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**Currency substitution and the transactions
demand for money in Vietnam**

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Abstract

We estimate the demand for money in Vietnam during the 1990s within a framework which distinguishes between currency substitution and portfolio dimensions of dollarization. This leads to a representation for the demand function in which the long-run income elasticity of demand is no longer constant but is a function of the expected rate of depreciation. We find evidence for currency substitution only in the long-run, and for portfolio effects only in the short-run. We interpret this as being consistent with the existence of costs associated with changing the transactions technology.

Keywords : Dollarization, Currency Substitution, Demand for Money, Vietnam.

Résumé

Nous estimons la demande de monnaie au Vietnam durant les années 1990 dans un cadre qui distingue la substitution des monnaies et la dollarisation de portefeuille. Ceci conduit à une représentation de la fonction de demande de monnaie dans laquelle l'élasticité de la demande de long-terme par rapport au revenu n'est plus constante mais est fonction du taux de dépréciation anticipé du taux de change. Nous trouvons l'effet de la substitution monétaire seulement dans le long-terme et l'effet de la dollarisation de portefeuille seulement dans le court-terme. Ceci est consistant avec l'existence de coûts associés au changement de technologie de transactions.

Mots-clefs : Dollarisation, Substitution Monétaire, Demande de Monnaie, Vietnam.

JEL Classification Numbers : E41, F41

1. Introduction

The dollarization of developing countries and transition economies is a widespread phenomenon. In the presence of effective controls of foreign exchange, dollar balances are typically held for portfolio purposes, providing hedging of wealth against domestic inflation and financial repression. Typically, though, domestic currency remains the sole means of exchange (even if domestic prices are indexed to world dollar prices). The use of foreign currency for transactions purposes – the correct meaning of currency substitution in the terminology of Calvo and Végh (1996)¹ – is less common outside conditions of conflict or state collapse. In recent years, however, systematic currency substitution has emerged in a number of low income and transition economies.

Although there is an extensive empirical literature purportedly on currency substitution (see, for example, Adam 1999, Agénor and Montiel, 1999, Sriram 1999) most of it tends to characterize the role of foreign exchange in terms of its portfolio effects by introducing the expected depreciation of the exchange rate as an element of the opportunity costs of *holding* money. However this method does not in fact measure the precise phenomenon of currency substitution, which is directly related to the transactions motive. In this paper we suggest an alternative characterization in which the expected rate of exchange rate depreciation operates *both* through its portfolio effects but also has a direct currency substitution or transactions effect. The latter is accommodated by defining the transactions elasticity of money demand as a function of the expected exchange rate depreciation. We argue that a correct characterization of the channels of dollarization may have important implications for the conduct of monetary policy. We further suggest that given the costs of switching currencies at the margin for transactions purposes, it is probable that currency-substitution is more likely to be observed as a long-run phenomenon, while portfolio effects dominate in the short-run.

¹ They suggest restricting the term *currency substitution* to describe the use of a foreign currency as a means of exchange and the term *dollarization* denotes the use of a foreign currency in any of its three functions, unit of account, means of exchange and store of value.

The empirics underpinning this paper are concerned with the currency substitution phenomenon in Vietnam. The US dollar began to circulate widely in Vietnam during the war against the United-States, but following re-unification in 1975 its circulation was strictly prohibited. From the late 1980s as the country began its transition towards a market economy dollarization, and specifically currency substitution, has re-emerged as a major feature of the Vietnamese economy. It is this recent episode that is the focus of our analysis.

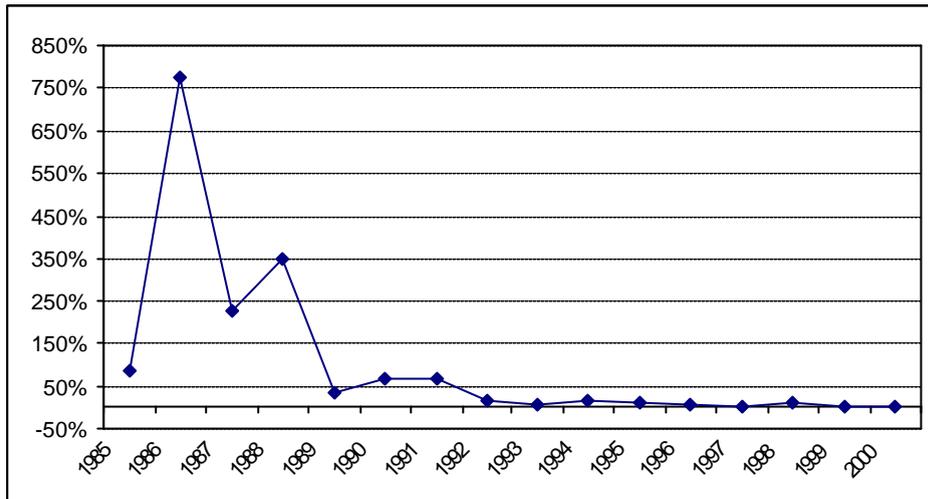
The paper is organised as follows. Section 2 describes the stylised facts of the dollarisation process in Vietnam. Section 3 presents the new specification of the demand for real money in presence of currency substitution. Section 4 describes the data and presents our results and Section 5 concludes.

