The Output Effect of Reversals from Persistent External Imbalances Two Case Studies: Mexico and South Korea

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Abstract

In this paper, I use a Competitive Equilibrium Standard Growth model to map the direct effect of reversals from persistent episodes of Current Account (CA) imbalances onto output. The study shows how the pro-cyclical relationship between net exports and output, generated by this type of model, helps closely predict the output drops following large reversals from surplus episodes. However, this positive relationship renders the model unable to explain the significant output recessions observed after reversals from large deficits. I empirically confirm these results using past deficits and surplus reversals from two prominent emerging markets, namely, Mexico and South Korea. The conclusions of the study acknowledge two potential sources for the asymmetric reaction of output to trade reversals; firstly, the differences in the degree of persistence between positive and negative shocks to the trade balance and; secondly, large swings in relative prices seem to be tightly associated to deficit reversals but do not appear to be present during surplus reversals.

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1. Introduction

In recent years, trade and financial global imbalances have drawn scholars' and policy makers' attention and moved back to a top position as downside risk factors affecting the global economy (see IMF). Although the risk considerations are similar to those posed in 1994, the current economic stance is quite different. Very large Current Account deficits are now posted by the Anglo-Saxon axis of developed countries[1]and the corresponding financing is provided by a wide array of countries led by Japan, emerging economies in East Asia and commodity exporters, such as Russia and Chile [2]. Scholars as well as policy makers have questioned the sustainability of this new global system, which has been precisely at the center of an intense debate[3] in the last five years. Particularly interesting is the scope to which pure reversals from the trade balance drive the determination of output during these endgames.

In the international finance literature, a widely established fact is that large depreciations and output drops follow what is labeled as "Sudden Stops" of capital inflows; in other words, sudden reversals from runs of persistent Current Account deficits. A less documented but seemingly as strong an empirical regularity is that little change in the real exchange rate as well as output declines after reversals from positive runs in the external balance. Precisely, the extent of these asymmetries has raised a series of interesting questions regarding the economic consequences of the potential abrupt unwinding of current global imbalances. Of particular interest is the paradigmatic disquieting example provided by emerging markets in Asia and the US. Bearing in mind the nature of current global imbalances, an imperative concern for policy makers involves gaining an in-depth understanding of first, output risks related to potential reversals of the large Current Account surpluses in emerging Asia; and second, the large Current Account deficits in its counterpart: the United States. Moreover, comprehending the role played by the real exchange rate in the output effect of these reversals is equally essential.

[1] Latest data points out that the United States absorbs approximately three fourths of all current account deficits in the world

[2] Latin American and East Asian emerging markets were in charge of the predominant deficits in the years previous to the Asian and Tequila crisis. Some Latin American emerging economies are currently reverting back to large deficits i.e. Mexico, Colombia or Panama.

[3] See for example papers posted in the FRBSF conference on BWII or more recently papers published by Brookings Institution in the 2005 (1) issue of its Papers on Economic Activity.

In spite of the large share of literature attempting to account for the means behind the output effect of large reversals on capital inflows[4], little attention has been paid to understanding the mechanisms of output effects derived from surplus reversals. Following in the footsteps of the empirical regularities found in Dooley (2005), Riera-Crichton (2006), and Edwards (2006), this paper examines the patterns of output adjustment after the collapse of long sustained net external positions. I compare the relationship between key macroeconomic factors of the business cycle characterizing the data from two case studies; namely Mexico and South Korea, to the relationship generated from a Standard Growth model affected by exogenous shocks to the trade balance. The motivation behind the selection of a General Equilibrium Real Business Cycle (RBC) model with no relative prices and exogenous shocks to the trade balance is twofold. Firstly, the model can be solved analytically; thus, allowing us to observe the transmission mechanism of the shocks in detail. Secondly, we expect to determine the effect of pure trade balance shocks to economic activity not only for deficit but also for surplus reversals.

The rest of the paper is organized as follows. The second section of the paper deals with the methodology employed for the analysis and provides a brief historical review of the events triggering the reversal episodes in Mexico and Korea. For each case, I select one reversal from a period of sustained deficits and a second reversal from a period of sustained surpluses. As a matter of fact, I revisit the 1994 sudden stop in Mexico as well as the episodes of surplus reversals in 1988. I check for robustness exploring two events in Korea; namely, that in 1997 in the mist of the Asian Crisis and a more recent episode at the end of 2002. The third section is dedicated to the construction of a Real Business Cycle model, where output labor and capital deviations from steady state are fueled by exogenous shocks to technology, government consumption and trade balance. Then, the parameters governing these shocks are estimated through the maximization of a likelihood function. At the end of the section, I discuss how the magnitude and persistence of shocks to the trade balance affect real output. The fourth section presents and discusses the results of estimating the model for the Mexican and

[4] See Calvo (1998), Mendoza (2004) or Neumeyer and Fabrizio (2004) for some recent examples

South Korean economies. In this section, the performance of the model is tested by comparing the predicted effects on output during reversal episodes to the ones observed in the data. Section 5 concludes.

2. Methodology and Data

Methodology

The methodology used to study the output effects of trade reversals follows closely that of Chari, Kehoe and McGrattan in their 2005 paper. This article deals with the output predictions of a Real Business Cycle (RBC) model in the event of sudden stops. The study reveals that fully flexible RBC models without built-in relative prices fail to predict the output declines following the sudden stop episodes. Conversely, their model accounts for increases in output generated through the surge in net exports. Chari et al. show that an open economy model with collateral constraints will follow the same dynamics as a close economy, where net export shocks are assumed exogenous and aggregated to the total government consumption. Under these premises, shocks to the trade balance will promote the same dynamics in the system as conventional fiscal shocks. The traditional transmission mechanism from a fiscal shock to output implies a net income effect in the labor supply that increases labor supply and output (see Hall (1980) and Barro (1987)).

The assumption of exogeneity in the trade balance serves two purposes. Firstly, the model gains in transparency, especially, when trying to outline the transmission mechanism from net exports to output. Secondly, the lack of relative prices discards any second order effect of the real exchange rate on output. This lack of relative prices will implicitly link their importance in determining output movements after reversals to the success of the model in predicting those movements.

Output effect of reversals in Mexico and South Korea

In this study, I pay empirical attention towards two very different emerging markets: Mexico and South Korea. The underlying reason behind the selection of such markets is twofold. Firstly, both countries undergo persistent runs of both, Current Account surpluses and Current Account deficits with the common characteristic of having suffered abrupt reversals from both types of episodes. Secondly, these economies are good representatives of very different regional development patterns. This fact allows for lesser control for distinct regional and strategic development in the empirical results of the model.

Mexico

Regarding the Mexican economy, the surplus reversals examined in this paper ended a series of persistent surplus, which originated in the early eighties and lasted for most of the "forgotten" decade. The apparent driving force behind the general trend reversal in Mexico's external balances after 1986 were the measures implemented by the Federal Government designed to open the Mexican economy. These measures included trade opening policies, following GATT directives, and greater flexibility in the inflation costly real exchange rate target, which translated in a slow appreciation of the Peso during the second half of the decade. Although, these series of real appreciations could be associated to the deterioration of the Current Account during 1986, the actual reversal in 1988, which led to persistent deficits in the nineties, resulted from rises in imports through strong domestic demand rather than from large appreciations in the real exchange rate[5].

As for the Current Account reversal from a persistent deficit, I analyze the episode of sudden reversal of capital inflows that led to the tequila crisis in 1994. In this case, major political unrest[6] fueled wide financial uncertainty, leading to an attack on the prevailing domestic currency peg that ended with a balance of payment crisis and a series of forced devaluations of the Peso. This dramatic depreciation was accompanied by a substantial output drop and a Current Account reversal accounting for 5 percent of GDP.

[5] See Banco de Mexico (1989).

[6] The assassination of the presidential candidate and opposition party leader joined with the upraise in the region of Chiapas

South Korea

With respect to South Korea, I study the output effect of the sudden current account deficit reversals experienced during the Asian Crisis of 1997, as well as a more recent instance of reversal from the persistent surplus balances occurred at the end of 2002. Although fundamentals look good during the months building up to October of 1997, moral hazard in large corporations left the country vulnerable to the large retrievals of capital from the region and attack to neighboring currencies. The elevation of risk in the region translated in South Korea with a very large reversal of capital inflows, a large real depreciation and severe output recession. Five years of persistent surplus later, in 2002, the South Korean economy suffered another reversal of the external balance. Even though the size of the Current Account reversal was relatively large (about 2 percent of GDP) and the country experienced a drop in output, real exchange rates remained largely unchanged. The reversal was mainly fueled by strong rise in Imports following increases in the international price of Oil and other commodities.

International Cyclical Properties of the Mexican and South Korean Economies

Tables 1 and 2 show the cyclical properties of the main aggregate indicators for the economies under study. In these tables, we observe familiar patterns found in the literature[7]. For the Korean economy, while consumption and private investment were more volatile than output, both macroeconomic aggregates seem to be highly pro-cyclical. Government consumption turns out to be relatively less unstable than output and slightly pro-cyclical. On the other hand, net exports in this economy are as volatile as output and highly counter cyclical. All variables except for government consumption and hours work displayed a high degree of persistence.

In the case of the Mexican economy, once again, we observe a very volatile investment, with respect to output, and a highly pro-cyclical series of private consumption and investment. Net exports continue to be highly counter cyclical in this economy with a similar degree of persistence as in the Korean economy.

