Impact of Monetary Policy on Exchange Market Pressure: The Case of Nepal*

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Abstract

This paper examines the impact of monetary policy on the exchange rate using a variant of Girton and Roper's (1977) monetary model of exchange market pressure (EMP). I apply a recently developed technique in empirical estimation, impulse indicator saturation (IIS), developed by Hendry, Johansen, and Santos (2008), where the regression equation is saturated by impulse indicators. Despite weak fundamentals such as a large trade deficit and a slowly growing economy, Nepal has maintained a pegged exchange-rate regime, with India, as its monetary policy anchor. Using different definitions of EMP, and taking domestic credit as a policy variable, this study finds that monetary policy is positively associated with EMP (easing pressure on the exchange rate following a contractionary monetary policy), using quarterly data for 1975-2009. The results show that the IIS technique along with general-to-specific (GETS) modeling in Autometrics helps to detect big fluctuations in the data and also improves the model's performance.

Keywords: exchange market pressure, monetary policy, impulse-indicator saturation, autometrics
JEL classification: E4, E5, F3

1 Introduction

In the literature, the EMP framework has been widely used to study the impact of monetary policy on the exchange rate. Policy makers in developing countries are confronted not only with situations evolving domestically, but they must remain vigilant to exogenous events and their ramifications, especially in light of globalization, rapid technological changes, and constantly evolving global economic relationships. One example of external changes that impact these countries is the nature of capital flows. Many emerging market economies have voiced their concern about the rush of capital inflows, which can fuel consumption, cause a real exchange-rate appreciation,

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and erode competitiveness. In a similar vein, many other less developed economies receive substantial inflows from remittances, which are different from capital inflows but nevertheless can have similar implications. A pertinent issue in this regard is the ability of the monetary authority to maintain a desired exchange-rate system, one that promotes economic stability and fosters growth. One key issue in this regard is to analyze policy effectiveness in averting a currency collapse, or even preventing the buildup of unsustainable pressure on the currency.

Girton and Roper (1977) introduced a framework that links policy variables to a measure of pressure on the currency. The authors introduced the term "exchange market pressure" (EMP), which defines pressure on the domestic currency as the sum of the percentage change in the exchange rate and the percentage change in international reserves. With this definition, EMP encompasses pressure on the currency under both flexible and fixed exchange-rate regimes. EMP is also a useful indicator of a potential currency crisis. In a typical sense, a currency crisis means severe pressure to depreciate and/or a substantial loss of foreign currency reserves, often measured by some threshold level of EMP. The focus of this paper is on whether monetary policy can mitigate or affect the way pressure is built on the currency.

In this context, it is necessary to note the distinction between periods when EMP reaches a tipping point, after which the currency is in a crisis stage, and periods when there is sustained pressure but the currency does not collapse. This differentiation is necessary because the policy response in these two situations can vary, as the former may require more than conventional policy treatment. This distinction also makes it possible to study the response of policy changes in countries which are not in crisis but face sustained pressure on their currency. According to the monetary model of EMP, this pressure results from disequilibrium in the money market. Particularly, an expansionary monetary policy increases pressure on the currency, while the tightening of money supply reduces this pressure. As such, monetary policy can have a direct impact in moderating pressure on the currency. Later studies have shown that this interaction, however, is contingent on a confluence of events and is rarely straightforward. Nevertheless, the monetary model's predictions are simple, and there is some empirical evidence in favor of the model in different countries.

In 2008, the IMF classified 68 countries, mostly developing, in the category of a conventional pegged system. There are several other countries which have some form of managed exchange-rate regime. Most of these countries place paramount interest in their goals towards external balance. Many countries even choose the exchange rate as the target for their monetary policy. Nepal is a case in point with its pegged exchange-rate regime (with India) as the monetary policy anchor. It has so far avoided any serious currency crisis, but continues to face unrelenting pressure on the exchange rate (NPR/INR).[1] [2] This is primarily due to weak growth and a huge trade deficit for goods and services. India is Nepal's dominant trading partner, accounting for more than 50 percent of its trade for a long time. Nepal's exports and imports from India averaged about 59 and 52 percent of the respective totals from 2000 to 2008. Average GDP growth during 2000 to 2009 was 3.9 percent, while the growth rate has never exceeded 6.9 percent. In the same period, India's economy has grown by 6.8 percent in real terms. Nepal's trade deficit (goods and services) in the same period deteriorated from 9 percent of GDP to 21 percent. Meanwhile, remittances as a percent of GDP grew from 2 to 23 between 2000 and 2009. As a reliable source of funds, Nepal's external balance and macroeconomic stability depend vitally on the foreign-currency reserves built from remittances. At the same time, remittances exert pressure on the domestic currency by expanding monetary conditions. By adding to the monetary base, remittances may lead to disequilibrium in the money market and thereby impact the exchange rate.

One important contribution of this paper is the application of a recently developed technique in empirical estimation called impulse indicator saturation (IIS). In modeling US expenditure on food, Hendry and Mizon (2011) note that the empirical testing of a theory that is essentially 'correct' may exhibit mis-specification if the inherent data generating process is not properly modeled. Many macroeconomic data often incorporate shocks to the system arising from structural changes in the economy following events such as recessions, wars, and changes in policy regime.

[1] In a recent study, Panday (2011a) finds evidence of overvaluation of the real exchange rate in Nepal in the period 1994-2008.

[2] NPR=Nepalese Rupee; INR=Indian Rupee

The authors argue that a theory can perform well in a general framework, which incorporates dynamics as well as the possibility of outliers, breaks, and shifts in the data. The IIS technique by Hendry, Johansen, and Santos (2008) allows for these possibilities in the special case of a regression equation in which a dummy variable is added for each observation. As the authors and others have discussed, the application of the IIS technique is useful not only in detecting structural changes in the data, but it is flexible enough to capture analytical insights when the model is complete and correct, reject the model if it is incorrect, and improve it when additional information is provided.[3] This paper applies the IIS technique to model the interaction of a monetary policy variable and an indicator of pressure on the currency, i.e., exchange market pressure (EMP), using a variant of Girton and Roper's (1977) monetary model of the exchange rate. In addition to the IIS technique, I also rely on generalized impulse responses using different vector autoregression (VAR) models.

Various estimates show that the IIS technique has several advantages over OLS. In particular, by treating domestic credit as a monetary-policy variable, I find evidence of easing pressure on the home currency following a contractionary policy as predicted by the theory. The remainder of the paper is organized as follows. Section 2 begins with various definitions of EMP, followed by the derivation of the monetary model, and a brief survey of the EMP literature. In section 3, preliminary data analysis is presented. This is followed by a brief discussion of the IIS technique, general-to-specific (GETS) modeling, and the algorithm in Autometrics in section 4. The identification of VAR models is also discussed. Finally, in section 5, the results are presented, with concluding remarks in section 6.

2 The EMP Model

2.1 Definitions

The first generation of EMP models, starting with Girton and Roper's monetary model, use the combination of the percentage change in the exchange rate and the

[3] See Johansen and Nielsen (2009), Santos and Oliveira (2010), and Castle, Doornik, and Hendry (2008)

change in international reserves scaled by base money as the indicator of pressure on the currency. By using the monetary model in a two-country setting, the authors derive an EMP indicator, one which is especially applicable in countries with some kind of managed exchange-rate regime. Intuitively, the model suggests that disequilibrium in the domestic money market can be restored through some combination of currency appreciation/depreciation and international reserves inflow/outflow.

