



Document de travail de la série

***Etudes et Documents***

E 2005.37

**Fighting inflation in a dollarized economy:  
the case of Vietnam**

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Abstract:

During its transition towards a market economy, Vietnam embarked upon a path of disinflation through dollarization. In this paper, we develop a model to shed light on the determinants of inflation under dollarization and estimate it for Vietnam in the 1990s using a two-step procedure. During this period, inflation was induced by exchange rate variations and by an excess of broad money. The paper shows that management of exchange rate fluctuations combined with a restrictive monetary policy based on broadly defined money was essential for the Vietnamese authorities to succeed in fighting inflation. Illustrative simulations based on the sharp 25% exchange rate depreciation of 1997 to 1998 suggest that this depreciation led to an additional cumulated inflation of 13% over the period.

JEL codes : E31, E41, E52

Keywords : inflation; demand for money; dollarization; cointegration; Vietnam.

## 1. Introduction

Dollarization, which is defined as the holding of foreign-currency-denominated assets by domestic residents, is widespread in the developing and transition economies that experience high inflation. Dollarization is an important consideration for the design of the macroeconomic policy; the current literature addresses two main issues. First, the choice of the exchange rate policy is crucial because dollarization exacerbates exchange rate volatility in a floating regime. Second, if monetary policy is based on money targeting, the inclusion or exclusion of foreign currency in the targeted monetary aggregate has important implications as Calvo and Végh (1997), Baliño *et al.* (1999), and Berg and Borensztein (2000) discuss. Although economists have not paid much attention to Vietnam, the experience of this country during the 1990s sheds light on these issues. Although the Vietnamese economy is partially dollarized, the government has followed a successful disinflation policy during its transition towards a market economy. In this paper, we investigate the monetary and exchange rate policies that may have contributed to the control of inflation in Vietnam and draw broader implications for other economies facing inflation in a dollarized context.

In Vietnam, dollarization started with the transition towards a market economy in the wake of the hyperinflation of 1986 to 1988. This bout with high inflation was fuelled by a loose monetary stance and by the dramatic depreciation of the exchange rate of the national currency unit, the dong, against the dollar.<sup>1</sup> By 1989, reforms consisted of the removal of price controls, the unification of the exchange rate regime, and the introduction of foreign currency deposits. Thereafter, an increase in interest rates on dong-denominated deposits induced a spectacular decline in inflation from 350% in 1988 to 35% in 1989. However, the pace of money supply creation increased again under weak domestic credit control resulting in a surge of inflation to 67% in 1990 and 72% in 1991, a cumulative depreciation of the dong to the dollar between 1988 and 1991 of 367%, and a spread of dollarization. At the end of

1991, the Vietnamese authorities decided to implement a shock-therapy approach to break the inflation-depreciation spiral, as Guillaumont Jeanneney (1994) discuss. Large dollar sales on the foreign exchange market caused a 25% appreciation of the dong to the dollar during 1992. Together with the control of monetary expansion, the authorities pursued a successful policy of pegging the dong to the dollar for the next five years. The process of dollarization was reversed momentarily and the annual average inflation rate remained below 10%. From 1997 to 1998, a sharp 25% exchange rate depreciation followed in the wake of the Asian crisis.<sup>2</sup> Since that time, dollarization has been growing steadily but inflation has been kept under control.<sup>3</sup>

Macroeconomic policy had two important characteristics during the 1990s in Vietnam. First, the authorities have opted for a heavily managed float so that the exchange rate remained stable from 1993 to 1999, except for the Asian crisis. Second, the restrictive monetary policy adopted since 1992 has been based on a broad monetary aggregate chosen as an intermediate target for monetary policy. The aggregate, denoted M2 or total liquidity, is composed of domestic money, both currency and deposits, and foreign currency deposits held in the domestic banking system; it is found in the State Bank of Vietnam Annual Reports.<sup>4</sup>

The remainder of this paper is organized as follows. In section 2, we present a model of Vietnamese inflation that highlights the contributions of monetary and exchange rate policies to the successful control of inflation in a dollarization scenario. In section 3, we estimate the model using a two-step procedure. Section 4 concludes with policy implications.

## **2. An inflation model for a dollarized economy**

We develop a model to investigate the determinants of inflation in the 1990s that is depicted in Figure 1. In the model, we take the standard price-taking small open economy to describe the Vietnamese economy during the relevant period. We make a distinction between

tradable (T) and non-tradable goods (NT) in consumption when calculating a consumer price index (CPI), which is defined as a geometric weighted average of price indices of both types of goods. Hence, domestic inflation rate is given by:

$$\Delta p_t = \theta \Delta p_t^T + (1-\theta) \Delta p_t^{NT}, \quad (1)$$

where small letters denote logarithms,  $p$  is the log of the CPI,  $p^T$  and  $p^{NT}$  are the logs of the prices of tradable and of non-tradable goods, respectively,  $\Delta$  is the first difference operator, and  $\theta$  is the constant weight of the prices of tradable goods in the CPI with  $0 < \theta < 1$ . Initially, we analyze the link between exchange rate policy and the change in the prices of tradable goods. Then, we take dollarization into account in analyzing the determination of the prices of non-tradable goods.

For a price-taking economy in world markets, the rate of change in the prices of tradable goods is given by:

$$\Delta p_t^T = \lambda \Delta e_t + \mu \Delta p_t^W + \delta_T, \quad (2)$$

where  $e$  denotes the log of the nominal exchange rate, defined in terms of domestic currency,  $p^W$  is the international prices of tradable goods in foreign currency,  $\delta_T$  is a constant capturing the evolution of other factors, e.g., transportation and transactions costs or trade policy, and  $\lambda$  and  $\mu$  are coefficients to be estimated. The coefficient  $\lambda$  is called the exchange rate pass-through so that  $0 < \lambda < 1$  indicates an incomplete pass-through of devaluation to the local currency prices of tradable goods. Thus,  $\lambda$  measures the variable mark-up of the prices of tradable goods over international prices following a change in the exchange rate. An incomplete pass-through for the prices of tradable goods may result from price stickiness or imperfect competition.<sup>5</sup> Given the small size of the Vietnam economy in comparison with its main trading partners, we expect a high exchange rate pass-through because foreign exporters to Vietnam and Vietnamese importers follow a mark-up pricing strategy. In the extreme case, assuming  $\lambda = \mu = 1$  leads to the following simplified version of equation (2):

$$\Delta p_t^T = \Delta e_t + \Delta p_t^W + \delta_T. \quad (2')$$

Equation (2') states that the relative version of the Law of One Price holds for tradable goods. Hence, the pass-through is complete for tradable goods, which is the textbook definition of tradability. Either equations (2) or (2') include two foreign sources of domestic inflation, namely, the change in the exchange rate and the change in foreign prices. If the economy is open, i.e. it is characterized by a large tradable goods sector, the willingness of the authorities to manage exchange rate variations is justified. This familiar framework is used to study the consequences of the exchange rate regime on domestic inflation in a cross-country study by Calderón and Schmidt-Hebbel (2003) and for two small Asian countries by Cheung and Yuen (2002).