[7] See Feldstein and Horioka (1980), Obsfeld (1981) and Mendoza (1991, 1995) among others.

3. A Neoclassical Growth Model of Real Business Cycles with exogenous shocks to net exports

The model used for our empirical analysis is based on the work of Kydland and Prescott (1982), and Long and Ploser (1983) with output fluctuations deriving from real shocks to the economy, such as technology, productivity, government consumption and shocks to the trade balance. The analytical solution of the model is possible through the log-linearization of the first order conditions and the production function. The solution strategy follows Campbell (1994) and Chari et al (2006). A detailed solution for this model is presented in an annex to the paper.

The Model

Our economy is comprised of households, firms and a government all of whom are infinitely lived. The object of the study is to solve the competitive equilibrium where the representative household must choose consumption, labor and investment to solve the following maximization problem[8]:

$$\max_{(X_t, C_t, l_t)} \mathrm{E} \sum_{t=0}^{\infty} \beta^t U(c_t, 1-l_t) N_t$$

Subject to:

$$c_t + x_t = r_t k_t + w_t l_t + tr_t$$

$$\mathrm{N}_{t+1} k_{t+1} = [(1-\delta)k_t + x_t] N_t$$

$$\mathrm{c}_t, x_t \geq 0 \text{ In all states}$$

Where we assume that the utility function follows the functional form $U(c, 1-l) = (c(1-l)^{\psi})^{1-\sigma} / (1-\sigma)$ with sigma serving as the relative risk aversion. Also, we have that capital evolving as $k_{t+1} = (1-\delta)k_t + x_t$

[8] See Appendix A for a detailed layout of the model.

Firms are competitive and maximize profits:

$$\max_{(K_t, L_t)} F(K_t, Z_t L_t) - r_t K_t - w_t L_t$$

The production function is defined as $F(K, L) = K_t^{\theta}(Z_t L_t)^{1-\theta}$.

Government follows always balance budget fiscal policies, so we constrained its actions to:

$$G_t + N_t tr_t = 0$$

Net exports enter in the global economic constraint as follows:

$$F(K_t, Z_t L_t) - N_t(c_t, x_t) - G = NX_t$$

Equilibrium in the capital and labor markets require:

$$N_t k_t = K_t$$

$$N_t l_t = L_1$$

All variables except for labor (which we assumed stationary) are detrended and converted to per capita measures using:

$$\hat{V} = \frac{V_t}{N_t (1 + g_z)_t}$$

Where we use the growth of labor productivity as the common trend for all processes.

The exogenous variables, technology, government consumption and net exports are assumed to follow a AR (1) process such that

$$s_{t+1} = P_0 + P s_t + Q \in_{s,t+1},$$

Where s represents the vector of exogenous processes $s_t = [\log z_t, \log \hat{g}_t, \log n\hat{x}]$ and all errors are distributed normally $\in_s \sim N(0_{3x1}, I_{3x3})$.

To solve the model we apply the techniques of dynamic programming[9] where the Lagrangian for this problem turns up to be:

$$L = \underset{(c_t, x_t, l_t)}{\text{Max}} \ \mathrm{E}\sum_{t} \tilde{\beta}^{t}[U(\hat{c}_t, 1-l_t) + \mu_t(r_t k_t + \hat{w}_t l_t + \hat{t}r_t - \hat{c}_t - \hat{x}_t)$$
$$+ \lambda_t\{(1-\delta)\hat{k}_t + \hat{x}_t - (1+g_z)(1+g_n)\hat{k}_t + 1\}]$$

And the corresponding first order conditions:

$$\text{FOC } \hat{\mathrm{c}}_{\mathrm{t}} \Rightarrow U_c(t) = \mu_t$$
$$\text{FOC } \hat{\mathrm{x}}_{\mathrm{t}} \Rightarrow -U_l(t) = -\mu_t \hat{w}_t$$

So that $\frac{\mathrm{U_l(t)}}{\mathrm{U_{\hat{c}}(t)}} = \hat{w}_t$, governing the relationship between consumption and labor.

$$\text{FOC } \hat{\mathrm{x}}_{\mathrm{t}} \Rightarrow -\mu_t + \lambda_t = 0 \Rightarrow \lambda_t = \mu_t = U_c(t)$$

$$\text{FOC } \hat{\mathrm{k}}_{\mathrm{t+1}} \Rightarrow \tilde{\beta}^{t}[-\lambda_t(1+g_z)(1+g_n)] + E\tilde{\beta}^{t+1}[\mu_{t+1} r_{t+1} + \lambda_{t+1}(1-\delta)] = 0$$
$$\tilde{\beta}^{t}[U_c(t)(1+g_z)(1+g_n)] = E\tilde{\beta}^{t+1}[U_c(t+1) r_{t+1} + U_{ct+1}(1-\delta)$$

Combining the last two equations, we find the Euler condition governing the consumption smoothing mechanism:

$$U_c(t) = E\hat{\beta} U_c(t+1)[r_{t+1} + (1-\delta)]$$

Finally, we need to incorporate the following additional conditions in the markets for capital and labor[10]:

$$\mathrm{r_t} = F_1(\hat{k}_t, z_t l_t)$$
$$\hat{w}_t = F_2(\hat{k}_t, z_t l_t) z_t$$

[9] See Stokey et al. (1989), Uhig (1996) or Chari et al. (2006)) for some close examples in how to solve these models.

[10] The Goods market equilibrium will follow by Walras's Law

And the global resource constraint with the detrended per capita variables (capped small letters):

$$\hat{c}_t + \hat{g}_t + \hat{x}_t + n\hat{x} = F(\hat{k}_t, z_t l_t)$$

To deal with the nonlinearity of the first order conditions, we proceed to log-linearize the equations above. Using the global constraints and the evolution equation of capital, we can build the constrained optimal conditions that need to be linearized.

$$\psi[\hat{k}_t^{\theta}(z_t l_t)^{1-\theta} - (1+g_n)(1+g_z)\hat{k}_{t+1} + (1-\delta)\hat{k}_t - g_t - n\hat{x}_t = (1-\theta)\hat{k}_t^{\theta} l_t^{-\theta} z_t^{1-\theta}(1-l_t) \qquad (1)$$

$$[\hat{k}_t^{\theta}(z_t l_t)^{1-\theta} - (1+g_n)(1+g_z)\hat{k}_{t+1} + (1-\delta)\hat{k}_t - \hat{g}_t - n\hat{x}_t]^{-\sigma}(1-l_t)^{\psi(1-\sigma)}$$
$$= \hat{\beta}\mathrm{E}_t[\hat{k}_{t+1}^{\theta}(z_{t+1}l_{t+1})^{1-\theta} - (1+g_n)(1+g_z)\hat{k}_{t+2} + (1-\delta)\hat{k}_{t+1} - \hat{g}_{t+1} - n\hat{x}_{t+1}]^{-\sigma}$$
$$(1-l_{t+1})^{\psi(1-\sigma)}[\theta\hat{k}_{t+1}^{\theta-1}(z_{t+1}l_{t+1})^{1-\theta} + (1-\delta)] \qquad (2)$$

Since the linearization is done through a first order Taylor approximation of the log of each variable around its steady state value, $\log \mathrm{v}_t \approx \frac{1}{v}(v_t - v)$ (where v represents the steady state), we need to find the steady state values of capital consumption and leisure.

To obtain these steady state values we eliminate the time subscripts in (1), so that, $\hat{\mathrm{k}}/l = (\frac{1-\hat{\beta}(1-\delta)}{\hat{\beta}\theta \mathrm{z}^{1-\theta}})^{\frac{1}{\theta-1}}$. Also, from the global resource constraint, we have that $\hat{\mathrm{c}} = [(\hat{\mathrm{k}}/l)^{\theta-1} z^{1-\theta} - (1+g_z)(1+g_n) + 1 - \delta]\hat{k} - \hat{g} - n\hat{x}$ or $\hat{c} = \xi_1\hat{k} - \hat{g} - n\hat{x}$. Finally from the consumption-leisure trade-off; $\hat{\mathrm{c}} = [(1-\theta)(\hat{k}/l)^{\theta} z^{1-\theta}/\psi](1-(1/\hat{k}/l)\,\hat{k})$. These three equations simplify to the following steady state values:

$$\hat{\mathrm{k}} = \frac{(\xi_2 + \hat{g} + n\hat{x})}{\xi_1\xi_3} \qquad (3)$$

$$\hat{\mathrm{c}} = \xi_1\hat{k} - \hat{g} - n\hat{x} \qquad (4)$$

$$l = (1/\hat{k}/l)\,\hat{k} \qquad (5)$$

Where ξ_1, ξ_2 and ξ_3 are functions of the underlying model parameters.