The next generation of the EMP model was based on the parameters derived from a structural model of the economy proposed first by Weymark (1995, 1998). The author presents an index to measure EMP, which includes a combination of the exchange-rate changes, ΔE_t, and the change in international reserves (scaled by the base money), ΔR_t. In addition, it also includes an elasticity component as shown below:

$$EMP_t = \Delta E_t + \eta \Delta R_t \tag{1}$$

where $\eta = -\frac{\partial \Delta E_t}{\partial \Delta R_t}$ is derived from a structural model that allows for the deviation of the exchange rate from purchasing power parity (PPP), and incorporates uncovered interest parity, money market equilibrium, and the foreign-reserve response function. As both of these definitions depend on the derivation of parameters, they are generally termed model dependent in the literature.

Critiquing the linear weighting scheme in the monetary model, Eichengreen, Rose, and Wyplosz (1994) proposed a model-free estimate of EMP. Unlike the equal weights assigned to the exchange-rate changes and the changes in international reserves in the Girton-Roper model, a weighting scheme is developed, which equalizes the variance of the components of EMP. As such, the weights are independent of any structural relationship. In this case, EMP also includes the changes in the interest-rate differential (home and foreign):

$$EMP_t = \Delta E_t + \eta_1 \Delta R_t + \eta_2 \Delta I_t \tag{2}$$

$$\eta_1 = \sqrt{\frac{var\Delta E_t}{var\Delta R_t}} \quad \text{and} \quad \eta_2 = \sqrt{\frac{var\Delta E_t}{var\Delta I_t}}$$

where ΔR_t and ΔI_t represent the differential in reserves and interest rates. The idea behind equalizing the variance is to smooth out the different degrees of volatility in each component so that neither would dominate the EMP index.[4] EMP thus calculated has been used to analyze policy changes leading up to and after crises, especially to study speculative attacks on a currency. The use of the interest-rate differential in the above formulation is relevant in open economies, where the authorities try to defend mounting pressure on the currency, inter alia, by adjusting the interest rate.[5] In Nepal, the monetary authorities have tried to keep interest rates above India's with the aim of preventing capital flight. Even with capital controls, the open border presents a challenge to the authorities, especially when the arbitrage opportunity is significant.[6] Thus, the interest-rate changes are designed to complement the explicit policy of targeting the exchange rate. It is therefore reasonable to include the interest-rate differential to capture the effects on the domestic currency of the possible divergence in returns on capital in Nepal and India.

2.2 A variant of the Girton and Roper model

Girton and Roper used conventional money demand and supply functions as well as purchasing power parity (PPP) to derive a monetary model of EMP. A variant of the original model is adopted here following Connolly and Da Silveria (1979), Kim (1985), Bahmani-Oskooee and Shiva (1998), Stavárek and Dohnal (2009), and many others.

The first component of the model is money demand, which is a stable function of real income (Y_t) and the price level (P_t):

$$M_t^d = kP_tY_t \tag{3}$$

where k is a constant and represents the fraction of income that firms and households

[4]The authors note that, in their sample, the conditional volatility of the percentage change in reserves is several times that of the percentage change in the exchange rate, which in turn is several times the percentage change in the interest-rate differential. In later studies, several authors reported similar observations and have since adopted the volatility-equalizing weights.

[5]One of the basic tenets of modern finance is the interest-rate parity relationship, which predicts the direction of movement in the exchange rate based on the interest-rate differential, at home and abroad.

[6]Nepal shares an open border with India to its East, South, and West, which spans about 900 miles, in total.

desire to hold as money balance. The money supply, M_t^s, is the product of the money multiplier (m_t) and the monetary base ($B_t = R_t + D_t$):

$$\begin{aligned} M_t^s &= m_t B_t \\ &= m_t(R_t + D_t) \end{aligned} \tag{4}$$

The monetary base is backed by the aggregate stock of foreign assets, R_t, and domestic credit, D_t.[7]

Two assumptions are needed at this point. First, the money market is assumed to be in continuous equilibrium. Second, PPP holds:[8]

$$M_t^d = M_t^s \tag{5}$$

$$P_t = E_t P_t^f \tag{6}$$

Combining equations 3-6 gives the following expression:

$$k E_t P_t^f Y_t = m_t(R_t + D_t) \tag{7}$$

Taking the logarithm of both sides and then the time derivative yields:

$$\frac{\dot{E}_t}{E_t} + \frac{\dot{P}_t^f}{P_t^f} + \frac{\dot{Y}_t}{Y_t} = \frac{\dot{m}_t}{m_t} + \frac{\dot{R}_t}{R_t + D_t} + \frac{\dot{D}_t}{R_t + D_t}$$

Re-define the variables as follows:

- $e_t = \frac{\dot{E}_t}{E_t}$ is the percentage change in the exchange rate;
- $p_t^f = \frac{\dot{P}_t^f}{P_t^f}$ is the percentage change in the foreign price level;

[7] The link between the monetary base and the stock of foreign assets plus domestic credit can be illustrated using the basic definition of central bank's balance sheet. Liabilities of the central bank are the outstanding currency in the economy and the deposits of the commercial banks. Proceeds from these are invested in various financial assets, foreign-exchange reserve, and gold. In the above definition of the monetary base, the liability side of the central bank is replaced by its asset holdings.

Assets	Liabilities
Financial assets	Currency
Foreign-exchange reserve	Deposits of the commercial banks
Gold	

[8] The exchange rate (E_t) is expressed as units of the home currency per unit of the foreign currency.

- $y_t = \frac{\dot{Y}_t}{Y_t}$ is the percentage change in real income;
- $mm_t = \frac{\dot{m}_t}{m_t}$ is the rate of change of the money multiplier;
- $rsv_t = \frac{\dot{R}_t}{R_t + D_t}$ is the change in foreign reserves as a proportion of the monetary base; and
- $dc_t = \frac{\dot{D}_t}{R_t + D_t}$ is the change in domestic credit as a proportion of the monetary base.

Rewriting the equilibrium in growth rate form yields the following expressions:

$$\begin{aligned} e_t + p_t^f + y_t &= mm_t + rsv_t + dc_t \\ rsv_t - e_t &= -dc_t - mm_t + p_t^f + y_t \end{aligned} \tag{8}$$

To consistently apply the notation of EMP, equation 8 is rewritten as:[9]

$$e_t - rsv_t = dc_t + mm_t - p_t^f - y_t \tag{9}$$

Here, rsv_t in equation represents the change in foreign-currency reserves scaled by the monetary base and e is the percentage change in the NPR/INR exchange rate. The foreign price is that of India. As derived, a rise in the left-hand side of equation (9) suggests rising pressure to depreciate the home currency.

The model suggests that an increase in domestic credit (dc), ceteris paribus, will result in a loss of foreign currency reserves when the exchange rate is fixed (i.e., $e = 0$), and in exchange-rate depreciation under a fully flexible system (i.e., $rsv = 0$). Clearly, the case of Nepal, in this study, is that of a managed-peg regime, and therefore an expansionary policy will result in either reserve losses, depreciation, or a combination of both. The monetary model predicts that domestic credit and the money multiplier will both have a coefficient of one. Similarly, increases in domestic income and higher inflation in the foreign country both will result in either appreciation of the home currency and/or increases in foreign reserves.