2. Dollarization in Vietnam

Background

In Vietnam, the widespread holding and use of US dollars first appeared during the war against the United-States when the American armed forces occupied the south of the country. Following the reunification of Vietnam in 1975, the holding of foreign currency by residents was strictly forbidden in order to reinforce the national currency unit, the Dong. Dollarization reappeared in the 1980s as a result of unsustainable inflationary pressures during the final years of the planned economy and the transition towards market economy. In the mid-1980s, the relaxation of price controls and the loose monetary stance in the face of weak domestic supply fuelled a period of high inflation episodes and the hyper-inflation in 1986-88 (see Figure 1). Following the sharp depreciation of the parallel exchange rate, the official exchange rate of the Dong was dramatically devalued (from 15 Dong per Dollar at the end-1985 to 3000 Dong per Dollar at the end-1988).

Figure 1
Inflation 1985-2000 (December to December)



Note: Rate of change of retail price index of goods and consumer services. Data before 1991 measure the retail price index of goods, excluding consumer services. Source: GSO (2000)

Further liberalization ensued in 1988-89. Controls on external trade were relaxed, virtually all price controls were eliminated, and the exchange rate regime unified. This was supported by the introduction of foreign currency deposit accounts for individuals and enterprises, although the Dong remained the only legal tender for domestic transactions. Institutional reforms were accompanied by changes in the monetary policy stance. Interest rates on Dong-denominated saving deposits were raised to above the inflation rate and kept positive in real terms throughout 1989, stimulating a significant rise in the demand for Dong liquidity and a spectacular decline in inflation which fell from 350% in 1988 to 35% in 1989. This gain was short-lived; weak domestic credit control saw the money supply increase again and inflation increased to 67% in 1990 and 72% in 1991, real interest rates once again turned negative, and the Dong depreciated to D/\$ 14000 by the end of 1991.

At the end of 1991 the Vietnamese authorities decided to implement a shock-therapy approach in order to break the inflation-depreciation spiral. After opening two foreign exchange markets, one in Hanoi and one in Ho Chi Minh City, the monetary authorities sold huge amounts of dollars on these markets, causing an *appreciation* of the exchange rate from D/\$ 14000 at the end-1991 to D/\$ 10500 in January 1993. Moreover, the central bank announced that it was ready to satisfy any demand of gold purchase made by individuals and enterprises (Guillaumont Jeanneney, 1994a and 1994b). These measures seem to have played an important role in establishing the credibility of the authorities' stabilisation policy and for

the next five years they successfully pursued a policy of shadowing the US dollar (at a rate of around D/\$ 11000). From 1992 to the end of the decade, inflation averaged less than 10 percent per annum.

A weakening trade balance in 1995-96 prompted concerns about the overvaluation of the Dong and induced to a speculative demand for dollars and eventual depreciation of the Dong. This process was reinforced by the Asian crisis in 1997-98 that curbed the dollar inflow into Vietnam. Despite new administrative measures, such as foreign exchange surrender requirements and import restrictions, the exchange rate came under pressure and depreciated from D/\$ 11000 at the end of 1996 to D/\$ 13900 at the end of 1998. From the beginning of 1999 a crawling depreciation was applied until a rate of D/\$ 15000 at the end of 2001.

Scale

Foreign currency deposits and US dollar banknotes represent a substantial proportion of the total money supply in Vietnam. The exact volume of US banknotes in circulation in Vietnam is hard to determine precisely, but one source estimated it to be around 42 trillions of Dong (US\$3billion at a rate of D/\$ 14000) in 2000, approximately 10 percent of GDP.² Foreign currency deposits in the banking system are more easily tracked. As Figure 2 indicates, these rose very rapidly during the early 1990s in line with inflation and the sharp depreciation of the exchange rate. Since the mid-1990s, however, foreign currency deposits have grown steadily, from just under 20 percent of broad money in 1994 to just under 35 percent in 2001. These accounts cannot be used directly for domestic transactions settlements³. By the end of 2000, total foreign currency accounted for 42 percent of the total money in Vietnam.