The first order Taylor approximation of around the steady state of equation(1) helps us find the following linear relationship driving labor:

$\text{Log}\, \text{l}_{\text{t}} = \phi_{\text{lk}} \log \text{k}_{\text{t}} + \phi_{\text{lg}} \log \hat{\text{g}}_{\text{t}} + \phi_{\text{lz}} \log \hat{\text{z}}_{\text{t}} + \phi_{\text{lnx}} \log \text{n}\hat{\text{x}}_{\text{t}} + \phi_{\text{lk'}} \log \hat{\text{k}}_{\text{t+1}}$, where each phi depends on the model parameters as follows:

$$\phi_{\text{lk}} = \frac{\psi\theta}{(1-\theta)(-\psi-\theta(\frac{1-l}{l})-1} - \frac{\hat{k}\psi(1-\delta)}{\hat{k}^{\theta}(zl)^{1-\theta}(1-\theta)(-\psi-\theta(\frac{1-l}{l})-1} - \frac{(\frac{1-l}{l})\theta}{(-\psi-\theta(\frac{1-l}{l})-1}$$

$$\phi_{\text{lz}} = \frac{\psi-(\frac{1-l}{l})(1-\theta)}{(-\psi-\theta(\frac{1-l}{l})-1}$$

$$\phi_{\text{lk'}} = \frac{-\psi\hat{k}(1+g_z)(1+g_n)}{\hat{k}^{\theta}(zl)^{1-\theta}(1-\theta)[-\psi-\theta(\frac{1-l}{l})-1]}$$

$$\phi_{\text{lg}} = \frac{-\psi\hat{g}}{(1-\theta)[-\psi-\theta(\frac{1-l}{l})-1]}$$

$$\phi_{\text{lnx}} = \frac{-\psi n\hat{x}}{(1-\theta)[-\psi-\theta(\frac{1-l}{l})-1]}$$

Similarly, linearizing the production function and the capital evolution equation we obtain:

$$\log \hat{y}_t = \theta \log \hat{k}_t + (1-\theta)\log z_t + (1-\theta)\log l_t$$

$$\log \hat{g}_t = (\theta + \phi_{lk}(1-\theta)\log \hat{k}_t + (1-\theta)(1+\phi_{lz})\log z_t + (1-\theta)\phi_{lk'}\log \hat{k}_{t+1} + \phi_{\text{lg}}\log \hat{g}_t + \phi_{\ln x}\log n\hat{x}_t$$

$$\log \hat{\text{x}}_{\text{t}} = (1+g_z)(1+g_n)\frac{\hat{k}}{\hat{x}}\log \hat{k}_{t+1} - (1-\delta)\frac{\hat{k}}{\hat{x}}\log \hat{k}_t$$

Finally, from the global economic constraint,

$$\log \hat{c}_t = \frac{\hat{y}}{\hat{c}} \log \hat{y}_t - \frac{\hat{x}}{\hat{c}} \log \hat{x}_t - \frac{\hat{g}}{\hat{c}} \log \hat{g}_t - \frac{n\hat{x}}{\hat{c}} \log n\hat{x}_t$$

Capital is derived through the method of undetermined coefficients where the following linear relationship between the control variable $\hat{k}_{t+1}$ and the state variables $\hat{g}_t, n\hat{x}_t, \hat{k}_t$ and $\hat{z}_t$ is assumed:

$$\log(\hat{\mathrm{k}}_{\mathrm{t+1}}) = \gamma_0 + \gamma_k \log \hat{k}_t + \gamma_z \log \hat{z}_t + \gamma_g \log \hat{g}_t + \gamma_{nx} \log n\hat{x}$$

To solve for the autocorrelation term, we need to log-linearize the Euler condition (2) and solve the quadratic equation form after collecting all the capital terms. Finding the stable root to this equation (usually the smaller) will give us the value of γ_k in terms of the model parameters. The remaining gammas are found collecting the remaining terms from the linearized Euler equation.

State Space representation of the system and MLE estimation

Once the model is solved analytically, we can estimate the autoregressive processes of the state variables. The estimations is done the through maximum likelihood method, a close example of this solution method can be found in McGrattan (1994).

In order build the likelihood function we can set system of equations representing the solution to the previous model in state space form as follows:

$$\begin{aligned} Z_{t+1} &= AZ_t + B\varepsilon_{t+1} \\ Y_t &= CZ_t + \mu_t \end{aligned} \qquad (3)$$

where, $Z_t = [\log \hat{z}_t, \log \hat{g}_t, \log n\hat{x}_t]$ and $Y_t = [\log \hat{y}_t, \log \hat{x}_t, \log \hat{g}_t, \log n\hat{x}_t]$. We allow serial correlation from the observables defining $\mu_t = D\mu_{t+1} + \zeta_t$, where the elements in the matrix D govern the serial correlation embodied in the data.

Assuming $E\mu_t\mu_t^{'} = \Omega$ and $E\mu_t\varepsilon_t^{'} = 0$; then, we can reformulate (3) as:

$$\begin{aligned} &Z_{t+1} = AZ_t + B\varepsilon_{t+1} \\ &\overline{Y}_t = Y_{t+1} - DY = (CA - DC)Z_t + C\varepsilon_{t+1} + \mu_{t+1} - D\mu_t = \overline{C}Z_t + \overline{\upsilon}_t \end{aligned} \qquad (4)$$

Assuming normally distributed white noise errors $[\varepsilon_{t+1}, \upsilon_t]$,we can build a likelihood function. Taking logs from the likelihood function of a normal distribution ($x_i \sim N(\mu, \sigma)$, we have that $\mathrm{L}(\mu,\sigma) = \mathrm{Log\,c - Tlog}\sigma - \frac{\sum_{i=1}^{T}(x_i - \overline{x})^2}{2\sigma^2}$ given or errors from (3) we can rewrite this in matrix form as: $\mathrm{L}(\Omega) = -\mathrm{Tlog}\left|\Sigma_{\mathrm{y}}\right| - \frac{1}{2}\mathrm{trace}(\Sigma_{\mathrm{y}}^{-1}\frac{1}{\mathrm{T}}\sum_{t=1}^{T}(\overline{Y}_t - \hat{Y}_t)(\overline{Y}_t - \hat{Y}_t)')$; where, Σ_y represents the prediction error from (4) and $\hat{Y}_t$ is the expected value of $\overline{Y}_t$, conditional to past realizations and the initial values of the estimated state variables[11].

I use unconstrained minimization methods[12] to find the global minimum of the function:

$$\mathrm{L}(\Omega) = \mathrm{Tlog}\left|\Sigma_{\mathrm{y}}\right| + \frac{1}{2}\mathrm{trace}(\Sigma_{\mathrm{y}}^{-1}\frac{1}{\mathrm{T}}\sum_{t=1}^{T}(\overline{Y}_t - \hat{Y}_t)(\overline{Y}_t - \hat{Y}_t)') + \mathrm{Penalty}$$ [13]

The parameters to be estimated in Gamma are the components of P and Q driving exogenous processes.

4. Application of the model to the Case studies of Mexico and South Korea

Tables (3)-(4) summarize the results of estimating the model for the Mexican and Korean economies from 1980 to 2006. From diagonal elements in the matrices "P", we

[11] See appendix for a detailed guide to the solution of this problem

[12] Coleman, T.F. and Y. Li, "On the Convergence of Reflective Newton Methods for Large-Scale Nonlinear Minimization Subject to Bounds," Mathematical Programming, Vol. 67, Number 2, pp. 189-224, 1994.

[13] We need to use a penalty term to account for the fact that the elements in Y have been detrended (see Dhrymes (1970))

notice that the model requires high values in the autocorrelation coefficients for all shocks. In other words, in order to replicate the path of economic activity displayed in the data, our model requires very high persistence shocks. This effect is common across the two countries under study. For the case of Mexico, the value of persistence estimated by the model is approximately 87 percent, about 5 percent higher than the observed value in the data. In the case of Korea, this difference increases to around 18 percent (from 80 to 98 percent). (See section below for further discussion in the role of persistence).

The elements in the matrices "C" give us the marginal effects of changes in the state variables to the variables of interest, output, labor and investment. Looking at the direct effects of the different shocks[14] in the determination of output investment and labor, we observe that in both case studies the elasticity of output to net exports is relatively small. As an example, we found that the coefficient representing the impact of productivity shocks to output is 10 times bigger in the case of Korea and over 50 times larger in the case of Mexico than the coefficient corresponding to next exports. This pattern is also true in the relationship of these processes with labor and investment. Obviously, this is quite an imperfect way of measuring the relative weight of each shock in the determination of the output spectrum. To obtain a more formal idea of the role of the trade balance in the determination of output, we need to conduct a variance decomposition analysis of equation (4).

Figures (1)-(2) show the variance decomposition of output with respect to our productivity and net exports. Both economies display a very different distribution of weights between net exports and productivity in the determination of the output spectrum. While in South Korea net exports absorb roughly one fourth of the economy's output variance, net exports in Mexico only account for approximately 10 percent. Alternatively, productivity shocks absorb only 30 percent of the output variance in South Korea; whereas in the case of Mexico, this number more than doubles. The relatively small impact on output variance of the trade balance in Mexico may help explain why the model has more trouble explaining output effects exclusively through shocks to the external balance.

[14] Following recent literature in this area we allow for exogenous investment (η_{xt}) and labor (η_{lt})` tax rates to enter the model.

Figures (3)-(4) show the projected impulse response of output to a reversal in the Current Account compared to the actual data. The estimated impulse response of output is calculated by feeding the genuine shock to the trade balance while using the pre-shock estimates for all other parameters. I normalize both series to 1 at the date just before the reversal.

Similarly to the results presented in Chari et al. (2004), figure (5) shows that the model for the Mexican Deficit reversal predicts a positive jump in the level of output after the surge in net exports. In contrast, the data shows a severe drop in real output after the reversal. The model's failure to predict the output reaction to deficit reversals is reinforced by the Korean case. As we observe from Figure (6), a large decline in economic activity follows, once more, after the shock to the trade balance. This evidence seems to confirm that the effects of pure exogenous shocks to the trade balance can not be responsible for the determination of output following large reversals in capital inflows. Moving beyond these findings, I test the performance of the model on opposite events, where countries suffered negative shocks in their trade balances, causing reversals from persistent surplus episodes to deficits. Surprisingly, the model's predictions capture almost perfectly the output drop following fall in net exports in South Korea; and points in the right direction in the Mexican case (although it fails to capture the full intensity of the large output slump). These results are exposed in figures (7)-(8).

