Working Paper 99-10/ Document de travail 99-10

Real Effects of Collapsing Exchange Rate Regimes: An Application to Mexico

by

Patrick N. Osakwe and Lawrence L. Schembri

Bank of Canada Banque du Canada

ISSN 1192-5434
ISBN 0-662-27859-3

Printed in Canada on recycled paper

Bank of Canada Working Paper 99-10

April 1999

Real Effects of Collapsing Exchange Rate Regimes: An Application to Mexico

by

Patrick N. Osakwe and Lawrence L. Schembri

International Department
Bank of Canada
Tel: (613) 782-8483; Fax: (613) 782-7658
lschembri@bank-banque-canada.ca
posakwe@bank-banque-canada.ca

Contents

Acknowledgements

We would like to thank Eduardo Borensztein, Robert Lafrance, John Murray, Pierre St-Amant, and Gregor Smith for comments on earlier versions of this paper. We also thank for their comments the participants in seminars at the Canadian Economics Association meetings in Ottawa, Canada (June 1998); the Latin American and Caribbean Economics Association meetings in Buenos Aires, Argentina (October 1998); the Bank of Canada; the University of Quebec at Montreal; Carleton University; and the Research Department at the IMF. Our gratitude also goes to Zahir Antia for his excellent research assistance.

Abstract

This paper examines the impact of a collapsing exchange rate regime on output in an open economy in which shocks to capital flows and exports predominate. A sticky-price rational expectations model is used to compare the variability of output under the collapsing regime to that under alternative fixed and flexible regimes. Output is found to be most stable under a flexible rate. A counterfactual exercise is performed for Mexico, using the parallel market exchange rate as a proxy for the shadow flexible rate. The main finding is that had Mexico been on a flexible rate for the past two decades, instead of a series of collapsing regimes, the variance of real output would have been reduced by half.

Résumé

Les auteurs de l'étude examinent les répercussions sur la production d'un régime de change susceptible de s'effondrer, dans le cadre d'une économie ouverte où les flux de capitaux et les exportations sont soumis à des chocs fréquents. À l'aide d'un modèle fondé sur des attentes rationnelles et des prix rigides, les auteurs comparent la variabilité que la production affiche sous un régime de change susceptible de s'effondrer et sa variabilité sous différents régimes de changes fixes ou flottants. C'est en régime de changes flottants que la production se révèle le plus stable. Les auteurs simulent un scénario dans lequel le Mexique laisse flotter sa monnaie; le taux de change fictif utilisé est élaboré à partir des cours du peso observés sur le marché parallèle. La principale conclusion des auteurs est que, si le Mexique avait eu un taux de change flottant au cours des deux dernières décennies au lieu d'une succession de régimes de change qui se sont tous écroulés, la variance de la production réelle aurait été réduite de moitié.

1. Introduction

The recent rash of currency crises and fixed exchange rate collapses in Latin America and East Asia provides ample evidence that the typical fixed or pegged exchange rate regime is virtually impossible to sustain in a world of liberalized financial flows, small transactions costs, and large pools of mobile capital.[1] These crises have had significant real costs in terms of lost output and employment because of tighter monetary and fiscal policies and because of widespread financial distress due to the halt in capital inflows and higher debt payments.[2] Thus, for countries vulnerable to such crises, the crucial policy decision lies in choosing an alternative exchange rate regime to avoid such disruptions in the future.[3] Currency boards or common currencies are often put forward as appropriate alternative regimes (for example, Argentina and the European Union). However, in this paper, we demonstrate theoretically and empirically that these countries should look instead to the opposite end of the exchange rate spectrum—and adopt a flexible exchange rate. A flexible exchange rate would provide greater macroeconomic stability in the face of capital flow and export demand shocks.[4]

As an illustration of this argument, consider Mexico's recent experience. Over the last 25 years, it has had a series of controlled exchange rate regimes—fixed, crawling peg, dual, and target zone—all of which ended in crises and collapses.[5] Each of the major crises over this period—August 1976, February and March 1982, July to November 1985, November 1987, and December 1994—was followed by a significant decline in economic growth. (See Figure 6.) Although the factors responsible for these collapses have been described in detail elsewhere, it is important to note that external shocks to goods and asset markets in the form of oil price changes, capital flow shifts, or interest rate changes played key roles.[6] The typical boom and bust cycle in Mexico over this period began with a favourable external shock, for example, an increase in oil exports (following a discovery or an oil price increase), a fall in world interest rates, or a liberalization of trade or capital flows. This shock was normally followed by large capital inflows, increased fiscal expenditures (typically deficit financed), an expansion of the domestic money supply, higher inflation, and an appreciation of the real exchange rate. However, this process eventually became unsustainable, especially if the initial favourable shock was reversed or another adverse shock struck. A smooth adjustment of the real exchange rate, however, was precluded by the combination of the