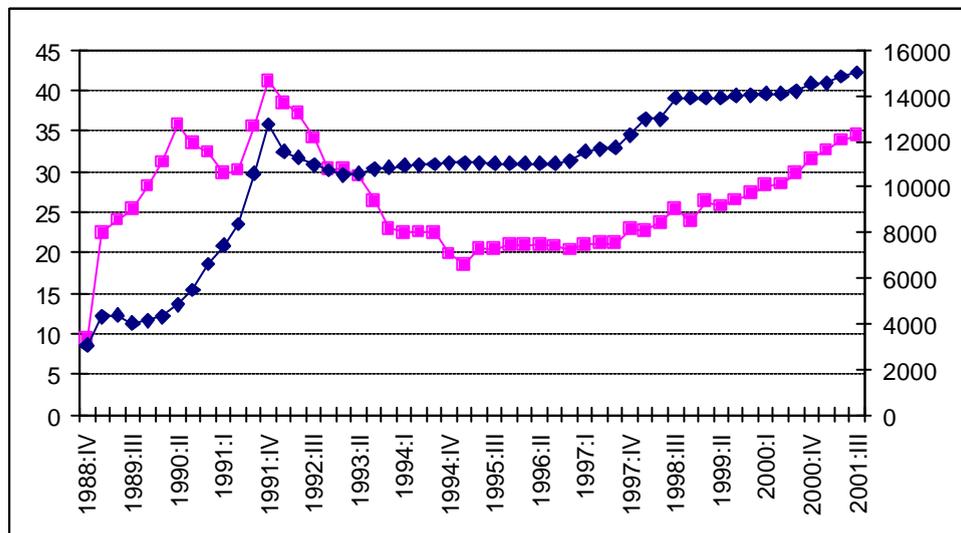
² See Unterberdoerster (2002). This is consistent with the anecdotal evidence suggesting that private sellers of goods or services rarely refuse to conduct trade in US dollar instead of Vietnamese dong, and that curb markets in foreign currencies are widespread in all the cities. In both cases, these activities are officially forbidden but very widely tolerated.

³ See IMF, *Exchange Arrangements and Exchange Restrictions*, various issues.

*Table 1**The composition of broad money including foreign currency in circulation (Dec 2000)*

	trillions of Đông	in %
Domestic currency in circulation outside banks	52.2	20
<i>Foreign currency in circulation outside banks (estimates)*</i>	42.0	16
Domestic currency demand deposits	58.4	22
<i>Foreign currency demand deposits</i>	16.8	6
Other domestic currency deposits	41.9	16
<i>Other foreign currency deposits</i>	53.6	20
TOTAL	264.9	100
<i>of which foreign currency</i>	<i>112.4</i>	<i>42</i>

Source : Data from IMF, 2002 and * from Unteroberdoerster, 2002. Calculations from the authors.

*Figure 2**Dollarization (DOL) and the Dong/Dollar exchange rate (E). Vietnam 1988-2001.*

Notes: DOL (◊—◊—), left-scaled, ratio of foreign currency deposits to broad money (including foreign currency deposits). E (◆—◆—), right-scaled, is the banking exchange rate of the Dong vis-à-vis the US dollar). Data from the State Bank of Vietnam.

3. The demand for money in the presence of currency substitution

Empirical work on the demand for money and currency substitution typically starts with a specification of the form

$$\frac{M}{P} = f(Y, x^e, Z) \quad (1)$$

where M is the nominal money aggregate, P the price level, Y a measure of the level of real economic activity, x^e the expected depreciation of the nominal exchange rate and Z is a vector of other opportunity cost or shift factors (interest rates, inflation etc.)⁴. In Vietnam, where the domestic financial system is relatively underdeveloped, real assets and foreign-currency-denominated assets are usually the only available alternative to domestic money. Following extensive analysis of the data we find that for the period under review and with the inclusion of the variable x^e it is possible to exclude the vector Z entirely.

Empirical estimation of (1) is typically based on a log-linear or semi-log representation with the general long-run form

$$(m - p)_t = \mathbf{b}_0 + \mathbf{b}_1 y_t + \mathbf{b}_2 x_t^e + \mathbf{e}_t \quad (2)$$

where $m = \log(M)$, $p = \log(P)$, and $y = \log(Y)$.