The Role of Shock persistence in the External Balance

Although net exports are always pro-cyclical in the model, there are significant differences in the magnitude of output effects originated from either persistent or transitory shocks to the trade balance. As previously mentioned, the correlation between net exports and output arises from the income effect on leisure, driving labor supply up after a positive shock to the external balance. Adapting the argument in Aiyagari et al. to trade balance shocks, we can divide the income effect on leisure in three stages; (1) the direct effect of trade balance shocks to labor supply leaving private investment unchanged, (2) the effect of trade balance shocks to investment and (3) the indirect effect of trade balance shocks on labor supply shocks through changes in investment. The key difference between persistent and transitory shocks to the trade balance relies in the second stage. Transitory shocks to net exports will cause investment to decrease due to the desire of individuals for consumption smoothing. On the other hand, permanent increases in the trade balance will increase the steady state of capital (see equation (3)) resulting in a permanent increase in investment.

In order to expose these mechanisms I estimate the elasticities of the trade balance to labor, investment and output for an array of fixed of autocorrelation coefficients in the net exports processes. Figures (9)-(10) present the evolution of these parameters for the two case studies. In these figures, we observe how net exports elasticity of private investment is consistently negative until the shock becomes permanent. Once the value of the autocorrelation coefficient gets close to one, net exports elasticity of investment moves abruptly towards positive values. Then, the indirect effect of investment on labor is aggregated to the direct effect from the trade balance and we observe a clear increase in both, the net exports elasticity of labor and output.

The patterns described above seem to be very similar across the two countries in the study. However, the net effects of permanent shocks to the trade balance seem to be significantly higher for the case of South Korea.

As discussed in this section, persistence can be a source of asymmetries between surplus and deficit reversals. Recent literature on Current Account persistence (see Edwards 2006) found evidence on higher deficit persistence. The assumption of more persistent deficits would work well with the findings in this paper. To justify this statement, recall that surplus reversals are negative shocks that drive the trade balance towards deficits. If we believe that these shocks are highly persistent, the investment effect on labor supply would increase the net export elasticity of output, making the trade balance better suited to project the changes in output.

Table (5): Timeline for Output growth and Real Exchange Rates during Endgames of Deficit Reversals

	Timeline						
Output Growth	-3	-2	-1	0	1	2	3
Average	4.32	3.61	2.73	1.49	5.78	6.14	3.82
STDEV	4.62	4.61	4.54	6.47	2.99	3.74	4.43
T-Test		-0.74	-0.92	-1.06	4.08	0.50	-2.54
Observations	46	46	46	46	45	42	39
REER	-3	-2	-1	0	1	2	3
Average	100.00	98.91	94.29	81.69	82.99	86.62	88.68
STDEV	0.00	9.79	11.19	16.19	22.39	30.96	33.14
T-Test		-0.66	-1.87	-3.84	0.28	0.54	0.25
Observations	36	36	36	36	35	32	29

Table (6): Timeline for Output growth and Real Exchange Rates during Endgames of Surplus Reversals

	Timeline						
Output Growth	-3	-2	-1	0	1	2	3
Average	2.60	4.50	6.63	5.99	3.90	4.52	3.24
STDEV	6.15	3.99	4.03	4.41	4.86	3.60	4.88
T-Test		1.16	1.68	-0.48	-1.38	0.44	-0.90
Observations	20	20	20	20	18	18	18
REER	-3	-2	-1	0	1	2	3
Average	100.00	98.25	103.92	102.89	103.05	106.40	110.55
STDEV	0.00	11.24	15.14	20.15	28.54	31.19	37.10
T-Test		-0.64	1.24	-0.17	0.02	0.32	0.34
Observations	17	17	17	17	16	16	15

Sources: IFS, WDI and OECD Source Data Set. The select sets of emerging markets comprised in the analysis are: Argentina, Bolivia, Brazil, Chile, China, Colombia, Dominican, Republic, Ecuador, El Salvador, Guatemala, India, Indonesia, Japan, Korea, Malaysia, Mexico, Panama, Paraguay, Peru, Philippines, Singapore, Thailand, Uruguay and Venezuela. The T-statistic is based on test where the null is

Represents no significant change in the mean where $T = \frac{\bar{Y_1} - \bar{Y_2}}{\sqrt{s_1^2/N_1 + s_2^2/N_2}}$

Real exchange rates and Current Account

The several waves of balance of payment crisis that ended large and persistent external deficits across emerging markets last decade, showed researchers that large real depreciation played a key role during the endgame of those reversals.

Despite the fact that large corrections in relative prices seem to be entrenched in the reversals, the relationship between output and relative prices is not straight forward, especially, in the issues concerning the direction of causality (See Kamin and Rogers (1997) for a study of these issues in Mexico).

Tables (5)-(6) show the average output response to Current Account reversals and the associated swing in real effective exchange rates[15]. The data displayed in the tables correspond to deficit and surplus reversals from selective emerging economies in the last 3 decades. Similar patterns can be found in Dooley et al. (2006) and Edwards (2006).

The results from this study leave the door open to a potential causal relation from relative prices to output during deficit reversals. This possibility arises through the inability of pure net export shocks to generate the observed output recessions. These failures seem to indicate that the causation of output after deficit reversals is due to factors that are not included in the model; namely, nominal rigidities and relative prices. Interestingly, this is not the case for surplus reversals, where real exchange rates do not play a key role either in the reversal itself or in the causation of the output drops that follow. In those cases, pure shocks to the trade balance are able to reproduce the observed declines in output, leaving real exchange with little or no job at all rates in the determination of output. Data from our two case studies show how relatively large corrections in the Current Account (2 percent of GDP for Korea in 2002 and 1.5 percent of GDP for Mexico in 1988) were reversed with no significant real appreciation in place (see Figures (12)-(13)).

[15] See Fig (10)-(11) for a visual representation of these endgames

5. Conclusion and Future Research

This paper goes beyond recent analysis of output recessions after sudden reversals of capital inflows to explore the asymmetric behavior of output after reversals from surplus episodes. In order to evaluate the pure effect of reversals in the trade balance over output, I use of a fully flexible Standard Growth model with no relative prices. Net exports enter the model as an exogenous autoregressive process. These assumptions allow us to easily solve the model analytically and examine the direct effect of the different shocks on the variables of interest. The solution to the competitive equilibrium of the model implies a weakly pro-cyclical trade balance. This positive correlation between net exports and economic activity is based on the income effect of net exports shocks onto the supply of labor. We also show how high (permanent) persistence shocks to the trade balance increase the steady state of capital; thus, increasing investment permanently. Since temporary shocks will have a negative effect on investment through consumption smoothing. This mechanism ensures that the more persistent the shock the higher the effects on output.

Applying this model to the two case studies provides a series of interesting results among which it is worth highlighting the following:

- The model generates pro-cyclical net exports series. This finding, although not a stranger in the RBC literature, is in conflict with and diverges from the high counter cyclical relationship found in the data for both countries in our study.
- As already stated in prior occasions in the body of literature, the positive relationship between the trade balance and output, predicted in the model, renders it poised to fail any attempt to map the large losses in economic activity following of severe reversal in capital inflows.
- Interestingly, the model works well predicting output declines after negative shocks to the trade balance representing a reversal from persistent surplus episodes. However, the model seems better suited to predict mild episodes, such as the case of Korea, as it was unable to match the intensity of the output drop displayed in the Mexican episode.

- Using a variance decomposition analysis, I find large differences in the contribution of net export shocks to the output spectrum among the two case studies. The low contribution of net export shocks in the Mexican economy may help explain, in part, the inability of net exports effect to fully match the drop in output during the 1988 episode.
- The model over-estimates the autocorrelation coefficient for shocks in net exports in order to explain changes in output after any reversal event. In this paper, I demonstrate how higher persistence in the shocks to net exports leads to larger effects on labor and investment; thus, to larger effects on output itself. A quick review of recent literature reveals that large deficits seem to be significantly more persistent than large surpluses. According to our analysis of the role persistence has in the model, negative shocks to the trade balance seem to be more persistent than positive ones. This fact may help explain the larger role of pure external shocks in the determination of output during surplus reversals.
- As for large reversals of capital inflows, a key policy question is to determine the exact role of real exchange rates during those episodes, as well as in the large output recessions that follow. The possibility of closely reproducing the output drops after surplus reversals, even if lacking any definition of relative prices in the model, is indicative of the asymmetric role played by real exchange rates during deficit and surplus reversals. This point is reinforced when we observe the endgame of reversals in a large set of emerging markets. The analysis shows a large significant real depreciation associated to deficit reversals; while no significant real appreciation exists following surplus reversals.

Future Research

Although the transparency of the standard framework used in this paper allows us to analyze the effects of pure external shocks to output and their transmission mechanism with clarity; further exploration of second order effects to output calls for the addition of relative prices in the model. It would be worth including a more complex version of foreign capital markets in the model to gain a more in-depth understanding of the part played by interest differentials during reversals.