Regarding the determination of the prices of non-tradable goods, dollarization introduces additional channels from exchange rate policy to inflation. The price of non-tradable goods is determined by equilibrium conditions in the domestic market by several factors. On the demand side, the main factor is linked to monetary policy. In the 1990s, Vietnamese monetary authorities chose as an intermediate target for monetary policy, namely, the growth in broad money, M2 inclusive of foreign currency deposits. Such a target is sensible because the U.S. dollar partially replaces the dong to perform the three main functions of money, i.e. as a unit of account, a means of exchange and a store of value. Hence, significant substitutability between the two currencies results in Vietnam, as Adam *et al.* (2004) discuss. When foreign currency is used for transactions, Calvo and Végh (1992) describe this situation as currency substitution, an increase in foreign currency can fuel the demand for goods and, as a result, inflation. Hence, the relevant money aggregate should include foreign-currency-denominated assets. In previous studies of dollarized economies, broad monetary aggregates including foreign currency deposits provide the tightest link to inflation, as Baliño *et al.* (1999), Berg and Borensztein (2000), and Reinhart *et al.* (2003) show.

The expansion of the money supply does not induce inflation necessarily because it may be absorbed by an equivalent increase in money demand. Therefore, we prefer to consider excess money, which is defined as the difference between actual money holdings and the long-run level of money desired by individuals. If individuals hold more than the desired amount of money at the beginning of the current period, they will adjust their holdings by buying goods and, thus, increase aggregate demand and eventually fuel inflation. Such an adjustment may be progressive over several periods due to the combination of adjustment speed, transaction costs, and uncertainties about expectations. In this framework, excess money, denoted EC, is defined as:

$$EC_t = (m-p)_t - (m-p)_t^* , \quad (3)$$

Where  $m$  is the log of nominal money denoted  $M$ . Desired money balances given by  $(m-p)^*$  is defined as the long-run demand for money, which depends on a vector of variables  $X$ , so that we have:

$$(m-p)_t^* = \beta' X_t , \quad (4)$$

where  $\beta$  is a vector of long-run parameters and  $X$  is a vector of determinants of the demand for money. The Representation Theorem in Engle and Granger (1987) allows us to replace the long-run relation in equation (4) with the following short-run error correction specification:

$$\Delta(m-p)_t = \alpha [ (m-p) - (m-p)^* ]_{t-1} + \sum_{i=1}^{k-1} \gamma_i \Delta(m-p)_{t-i} + \sum_{j=0}^{k-1} \delta_j \Delta X_j . \quad (5)$$

Equation (5) states that short-run changes in money balances depend on short-run shocks that affect  $X$  and on the excess money correction of  $\alpha$  per period. In other words, money holders eliminate a proportion  $\alpha$  of excess money, which increases the demand for goods.

Dollarization not only necessitates using a broad concept of money as an indicator of monetary policy but it also has consequences for the impact of exchange rate policy through the three potential channels outlined below. First, exchange rate variations have a direct

impact not only on the prices of tradable goods but also on non-tradable goods. In Vietnam, some non-tradable goods, particularly durable goods and real estate, are priced in dollars; in addition, some services, including some long-term contracts and rents, are also quoted in dollars. Therefore, the domestic-money-equivalent price of these goods is indexed to the exchange rate so that exchange rate variations pass through to domestic inflation for a broader set of goods than in a non-dollarized economy. Second, in the case of a dollarized economy, exchange rate variations have a direct impact on broad money. Hence, exchange rate depreciation increases the money supply because the domestic-currency-equivalent of foreign-currency assets varies with the exchange rate. Thus, exchange rate variations affect excess money and inflation. These features of a dollarized economy reinforce the relevance of managing the exchange rate and even suggest adopting a peg.

Third, following an exchange rate depreciation, a rise in the prices of tradable goods and of non-tradable goods for which prices are indexed to the exchange rate affects the demand for, and the supply of, the other non-tradable goods. As the relative price of tradable goods to non-tradable goods increases, the supply of non-tradable goods is reduced while the demand for them is increased. However, if we assume that the substitution in demand for the two categories of goods is low and that the reallocation of production factors between the two sectors can occur only in the long run, this last consequence of exchange rate variations can be neglected.<sup>6</sup> Moreover, unemployment was high in rural and urban areas in the 1990s in Vietnam, as Chandrasiri and de Silva (1996), CIEM (1999), and World Bank (1999) attest. Hence, the increase in production of tradable goods does not necessarily imply a reduction in non-tradable goods. The importance of unemployment also suggests that wage increases were not a significant source of non-tradable inflation.

Finally, in a transition economy, inflation is influenced dramatically by structural reforms, i.e., trade and price liberalization along with the privatization of state-owned enterprises

(SOEs). In Vietnam, significant structural reforms were adopted before the period under consideration. The liberalization of all prices, except for some public services, was undertaken from 1988 to 1989. Reforms in the SOE sector were dramatic in the late 1980s but further reform progressed slowly in the 1990s.<sup>7</sup> During this last period, SOEs were not exposed to significant competition and they benefited from a large amount of foreign direct investment and development aid without having to undertake major changes in their management according to IMF (1999) and World Bank (1999). Overall, changes in the competitive pressure on firms appear to have been moderate during the 1990s even if these are hard to measure due to the lack of data.

Based on these considerations, a sensible specification for the equation describing the change in the non-tradable goods price is:

$$\Delta p_{t}^{NT} = \alpha EC_{t-1} + \zeta \Delta e_t + \delta_{NT}, \quad (6)$$

where  $\zeta$  measures the impact of the indexation of the dollar-denominated price of particular non-tradables. Assuming a one-for-one response of the domestic-currency price of these goods to the exchange rate,  $\zeta$  is the share of these goods in the consumption of non-tradables. The inflation equation is derived by substituting equations (2) and (6) into equation (1) to obtain:

$$\Delta p_t = [\lambda\theta + (1-\theta)\zeta]\Delta e_t + \theta\mu\Delta p_t^W + (1-\theta)\alpha EC_{t-1} + \delta. \quad (7)$$

Equation (7) indicates that the impact of excess money,  $EC$ , depends on the speed of excess money correction and on the weight of the prices of non-tradable goods in the CPI. Equation (7) also suggests that the impact of exchange rate depreciation is exacerbated by the indexation to the exchange rate of some non-tradable goods prices. In addition, this equation allows for the estimation of the share of these dollar-linked goods among non-tradables under the maintained hypotheses. Finally, equation (7) can be written in reduced form as:

$$\Delta p_t = \kappa_1 \Delta e_t + \kappa_2 \Delta p_t^W + \kappa_3 EC_{t-1} + \delta, \quad (8)$$

where  $\kappa_1$ ,  $\kappa_2$ , and  $\kappa_3$  each belongs to the unit interval  $[0,1]$ . This reduced-form inflation equation is estimated using a two-step procedure in the following section.