The fundamental argument in this paper is that a specification such as (2) is not really correct to capture the currency substitution phenomenon. The problem is that the specification (2) presumes a constant transactions elasticity of the money demand: whatever the expected depreciation, the relationship between the volume of transactions and the need for domestic money is constant so that the expected rate of exchange rate depreciation is treated only as an opportunity cost of *holding* domestic money, not a cost of *using* domestic money in transactions. We argue that a given level of the economic activity may have less (more) effect on the transactions demand for domestic money in the case of an higher (lower) expected

⁴ For example Adam (1992, 1999), Arize (1992, 1994), Bahmani-Oskooee and Malixi (1991), Buch (2001), Choudhry (1998), Chowdhury (1997), Dekle and Pradhan (1997), Perera (1993), Tan (1997), Weliwita (1998) and the survey paper by Sriram (2001).

depreciation since individuals and enterprises are pushed to use the dollar (the Dong) to lead transactions⁵.

An obvious way of explicitly taking into account the competition between the Dong and the Dollar in the transaction motives is to allow for the transactions elasticity of the demand for domestic money to be a function of the expected rate of exchange rate depreciation. Hence

$$(m - p)_t = \mathbf{b}_0 + \mathbf{x}(x_t^e) y_t + \mathbf{b}_2 x_t^e + \mathbf{e}_t \quad (3)$$

where the transactions elasticity of demand $\mathbf{x}(x_t^e)$ is function of the expected rate of depreciation. A natural functional form for this elasticity is $\mathbf{x}(x_t^e) = \mathbf{b}_1 e^{-d x_t^e}$ where \mathbf{b}_1 and \mathbf{d} are expected to be positive⁶.

This negative exponential form has the convenient property that when agents expect no exchange rate depreciation, $x^e = 0$, so that $e^{-d x^e} = 1$, the transactions elasticity of demand is simply \mathbf{b}_1 . By contrast, when agents expect a depreciation (appreciation), $x^e > 0$ ($x^e < 0$), we have $e^{-d x^e} < 1$ ($e^{-d x^e} > 1$) and the transactions elasticity $\mathbf{x}(x_t^e)$ is smaller than \mathbf{b}_1 (greater than \mathbf{b}_1). Similarly, if $\mathbf{d} = 0$ the specification again collapses to the constant elasticity case.

Our preferred empirical specification therefore takes the general form

$$(m - p)_t = \mathbf{b}_0 + \mathbf{b}_1 e^{-d x_t^e} y_t + \mathbf{b}_2 x_t^e + \mathbf{e}_t \quad (4)$$

Equation (4) provides a basis for a direct test of the currency substitution hypothesis (conditional on the presence of portfolio considerations). The restriction $\mathbf{d} = 0$ implies a constant income elasticity model, while rejecting the restriction in favor of $\mathbf{d} > 0$ indicates the presence of currency substitution for transaction motives. If \mathbf{b}_2 is different from zero (and

⁵ In other terms, in an economy where foreign currency is used for transactions, the impact of the expected depreciation on the demand for the domestic money is conditional on the amount of transactions.

⁶ Traditionally, the speculative demand for money is an exponential function of the opportunity cost. Then it seems rational to give the same form for transaction motives. Moreover, preliminary results suggest that an exponential form have to be preferred to a more simple multiplicative form.

negative), then the portfolio dimension of dollarization is present (i.e. exchange rate depreciation is an opportunity cost of holding domestic money as a store of value)⁷.

4. Data and estimation

Our aim being the estimate of the domestic money demand for transactions, we focus on the demand for the narrow money aggregate, M1, which consists of Dong in circulation outside banks and Dong-denominated demand deposits in the banking system. The price index is the consumer price index, the only consistently reported price index in Vietnam. Data on these variables are available on a monthly frequency. We face a greater problem in choosing a measure for the level of real economic activity. Ideally we would use a measure of gross domestic product or gross domestic expenditure but the series on these data are incomplete and only available at annual or quarterly frequency. Instead we use the index of monthly industrial output. Although this measures less than one third of constant-price GDP in Vietnam over the 1990s⁸, industrial activity is highly correlated with total GDP and has the advantage that it reflects the sector of the economy in which currency substitution is, arguably, most likely to be observed.