References

Aiyagari, S. R., L. J. Christiano & M. Eichenbaum (1990), "The Output, Employment, and Interest Rate Effects of Government Consumption", *NBER Working Paper Series,* No. 3330, April.

Aizenman, Joshua (2006), "International Reserves Management and the Current Account", Prepared for the 10th Annual Conference at the Central Bank of Chile "*Current Account and External Financing"*, November 9-10.

Backus, David K., Patrick J. Kehoe & Finn E. Kydland (1993), "International Business Cycles: Theory and Evidence", *NBER Working Paper Series*, No. 4493, October.

________________(1992), "International Real Business Cycles", *The Journal of Political Economy*, Vol. 100, No. 4, pp. 745-775, August.

Barro, R.J. (1984), *Macroeconomics*, 2nd Ed., John Wiley & Sons, New York.

________________(1981), "Output effects of government purchases", *Journal of Political Economy*, Vol.89, No. 6, pp. 1086–1121

Barro, Robert J. & Robert G. King (1985), "Time-Separable Preference and Intertemporal-Substitution Models of Business Cycles", *NBER Working Paper Series,* No. 888.

Calvo, Guillermo A. (1998), "Capital Flows and Capital-Market Crises: The SimpleEconomics of Sudden Stops", *Journal of Applied Economics*, Vol. 1, No. 1, November, pp. 35-54.

Campbell, John Y. (1992), "Inspecting the Mechanism: An Analytical Approach to the Stochastic Growth Model", *NBER Working Paper Series*, No. 4188, October.

Chari, V. V., Patrick J. Kehoe & Ellen R. McGrattan (2006), “Business Cycle Accounting”, *Research Department Staff Report*, No.328, Federal Reserve Bank of Minneapolis, February, Revised.

________________(2005a), “Sudden Stops and Output Drops”, *Research Department Staff Report, No.* 353, Federal Reserve Bank of Minneapolis, January.

________________ (2005b), “Appendices: Business Cycle Accounting,” *Research Department Staff Report, No.* 362, Federal Reserve Bank of Minneapolis, April.

Daniel, Betty C. (1997), “Precautionary Saving and Persistent Current Account Imbalance”, *Journal of International Economics,* No. 42, pp. 179-193.

Dooley, M. P., D. Folkerts-Landau & P. Garber (2004), “The US Current Account Deficit: Collateral for a Total Return Swap”, *Global Markets Research*, Deutsche Bank, August.

__________________ (2003),” An Essay on The Revived Bretton Woods System”, *NBER Working Paper Series*, No. 9971, September.

Edwards, Sebastian (2006), “On Current Account Surpluses and the Correction of Global Imbalances”, Paper presented at the Central Bank of Chile Research Conference, November 9-10, 2006.

Feldstein, Martin & Charles Horioka (1980), "Domestic Saving and International Capital Flows", *Economic Journal*, Vol. 90, pp. 314-329, June.

Hall, R.E. (1980), "Labor Supply and Aggregate Fluctuations", in *Carnegie-Rochester Conference Series on Public Policy*, Vol. 12, pp. 7-33.

Herwartz, Helmut & Fang Xu (2006), “Reviewing the Sustainability / Stationarity of Current Account Imbalances with Tests for Bounded Integration”, *Economics Working Paper Series*, No. 2006-07, Institute for Statistics and Econometrics, Christian-Albrechts-University of Kiel, May.

International Monetary Fund (2007), World Economic Outlook. Spillovers and Cycles in the Global Economy, *World Economic and Financial Surveys,*April.

International Monetary Fund (2006), Financial Systems and Economic Cycles, *World Economic and Financial Surveys,* September.

International Monetary Fund (2006), Globalization and Inflation, *World Economic and Financial Surveys,* April.

Kamin, Steven B. & John H. Rogers (1997), "Output and the Real Exchange Rate in Developing Countries: An Application to Mexico", *International Finance Discussion Papers,* Board of Governors of the Federal Reserve System, No. 580, May.

Kydland, Finn E. (1982), "The Role of Money in a Competitive Model of Business Fluctuations", *Manuscript*, Carnegie Mellon University.

Kydland, Finn E. & Edward C. Prescott (1982), "Time to Build and Aggregate Fluctuations", *Econometrica*, Vol. 50, No. 6, pp. 1345-1370, November.

Long, J. and Plosser, C. (1983) ,"Real Business. Cycles," J*ournal of Political Economy, Vol.* 91, pp. 39-69.

McGrattan, Ellen E. (1991), "The Macroeconomic Effects of Distortionary Taxation", *Discussion Paper Series,* No. 37, Institute for Empirical Macroeconomics, Federal Reserve Bank of Minneapolis, January.

___________________(1990), "Solving the Stochastic Growth Model by Linear-Quadratic Approximation", *Journal of Business & Economic Statistics,* Vol. 8, No.1, pp. 41-44, January.

Mendoza, E. (2005), "Real Exchange Rate Volatility and the Price of Nontradables in Sudden-Stop-Prone Economies", *NBER Working Paper Series,* No. 11691.

_________________(2004), “Sudden Stops in Equilibrium Business Cycle Model with Credit Contraints: A Fisherian Deflation of Tobin’s q.”, Manuscript, University of Maryland.

_________________(1995), “The Terms of Trade, the Real Exchange Rate and Economic Fluctuations,” *International Economic Review*, Vol. 36, No.1. pp. 101-137.

_________________(1991), “Real Business Cycles in a Small Economy,” *The American Economic Review*, Vol. 81, No.4 pp. 797-818, September.

Neumeyer, Pablo A. & Fabrizio Perri (2004), “Business Cycles in Emerging Economies: The Role of Interest Rates”, *NBER Working Paper Series*, No. 10387.

Obstfeld, Maurice (1981), **“**Macroeconomic Policy, Exchange-Rate Dynamics, and Optimal Asset Accumulation”, *The Journal of Political Economy*, Vol. 89, No. 6, pp. 1142-1161, December.

Riera-Crichton (2007), “Persistent Episodes of Current Account Imbalances: An Empirical Analysis”, *Mimeo*, University of California –Santa Cruz.

Sims, Christopher A. (1980), “Macroeconomics and Reality”, *Econometrica*, Vol. 48, No. 1, pp. 1-48, January.

Taylor, M. Alan (2002), “A Century of Current Account Dynamics”, *NBER Working Paper Series*, No. 8927, May.

Uhlig, Harald (1996), “A Toolkit for Analyzing Nonlinear Dynamic Stochastic Models Easily”, *Discussion Paper Series*, No. 9597, CentER, University of Tilburg and CEPR, Revised.

TABLE 1: Cyclical Properties of the South Korean Economy

	Standard Deviation		Autocorrelation	Cross Correlation with Output (Lags)										
Variable	**Percent**	**Relative to Output**		**-5**	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
Output	2.17	1.00	0.82	-0.15	0.03	0.27	0.57	0.82	1.00	0.82	0.57	0.27	0.03	-0.15
Consumption	3.18	1.47	0.84	-0.09	0.06	0.25	0.49	0.72	0.88	0.78	0.57	0.31	0.08	-0.11
Government Consumption	1.43	0.66	0.58	0.28	0.29	0.21	0.14	0.12	0.14	0.11	0.07	0.01	-0.14	-0.26
Fixed Investment	5.98	2.76	0.85	-0.08	0.10	0.33	0.57	0.76	0.85	0.73	0.52	0.28	0.06	-0.16
Hours	1.86	0.86	0.48	-0.69	-0.65	-0.49	-0.26	0.02	0.32	0.40	0.45	0.34	0.22	0.16
Net Exports/Output	2.09	0.96	0.80	0.07	-0.04	-0.13	-0.33	-0.52	-0.72	-0.76	-0.63	-0.43	-0.19	0.03

Source: OECD, IFS, see Appendix for the variable definition. All series were seasonally adjusted and detrended using the Hodrick-Prescott filter with lambda at 1600. All variables are in natural logarithms except net exports. Based on quarterly data between 1980:1 to 2006:4.

TABLE 2: Cyclical Properties of the Mexican Economy

Variable	Standard Deviation Percent	Standard Deviation Relative to Output	Autocorrelation	Cross Correlation with Output (Lags) -5	-4	-3	-2	-1	0	1	2	3	4	5
Output	2.45	1.00	0.80	-0.11	0.03	0.25	0.57	0.80	1.00	0.80	0.57	0.25	0.03	-0.11
Consumption	3.01	1.23	0.82	0.06	0.21	0.36	0.62	0.79	0.92	0.75	0.51	0.22	-0.03	-0.15
Government Consumption	3.13	1.28	0.27	-0.01	0.10	0.21	0.22	0.37	0.43	0.47	0.36	0.21	0.07	-0.18
Fixed Investment	9.80	4.01	0.85	-0.24	-0.07	0.19	0.49	0.73	0.91	0.82	0.60	0.32	0.07	-0.08
Hours	3.56	1.46	0.86	-0.22	-0.03	0.19	0.47	0.67	0.84	0.74	0.59	0.40	0.23	0.14
Net Exports/Output	2.14	0.87	0.82	0.16	0.02	-0.15	-0.37	-0.58	-0.72	-0.74	-0.55	-0.31	-0.07	0.12

Source: OECD, IFS, see Appendix for the variable definition. All series were seasonally adjusted and detrended using the Hodrick-Prescott filter with lambda at 1600. All variables are in natural logarithms except net exports. Based on quarterly data between 1980:1 to 2006:4.

