market is closed, goods market opens allowing households to purchase desired amount of goods c_t . Since domestic currency is the sole legal means of payment in the economy, households are subject to cash-in-advance constrain of the form:

$$\frac{m_t}{1 + \varepsilon_{t+1}} \geq c_t. \quad (3)$$

The households' wealth at the beginning of period $t + 1$ is given by:

$$w_{t+1} = (1 + r^*)b_t + (1 + r)h_t + \frac{m_t}{1 + \varepsilon_{t+1}} + d_t - c_t, \quad (4)$$

where $\varepsilon_{t+1} = (E_{t+1} - E_t)/E_t$ denotes the devaluation rate in the period $t + 1$. To ensure a positive nominal interest rate, is assumed to satisfy the inequalities $(1 + \varepsilon_{t+1})(1 + r) > 1$ and $(1 + \varepsilon_{t+1})(1 + r^*) > 1$ for all $t \geq 0$. Combining (2) and (4) yields the following expression:

$$w_{t+1} \leq (1 + r^*)(w_t + y_t) + (r - r^*)h_t + \left(\frac{1 - (1 + r^*)(1 + \varepsilon_{t+1})}{(1 + \varepsilon_{t+1})} \right) m_t - r^* d_t - c_t. \quad (5)$$

Also households are assumed to be subject to the borrowing constraints that prevent them from engaging into Ponzi games:

$$\lim_{t \rightarrow \infty} \frac{w_t}{(1 + r)^t} \geq 0. \quad (6)$$

Thus, households behave in such a way so that to maximize (1) subject to (3), (5) and (6) taking w_0 and $\{\varepsilon_{t+1}, y_t, \mu_t, k_t, \kappa_t\}_{t=0}^{\infty}$ as given and choosing $\{c_t, m_t, d_t, b_t, h_t, w_{t+1}\}$.

There are two confidence variables in the model, namely non-confidence in the government and confidence in banks. The first variable allows explaining the choice between domestic cash and foreign cash, while the latter allows explaining the choice between foreign currencies at home ("under mattress") and in banks. For the non-confidence in the government, we suggest the following laws of motion:

$$k_t = (1 - \delta_1)k_t + F_1(\varepsilon_t), \quad (7)$$

where $\delta_1 \in (0; 1]$ refers to forgetfulness effect (depreciation), and $F_1(\cdot)$ satisfies the following conditions: $F_1: R \rightarrow R^+$ is continuously differentiable, strictly increasing, and strictly concave, with $F_1(0) = 0$.

The assumption of strictly increasing function

$F_1(\cdot)$ means that households are persistently sensitive to changes in exchange rate, and any devaluation of the currency they perceive as negative signal, consequently increasing overall non-confidence in the government. This is a quite strong assumption, since any change in the level of exchange rate even if it happened after a long period of stability will cause immediate negative reaction and fall in confidence. Assumption $F_1(0) = 0$ together with the presence of forgetfulness effect creates the conditions when non-confidence in the government gradually declines in the situation of stability. The speed of decline depends on the level of δ_1 .

Figure 1 presents the phase diagram of non-confidence in the government for two states of devaluation: ε_H and ε_L , where $\varepsilon_L < \varepsilon_H$. As can be seen, in either case there are two steady states. The first unstable steady state is at zero level. If we leave this point, we converge to stable steady state at the level of f_1 (low devaluation) or f_2 (high devaluation) disregarding whether we start at the level above or below f . If devaluation is increasing, we shift from one steady state to other, for instance from f_1 to f_2 for $f_1 < f_2$. Thus, there is a sequence of steady states in the economy conditioned on the level of devaluation. Actually, it is likely that households have some devaluation ranks (or frames), and the shift from one steady state to another occurs that devaluation breaks a threshold.

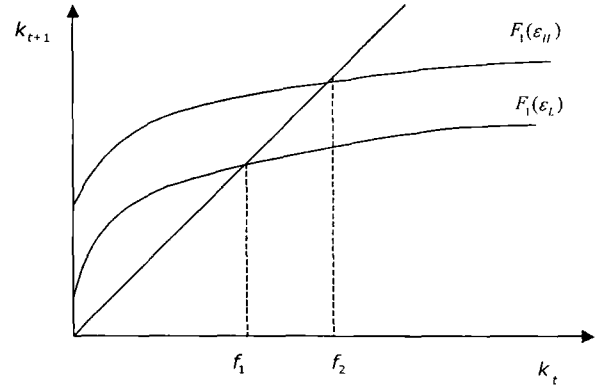


Fig. 1. Phase diagram of non-confidence in the government

For confidence in banks the law of motion is the following:

$$\kappa_t = (1 - \delta_2)\kappa_{t-1} + F_2(s_t), \quad (8)$$

where s_t is an indicator of banks' credibility, and $\delta_2 \in (0; 1]$ refers to forgetfulness effect (depreciation). The function $F_2(\cdot)$ satisfies the following conditions: $F_2: R \rightarrow R^+$ is continuously differentiable, strictly increasing, and strictly concave, with $F_2(0) = 0$, i. e. it is quite close to the previous case.