### 3. Estimation results

Considering the difficulties associated with estimating and interpreting large cointegration spaces between non-stationary variables particularly with small samples, we use the two-step estimation method developed by Juselius (1992), Metin (1995), and Hendry (2001).<sup>8</sup> This method consists in segmenting variables according to economic sectors from which long-run cointegration relationships are derived by estimating sector vector autoregressive models (VAR), which are easier to handle than one large VAR consisting of all variables. Deviations from these cointegration relationships define disequilibria that may cause inflation. Initially, we investigate cointegration in the monetary sector, which leads to the calculation of excess money.<sup>9</sup> Then, equation (8) is estimated using the computed measure for excess money.

Regarding the data, the monetary aggregate M2 consists of the dong in circulation outside banks along with dong-denominated and dollar-denominated bank deposits. The price index is the CPI. The long-run demand for money depends on real economic activity, which is measured by the index of monthly industrial output because this is the only monthly economic activity reported in Vietnam. The preferred measure of the opportunity cost of holding money used in studies in developing countries is expected inflation, as Sriram (2001) attests. However, M2 holdings in Vietnam may be invariant to the expected inflation rate because this aggregate includes foreign currency deposits that constitute a hedge against depreciation and inflation. In other words, if exchange rate depreciation and inflation are linked, foreign currency deposits may be used as a store of value. We test this hypothesis by taking the actual inflation rate as a proxy for the expected rate, under the assumption of perfect foresight, to be a determinant of the demand for M2. Data are from the State Bank of Vietnam and cover the

period from January 1991 to June 1999 so that we have 102 data points for estimation. Details on the data and the results of the augmented Dickey-Fuller tests are reported in Appendix A. The null hypothesis of one unit-root is accepted for all variables with the exception of the inflation rate. Therefore, a cointegration framework is used to analyze the vector  $Y = \{(m2-p), y, \Delta p\}$ , where  $(m2-p)$  is real money holdings,  $y$  is real income, and  $\Delta p$  is inflation.

A vector error-correction model (VECM), which is a generalization of equation (5), is estimated. This approach permits us to test for the number of cointegrating vectors and the endogeneity of variables. Therefore, we specify:

$$\Delta Y_t = \alpha \beta' Y_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + D_t + \varepsilon_t \quad (9)$$

where  $Y = \{(m2-p), y, \Delta p\}$ .  $\beta'$  denotes the matrix of parameters of the cointegrating vectors,  $\beta'Y_{t-k}$  are error-correction terms, and  $\alpha$  is the matrix of equilibrium-correction or feedback effects. The matrix denoted  $\Gamma_i$  consists of the short-run parameters and  $D_t$  denotes the deterministic components that consist of a vector of centered seasonal dummies, constants, and trends. A lag length of  $k$  equal to 6 captures fully the dynamics between the variables of the vector  $Y$  and renders the vector of error-terms approximately Gaussian. Since Vietnam experienced significant growth in real money  $(m2-p)$  and real income  $(y)$  in the 1990s, the only acceptable deterministic components are either a trend restricted to lie in the cointegration space and an unrestricted intercept or no trend and an unrestricted intercept if the trend is cancelled out in the cointegrating vectors, as Johansen (1995) discusses. The full results of the cointegration analysis for both cases are reported in appendix B. Since the case of restricted trend and unrestricted intercept is the most general model and allows us to test for trend exclusion, we present the main results of the cointegration analysis for this case with the details relegated to Appendix B.1. However, similar results are obtained for the case of no-trend and unrestricted intercept, as shown in Appendix B.2. In both cases, residual-based

tests indicate the absence of serious statistical misspecification of the underlying vector autoregression but trace tests suggest the absence of cointegration. Hence, we might have omitted some variables but other natural candidates are unavailable or have proved insignificant in the analysis.<sup>10</sup> Since the size of the sample is quite small, the power of the trace test remains low even with small sample correction so that the test may reject cointegration incorrectly, as Hendry and Juselius (2001) discuss. Indeed, the first vector  $\beta$  appears to be broadly consistent with a long-run demand for money function having positive income elasticity, while coefficients for the inflation rate and the trend are very small. Moreover, feedback coefficients  $\alpha$  indicate that money is adjusting to this vector. Therefore, we continue the analysis assuming that the cointegration rank, i.e., the number of cointegration relationships, is one.<sup>11</sup>

Based on these characteristics, we test the following restrictions on the cointegrating vector and feedback coefficients using Likelihood Ratio (LR) tests. Together with the exclusion of the trend, the exclusion of the inflation rate  $\Delta p$  from  $\beta$  is tested because M2 includes inflation-hedging assets. These restrictions on  $\beta$  are accepted as the LR test has a value of  $\chi^2(2) = 0.97$  [0.61]. Then, the weak exogeneity of  $y$  with respect to  $\beta$  is tested and accepted with LR test having a value of  $\chi^2(3) = 4.24$  [0.23]. Hence, the restricted equation for the long-run demand for money takes the form:

$$(m2-p)_t = 1.15 y_t ,$$

with a significant feedback coefficient on  $\Delta(m2-p)_t$  of  $\hat{\alpha} = -0.16$ .

The income elasticity of money demand is above unity indicating an ongoing monetization process in Vietnam. Moreover, demand for M2 does not respond to expectations about inflation. Hence, targeting M2 requires the forecast of economic activity only as compared with targeting a domestic currency aggregate that would require taking the expected inflation rate into account. Concerning the feedback coefficients, individuals reduce

their excess money holdings considerably by about 16% per month and inflation is weakly adjusting, although this result is investigated further by taking other sources of inflation into account. Excess money is given by:

$$ECm2_t = (m2-p)_t - 1.15 y_t$$

and depicted in Figure 2. As indicated in the figure, a decrease in excess money occurs just before disinflation in 1992.

Having estimated excess money,  $ECm2$ , we investigate the determinants of inflation using equation (8).<sup>12</sup> Since unit values for exports and imports are unavailable, proxies for the international price of tradable goods, denoted  $\Delta p^W$ , are used. First, we compute a measure of foreign inflation as a weighted mean of the inflation rates of the ten main commercial partners of Vietnam.<sup>13</sup> Second, rice is a tradable or exportable good in Vietnam and it constitutes a significant share of domestic consumption in this country.<sup>14</sup> We use a dollar-denominated export price of Vietnamese rice as a relevant proxy for the international price of this tradable good. Furthermore, this export price can be considered to be exogenous given that, although Vietnam is one of the largest rice exporters in the world, it is not a price-maker in the global rice market. A full set of seasonal dummies is also included in the inflation equation.<sup>15</sup>