The lack of direct measures of expectations means that different measures have been used in empirical studies to proxy the expected rate of exchange rate depreciation. Ideally we would use a measure based on the forward exchange rate but in the absence of such markets empirical work on developing countries tends to use a variety of proxies, either a rational expectations structure in which the actual current or future rate of depreciation is used to proxy the expected rate in which lagged values of the exchange rate depreciation and other regressors are used to instrument the proxy (e.g. Adam, 1999, Bush, 2001, Perera, 1993, Chowdhury, 1997, Weliwita, 1998, Arize, 1994, Choudhry, 1998, Tan, 1997), or an adaptive structure based directly on lags of the rate of depreciation (Bahmani-Oskooee, 1991, Arize, 1992).

⁷ Here the aim is to test whether the transactions demand for money is function of the expected depreciation, or put differently, whether the impact of the expected depreciation on money demand depends on the transactions amount

⁸ In 1990, the structure of GDP was agriculture 38.7%, industry 22.7% and services 38.6% and in 1999 agriculture 25.4%, industry 34.5% and services 40.1%. Source GSO, 2000, table 17 p.28. The sample correlation between industrial output and total constant price GDP, based on quarterly data, is 0.983.

We have chosen a hybrid of these two approaches using a moving average of actual and lagged values of exchange rate depreciation⁹ $x_t^e = \frac{1}{4} \sum_{s=0}^3 x_{t-s}$ where x is defined $x_t = (E_t - E_{t-1})/E_{t-1}$ and E is the parallel exchange rate (i.e. the Hanoi black market rate). The parallel exchange rate was preferred to the official or banking exchange rate because it is more freely determined and then more variable over time, even if there is no significant premium between these rates.

All the data have been obtained from the State Bank of Vietnam and cover the period from January 1991 to June 1999, giving 102 data points for estimation. As indicated in Appendix Table 1 there is strong evidence that real money balance and real economic activity contain a unit root, and slightly weaker evidence that the expected depreciation does. We therefore employ a cointegration framework for analysis.

The presence of non-stationary series binds us to an analysis of the potential cointegration between the variables of the demand for money function. However equation (4) is non-linear in parameters and these long-run parameters cannot be estimated using conventional (linear) cointegration methods.¹⁰ We therefore structure our estimation procedure as follows. First, to examine the possible long-run equilibrium structure of the model we impose the restriction that $d=1$ so that (4) is rendered linear in (free) long-run parameters thus

$$(m-p)_t = \mathbf{b}_0 + \mathbf{b}_1(e^{-x_t^e} y_t) + \mathbf{b}_2 x_t^e + \mathbf{e}_t. \quad (4')$$

Our cointegration analysis is therefore based on a version of (4'). Later, however, we re-estimate the dynamic error correction representation of (4') using non-linear methods to directly estimate the coefficient \mathbf{d} .

Cointegration analysis

We follow Johansen (1995) to analyse the cointegration structure of the vector $\mathbf{Y}_t = \{(m-p)_t, e^{-x_t^e} y_t, x_t^e\}$ using a vector error-correction model (VECM) of the form

⁹ Other specifications of the expected depreciation do not reject our model, but preliminary results have indicated that this type of specification leads to the best goodness-of-fit of the model.

¹⁰ The literature on so-called 'non-linear cointegration' tends to focus on non-linearities in the adjustment process. See for example Enders and Granger (1998).

$$\Delta Y_t = \mathbf{a}\mathbf{b}' Y_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + D_t + \mathbf{e}_t \quad (5)$$

where \mathbf{b}' denotes the matrix of parameters of the cointegrating vectors ($\beta' Y_{t-k}$ are long-run relationships), and \mathbf{a} the matrix of equilibrium-correction or feedback effects, Γ_i is the matrix of short-run parameters, D_t denotes deterministic components (the constant and monthly seasonal dummy variables)¹¹ and \mathbf{e}_t is the vector of error-term.

A lag length $k=6$ was found to be necessary to fully capture the dynamics between the variables of the vector Y and render \mathbf{e}_t approximately Gaussian. Table 2 reports the VECM residual diagnostic statistics and Table 3 summarizes the principal features of the cointegration analysis.¹²

Table 2
VECM residuals diagnostic statistics for $Y_t = \{(m-p)_t, e^{-x^e} y_t, x^e\}$
Sample (1991(8) – 1999(6)) T=95

	AR(1)	JB	ARCH(1)	H
Y	0.97 [0.46]	17.0 [0.01]		0.86 [0.84]
$m-p$	0.01 [0.92]	7.52 [0.02]	1.69 [0.20]	0.32 [0.99]
$e^{-x^e} y$	3.75 [0.06]	1.35 [0.51]	0.16 [0.69]	1.22 [0.29]
x^e	1.02 [0.31]	2.80 [0.25]	11.2 [0.00]	4.00 [0.00]

AR(1) is the test for first-order autocorrelation (distribution F). JB is the test for normality (distribution ?2). ARCH is the test for conditional heteroscedasticity (distribution F). H is test for heteroscedasticity (distribution F). Marginal significance levels are in parentheses.