However, opposite to it, strictly increasing indicates the persistent growth in confidence with any sign of improvement of the banking system. Same phase diagram as Figure 1 can be applied to the confidence in banks. The only difference is that the growth of banks stability will be mirrored in growth of banks confidence.

Assuming no correlation between non-confidence in government and confidence in banks and constant value of households' portfolio within each period the following scenarios of currency choice exist (Table 2). All the scenarios allow convergence to stable steady states. In the case of high bank confidence and high non-confidence in government (scenario I), households will tend to use foreign currency in banks and in cash and will try to minimize the usage of domestic currency. If bank confidence is also low (scenario III), households will tend to keep all wealth in foreign cash. Alternatively, under low bank confidence and low non-confidence in the government households (scenario IV) may almost completely shift to domestic cash. Finally, in the case of high bank confidence and low inflation (scenario II), people will tend to use domestic currency both in form of cash and bank deposits, while the situation with bank deposits in foreign currency is twofold. On the one hand, higher bank confidence increase the attractiveness of this form of financial assets. On the other, non-confidence in the government is low, thus holding of foreign currency is perceived as more costly assuming existence of transaction costs on its exchange. Thus, the sign remains ambiguous.

Table 2. Scenarios of currency substitution

	State	b_t	h_t	d_t	m_t
I	$\kappa_t(\kappa_0, s_{II})$ and $k_t(k_0, \varepsilon_{II})$	+	-	+	-
II	$\kappa_t(\kappa_0, s_{II})$ and $k_t(k_0, \varepsilon_L)$?	+	-	+
III	$\kappa_t(\kappa_0, s_{II})$ and $k_t(k_0, \varepsilon_{II})$	-	-	+	-
IV	$\kappa_t(\kappa_0, s_L)$ and $k_t(k_0, \varepsilon_L)$	-	-	-	+

To summarize, we proposed a model of households' behaviour that incorporates several specific features of currency substitution that are characteristic for Ukraine. First, foreign currency is generally not accepted as legal mean of payments, although foreign currency exchange services are freely available. Second, domestic financial system usually is poorly developed, while the access to world financial markets is limited. We suggested explaining a choice of currencies by two confidence indicators: non-confidence in government and confidence in banks. These indicators have stable non-zero steady state. The laws of motion of these indices allowed constructing four scenarios of assets composition of households' portfolio. As can be seen from these scenarios, the most preferable is the second scenario, when domestic currency is used both in form of cash and bank deposits. That can be achieved if the government established and sustain the confidence in its actions, while the financial sector develops. Also, the condition that domestic currency is the sole legal means of payments in the economy doesn't allow persistence of currency substitution, as it does in the model [7].

1. Berg A., Borensztein E. The Choice of Exchange Rate Regime and Monetary Target in Highly Dollarized Economies // IMF Working Paper.- 2000.- N 29.
2. Calvo G., Végh C. Currency Substitution in Developing Countries: an Introduction // IMF Working Paper.- 1992.- N 40.
3. McKinnon R. Direct and Indirect Concepts of Interdomestic Currency Substitution // The Macroeconomics of International Currencies: Theory, Policy, and Evidence / Edited by Paul Mitzen and Eric J. Pentecost.- London.- 1996.
4. Mitzen P., Pentecost E. Currency Substitution in Theory and Practice // The Macroeconomics of International Currencies: Theory, Policy, and Evidence / Edited by Paul

- Mitzen and Eric J. Pentecost.- London.- 1996.
5. Sahay R., Végh C. Dollarisation in Transition Economies: Evidence and Policy Implications // The Macroeconomics of International Currencies: Theory, Policy, and Evidence / Edited by Paul Mitzen and Eric J. Pentecost.- London.- 1996.
6. Movchan V. Currency Substitution in Ukraine: Behaviour of Households // Presentation at the METU International Conference in Economics VI in Ankara, Turkey, September 2002.
7. Uribe M. Hysteresis in a Simple Model of Currency Substitution // Journal of Monetary Economics.- 1997.- Vol. 40.- P. 185-202.

В. Мовчан, В. Шпортюк

ФЕНОМЕН ЗАМІЩЕННЯ ВАЛЮТ У ВИПАДКУ, КОЛИ НАЦІОНАЛЬНА ВАЛЮТА Є ЄДИНИМ ПЛАТІЖНИМ ЗАСОБОМ У КРАЇНІ

Робота представляє модель заміщення валют у економіці, що має інституційні обмеження щодо використання іноземної валюти у щоденних транзакціях, хоча бажаний баланс валют можна отримати шляхом обміну. Другою особливістю економіки є недостатня розвиненість фінансових ринків. Таке формулювання моделі, на нашу думку, дозволяє краще зрозуміти процес заміщення валют в Україні.