Taking account of the usual lags of adjustment in monetary dynamics, a general autoregressive distributed-lag (ADL) specification is given by:

$$\Delta p_t = \sum_{i=1}^k \eta_i \Delta p_{t-i} + \sum_{j=0}^k K_j V_{t-j} + \text{constant} + \text{seas dummies} + u_t \quad (10)$$

where the vector of stationary variables is  $V = \{\Delta e, \Delta p^W, EC\}$  and the associated vector of short-run coefficients is  $K = \{\kappa_1, \kappa_2, \dots\}$ . Including various lags of  $EC_t$ , i.e.  $EC_{t-j}$  with  $j=0, \dots, k$ , allows us to test whether  $EC_{t-1}$ , the one-period-lagged  $EC$ , is relevant when monthly data are used. The use of either the foreign inflation rate or the rice export price for  $\Delta p^W$  leads to similar results. Estimates using the rice export price are reported because they display a

tighter link with inflation. From an initial six-period lag, a simplification procedure is adopted to obtain parsimony without erroneous exclusion as Hendry (1995) recommends. Table 1 reports the alternative Ordinary Least Squares (OLS) estimates.<sup>16</sup>

The first estimate in column 1 uses excess broad money ECm2 and is preferred after the exclusion of insignificant regressors. Residuals-based tests do not detect statistical misspecification and the goodness-of-fit is high with  $R^2 = 0.85$ . The inflation process displays inertia with significant lagged inflation rates, implying that the short-run impact of the regressors is significant but weak. Coefficients have the expected sign. Although not reported, seasonal dummies are jointly significant with  $F(11,77) = 12.8 [0.00]$ . Foreign sources of inflation are apparent and indicated by the significant impact of exchange rate depreciation and of the rice export price.<sup>17</sup> The exchange rate has a stronger impact probably because of the expected additional impact of exchange rate changes through the dollar-denominated prices of particular non-tradable goods. The estimated exchange rate pass-through coefficient is  $(0.07+0.10)/(1-0.40-0.30)=0.54$ , which is comparable to estimates in cross-country studies on developing and dollarized economies by Honohan and Shi (2003) and Reinhart *et al.* (2003).

From equation (7), the exchange rate pass-through is  $(\lambda\theta + (1-\theta)\zeta)$  where  $\theta$  is the share of the prices of tradable goods in the CPI,  $\lambda$  is the exchange rate pass-through for the prices of tradable goods, and  $\zeta$  is the share of the dollar-denominated price non-tradable goods in the non-tradable category. An accurate proxy for  $\theta$  is unavailable because little information about the weighting pattern in the CPI is accessible.<sup>18</sup> On the supply side, the share of the tradable goods sectors in GDP can be estimated at between 40% and 48% in the 1990s.<sup>19</sup> Assuming that the Law of One Price holds for tradable goods, i.e.  $\lambda=1$ , the additional impact of exchange rate variations through the dollar-denominated price of particular non-tradable

goods  $(1-\theta)\zeta$  would range from 6 to 14 percentage points. Then, the derived share of the dollar-denominated price of non-tradable goods  $\zeta$  would be between 11% and 20%.<sup>20</sup>

One-period-lagged excess money  $ECm_{t-1}$  has a significant impact indicating that current inflation is affected by the correction of excess money in the preceding month, with excess money determined by previous excesses and by short-run shocks. The short-run effect of  $ECm_{t-1}$  is weak having a coefficient of 0.03 indicating that a one-percentage point reduction in EC induces a decrease in the inflation rate of 0.03 percentage points. This weak impact is explained by inflation inertia and by the fact that only a proportion of excess money,  $\alpha$  estimated at 16% per month, adds to the demand for goods and inflation in the current period. The actual inflation rate and the fitted rate from the preferred specification in column 1 are depicted in Figure 3. Stability tests from recursive least-square estimates shown in Figure 4 do not reject this final specification. Recursive coefficients and residuals are stable, lying within the bands calculated using two standard errors, and Chow tests do not detect any significant instability.

Columns 2 and 3 in table 1 provide alternative estimates based on different specifications for excess money. In column 2, the rate of change in the money supply is substituted for EC, allowing us to test whether inflation is affected by the money supply but rather than by excess money. From a general ADL specification and after simplification, we obtain the coefficients in column 2 in which only the money supply lagged two periods is significant. However, this variable is less significant than the excess money variable in column 1, which confirms our expectation that the latter is a better proxy for the monetary source of inflation. Although the explanatory power of this specification is good, we can reject it based on the error normality test. The tests reported in Table 2 confirm marginally that the specification in column 1 encompasses the specification in column 2.

Next, we test the relevance of the broad monetary aggregate M2 against the alternative of a domestic monetary aggregate, denoted M2D, and consisting of the dong in circulation and only dong-denominated deposits. Hence, M2D excludes the foreign currency deposits that are included in M2. The estimated domestic money demand equation is given by: <sup>21</sup>

$$(m2d-p) = 1.15y - 11.9\Delta p$$

where inflation expectations represent a significant opportunity cost of holding money. In contrast to M2, adopting domestic money as an intermediate target for monetary policy would be more difficult because inflation expectations would need to be taken into account. Thus, if authorities adopt a monetary aggregate as an intermediate target, the target should be a broad aggregate that includes inflation-hedging assets, i.e., M2. The excess of domestic money is given by  $ECm2d = (m2d-p) - 1.15y + 11.9\Delta p$ . We substitute this measure for  $ECm2$  in the inflation equation and, after simplification, we obtain the specification reported in column 3 of Table 1. The Ramsey RESET statistic detects instability and  $ECm2d$  has no significant impact on inflation. Hence, we conclude that a broad monetary aggregate is relevant based on its link with inflation.

During the 1990s, the Vietnamese authorities adopted a broad monetary target that includes foreign currency deposits, M2, as an intermediate target for monetary policy. Hence, our results explain why the final target of disinflation was met. However, since exchange rate variations automatically affect the excess of broad money, the control of inflation through the monetary expansion also requires control of the exchange rate. To investigate further this issue, we retrieve the cumulative contribution to inflation of an exchange rate depreciation from the static solution of the dynamic specification in column 1 following a procedure in Hendry (1995). Thus, we have:

$$\Delta p = 0.001 + 0.40\Delta p + 0.30\Delta p + 0.03EC + 0.07\Delta e + 0.10\Delta e + 0.03\Delta rice.$$

or, equivalently,

$$\Delta p = 0.01 + 0.1EC + 0.5\Delta e + 0.1\Delta \text{rice}.$$

As an illustration, we take the years from 1997 to 1998 during which the exchange rate was depreciated drastically by around 25%. Given that the share of foreign currency deposits in M2 was around 20%, depreciation would induce a  $25\% \times 20\% = 5\%$  increase in M2. Under the assumption that the monetary authorities would not react to this increase, additional excess money of around 5% would be forthcoming, conditional on weak initial excess money.<sup>22</sup> In this case, the 25% depreciation would generate additional inflation of:

$$\Delta p = 0.1 \times 5\% + 0.5 \times 25\% = 0.5\% + 12.5\% = 13\%.$$

This estimated additional inflation for 1997 to 1998 is very close to the cumulated inflation rate observed during that period in Vietnam, which was also around 13% due to an annual inflation rate of 3.6% in 1997 and 9.2% in 1998.<sup>23</sup> This illustration highlights the major role played by depreciation in inflation from 1997 to 1998. This contribution came mainly through the prices of tradable goods and through the dollar-denominated prices of particular non-tradable goods.<sup>24</sup> The illustration also suggests that our estimated coefficients are not only statistically significant, but also economically relevant.