¹¹ Preliminary results suggest that the deterministic components included in the dynamics should be a constant restricted to the long-run relationships, unrestricted (centred) seasonal dummies but no deterministic trend.

¹² Estimations are carried out with PcGive 10.0 (Hendry and Doornick, 2001).

*Table 3**I(1) cointegration analysis**Reduced-Rank Statistics*

Eigenvalues	H0: rank =	Trace test
0.252	0	55.850 [0.000]
0.199	1	27.875 [0.003]
0.065	2	6.5538 [0.157]

Marginal significance levels are in square parentheses.

Standardised eigenvectors (scaled on diagonal) and adjustment coefficients.

b	b1	b2	V3	a	a1	a2	V3
<i>m-p</i>	1.00	-1.30	-0.12	D(m-p)	-0.07	0.02	0.15
$e^{-x^e} y$	-1.05	1.00	0.09	D(e^{-x^e} y)	-0.01	-0.07	0.52
x^e	-2.12	-8.14	1.00	D x^e	-0.00	0.00	-0.08
<i>C</i>	-3.71	7.17	0.71				

Individual significance tests

	<i>m-p</i>	$e^{-x^e} y$	x^e	<i>Constant</i>
$\chi^2(1)$	3.99 [0.04]	4.73 [0.03]	0.41 [0.51]	2.66 [0.10]

Note: tests conducted under the assumption of one cointegrating vector.

The residual-based tests reported in Table 2 indicate the absence of serious statistical misspecification of the underlying vector autoregression while the first block of Table 3 suggests the presence of two cointegrating vectors. Neither is immediately interpretable, although the first vector (the column denoted β_1) would appear to be broadly consistent with the long-run demand for money function:

$$m - p_t = 3.71 + 1.05e^{-x_t^e} y_t + 2.12x_t^e \quad (6)$$

in which the residuals enters with a feedback coefficient of $\alpha_1 = -0.07$ in the short-run demand for money equation $D(m-p)_t$. The problem with this interpretation is that the coefficient on the expected rate of depreciation is positive when theory would suggest it be negative. However, as the third block of Table 4 suggests it is possible to reject this variable but not the other two from the (first) cointegrating vector (the Likelihood ratio test has a value of $\chi^2(1) = 0.41$ [0.512]), suggesting that in the long run at least, and conditional on the presence of potential currency substitution, portfolio-based dollarization effects do not appear to operate on the demand for M1. This result is consistent with the evidence from the second vector, β_2 , which indicates that x^e appears to be stationary (as suggested by the univariate tests reported in Appendix Table 1).

These two features point to the following restrictions on the vector $\Pi = \mathbf{a}\mathbf{b}'$ conditional on the cointegrating rank being $r=2$.

$$\Pi_r = \mathbf{a}_r \mathbf{b}_r' = \begin{pmatrix} \mathbf{a}_{11} & 0 \\ 0 & \mathbf{a}_{22} \\ 0 & \mathbf{a}_{23} \end{pmatrix} \begin{pmatrix} 1 & \mathbf{b}_{12} & 0 & c_1 \\ 0 & 0 & 1 & c_2 \end{pmatrix}. \quad (7)$$

The restrictions on the \mathbf{b} component of the Π matrix imply that no long-run portfolio effect enters the first cointegrating vector representing the long-run demand for money, while those on the \mathbf{a} component imply that (i) the (short-run) demand for money corrects to deviations from the cointegrating vector only, and, (ii) the first cointegrating vectors only feeds back onto the short-run demand for money. If these restrictions are accepted then it is possible to move from the VECM to a single-equation equilibrium-correction representation of the short-run demand for money where the variables $e^{-x^e} y$ and x^e are weakly exogenous (Johansen, 1992). As we discuss below, this provides a basis for investigating the non-linearity of our preferred specification more thoroughly.