Figure (1): Variance Decomposition of Output with respect to productivity and net exports for South Korea

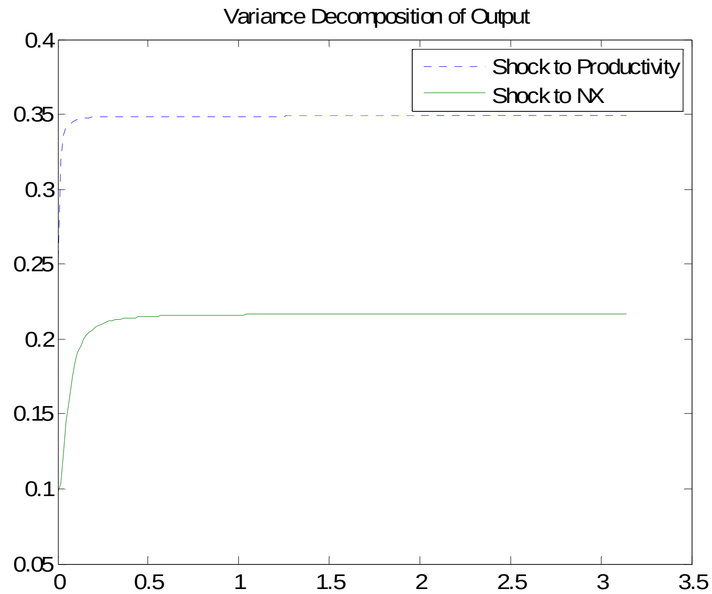
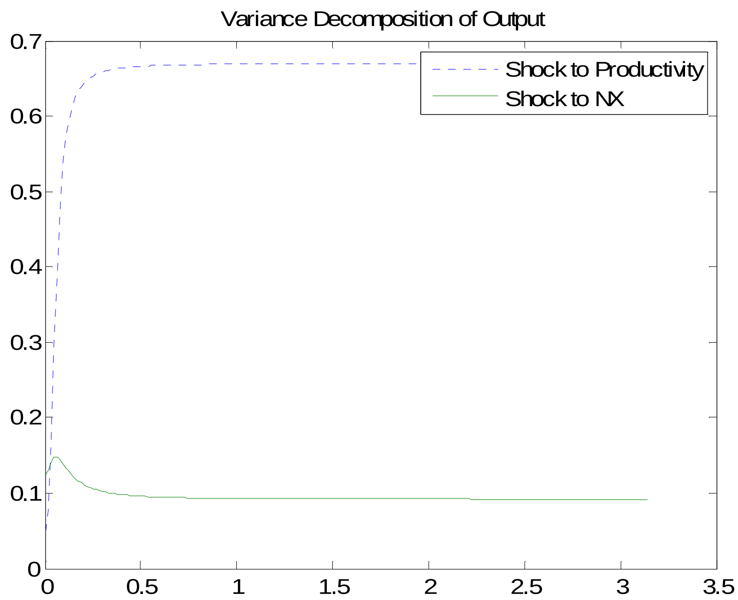


Figure (2): Variance Decomposition of Output with respect to productivity and net exports for Mexico



Notes: Shocks to taxes and government consumption has been omitted and represent the remaining percentage points up to 1

Table (3): State Space representation of the optimal solution for the South Korean Model

A

$$\begin{bmatrix} \text{Log } \hat{k}_{t+!} \\ \text{Log } \hat{z}_{t+!} \\ \eta_{kt+!} \\ \eta_{xt+!} \\ \text{Log } n\hat{x}_{t+!} \\ 1 \end{bmatrix} = \begin{bmatrix} 0.962 & 0.059 & -0.055 & -0.071 & 0.001 & 0.119 \\ 0 & 0.976 & 0 & 0 & 0 & -0.001 \\ 0 & 0 & 0.995 & 0 & 0 & 0.002 \\ 0 & 0 & 0 & 0.983 & 0 & 0.002 \\ 0 & 0 & 0 & 0 & 0.983 & -0.041 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \text{Log } \hat{k}_{t} \\ \text{Log } \hat{z}_{t} \\ \eta_{kt} \\ \eta_{xt} \\ \text{Log } n\hat{x}_{t} \\ 1 \end{bmatrix}$$

B

$$+ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0.212 & 0 & 0 & 0 \\ 0.059 & -0.017 & 0 & 0 \\ 0.183 & -0.003 & 0.015 & 0 \\ -0.190 & -0.150 & -0.011 & 0.000 \\ 0 & 0 & 0 & 0 \end{bmatrix} \varepsilon_t$$

C

$$\begin{bmatrix} \text{Log } \hat{y}_{t} \\ \text{Log } \hat{x}_{t} \\ \text{Log } l_{t} \end{bmatrix} = \begin{bmatrix} 0.091 & 0.992 & -1.168 & -0.576 & 0.099 & 0.257 \\ -0.965 & 3.060 & -2.858 & -3.689 & 0.070 & 2.226 \\ -0.337 & 0.459 & -1.718 & -0.848 & 0.146 & 0.377 \end{bmatrix} \begin{bmatrix} \text{Log } \hat{k}_{t} \\ \text{Log } \hat{z}_{t} \\ \eta_{kt} \\ \eta_{xt} \\ \text{Log } n\hat{x}_{t} \\ 1 \end{bmatrix} + \mu_t$$

Notes: Matrices A and B represent optimal values estimated through maximum likelihood method. y, x and l represent the set of "observables" output investment and hours work. Among the state variables we include capital, labor productivity, capital and investment tax rates and net exports. The values in matrix C represent the elasticities of the main economic indicators to the state variables.

Table (4): State Space representation of the optimal solution for the Mexican model.

A

$$\begin{bmatrix} \text{Log } \hat{k}_{t+!} \\ \text{Log } \hat{z}_{t+!} \\ \eta_{kt+!} \\ \eta_{xt+!} \\ \text{Log } n\hat{x}_{t+!} \\ 1 \end{bmatrix} = \begin{bmatrix} 0.960 & 0.078 & -0.081 & -0.070 & -0.004 & 0.090 \\ 0 & 0.944 & 0 & 0 & 0 & 0.024 \\ 0 & 0 & 0.957 & 0 & 0 & 0.014 \\ 0 & 0 & 0 & 0.995 & 0 & 0.000 \\ 0 & 0 & 0 & 0 & 0.876 & -0.302 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \text{Log } \hat{k}_{t} \\ \text{Log } \hat{z}_{t} \\ \eta_{kt} \\ \eta_{xt} \\ \text{Log } n\hat{x}_{t} \\ 1 \end{bmatrix}$$

B

$$+ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0.023 & 0 & 0 & 0 \\ 0.011 & -0.022 & 0 & 0 \\ -0.010 & 0.038 & -0.007 & 0 \\ -0.063 & -0.207 & -0.084 & -0.124 \\ 0 & 0 & 0 & 0 \end{bmatrix} \varepsilon_t$$

C

$$\begin{bmatrix} \text{Log } \hat{y}_{t} \\ \text{Log } \hat{x}_{t} \\ \text{Log } l_{t} \end{bmatrix} = \begin{bmatrix} 0.069 & 1.189 & -1.276 & -0.569 & 0.021 & -0.145 \\ -1.070 & 4.032 & -4.198 & -3.612 & -0.187 & 0.743 \\ -0.330 & 0.699 & -1.823 & -0.812 & 0.031 & -0.207 \end{bmatrix} \begin{bmatrix} \text{Log } \hat{k}_{t} \\ \text{Log } \hat{z}_{t} \\ \eta_{kt} \\ \eta_{xt} \\ \text{Log } n\hat{x}_{t} \\ 1 \end{bmatrix} + \mu_t$$

Notes: Matrices A and B represent optimal values estimated through maximum likelihood method. y, x and l represent the set of "observables" output investment and hours work. Among the state variables we include capital, labor productivity, capital and investment tax rates and net exports. The values in matrix C represent the elasticities of the main economic indicators to the state variables.

Figure (5): Output reaction to a reversal from a persistent deficit Episode in Mexico