#### **4. Conclusion**

In this paper, we investigate the determinants of inflation in Vietnam in the 1990s. In addition to idiosyncratic factors such as the export price of rice, the results indicate that inflation is explained by exchange rate changes and by excess money. Hence, in a dollarized economy, the relevant concept of money should include foreign currency deposits held in the domestic banking system. This result is consistent with earlier studies of other dollarized economies in which broad monetary aggregates display a tight link to inflation. The policy implications are especially important in developing countries with relatively thin financial markets so that a monetary aggregate is required as an intermediate target for monetary

policy. Given the automatic impact of exchange rate variations on broad money supply, an additional implication is that controlling monetary expansion requires controlling the exchange rate. Moreover, we highlight the additional impact of exchange rate variation on inflation through the dollar-denominated price of some non-tradable goods. Overall, we showed that dollarization makes the control of exchange rate more desirable, even during periods of moderate inflation as Vietnam experienced in the 1990s.

Our analysis provides several important policy implications for other dollarized economies. First, by estimating the extent of dollar indexation of non-tradable goods in a dollarized economy, we show that this indexation explains why exchange rate pass-through is greater than what would be expected given the relative openness of a country. Second, we find that money matters to the inflation process in such an economy, but only when dollar holdings are included. Taken together, these two results indicate that the impact of exchange rate variations would be underestimated and the impact of money would be misjudged if the impact of dollarization is not taken into account explicitly. Consequently, erroneous conclusions would be drawn about the efficiency and complementarity of monetary and exchange rate policies in controlling inflation by this omission.

Our case study of Vietnam suggests that exchange rate management coupled with restrictive monetary policy based on a broad concept of money are twin objectives in the quest for lasting disinflation in a dollarized economy. Given its success with disinflation, Vietnam merits consideration as an example of well-designed monetary and exchange rate policy in a dollarized economy. In addition, the framework in this paper is sufficiently simple and parsimonious regarding data exigencies to be applied to other transition countries and developing countries to examine the consequences of dollarization for monetary policy in a disinflationary environment.

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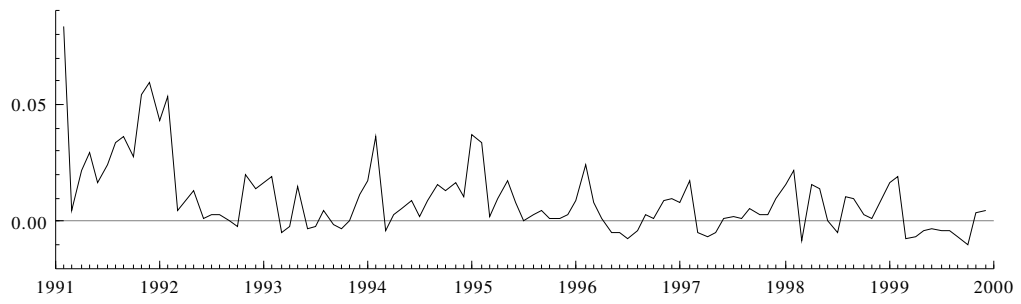


Fig. 1. Monthly inflation rates (CPI)

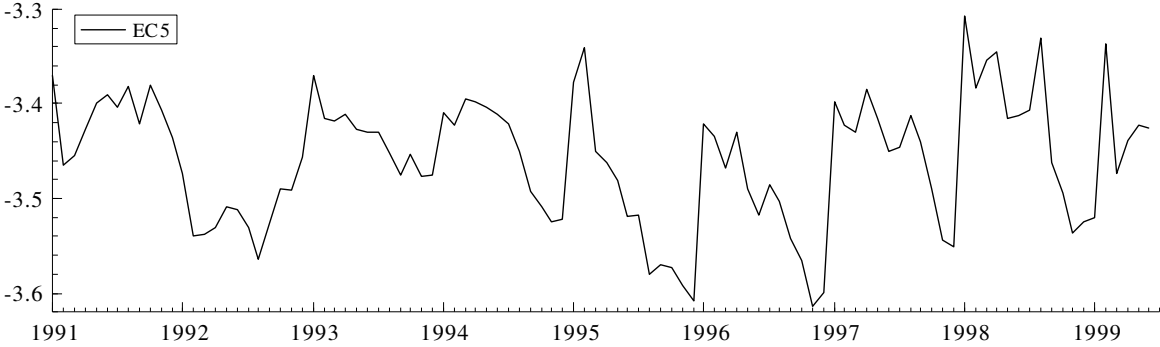


Fig. 2. Excess money

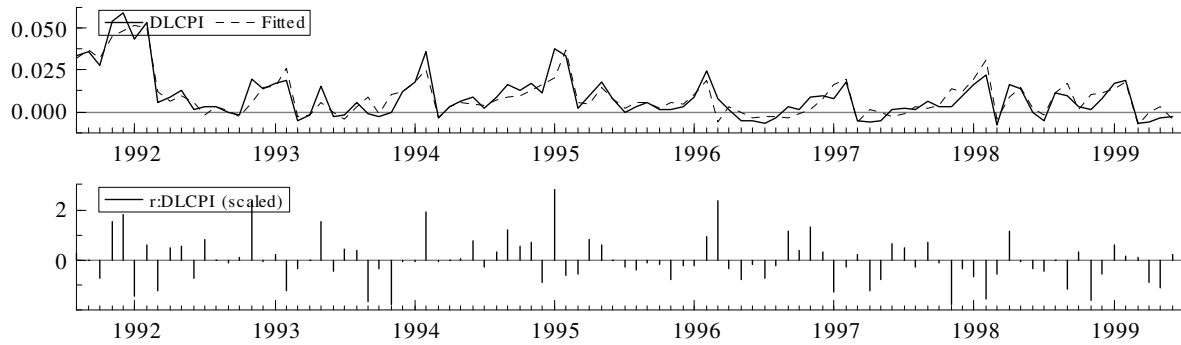


Fig. 3. Actual and fitted values of inflation and the scaled residuals.

Notes:

- i. The first graph reports actual and fitted values of  $\Delta p$  for the specification in column 1 of Table 1.
- ii. The second graph depicts scaled residuals defined as actual  $\Delta p$  minus fitted  $\Delta p$ .