*Table 4**Restricted eigenvectors and adjustment coefficients.*

b	b1	b2	a	a1	a2
$m-p$	1	0	$D(m-p)$	-0.10 [0.02]	0
$e^{-x^e} y$	-0.95 [0.08]	0	$D(e^{-x^e} y)$	0	-0.60 [0.19]
x^e	0	1	Dx^e	0	-0.03 [0.02]
c	-4.39 [0.61]	0.05 [0.02]			

Standard errors of unrestricted coefficients estimates reported in [...].

LR test of restrictions: $\text{Chi}^2(4) = 4.46 [0.347]$

Table 4 reports the results from estimating the model under the restrictions described in (7). The likelihood ratio test indicates that the restrictions are accepted by the data leading to the restricted long-run demand function taking the form

$$m - p_t = 4.39 + 0.95e^{-x_t^e} y_t \quad (8)$$

with a feedback coefficient on $\Delta(m-p)$ of -0.10 (i.e. 10 percent per month).

So far we have only rejected a long-run *portfolio dimension* to dollarization in Vietnam. Since we have imposed the restriction $\mathbf{d} = 1$, our characterization of the currency substitution hypothesis remains incomplete, although it is not inconsistent with the data under this restriction. We therefore turn to alternative single equation representations of the data to attempt to cast more light on the relationship.

Single equation error-correction model.

The general specification of the dynamic model for $D(m-p)_t$ can be written as:

$$\Delta(m-p)_t = \mathbf{a}\mathbf{m}_{t-k} + \sum_{i=0}^{k-1} \mathbf{g}_i \Delta Y_{t-i} + \mathbf{n}_t \quad (9)$$

where Δ is the monthly difference operator, \mathbf{m} is the equilibrium-correction term (the deviation of $(m-p)$ from its long-run equilibrium level), \mathbf{a} is the speed-of-adjustment coefficient, and \mathbf{g} the vector of parameters describing the short-run dynamic behaviour of the demand for money in response to short-

run variation in the regressors. Our results are reported in summary form in Table 5¹³. We estimate three alternative representations of (9). First we estimate the model using a two-step method which embeds the cointegrating vector (7) as the representation of the long-run demand for money, and second we re-estimate (9) as single-equation equilibrium correction model. In both cases we maintain the restriction that $\mathbf{d} = 1$. Finally, we estimate a non-linear equilibrium-correction model in which we directly estimate \mathbf{d} , allowing us to directly test the restriction we exploited to implement the (linear) cointegration analysis. The dynamics of (9) are data-determined; we start by allowing for both currency substitution and portfolio effects of dollarization to shape the demand for money in the short-run, and follow a standard reduction strategy to eliminate insignificant regressors. We also include a full set of seasonal dummy variables which, in all cases, are jointly significant.

¹³ Full details of all the results are available from the corresponding authors.

*Table 5**Estimations of alternative ECM representations of (9)*Dependent variable is $\Delta(m-p)$. 1991(1)-1999(6). 96 observations.

	[1] 2-step	[2] 1-step	[3] NLS
Long-run coefficients			
d	-	-	0.929 [2.51]
$y e^{-dx^e}$ $t-6$ $d = 1$	0.950	0.914 [4.95]	-
$d = \hat{d}$	-		0.930 [3.11]
Const	4.390	4.867 [4.43]	4.945 [4.35]
Dynamic coefficients			
m_{t-6}	-0.103 [5.19]	-0.105 [5.16]	-0.109 [3.73]
$\Delta(m-p)_{t-1}$	-0.303 [2.87]	-0.306 [2.88]	-0.307 [2.87]
Δx_{t-3}	-0.599 [1.77]	-0.574 [1.67]	-0.562 [1.60]
Δx_{t-4}	-0.84 [2.49]	-0.827 [2.43]	-0.816 [2.34]
R-square	0.546	0.548	
LL	225.2	225.4	225.4
Eqn s.e	0.025	0.025	0.026
AR(6)	[0.855]	[0.863]	[0.855]
ARCH(6)	[0.342]	[0.332]	[0.343]
H	[0.189]	[0.276]	[0.432]
J-B	[0.008]**	[0.010]**	[0.009]**
Inst-var	0.155	0.167	
Inst-joint	3.806	3.936	

Notes: coefficient of seasonal dummies variables not reported. LL is the log-likelihood. sigma is the standard error. RSS is the residual sum of squares. DW is the Durbin-Watson statistic. AR(1) and ARCH(1) are tests against the null of autocorrelation and autoregressive conditional heteroscedasticity of order 1. H and J-B are tests against the null of homoscedastic and normally-distributed errors. RESET is the Ramsey stability test. Inst-var and Inst-joint are Hansen's tests for variance and joint parameter stability. Figures in square brackets [...] are tests statistics marginal significance levels. See for details the Pc Give 10.0 Manual by Hendry and Doornick (2001).