However, Garcia and Malet (2005) point that the relationship between domestic

[9] Some authors have also added the term $q = \frac{e}{rsv}$ to the right hand side of equation (8) to see if pressure is absorbed through the exchange rate and/or reserves. Connolly and Da Silveira (1979) include $q = \frac{e-1}{rsv-1}$ on the right hand side.

credit and EMP may not be straightforward. They argue that while restrictive credit policy will reduce pressure against the domestic currency, it can at the same time be adverse to economic growth. A decline in growth can in turn bring pressure against the domestic currency. Furthermore, the policy response in large part depends upon the growth prospects of the economy. In a growing economy, a policy change is closely linked with the state of the economy, which makes a case for possible interaction of variables.

2.3 Literature review

As noted above, EMP has been used as an indicator of pressure on the currency by many researchers for different purposes. After the Girton-Roper paper, several authors tried to use their model, or variants thereof, to analyze the interaction of monetary policy and EMP. The model has been widely used in countries with pegged or managed-peg type exchange-rate regime. Even with some strong assumptions (such as PPP and the quantity theory of money), there is general empirical support for the predictions of the Girton-Roper type monetary model. The two key issues consistently discussed in the literature are: a) the use of domestic credit as a policy variable; and b) the appropriate estimation technique.

First, the domestic credit component of the monetary base is an important channel through which monetary policy operates. In the literature, there are two channels through which monetary policy affects economic activities. The standard approach, also known as the "money view," entails changing the short-term interest rate or money supply, to alter the credit availability conditions. Similarly, in times of financial stress, the central bank can directly inject liquidity into the banking system, with the intention of increasing the credit supply. There is another channel through which monetary policy can have broader effects on the economy. This is the so-called "credit view."[10] The credit view is premised on the possible existence of a gap between the external and internal sources of financing for borrowers. A change in monetary policy can affect this gap. There are two ways through which the credit channel operates. First, a policy change, for example a contractionary

[10] See Hubbard (1995).

one, can increase the external finance premium for some borrowers, especially those with low net worth. This can lead to decrease in business investment and household consumption. Second, a similar policy change reduces retail deposits as well as drains reserves from the financial institutions (banks). This in turn can induce banks to respond by lowering lending (i.e., reduce credit supply) to businesses and households. In Nepal, remittances add an interesting dimension to policy changes and their intended effects since it has direct effects on the credit/money base of the economy. A policy change, therefore, has to not only anticipate the possible trajectory of remittances but also incorporate its effects on the channels (money and credit) through which monetary policy operates in the economy.

By using domestic credit as the policy variable, it is possible to accommodate some of the effects of policy changes as just discussed. Moreover, using domestic credit allows one to capture the possible endogenous relationship with EMP during a financial crisis. In fact, some studies have shown that the authorities were successful in relaxing monetary conditions by increasing domestic credit in response to higher EMP. Tanner (2000, 2002) argues that although the interest rate reflects the ex-ante policy stance, domestic credit indicates if monetary policy has been tight or loose ex-post. The author also proposes using the interest-rate differential, in addition to domestic credit, to more fully incorporate policy changes and their impact. A lower marginal rate can induce capital flight from a country and result in reserve losses. In several papers that use EMP to study a currency crisis, researchers have augmented EMP with an interest-rate differential term.

The original Girton-Roper model and the modified version presented earlier have been widely tested to establish the static relationship between the variables. Many of the papers did not consider dynamic effects and also used the OLS technique, in spite of possible endogeneity, especially between foreign reserves and domestic credit. Some papers have used two-stage least squares (2SLS), while others have used maximum likelihood, to address endogeneity. Several other papers have used VAR models to account for dynamic effects and the endogenous relationships between the variables. Although the VAR identification is a matter of concern, this has been dealt with either by altering the ordering of the variables or by using the generalized impulse response, which permits order-invariant identification. Tanner (2000, 2002), in this regard, points out that the VAR formulation allows one to detect if monetary policy affects EMP in the direction prescribed by theory, while allowing for endogenous relationships, without being too concerned about the parameter estimates. In table 1, a brief survey of empirical studies of the monetary model of EMP, especially the Girton-Roper type and its variants, is presented.

3 Data discussion and unit-root tests

I rely primarily on quarterly data (1975Q1-2009Q4) for the empirical analysis. Except for the data on output, all other series are available on quarterly basis. Real GDP is available only in annual series. Further, there is no industrial production data to proxy output. Therefore, I apply linear interpolation to generate the quarterly output series from the annual data.[11]

In table 2, various descriptive statistics are presented.[12] [13] All of the variables have high Kurtosis, and therefore the normality assumption is rejected. The plots of EMP and domestic credit (*dc*) are shown in figures 1. In figure 1, EMP (*emp*1 and *emp*2) and domestic credit growth show a broad pattern of comovement, with correlation coefficients of 0.05 and 0.18, respectively. Further, in table 3, the growth rate of the money multiplier is positively associated with *emp*1, while income growth is negatively associated. Correlation coefficients between the foreign inflation and the two EMP measures show opposite signs.

Next, in order to ensure that the variables are stationary as proposed, a number of unit-root tests were done and the results are shown in table 4. All tests confirm that none of the series contains a unit root. [14]

[11] There are minor differences in the data due to modified interpretation by the IMF over time. Similarly, small difference exists due to data source (i.e., between Nepal's central bank and the IMF).

[12] There are primarily two measures of EMP used in this study. The first one uses the Girton-Roper definition (*emp*1), while the second one (*emp*2) is constructed by adding an interest-rate differential term to it.

[13] $emp1 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}}$; $emp2 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}} + \Delta(i_t - i_t^f)$

[14] These results are shown only in the case where the test equation includes a constant. They are not presented in the case where the test equation includes both a constant and the trend term. This is mainly because the plot of the variables show no trending behavior.

4 Estimation

In this study, I primarily apply the IIS technique for estimation following the approach taken in Hendry and Mizon (2011). The authors apply the technique in modeling U.S. expenditure on food. They also use Autometrics to select a parsimonious model based on the general-to-specific (GETS) modeling approach. The dynamic models are simple autoregressive distributed lag (ARDL) single-equation estimates. Alternately, I also consider the VAR estimation and the impulse response analysis. I begin with a brief discussion of the IIS technique and the VAR model.

4.1 OLS with IIS

Hendry, Johasen, and Santos (2008) propose selecting a regression model, using the general-to-specific approach, for the case where there are more variables than observations. It is a special case where the regression equation is saturated by indicator variables, i.e., the regression equation is augmented by impulse dummies for each observation. Their initial model is a static regression of an i.i.d. random variable y_t on a constant, augmented by a block of impulse indicators (half of the sample size):

$$y_t = \mu + \sum_{j=1}^{T/2} \delta_j d_{j,t} + \epsilon_t \tag{10}$$

where $d_{j,t} = 1_{(j=t)}$ is a set of T indicators, one for every j. In a two-step process, first, the half of total indicators is included in the estimation and all significant indicators are recorded. Next, the estimation is repeated for the remaining half of the indicators. Finally, the significant indicators from the two regressions are combined. When testing the null of no significant indicators in the regression, the authors find that the average retention rate of impulse indicators is αT, where α is the significance level (target size) of the test. They also show that the sample could be split to smaller size without affecting the retention rate. Johansen and Nielsen (2008) show that this approach can be generalized to dynamic models, and, for small α, the cost of retaining impulse indicators corresponds to omitting observations equals αT.[15] A more useful representation of equation 10 is shown below:

$$y_t = \beta' X_t + \sum_{i=1}^{T} \gamma_i 1_{(i=t)} + \epsilon_t \qquad t = 1, ..., T \tag{11}$$

where X_t is an m-dimensional vector of regressors and γ_i represents the coefficient of a significant impulse indicator where $1_{(t)} = 1$ for observation at time 't'', and 0 otherwise.[16]

Santos and Oliveira (2010) note that the IIS technique can detect breaks at unknown dates, both in the mean and in the variance.[17] Hendry and Santos (2010) argue that the IIS technique not only detects outliers, "but may also reveal other shifts that are hidden by being 'picked up' incorrectly by other variables." Outliers are generally located at the start and the end of the sample and removing them helps to reveal any shifts in the data. In general, the IIS technique is credited for detecting unknown number of structural breaks, occurring at unknown times, with unknown duration, and occurring anywhere in the sample. Thus, the technique can detect breaks and also handle a fat-tailed distribution. Next, I discuss the GETS approach in Autometrics.