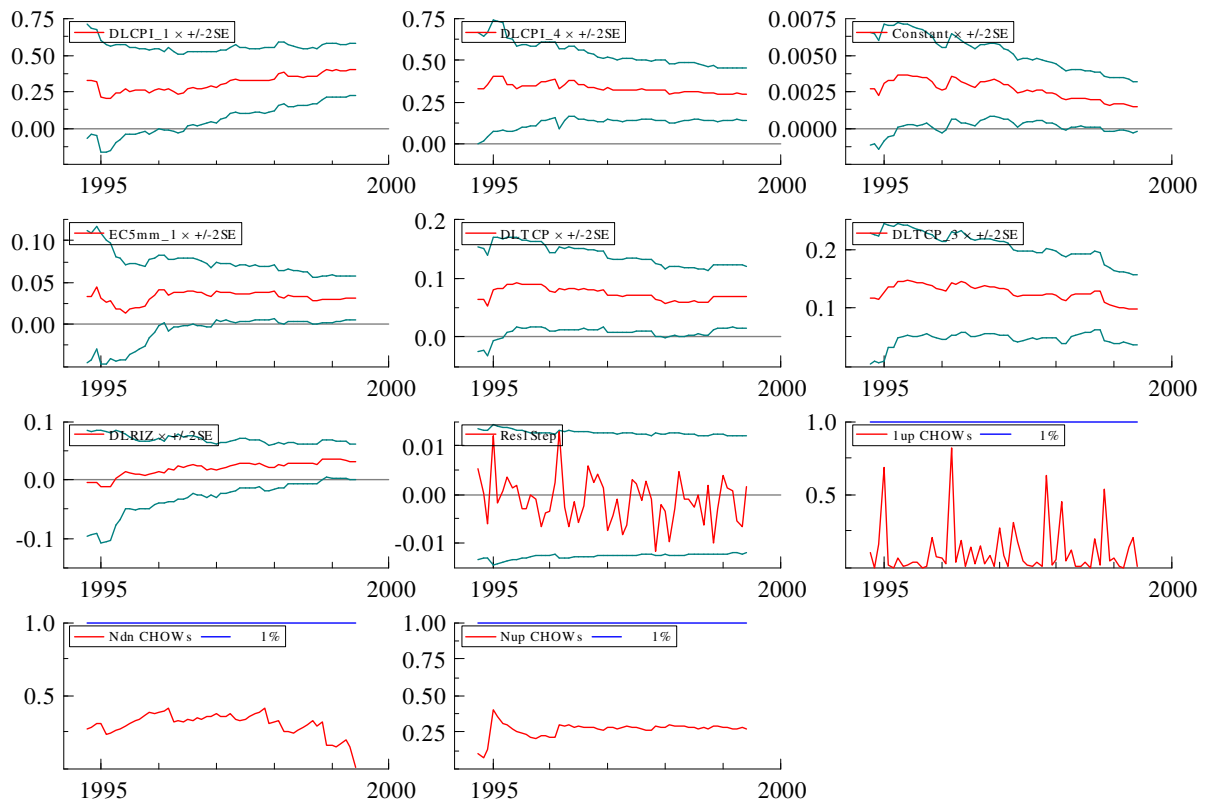


Fig. 4. Tests of coefficient constancy and specification stability

Note:

The graphs depict the seven recursively estimated coefficients with two standard errors bands, the one-step ahead residuals, the one-step forecast Chow test (1-up), the break-point Chow test (N-down), and the forecast Chow test (N-up). Details of these tests are found in Hendry and Doornick (2001).

Table 1

Inflation equation estimates (OLS):1991:08 – 1999:06.  
(Dependent variable is  $\Delta p_t$ .)

Specification	[1]	[2]	[3]
included monetary variables:	Excess broad money ECm2	Broad money supply $\Delta m2$	Excess domestic money ECm2d
constant	0.00 (1.71)	0.00 (0.24)	0.01 (0.65)
$\Delta p_{t-1}$	0.40 (4.57)	0.42 (5.89)	0.42 (3.27)
$\Delta p_{t-4}$	0.30 (3.86)	0.26 (3.97)	0.26 (2.80)
$EC_{t-1}$	0.03 (2.42)	-	0.00 (0.70)
$\Delta m_{t-2}$	-	0.05 (1.99)	-
$\Delta e_t$	0.07 (2.57)	0.07 (2.42)	0.08 (2.93)
$\Delta e_{t-3}$	0.10 (3.24)	0.11 (3.64)	0.11 (3.86)
$\Delta rice_t$	0.03 (1.97)	0.03 (1.95)	0.03 (1.83)
$R^2$	0.85	0.84	0.83
DW	2.02	1.95	2.01
AR(1-6)	0.40[0.87]	0.37[0.89]	0.23[0.96]
ARCH(1-6)	0.81[0.56]	0.89[0.50]	0.93[0.48]
J-B	5.07[0.08]	6.23[0.04]	6.03[0.05]
H	1.16[0.31]	0.96[0.51]	1.02[0.45]
RESET	3.00[0.09]	2.94[0.12]	4.03[0.05]
Inst-var	0.09	0.10	0.11
Inst-joint	3.43	3.13	3.33

Notes:

- i. Coefficients on seasonal dummies variables are not reported. HCSE-t-values are presented in parentheses.
- ii. DW is the Durbin-Watson statistic. AR(1-6) and ARCH(1-6) are tests against the null of autocorrelation and autoregressive conditional heteroscedasticity of order 1 to 6. H and J-B are tests against the null of homoscedastic and normally-distributed errors. RESET is the regression stability test. Inst-var and Inst-joint are Hansen's tests for variance and joint parameter stability. Details of these tests are in Hendry and Doornick (2001).
- iii. Marginal significance levels of the test statistics are presented in square brackets.

Table 2

Encompassing tests statistics.

Specification [1] {Excess of broad money} versus Specification [2] {Broad money supply}.

		Spec. [1] $\in$ Spec. [2]	Spec. [2] $\in$ Spec. [1]
Cox	N(0,1)	-6.99 [0.00]	-10.2 [0.00]
Ericsson IV	N(0,1)	6.12 [0.00]	8.89 [0.00]
Sargan IV	Chi <sup>2</sup> (1)	3.22 [0.07]	4.43 [0.03]
Joint Model	F(1,76)	3.32 [0.07]	4.64 [0.03]
sigma[Spec.1] = 0.0060		sigma[Spec.2] = 0.0061	sigma[Joint] = 0.0059

Notes:

- i. The tests are taken from Cox (1961), and from Ericsson (1983) and Sargan (1959) that are based on the instrumental variables method. Joint Model is the F-test for each model being a valid simplification of the linear union of the two models under test. The null hypothesis H<sub>0</sub> is that specification i encompasses ( $\in$ ) specification j. Details of these tests are in Hendry and Doornick (2001).
- ii. Marginal significance levels of the test statistics are presented in square brackets.

**Appendix A – Data and unit root tests**

Table A.1

Notation for monthly series from 1991:01 to 1999:06

Notation	Variable	Details	Source
m2-p	$\log(M2/CPI)$	M2 = domestic currency in circulation + dong-denominated banking deposits + foreign currency deposits	SBV in SBV Annual Reports, CIEM (2000) and Vo Tri Thanh (2000).  and IMF International Financial Statistics.
m2d-p	$\log(M2D/CPI)$	M2D = domestic currency in circulation + dong-denominated banking deposits	
p	$\log(CPI)$	CPI consumer price index	
y	$\log(IND)$	IND real industrial output index	SBV in CIEM (2000) and Vo Tri Thanh (2000).
e	$\log(BER)$	BER Hanoi black market exchange rate	SBV Annual Reports.
p <sup>w</sup>	$\log(CPI^w)$	CPI <sup>w</sup> consumer price index of the 10 main trading partners of Vietnam; weighted mean with the share of each partner in the 1995-2000 trade: Japan (22,3%), Singapore (18,9%), Taiwan (12,9%), Korea (11,8%), China (8,7%), Hong-Kong (5,7%), Germany (5,3%), Thailand (5,2%), United-States (4,9%), France (4,4%). These 10 countries account for around 80% of Vietnam trade.	Calculations from the author with data from IMF in International Financial Statistics and Direction of Trade Statistics, except for Taiwan in <a href="http://www.stat.gov.tw">www.stat.gov.tw</a>
rice	$\log(RICE)$	RICE Export price of Vietnam rice in dollar	Osiriz Monthly Bulletin

Note: The series are not seasonally adjusted.