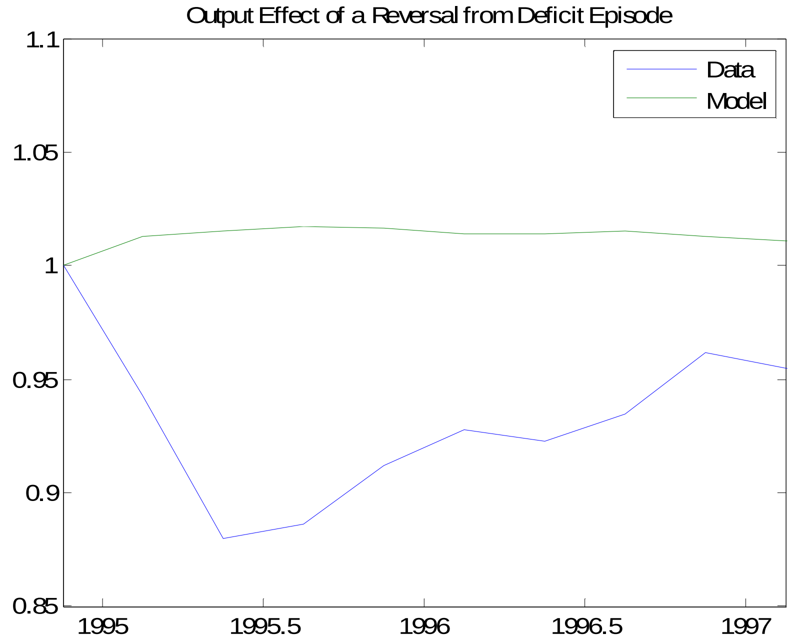
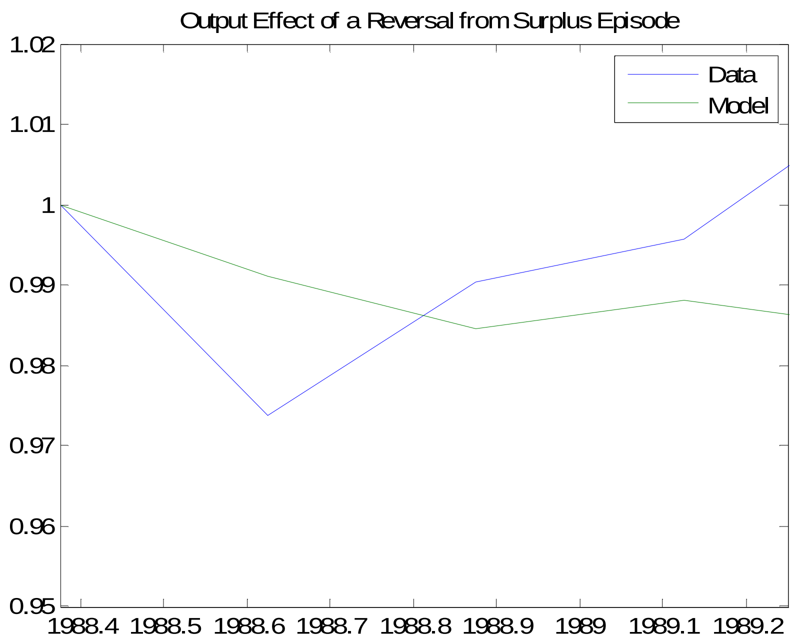


Figure (6): Output reaction to a reversal from a persistent deficit Episode in Mexico



Notes: All data series has been normalized to 1 at the time of the reversal.
Sources: OECD Source Dataset, IFS.

Figure (7): Output reaction to a reversal from a persistent deficit Episode in South Korea

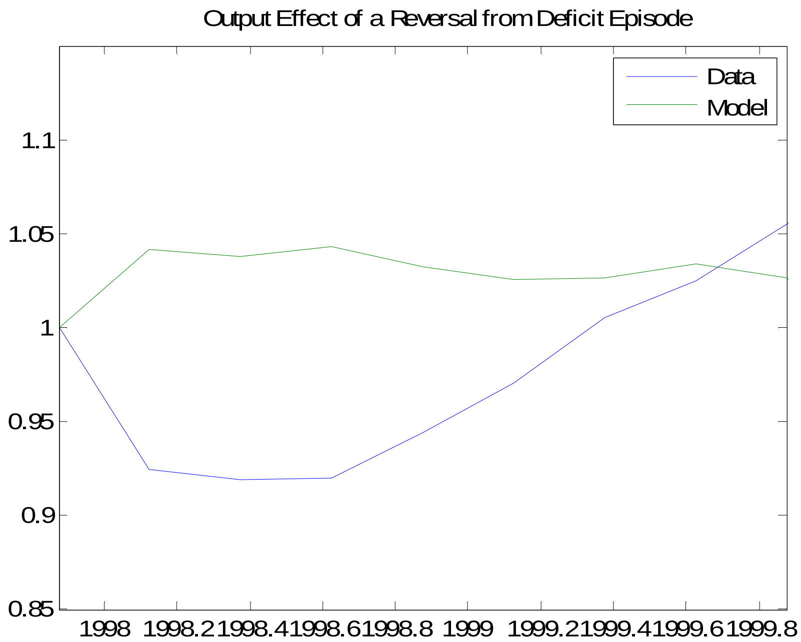
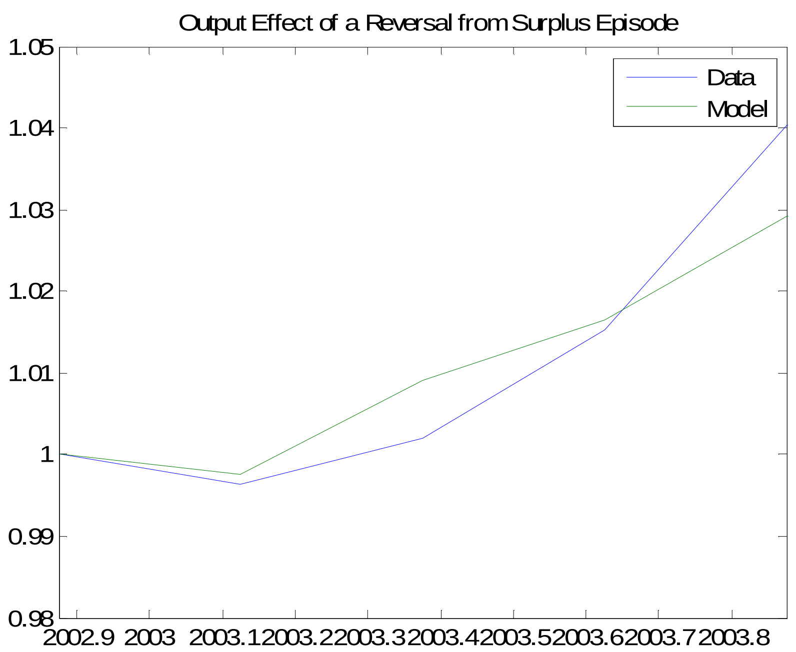


Figure (8): Output reaction to a reversal from a persistent deficit Episode in South Korea



Notes: All data series has been normalized to 1 at the time of the reversal.
Sources: OECD Source Dataset, IFS.

Figure (9): Net exports elasticity of Output, Investment and Labor vs. Shock Persistence. Mexico

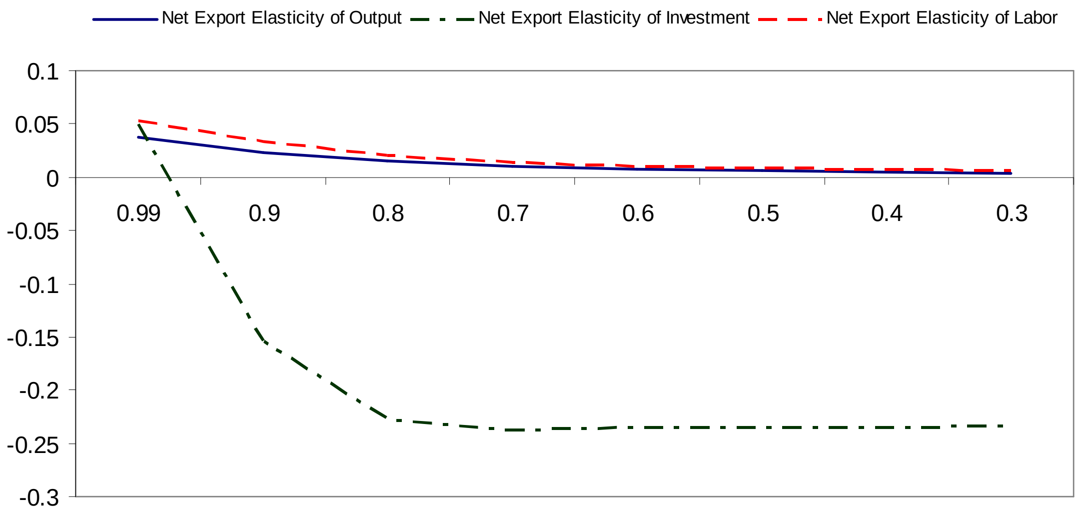
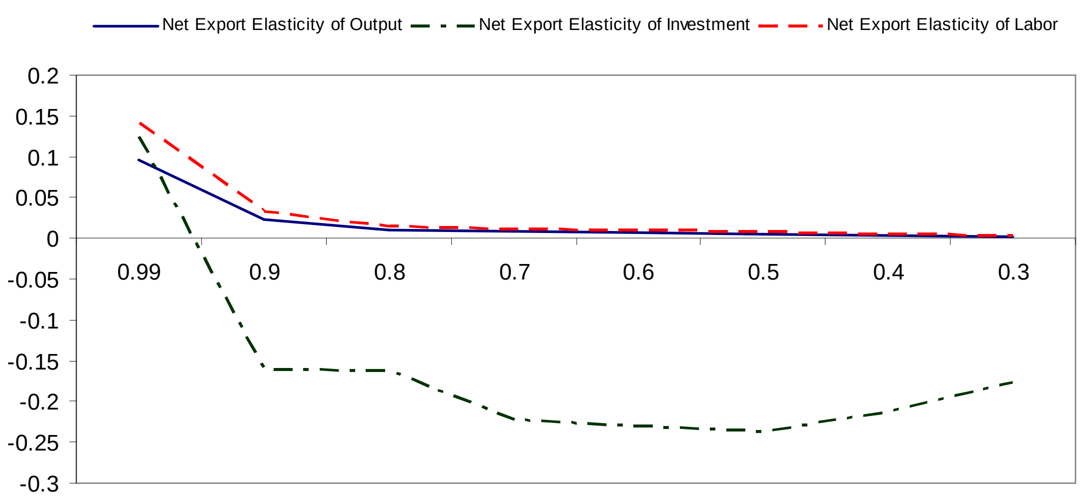