All three representations appear to be broadly coherent with the data and consistent with theory. There is no evidence of serious dynamic misspecification nor of significant parameter instability.¹⁴ The equilibrium-correction structure is validated and the feedback of a plausible magnitude of around 11 percent per month across all three models.

In terms of the principal argument of this paper, Table 5 highlights two key results. The first concerns the nature of the long run demand for money. Columns [1] and [2] suggest that the two-step and one-step equilibrium correction models in which we impose the restriction $d = 1$ generate virtually identical results, both in terms of their statistical properties and the point estimates they generate. Column [3], which reports the results of using a non-linear ECM estimator, generates an estimate of $d = 0.929$. This is strongly statistically different from zero implying that we can reject a constant long-run income elasticity of the demand for money in favour of the currency-substitution hypothesis.

However we cannot reject the restriction $d = 1$; the LR test of the restriction has a value of $\chi^2(1) = 0.036$ [0.849]. The implication, as implied by the comparison across the columns of Table 5, is that the simple negative exponential specification for the income variable, $y e^{-x^e}$ offers a good approximation of the data for Vietnam.

The second principal result is that the short-run dynamics do not admit a role for currency substitution, even though it is present in the long-run. By contrast there is strong evidence of a more conventional portfolio effect at work. An increase in the expected rate of exchange rate depreciation induces a shift out of domestic money, with this portfolio effect being felt with a three to four month lag. This is consistent with the idea that because of the costs of changing transaction technology, in that agents need time to adjust their behavior in transactions: the seller and the buyer have to learn how to use the new currency and to approve the adoption of the new currency as the means of payment, short-run dollarization is likely to be dominated by portfolio rather than currency substitution considerations.

¹⁴ The evidence from Hansen's instability tests is supported by recursive estimation results, which are available on request from the corresponding author.

5. Conclusion

The evidence presented in this paper suggests that traditional linear specifications of the demand for money may be mis-specified for economies in which currency substitution is an important phenomenon. We have shown that for one such country, Vietnam, the data for the 1990s suggest a characterization of the dollarization process in which currency-substitution effects alter the economy's transactions technology and hence the (traditionally specified) long-run income elasticity of the demand for money whereas more traditional portfolio or hedging considerations are relevant only in the short-run. Our specification implies a variable long-run income elasticity of demand. In industrialized countries monetary targeting has tended to be abandoned for interest rate policies, but in developing countries the relative thinness of financial markets does not allow monetary authorities to rely only on interest rate and a monetary aggregate is often required as an intermediate target of monetary policy. In such circumstances, the failure to estimate correctly the currency substitution effect will lead to systematic mis-prediction of the demand for money in circumstances where there is a tendency for the nominal exchange rate to move over time (e.g. in high inflation contexts).

An important feature of the results for Vietnam is that a simple negative exponential representation for the income elasticity (i.e. where $d=1$) could not be rejected against a more general specification. If this result were true more generally it would imply a very simple respecification of the demand form money. A natural next step in the analysis is therefore to examine the properties of the demand for money across a wider range of low income and transition economies.

Appendix Table 1.**ADF test for monthly series 1991:1 – 1999:6.**

Unit-root tests with 6 initial lags for 1991 (8) to 1999 (6)- 95 observations.

ADF (lags) with constant and centred seasonal dummies. T=95

	m-p		y		x ^e	
	Test	ADF – t	Test	ADF – t	Test	ADF – t
level	ADF(2)	-1.18	ADF(5)	0.33	ADF(5)	-2.46
1 st diff.	ADF(1)	-5.12**	ADF(4)	-5.96**	ADF(4)	-5.05**

Critical values used in ADF test: 5%=-2.89, 1%=-3.50

ADF (lags) with constant, **deterministic trend**, and centred seasonal dummies. T=95

	m-p		y		x ^e	
	Test	ADF – t	Test	ADF – t	Test	ADF – t
level	ADF(2)	-1.66	ADF(6)	-3.43	ADF(5)	-2.51
1 st diff.	ADF(1)	-5.17**	ADF(4)	-5.95**	ADF(4)	-5.11**

Critical values used in ADF test: 5%=-3.45, 1%=-4.05

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