Table A.2

Unit-root tests on monthly series from 1991:07 to 1999:06

	<b>with trend</b>		<b>without trend</b>	
	x	$\Delta x$	x	$\Delta x$
m2-p	(0) -2.664	(0) -9.065***	(0) 0.573	(0) -9.031***
m2d-p	(0) -2.085	(0) -8.515***	(0) -0.342	(0) -8.568***
y	(0) -5.637***		(5) 0.329	(4) -5.964***
$\Delta p$	(0) -4.120***		(0) -3.816***	
$\Delta p^w$	(0) -8.673***		(0) -6.437***	
$\Delta rice$	(0) -5.691***		(0) -5.722***	
$\Delta e$	(0) -5.480***		(0) -5.503***	

Notes:

- i. The ADF-tests include constant and seasonal dummies, with or without a deterministic trend.
- ii. The lag length is given in parentheses; it is selected using the Akaike Information Criterion.
- iii. The symbol \*\*\* denotes rejection of the null hypothesis of a unit-root at a significance level of 1%. The critical values used are -4.06 and -3.50 with and without trend, respectively.

**Appendix B – I(1) cointegration analysis of the monetary sector**

Table B.1

Vector  $Y = \{ (m2-p), y, \Delta p \}$ , unrestricted constant / restricted trend.

VECM residuals diagnostic statistics for  $Y_t$ . OLS. 1991:08 – 1999:06

	AR(1)	AR(6)	JB	ARCH(6)	H
Y	1.06 [0.39]	1.49 [0.03]	13.3 [0.04]		0.58 [0.99]
m2-p	0.93 [0.33]	1.49 [0.19]	1.61 [0.44]	1.46 [0.20]	0.55 [0.95]
y	1.42 [0.23]	1.83 [0.10]	4.19 [0.12]	2.17 [0.06]	2.21 [0.02]
$\Delta p$	0.14 [0.70]	0.86 [0.52]	7.60 [0.02]	0.26 [0.94]	0.27 [0.99]

## Reduced-Rank Statistics.

Eigenvalues	H0: rank $\leq$	Trace test
0.13744	0	29.607 [0.531]
0.09232	1	15.560 [0.536]
0.06473	2	6.3580 [0.427]

## Adjustment coefficients and standardized eigenvectors (scaled on diagonal).

$\alpha$	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\beta$	$\beta_1$	$\beta_2$	$\beta_3$
$\Delta(m2-p)$	-0.10	-0.08	-0.03	m2-p	1.00	-0.54	3.02
$\Delta y$	0.12	0.04	-0.03	y	-2.52	1.00	6.17
$\Delta\Delta p$	0.01	-0.04	0.00	$\Delta p$	1.78	4.99	1.00
				trend	0.01	-0.00	-0.10

## Adjustment coefficients and restricted eigenvectors.

LR test of restrictions:  $\text{Chi}^2(3) = 4.24 [0.23]$

$\alpha$	$\alpha_1$	$\beta$	$\beta_1$
$\Delta(m2-p)$	-0.16 (0.08)	m2-p	1
$\Delta y$	0	y	-1.15 (0.05)
$\Delta\Delta p$	0.04 (0.02)	$\Delta p$	0
		trend	0

Notes:

- i. AR(1) and AR(6) are LM tests for first-order and 1-to-6-order autocorrelation. JB is the Jarque-Bera test for normality. ARCH is an LM test for conditional heteroscedasticity. H is the test for heteroscedasticity from White (1980).
- ii. Marginal significance levels of the test statistics are presented in square brackets.
- iii. Standard errors of unrestricted coefficients estimates are presented in parentheses.

Table B.2

Vector  $Y = \{ (m2-p), y, \Delta p \}$ , unrestricted constant / no trend

VECM residuals diagnostic statistics for  $Y_t$ . OLS. 1991:08 – 1999:06

	AR(1)	AR(6)	JB	ARCH(6)	H
Y	0.91 [0.51]	1.42 [0.05]	12.6 [0.05]		0.57 [0.99]
m2-p	0.82 [0.36]	1.57 [0.17]	1.39 [0.49]	1.53 [0.18]	0.62 [0.90]
y	0.48 [0.49]	1.92 [0.09]	3.62 [0.16]	1.65 [0.15]	1.54 [0.12]
$\Delta p$	0.18 [0.66]	0.84 [0.54]	7.43 [0.02]	0.28 [0.94]	0.29 [0.99]

Reduced-Rank Statistics.

Eigenvalues	H0: rank $\leq$	Trace test
0.13192	0	23.481 [0.231]
0.09199	1	10.042 [0.283]
0.00915	2	0.8740 [0.350]

Adjustment coefficients and standardized eigenvectors (scaled on diagonal).

$\alpha$	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\beta$	$\beta_1$	$\beta_2$	$\beta_3$
$\Delta(m2-p)$	-0.16	-0.06	0.07	m2-p	1.00	-0.81	-0.08
$\Delta y$	0.13	0.04	0.11	y	-1.11	1.00	0.16
$\Delta\Delta p$	0.02	-0.04	-0.00	$\Delta p$	1.86	6.04	1.00

Adjustment coefficients and restricted eigenvectors.

LR test of restrictions:  $\text{Chi}^2(2) = 3.63 [0.16]$

$\alpha$	$\alpha_1$	$\beta$	$\beta_1$
$\Delta(m2-p)$	-0.16 (0.08)	m2-p	1
$\Delta y$	0	y	-1.15 (0.05)
$\Delta\Delta p$	0.04 (0.02)	$\Delta p$	0

Notes:

- i. AR(1) and AR(6) are LM tests for first-order and 1-to-6-order autocorrelation. JB is the Jarque-Bera test for normality. ARCH is an LM test for conditional heteroscedasticity. H is the test for heteroscedasticity from White (1980).
- ii. Marginal significance levels of the test statistics are presented in square brackets.
- iii. Standard errors of unrestricted coefficients estimates are presented in parentheses.

## Acknowledgments

An earlier version of this paper benefited from comments by participants at the conference on development and transition economics at CERDI. This version reports results of additional tests and is available from the CERDI website [www.cerdi.org](http://www.cerdi.org). Without implication, I thank Jaime de Melo, Christopher Adam, Sylviane Guillaumont Jeanneney, the Editor, and two anonymous referees for helpful comments on earlier drafts of this paper.