Figure (9): Net exports elasticity of Output, Investment and Labor vs. Shock Persistence. Mexico



Notes: The x axis represents the first order autoregressive coefficient of the process for net exports

Figure (10): Average Effect of reversals from persistent deficits on output growth in Emerging Economies

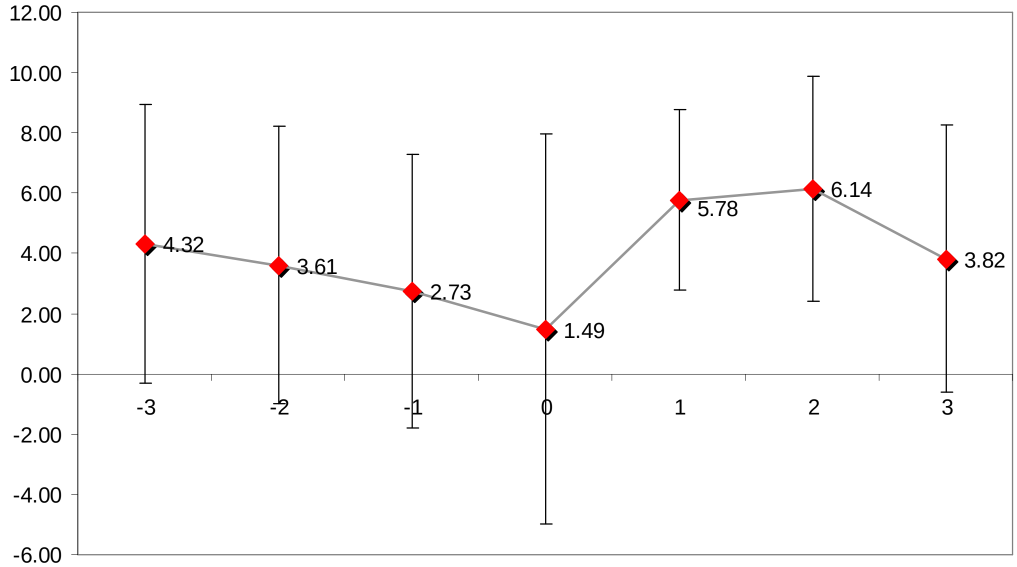
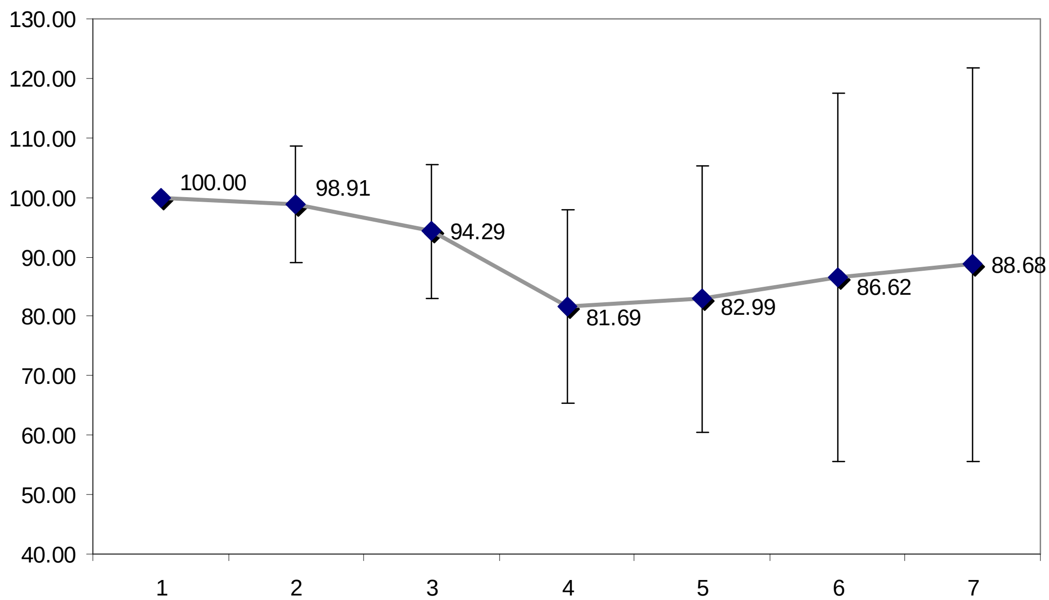


Figure (11): Average Effect of reversals from persistent deficits on the Real Effective Exchange rate in Emerging Economies



Sources: IFS, WDI and OECD Source Data Set. The select sets of emerging markets comprised in the analysis are: Argentina, Bolivia, Brazil, Chile, China, Colombia, Dominican, Republic, Ecuador, El Salvador, Guatemala, India, Indonesia, Japan, Korea, Malaysia, Mexico, Panama, Paraguay, Peru, Philippines, Singapore, Thailand, Uruguay and Venezuela.

Figure (12): Real Effective Exchange Rates during reversal episodes.
Korea

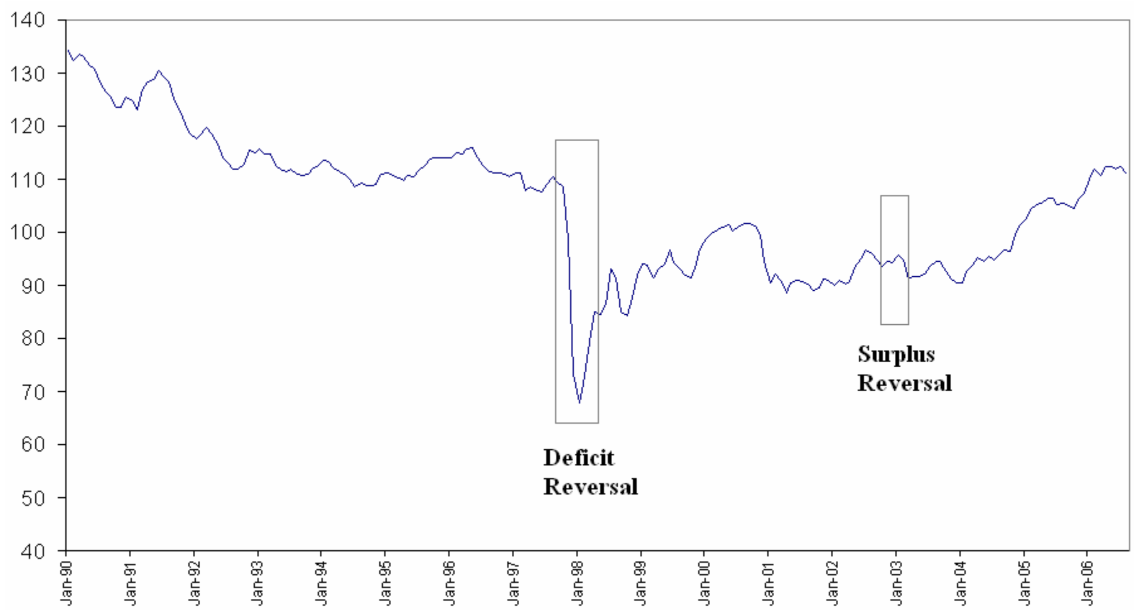
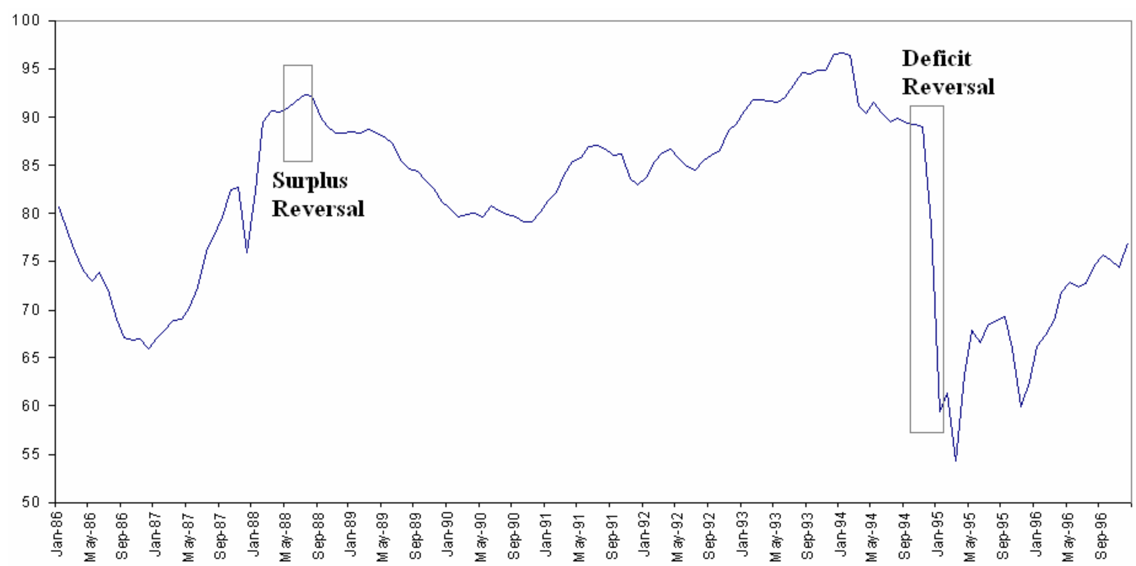


Figure (12): Real Effective Exchange Rates during reversal episodes.
Mexico



Notes: Monthly Data from 1970 to 2007
Source: JPMorgan, Broad Base Effective Exchange Rate