4.1.1 Autometrics and GETS

Autometrics is a computer-automated package that uses the tree-search method to detect and eliminate insignificant variables.[18] The tree-search method is an improvement over the multi-path search used in general-to-specific modeling. Ericsson (2010) has a nice illustration of the algorithm used in Autometrics. There are mainly three stages in selecting variables, beginning with the initial general unrestricted model (GUM). In the second stage, a variable is eliminated subject to the

[15] For example, in a sample of 100 observations, with a target size of 0.01 (1 percent), only one observation is lost.

[16] Note that a constant is recommended in the regression. In the absence of the constant, the IIS procedure in Autometrics is found to perform poorly in identifying breaks and shifts in the data. Autometrics allows retaining the constant and other variables in the regression.

[17] The authors also apply step indicators to identify different regimes. Specifically, they chose eight periods of consecutive significant dummies with same sign and similar magnitude to constitute a different regime.

[18] In a typical regression, there are, in total, 2^N (N being the number of regressors) possible models from which to select.

new model passing the encompassing test and maintaining congruency.[19] The encompassing test ensures that the new model is a valid reduction of the GUM at the chosen α. A path terminates when there is no variable to be reduced following the criterion. At the final stage, there can be one or more terminal models and the selection can be based on a tie-breaker, such as the Schwarz information criterion (SIC).

4.1.2 Autometrics with IIS and GETS

As already noted, this paper follows the econometric approach taken in Hendry and Mizon (2011). Accordingly, I first estimate an ARDL model with four lags. Second, I introduce the IIS technique and GETS approach to select the impulse indicators in Autometrics and present the results.[20] Third, again in line with the Hendry and Mizon paper, I allow Autometrics to select the impulses, but now I also allow Autometrics to pick the lags of all regressors. The authors find that by retaining (contemporaneous) theory variables in the regression and allowing Autometrics to select the lags and impulses significantly improved the result. The ARDL(p,q) model estimated in this study is shown in equation 12, where the order of the dependent variable (emp_t) and regressors (X_t) along with the selection of statistically-significant impulse indicators are based on the GETS approach. All estimations were carried out in PCGive 13.1.[21]

$$emp_t = \beta_0 + \sum_{i=1}^{p} \alpha_i emp_{t-i} + \sum_{i=0}^{q} \beta_i X_{t-i} + \sum_{i=0}^{T} \gamma_i 1_{(i=t)} + \epsilon_t \tag{12}$$

[19] Bauwens and Sucarrat (2006) point to five aspects of model selection to be taken together as the definition of congruency. They are:

- Innovation errors;
- Weak exogeneity;
- Parameter constancy;
- Theory consistent, identifiable structures; and
- Data admissibility;

[20] In applying the IIS technique, I retain all regressors including the constant in each stage of model selection.

[21] In the final stage, the authors allow Autometrics to select all regressors, their lags, and impulse dummies. This final stage is not incorporated in this study mainly because doing so eliminated most of the theory variables and often resulted in problematic errors. In all regression equations, a constant is always included, and a target size of 0.005 is used in the IIS technique.

4.2 VAR identification

As an alternative to the single-equation estimation, a system-based vector autoregression (VAR) model is also considered. There are some valid reasons for using a VAR model in the EMP analysis. Recent studies (see table 1) have shown the increasing use of the VAR models in the EMP analysis. Using a VAR model allows us not only to observe the effects of conventional monetary policy, but also to analyze how the authorities respond to pressure on the domestic currency. The possibility of reverse causality (endogeneity) can be addressed easily in a VAR framework. Formally, a reduced form VAR of order p is given as follows:

$$z_t = A_1 z_{t-1} + ... + A_p z_{t-p} + \varepsilon_t \tag{13}$$

where z_t is a vector of all domestic variables $(emp_t, dc_t, mm_t, y_t)$and ε_t is a vector of i.i.d. shocks. An important step in VAR estimation is the identification, more commonly known as the causal ordering of the variables. In equation 9, except for foreign inflation, all of the variables enter the VAR specification as endogenous variables. Some ad hoc assumptions are needed to complete the identification. In line with several previous studies, the exogeneity restriction or the Choleski ordering of the variables is as shown below:

$$\varepsilon_y = e_y \tag{14}$$

$$\varepsilon_{dc} = e_{dc} + e_{y,dc} \tag{15}$$

$$\varepsilon_{mm} = e_{mm} + e_{y,mm} + e_{dc,mm} \tag{16}$$

$$\varepsilon_{emp} = e_{emp} + e_{y,emp} + e_{dc,emp} + e_{mm,emp} \tag{17}$$

In equations 14-17, income growth is treated as the least endogenous, while EMP is the most endogenous. Income (y) is affected in current period only by its own shocks, while other shocks have a lagged effect. On the other hand, innovations in EMP are correlated with all other shocks and are therefore affected by contemporaneous as well as lagged feedbacks from all other shocks. Similarly, domestic credit is affected by current and past shocks of its own and income growth, while EMP has a lagged effect, which is reasonable given that authorities are likely to respond to rising EMP with some lag rather than acting concurrently.

The economic relationship underpinning the causal ordering in equations 14-17 cannot be firmly established if the alternative ordering produces significantly different implications. This remains one key point of contention in the literature on the use of VAR models. Some have tried alternate ways to deal with the issue. For example, Pesaran and Shin (1998) proposed the "generalized impulse response" analysis, which does not require the orthogonalization of shocks and is invariant to variable ordering in the unrestricted VAR. The order-invariant approach is useful when there is conflict in results using alternative orderings and/or when a causal pattern is not discernable.

5 Results

This section begins by briefly highlighting the differences in results due to different estimation techniques. I will then discuss the results from using the IIS technique and VAR models. Finally, a discussion highlighting economic reasoning of the finding ends the section.

5.1 OLS and OLS with IIS and Autometrics

As introduced in section 4, the IIS technique is useful for detecting shifts, breaks, and outliers in time-series data. This helps not only to identify the underlying structure, but also to correct the regression error and helps to attain the right specification. As Hendry and Mizon (2011) suggest in their paper, I also find evidence in this study to broadly concur with their observation regarding the usefulness of the IIS technique. In general, the application of the technique improved results, mainly by getting the correct model specification. Moreover, by retaining the theory variables (contemporaneous value of all regressors), while allowing the IIS technique to select dummies and dynamic effects, the estimation resulted in theory-consistent effects. As will be seen, this is clearly an improvement over OLS, which resulted in incorrect specification and either wrongly signed or insignificant coefficients. In figures 2-3, different actual and fitted series are shown. Clearly, there is evidence of better fit using the IIS technique.