## Footnotes

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<sup>1</sup> The exchange rate depreciated from VND/USD 15 at the end of 1985 to VND/USD 3,000 at the end of 1988. In Vietnam, the widespread circulation of U.S. dollars first appeared at the end of the 1960s when American armed forces were based in the South. However, following reunification of the country in 1975, the holding of foreign currency by residents was strictly forbidden in order to promote the dong as the currency of Vietnam.

<sup>2</sup> A weakening trade balance in 1995 to 1996 raised the concern that the dong might be overvalued and induced a speculative demand for dollars, which was reinforced by the Asian crisis in 1997 to 1998. The exchange rate came under pressure and the dong depreciated from VND/USD 11,000 at the end of 1996 to VND/USD 14,000 at the end of 1999.

<sup>3</sup> Foreign currency deposits and U.S. dollar banknotes represent a substantial proportion of the total money supply in Vietnam. The exact volume of U.S. banknotes in circulation is hard to determine precisely. Unterberdoerster (2002) estimates it to be around USD 3 billion in 2000, which is approximately 10% of GDP. Using data from IMF (2002) and Unterberdoerster (2002), we calculate the relevant shares for 2000 to have been domestic currency in circulation 20%, domestic currency deposits 38%, foreign currency in circulation 16%, and foreign currency deposits 26%. By these estimates, total foreign currency would have accounted for 42% of the total money supply in Vietnam in 2000. Foreign currency deposits held abroad by Vietnamese residents are negligible because of efficient restrictions according to International Monetary Fund, *Exchange Arrangements and Exchange Restrictions* (various issues).

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<sup>4</sup> The restrictive monetary policy was preceded by the imposition of a hard budget constraint on both state-owned enterprises and on government spending, which allowed the slowdown in the growth of the credit at the beginning of the 1990s. In the presence of a low fiscal budget deficit, the State Bank of Vietnam used mainly restrictive banking credit ceilings to control the growth in M2 in the 1990s.

<sup>5</sup> In the empirical literature, explanations for the incompleteness of pass-through tend to focus on imperfect competition in trade between industrialized countries at the industry level, e.g., Rogoff (1996) and Goldberg and Knetter (1997). However, the smaller and the less developed is the economy, the more complete must be the pass-through according to Ghei and Pritchett (1999) and Feinberg (2000).

<sup>6</sup> Relaxing this hypothesis would not imply a modification of the reduced form equation of inflation in equation (8).

<sup>7</sup> The number of SOEs dropped dramatically from 12,000 to 6,000 during the period of 1989 to 1992, mainly through mergers, and employment in SOEs fell by more than one third.

<sup>8</sup> This method is also used by Jonsson (2001), Nachegea (2001), and Sekine (2001).

<sup>9</sup> Preliminary results of the cointegration analysis in the foreign sector between domestic prices, foreign prices, and the exchange rate reject such a long-run relationship, suggesting that purchasing power parity may be irrelevant for a transition economy such as Vietnam.

<sup>10</sup> First, expected depreciation could be an opportunity cost of holding M2 because it could lead to a substitution not only between the components of M2 but also possibly between M2 and dollar banknotes that are excluded from M2. However, the depreciation rate is insignificant in the cointegration analysis of the monetary sector. Second, the financial system is relatively underdeveloped in Vietnam. The only available data on interest rates for 1991 to 1999 on a monthly frequency are the three-month dong deposit rates, which are a yield on these deposits but an opportunity cost of holding the other components of M2. As was every interest rate in Vietnam, this rate was administrated during the 1990s and shows only small variations. Preliminary results suggest that this interest rate does not affect money demand.

<sup>11</sup> I thank an anonymous referee for suggesting this empirical strategy.

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<sup>12</sup> Following Hendry and Doornik (2001), we re-parametrize ECm2 to have zero mean, i.e.  $EC = ECm2 + 3.46$ . Hence, the intercept that remains in equation (8) measures only an interpretable autonomous inflation component.

<sup>13</sup> A shortcoming of using inflation rates is that consumer price indexes include non-tradable goods consumed in foreign countries. Moreover, tradable goods consumed in foreign countries can be different from those consumed in Vietnam.

<sup>14</sup> Dodsworth *et al.* (1996) suggest that high export prices sometimes diverted domestic supply causing an increase in the domestic price.

<sup>15</sup> In particular, before and during the Lunar New Year celebrations in January-February of every year, inflation accelerates as the demand for consumer goods increases.

<sup>16</sup> Similar results are obtained when the instrumental variable estimator is used.

<sup>17</sup> The use of the instrumental variable estimator yields similar results, except that export price of rice is less significant indicating that it is not perfectly exogenous.

<sup>18</sup> The problem arises from the aggregation of food items into one category, which had a weight of over 60% in the CPI prior to July 2001 and contained tradable as well as non-tradable goods. During the period under consideration, the weights in the CPI were food 61%, clothes and footwear 6%, household goods 5%, housing and construction 3%, transport and communications 7%, and other items 18% according to IMF (2002).

<sup>19</sup> The share of the tradable sectors in GDP can be computed using annual GDP sectoral disaggregation published by the IMF (IMF, 1999 and 2002, tables 2 and 3). Assuming that tradable goods are produced in the primary and manufacturing sectors, the share of tradable goods in GDP was between 46% and 50% from 1991 to 1999, with an average of 48%. However, SOEs account for around 50% of the industrial sector and are protected by the authorities in some cases by import quotas or bans. Hence, assuming alternatively that tradable goods are produced in the primary sector and only non-state owned manufacturing sector, the share of tradable goods in GDP ranges from 38% to 42%, with an average of 40%. Details are available from the author upon request.

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<sup>20</sup> Alternatively, if the pass-through for the prices of tradable goods is incomplete at  $\lambda=0.9$ , the additional impact of exchange rate variations ranges from 11 to 18 percentage points and the share of the dollar-denominated price of non-tradable goods ranges from 20% to 30%.

<sup>21</sup> Full results for the cointegration analysis of the vector  $\{(m2d-p), y, \Delta p\}$  are available from the author upon request. The results from the analysis with narrower concepts of money, e.g. domestic currency in circulation (M0), and M0 plus domestic currency demand deposits (M1), indicate they do not cause inflation.

<sup>22</sup> Let  $EC_0$  be initial excess money in real terms. This simplifies in nominal terms to  $EC_0=(M2-M2^*)/M2^*$  and thus  $M2=M2^*(1+EC_0)$  where  $M2$  and  $M2^*$  are the supply of money and the demand for money, respectively. Apart from the effect of the depreciation, assume that the money supply increases at the same rate  $g$  as does the demand for money. Additional excess money is given by  $\{[M2^*(1+EC_0)(1+g)(1+5\%)-M2^*(1+g)]/[M2^*(1+g)]\} - EC_0$  which simplifies to  $(1+EC_0)5\%$ .

<sup>23</sup> The mean rate of change in the price of rice is insignificant in these years.

<sup>24</sup> The impact of the depreciation through excess money would be more important if dollar banknotes in circulation were taken into account.