Interestingly, however, the selection of impulse dummies did not reveal any regime shift, mainly because they were transitory in nature, and appeared more like detecting outliers. In modeling French inflation, Santos and Oliveira (2010) use eight consecutive periods of significant impulse dummies that have the same sign and similar magnitude to characterize a regime. If such a regime existed, then a step indicator could be used to accommodate it. Castle, Doornik, and Hendry (2008) also suggest a similar approach to identify regime shifts. I find no evidence of such a pattern in this study.

5.2 Estimates using the IIS technique

The main results are presented in table 5.[22] In the table, column (1) shows the results using OLS; in column (2), the IIS technique is introduced and the general-to-specific modeling under Autometrics is allowed to select the impulse indicators, while retaining all theory variables and their lags; finally, in columns (3a) & (3b)—estimates in these two columns differ only in the use of target size—the IIS technique is applied to select lags and impulse indicators. In the remainder of the table, various test results to check model specification are shown.

In column (1), except the money multiplier none of the other variables is significant. The OLS estimates clearly shows statistical inadequacy.[23] The model's inadequacy can be seen in the rejection of the null hypotheses of time-invariant volatility and linear specification in the residuals, respectively, under ARCH (autoregressive conditional heteroskedasticity) and Reset tests. Clearly, there is no explanatory power in this model as shown by adjusted R-squared. Next, as seen in column (2), with the IIS technique, domestic credit and the money multiplier become significant, although the third-period lag of domestic credit is wrongly signed. Foreign inflation and income growth are still insignificant. Moreover, there are four significant impulse indicators chosen in this step. The drastic improvement in model specification is evident. Not only do the residual tests confirm the statistical adequacy, but the

[22]The estimates using $emp2$ as the dependent variable is not presented here to consider brevity of the presentation, although the main conclusion is not different in the two.

[23]Insignificant variables are not shown in columns (1) and (2), but are shown in (3a) and (3b).

model now has a decent explanatory power.

Now, in the next two columns (3a and 3b), there is further improvement in model estimates. As already mentioned, the estimates in the two columns differ in the use of target size in Autometrics. This was done to account for sensitivity associated with using different target sizes.[24]

In the two columns, the variables are correctly signed and almost identical. Domestic credit and the money multiplier are highly significant. Foreign inflation is insignificant in both, which may be due to the choice of foreign CPI used in calculating the foreign inflation. A better indicator, in this regard, perhaps is the WPI/PPI, which are available only since 2000 and are therefore not used in this study. Income growth has a borderline significance in column (3a), with a p-value of 0.1052, but is significant at 10 percent in column (3b). The main difference between columns (3a) and (3b) is the inclusion of an additional impulse indicator, $I_{93(1)}$, in the latter.[25] In terms of model specification, all tests confirm randomness of the residuals. The p-values of these tests are given in the parenthesis. First, the AR test confirms failure to reject the null of no autocorrelation in the residuals. Second, the ARCH and heteroskedasticity tests show that the null of no time-varying volatility in the residuals can not be rejected. Third, the normality test confirms that the residuals are asymptotically normal. Finally, the Reset test suggests there is no non-linear behavior in the residuals.

One interesting observation in all these estimates is the selection of impulse indicators and its impact on the model's performance. It is consistently found that with the rise in the number of impulse indicators, the model performs better in many regards. One crude comparison of this is the improvement in model's explanatory power as indicated by adjusted R^2. Similarly, the σ estimate (standard deviation of the regression error) is also better when including the impulse dummies.

[24] In the fuller version of this paper, using higher target size often resulted in large number of impulse indicators, which can sometime be problematic.

[25] Note that the impulse indicator is read as, for instance, I93(1), where 93 indicates year 1993 and number 1 in the parenthesis indicates the first quarter of the year.

5.3 VAR results

Prior to estimating the VAR model as outlined in section 4.2, a number of tests were conducted to discern the causality pattern. It is important to point out that the suitability of the variable ordering depends on the possibility of observing such a relationship in the data. The test results reported here are thus complementary to the earlier discussion. Tables 6-7 present the pairwise Granger-causality test results and the VAR block-exogeneity test results.

First, in the Granger-causality test, a simple bi-variate OLS regression is estimated, where each endogenous variable is regressed on its lags and the lags of another variable. In this case, eight lags were used in the test. The F-statistics show the test results on the null of the joint coefficient restriction (set to zero) on the lags of another variable. As shown in table 6, the null of no causality cannot be rejected in each test. Additionally, the VAR block-exogeneity test shows whether a set of endogenous variables can be treated exogenous with respect to each of the remaining variables. The results from table 7 suggest that the block-exogeneity of the endogenous variables cannot be rejected. The failure to establish a causal pattern through these tests is worrying since there is no evidence of lagged feedback between the variables. This leaves the possibility of contemporaneous feedback as the only source of endogeneity in the variables.

Next, in light of the causality test results, various VAR models were estimated, including the one discussed in section 4.2. In addition to trying alternate variable orderings, I also apply the order-invariant orthogonalization of shocks following the Pesaran and Shin generalized-impulse-response technique. The results from various VAR estimations suggest that there isn't any significant effect of shocks to domestic credit on EMP.[26] However, in all of the VAR estimations there was a common issue of non-normal VAR residuals. Even including additional lags didn't rectify the problem. Yet the earlier results using the IIS technique suggest that the reason for the failure of the normality test may be due to a few outliers. It is reasonable to

[26] In one of the VAR estimates using $emp2$ as the dependent variable, the generalized impulse response showed correct effect. This graph is shown in figure 4. It shows that there is an instantaneous jump in EMP in response to a shock to domestic credit. The impact, however, falls quickly and dissipates before the second period.

expect statistically significant, theory-consistent effect if the outliers can be treated better within a VAR framework. Finally, it is also important to recognize that the VAR-type setting may be more relevant in Nepal in the last ten years, when remittances have grown significantly (from 2 percent of GDP to almost 23 percent between 2000 to 2009), and in which the possibility of endogenous evolution of variables is more likely.

5.4 Discussion

In this subsection, economic discussion of the findings is presented. To that end, I will use the estimates from column (3b) in table 5.

Before analyzing the effects of the regressors, it is relevant to note two previous studies on Nepal on related topics. Ginting (2007) found that price developments in Nepal were affected by Indian prices. Nepal's core inflation converges with India's core inflation, and the duration of pass-through is about 7-8 months. In an earlier study of the correct currency anchor for Nepal, Yelten (2004) found that import prices in Nepal were solely determined by the Indian currency area, and that fluctuations in third currencies (dollar/rupee, euro/rupee) did not lead to inflationary or deflationary pressures in Nepalese import prices. Although it is questionable whether import prices are completely determined in India, and the study considers only a small sample of monthly observations (2001:01-2003:05) and using the import goods component of the wholesale price index, it nevertheless gives credence to the argument that traded goods prices may have a big role in overall price determination in Nepal.

These earlier findings also indicate a limited role for policy effectiveness. Unlike the one-to-one effect of money supply on the exchange rate, it is therefore plausible to expect a lesser impact. The coefficients reported in column (3b) of table 5 above for domestic credit and the money multiplier are well below one. The negative coefficient on income growth suggests appreciation (and/or reserve accumulation) of the exchange rate. Higher income growth means higher money demand, which, ceteris paribus, necessitates a fall in prices to maintain real money balances, resulting in appreciation. Several studies in the past have also failed to find full support for the monetary model's predictions. They commonly cite unrealistic assumptions regarding price flexibility, which are central to the monetary model. Moreover, there can be some restrictions in the economy such as capital control and trade barriers that can lessen the impact of monetary policy variables on EMP.

In some previous studies using the EMP framework, policy variables have been analyzed for the role and efficacy of policy changes. It is then reasonable to argue that often the focus is primarily on policy interaction, more than the expectation of observing the full-blown effect as predicted by the monetary model. In this regard, the estimated effect of domestic credit on EMP suggests some role for monetary policy in Nepal. Specifically, a contractionary monetary policy can help to reduce pressure on the domestic currency. Yet it is important to remember that the open border presents added challenge to the pursuit of an independent monetary policy because of the risk of capital flows. So far, however, the central bank has been able to exercise effective capital control.[27] In light of the present findings, it is safe to say that monetary policy in Nepal has some scope in managing/supporting the exchange-rate regime.

In column (3b) of table 5, a number of impulse indicators are found significant. Except the first (I93(1)), all other indicators are in the post-liberalization period, when there was a fixed nominal peg so EMP includes changes in foreign reserves only.[28] Moreover, the impulse indicators in the post-liberalization period (1993 onwards) are sparsely located and appear more like outliers. The I93(1) indicator captures the economically important transition period. The indicator is negatively signed, suggesting a reduction in EMP as a result of appreciation and/or a gain in reserves. During the first quarter of 1993, the central bank had directly intervened to adjust the parity of the NPR/INR exchange rate for the last time. The exchange rate was revalued to 1.6 from 1.65, an appreciation of about 3 percent. This followed the announcement of the current account liberalization, which is in sync with the liberal orientation of the economy at the time. It is also important to note the

[27] Lately, the central bank has issued a limit on the ATM withdrawal on transactions originating in India, after reports of substantial cash withdrawal for speculative purposes.

[28] Nepal's economy until early 1990s was more isolated from the global economy. There were several restrictions in the economy, including limited transactions on the current account. In a series of reform measures, several liberal economic policies were adopted.

announcement of economic liberalization in India during this period. It is, however, unclear if there was a need to revalue the exchange rate. With the current account as a percent of GDP in 1991, 1992, and 1993 standing at -7.76, -5.33, and -6.01 respectively, and a stable stock of net foreign assets, the authorities might have considered mitigating the impact of import prices on inflation. Weakening of the Indian currency may have been the reason to appreciate the exchange rate.[29] Earlier, in 1991, the central bank had intervened to appreciate the exchange rate from 1.68 to 1.65 in response to devaluation (vis-à-vis the dollar) by India.

The remaining impulse indicators capture fluctuations in the data that do not correspond to any significant events. Their inclusion can be better understood with the help of some macro data, especially changes in the current account. In table 8, some selected variables for periods near those captured by the impulse indicators are shown. The current account deficit increased to 7.89 percent of GDP in 1997. The trend continued until the third quarter. Gains in the financial account, however, moderated the impact on the overall balance of payments. The stock of net foreign assets grew in the third quarter of 1997, while it fell in the first quarter of 1998. These fluctuations in net foreign assets are captured by a negative coefficient in I97(3), signifying a fall in EMP, and a positive coefficient in I98(1), indicating a rise in EMP. Similarly, the positive coefficient in I04(2) and the negative one in I08(2) may be explained by the fall and rise in the current account surplus, respectively, in the corresponding periods.

Before concluding this section, it is appropriate to discuss the possible endogeneity of the variables with reference to Nepal's economy. Earlier it was noted that during a currency crisis, the interaction of policy variables and EMP is often intertwined. While the rise in EMP indicates mounting pressure on the domestic currency, the authorities often respond by injecting capital to the system to defend the peg and prevent further reserve losses. This means that credit in the system rises following increasing pressure on the currency. Nepal has so far managed to respond to pressure on its currency by adjusting the exchange rate and through sales

[29] For instance, in March 1993, the Indian rupee depreciated substantially against the dollar. It fell from 26.20 INR/USD to 31.26 INR/USD, a depreciation of about 19 percent.

and purchases of the foreign-exchange reserves. No direct liquidity support to the system has yet occurred. However, with the growing influence of remittances, which contribute to the stock of foreign reserves and to the deposit base of the banking system, there is a possibility of circular relationship between EMP and domestic credit. In the full sample analyzed here, this possibility was addressed in the VAR analysis. The results, however, did not show evidence of any significant impact of a shock to EMP on domestic credit. It would be an interesting extension of this study to incorporate directly the interaction of remittances, credit growth, and the exchange rate, especially in the last decade when remittances have grown significantly. The scope for understanding the impact of remittances on macroeconomic stability is greater in countries that are overly dependent on it. Chami et al. (2008) report that remittances generally tend to appreciate the real exchange rate, resulting in the Dutch-disease effects in the recipient countries. One topic for future research would be to see if remittances affect countries differently in the context of different exchange-rate regimes.

6 Conclusion

Many countries, especially in a non-floating exchange-rate regime, face pressure on their currency. Only a few of them suffer currency collapse. It is possible that by establishing a proper role for monetary policy, the monetary authorities can adopt corrective action preemptively to reduce pressure on the currency and avert a serious crisis. The EMP framework based on the monetary model offers one such link to investigate the impact of policy changes on the exchange rate using the EMP indicator. While Girton and Roper suggested an equally-weighted combination of the exchange rate changes and the changes in the international reserves as the indicator of EMP, many researchers have developed alternate definitions using different weighting schemes, and, also, by adding an interest-rate differential term.

In this study, Nepal's exchange-rate regime with India was investigated using the EMP framework based on the monetary model of the exchange rate. Different definitions of EMP were used. The equally weighted approach, with and without the interest-rate differential, was used. Despite weak fundamentals, Nepal continues to maintain a pegged exchange-rate regime with support from exogenous sources, like remittances, which have underpinned the balance of payments for a long time. By focusing on domestic credit as a policy variable, a positive association between increases in domestic credit and EMP was found. The coefficients on domestic credit and monetary policy had positive signs, but were well below one. Output growth was found to lower EMP as expected. Foreign inflation, however, is insignificant, which may be due to the choice of price measure used in the study. As noted, despite finding less than the predicted effect under the monetary model, these results suggest that monetary policy is relevant in Nepal, and a contractionary policy can reduce pressure on the home currency. In a fuller version of this paper, I also use EMP based on one of the variance equalizing schemes. Moreover, I use annual data to complete the analysis using different definitions of EMP. The main conclusion in all these estimates is that monetary policy has the predicted effect on the exchange rate.

One important dimension of the study was the application of the IIS technique. By allowing impulse dummies for each observation, the technique enabled us to identify outliers as well as breaks and shifts in the data. The IIS technique was used to select impulse indicators and the lags of all variables, using the GETS approach in Autometrics. In most of the regressions, the selection of impulse indicators significantly improved the model's performance by confirming to various specification tests and producing theory-consistent effects. There were five impulse indicators in the chosen model, with the first one corresponding to the first quarter of 1993, which is important due to several economically significant events occurring at the time. The rest of the impulse indicators merely picked out big fluctuations in the data.

Table 1: Survey of studies based on the monetary model of EMP

Authors	**EMP model**	**Estimation**	**Result**
Girton and Roper (1977)	Monetary approach to EMP (Canada)	OLS	Domestic credit is significant and has correct sign. Other variables are also significant and have predicted effect.
Connolly and Silveira (1979)	Variant of the G-R model (Brazil)	OLS	Variables are significant and have correct signs.
Kim (1985)	Variant of the G-R model (Korea)	OLS	Domestic credit and real wage income have correct signs, but the foreign inflation is insignificant.
Mathur (1999)	Different version of the G-R model (India)	OLS	Domestic credit and income have correct signs and are significant.
Martinez (1999)	Modified G-R model (Mexico)	Cointegrated-VAR model	Long-run relationship between the growth rate of domestic credit, exchange-rate changes, and international reserves is found.
Pentecost, Hooydonk, and Poeck (2001)	Wealth augmented monetary model (several EU countries)	Principal-component analysis and OLS	Current account and budget deficits have inverse relationship with EMP in some countries. Similarly, the competitiveness (change in the real exchange rate) measure has a direct effect on EMP.

Table 1 – Continued

Authors	EMP Model	Estimation	Result
Tanner (2000, 2002)	Modified G-R without real income	VAR	Tighter money reduces EMP (in line with theory) in many emerging-market countries.
Garcia and Malet (2005)	Modified G-R model (Argentina)	VAR	Increasing domestic credit resulted in higher EMP. Domestic real income has ambiguous effect.
Gochoco-Bautista and Bautista (2005)	Interaction of domestic credit, EMP, and the interest-rate differential in the Philippines	VAR	Generally, reducing domestic credit and increasing interest-rate differential resulted in reducing EMP.
Kumah (2007)	Interaction among money growth, inflation, and exchange-rate changes in Kyrgyz Republic	Markov regime-switching model	Contractionary monetary policy has the dampening effect on pressure to depreciate.
Stavarek and Dohnal (2009)	Variant of the G-R model	OLS	Variables have predicted effect in four central European countries.
Hegerty (2009)	Interaction of EMP, domestic credit growth, and capital inflows in Bulgaria	VAR generalized impulses	FDI and non-FDI investment reduce pressure on the exchange rate.

Table 2: Descriptive Statistics

Variables	$emp1$	$emp2$	dc	mm	y	p^f
Mean	-0.04	-0.06	0.1	0.02	0.01	0.00
Median	-0.04	-0.03	0.09	0.02	0.01	-0.01
Maximum	0.33	2.94	0.61	0.07	0.03	0.19
Minimum	-0.45	-3.92	-0.32	-0.07	-0.01	-0.14
Std.Dev	0.1	0.61	0.1	0.02	0.01	0.06
Skewness	-0.33	-0.84	0.95	-0.63	-0.59	0.58
Kurtosis	5.77	19.97	9.4	5.21	4.81	3.21
Jarque-Bera	46.88	1683.55	259.63	37.51	26.56	8.07
Probability	0.00	0.00	0.00	0.00	0.00	0.02
Sum	-5.87	-8.37	13.92	2.51	1.41	0.11
sum Sq. Dev.	1.32	50.62	1.45	0.05	0.01	0.51
Observations	139	139	140	139	136	140

[a] $emp1 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}}$

[b] $emp2 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}} + \Delta(i_t - i_t^f)$

Table 3: Matrix of correlation coefficients

Variables	$emp1$	$emp2$	dc	mm	y	p^f
$emp1$	1					
$emp2$	0.03	1				
dc	0.05	0.18	1			
mm	0.22	-0.19	-0.23	1		
y	-0.14	-0.03	0.04	-0.08	1	
p^f	0.13	-0.18	0.00	0.35	-0.07	1

[a] $emp1 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}}$

[b] $emp2 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}} + \Delta(i_t - i_t^f)$

Table 4: Various unit-root test results

Variable	Test type	DFGLS Null: Uroot	PP Null:Uroot	KPSS Null:Stationary
$emp1$	c	-3.56***	-11.44***	0.17
$emp2$	c	-11.83***	-12.31***	0.07
dc	c	-1.14	-12.47***	0.22
mm	c	-0.55	-21.77***	0.08
p^f	c	-3.57***	-8.55***	0.16
y	c	-1.75*	-3.9***	0.09

[a] Lag selection for DFGLS is based on the Schwartz Information Criterion (SC).

[b] emp1 $= \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}}$

[c] emp2 $= \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}} + \Delta(i_t - i_t^f)$

[d] Significance levels: ***1 percent, ** 5 percent, and * 10 percent

Table 5: Estimation results for emp1 (1975Q1-2009Q4)

Variables	OLS (1)	OLS w/IIS and regressors 'fixed' (2)	OLS w/IIS and selecting dynamics(TS 0.5%) (3a)	OLS w/IIS and selecting dynamics(TS 1%) (3b)
Constant		-0.07**	-0.05***	-0.04***
		(0.03)	(0.02)	(0.02)
$emp1_{t-3}$		0.15*		
		(0.08)		
dc		0.3***	0.23***	0.21***
		(0.09)	(0.08)	(0.08)
dc_{t-3}		-0.15*		
		(0.08)		
mm	0.63***	0.67***	0.42***	0.38***
	(0.21)	(0.18)	(0.13)	(0.13)
mm_{t-1}		0.43**		
		(0.18)		
p^f			0.14	0.05
			(0.41)	(0.4)
y			-1.6	-1.73*
			(0.98)	(0.96)
I93(1)				-0.21***
				(0.08)
I97(3)		-0.37***	-0.37***	-0.37***
		(0.08)	(0.08)	(0.08)
I98(1)		0.39***	0.35***	0.35***
		(0.09)	(0.08)	(0.08)
I04(2)		0.27***	0.25***	0.25***
		(0.09)	(0.08)	(0.08)
I08(2)		-0.38***	-0.34***	-0.33***
		(0.09)	(0.09)	(0.09)
σ	0.1	0.08	0.08	0.08
R^2	0.19	0.52	0.41	0.44
$\bar{R}^2$	0.01	0.39	0.37	0.4
AR test	1.1	0.5	0.63	0.79
	(0.36)	(0.78)	(0.67)	(0.56)
ARCH test	2.2*	0.25	0.16	0.13
	(0.07)	(0.91)	(0.96)	(0.97)
Normality	25.26***	0.94	0.35	0.02
	(0.00)	(0.63)	(0.84)	(0.98)
Hetero	1.25	1.11	0.65	0.77
	(0.19)	(0.33)	(0.73)	(0.63)
Reset	0.4	0.43	0.54	0.56
	(0.67)	(0.65)	(0.58)	(0.57)

[a] Dependent variable:$emp1 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{nfa_t - nfa_{t-1}}{mb_{t-1}}$.

[b] The second column presents results based on the IIS technique where all regressors are retained in the model, i.e., Autometrics does not eliminate these variables, but only selects impulse indicators. In the third and fourth columns, all (contemporaneous) theory variables are retained, but the selection of lags and impulse dummies is based on Autometrics. Insignificant coefficients are not shown in the second and third columns.

[c] Standard error for coefficients are shown in parenthesis, and diagnostic tests show the p-value in parenthesis.

[d] Variable significance levels: *** 1 percent, ** 5 percent, and * 10 percent

Table 6: Pairwise Granger-causality test with two lags using $emp1$ for period 1975:01 to 2009:04. (p^f treated exogenous.)

Null hypothesis	F-Statistics	Probability
dc does not Granger Cause $emp1$	0.51	0.85
$emp1$ does not Granger Cause dc	0.45	0.89
mm does not Granger Cause $emp1$	0.82	0.59
$emp1$ does not Granger Cause mm	0.85	0.56
y does not Granger Cause $emp1$	0.82	0.58
$emp1$ does not Granger Cause y	0.46	0.88
mm does not Granger Cause dc	0.86	0.55
dc does not Granger Cause mm	1.66	0.12
y does not Granger Cause dc	0.53	0.83
dc does not Granger Cause y	0.45	0.89
y does not Granger Cause mm	1.37	0.22
mm does not Granger Cause y	0.32	0.96

Table 7: VAR Gragner causality/Block exogeneity Wald test (1975:01-2009:04) (p^f treated exogenous.)

Dependent variable:$emp1$			
Excluded	chi-sq	df	Probability
mm	4.23	4	0.38
dc	0.48	4	0.98
y	1.84	4	0.77
All	7.14	12	0.85
Dependent variable:dc			
Excluded	chi-sq	df	Probability
$emp1$	2.92	4	0.57
mm	1.18	4	0.88
y	0.88	4	0.93
All	5.96	12	0.92
Dependent variable:mm			
Excluded	chi-sq	df	Probability
$emp1$	2.24	4	0.7
dc	11.5	4	0.02
y	7.24	4	0.12
All	22.7	12	0.03
Dependent variable:y			
Excluded	chi-sq	df	Probability
$emp1$	3.94	4	0.41
mm	2.08	4	0.72
dc	2.71	4	0.61
All	7.91	12	0.8

Table 8: Some macroeconomic variables

Time	Net current a/c	Net financial a/c	Net foreign assets	CA as a percent of GDP
	Flow(M, USD)	Flow(M, USD)	Stock(B, NPR)	
1997Q1	-85.38	38.45	40.45	-7.89 in 1997
1997Q2	-113.2	128.19	40.59	
1997Q3	-128.86	30.82	58.22	
1997Q4	-60.64	-25.97	65.68	
1998Q1	-21.13	17.16	47.63	-1.38 in 1998
2004Q1	39.83	-112.7	116.55	1.88 in 2004
2004Q2	3.07	-150.28	104.44	
2004Q3	29.49	-53.31	116.12	
2008Q1	180.58	-167.75	166.78	5.81 in 2008
2008Q2	332.63	-283.12	201.6	

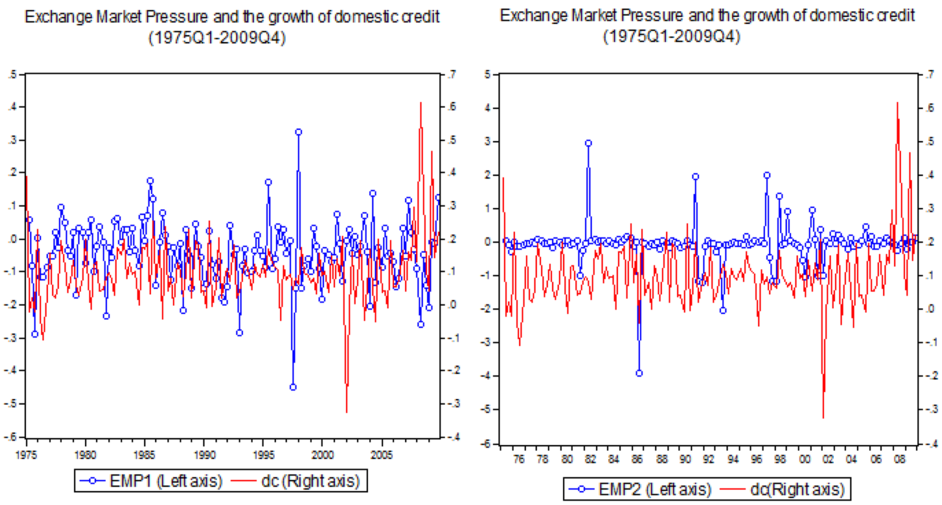

Figure 1: EMP and domestic credit (quarterly, 1975Q1-2009Q4) Left panel: $emp1$ and dc; Right panel: $emp2$ and dc

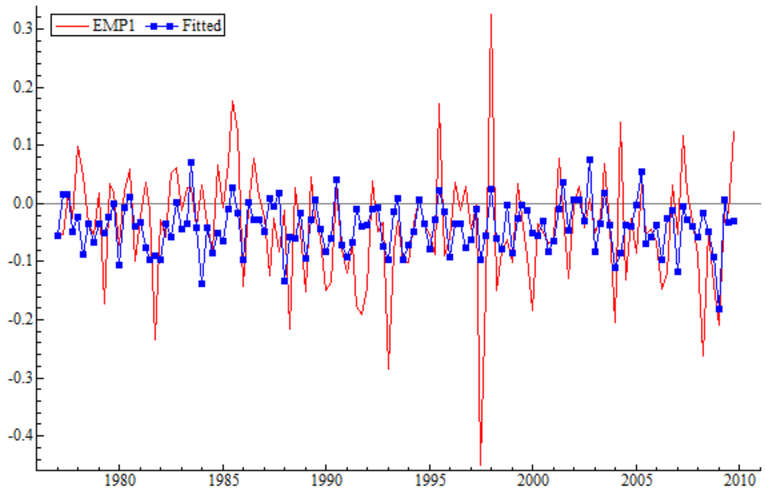

Figure 2: Actual and fitted *emp*1 using OLS

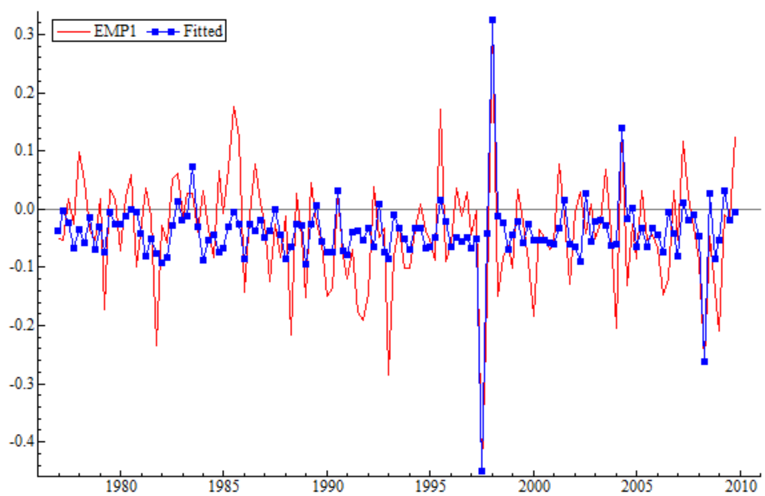

Figure 3: Actual and fitted *emp*1 using the IIS technique

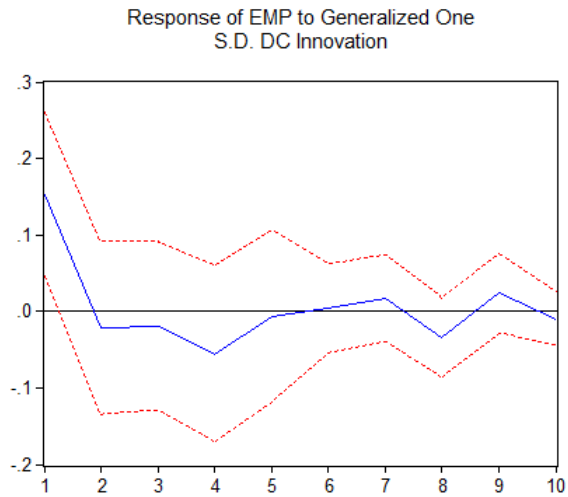

Figure 4: Response of emp2 to a domestic-credit shock. (This is a generalized impulse response using 4 lags, with the foreign inflation treated as the exogenous variable.)

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