---

1. Obstfeld and Rogoff (1995) argue persuasively that, although a fixed exchange rate regime is technically feasible for most countries, it is not politically viable because it may require the subversion of other important macroeconomic goals, chiefly stable employment and output growth.
2. For example, output in Mexico fell by 6.2 per cent in 1995 after averaging 3.5 per cent growth in the previous four years. Osakwe and Schembri (1998) provide an overview of recent crises and their output effects.
3. Laidler (1999) argues that the appropriate comparison is not among alternative exchange rate regimes per se, but among alternative monetary orders. We agree with Laidler as well as Obstfeld and Rogoff (1995) that a flexible exchange rate regime should be accompanied by a low inflation target for it to be a superior alternative to a fixed exchange rate.
4. Other authors have also emphasized the advantages of a flexible exchange rate regime. For example, Meigs (1997) argues that, if Mexico had adopted a flexible exchange rate regime, there would have been no peso crisis in 1994–95.
5. For an overview of Mexico's recent controlled exchange rate regimes and their collapses, see Otker and Pazarbasioglu (1996).
6. For example, see Cardoso and Levy (1988), Dornbusch (1988), Aspe (1993), Dornbusch and Werner (1994), Calvo and Mendoza (1996), Gavin (1996), Edwards (1997), and Werner (1998).

government's commitment to the controlled nominal exchange rate and the downward stickiness of prices and wages. So the economy was stuck with an overvalued real rate, which generated the expectation of a future devaluation and consequent increase in the price of foreign goods. This in turn fuelled an import boom and a flight of capital that reduced the foreign reserves of the central bank and eventually precipitated the collapse. Had the government instead adopted a flexible exchange rate, the favourable external shock and the resulting capital inflows would have appreciated the exchange rate; this would have reduced aggregate demand and the incentive to borrow. Similarly, when circumstances reversed, a depreciation would have occurred, thus avoiding the severe contractionary effects of a crisis and an exchange rate collapse.

The paper is divided into two parts. First, a theoretical model is derived under assumptions appropriate for countries like Mexico that have experienced such crises. Using the model, we then show that, in terms of minimizing the variability of real output, a flexible exchange rate regime dominates a fixed exchange rate that may collapse, as well as a permanent fixed regime (like a currency board). In the second part, a counterfactual empirical exercise is performed, using data for Mexico. This exercise indicates that, if Mexico had adopted a flexible rate over the last 20 years rather than a series of controlled exchange rate regimes, the volatility of real output would have been substantially less.

2. Theoretical framework

2.1 The basic model

The model presented here is a modified version of Flood and Hodrick's (1986) model. Both are stochastic versions of the familiar Dornbusch (1976) model in which prices of goods are predetermined and output is demand determined.[7] The exchange rate and interest rate, however, adjust immediately to clear domestic money and international bond markets. The economy is said to be "medium-sized" because movements in the exchange rate alter the foreign price of its goods. The two main differences between this model and the Flood and Hodrick (FH) model are that the income elasticity of money demand is positive and the response of aggregate demand to changes in the interest rate is negative. In the FH model, both these key parameters are set to zero. These modifications have significant implications for comparing the real effects of alternative exchange rate regimes. A positive income elasticity of money demand opens the standard channel through which a flexible exchange rate can stabilize output in the face of shocks to aggregate demand. For example, a negative demand shock such as a fall in exports will reduce aggregate demand, output, and money demand, thereby causing the interest rate to fall and the exchange rate to depreciate. This makes domestic goods more competitive.

7. Blanco and Garber (1986) and Goldberg (1991) use similar models in their analyses of Mexican currency crises.

The introduction of the domestic interest rate into the aggregate demand equation is important because it captures the channel through which international capital flows can affect output. It is widely held that large and potentially volatile capital flows are a contributing factor in many currency crises, including the Mexican crisis of 1994. Under a fixed exchange rate, the central bank cannot completely sterilize the impact of capital flows on the domestic money supply. Thus large capital inflows will generally expand the money supply, lowering interest rates and raising aggregate demand.[8] In contrast, under a flexible exchange rate, such an inflow would cause the exchange rate to appreciate, mitigating the impact of the capital inflow on demand and output. To represent capital flow shocks, the foreign interest rate is assumed to be stochastic; that is, a negative shock to the foreign interest rate is assumed to generate a capital inflow.[9]

Therefore, the motivation for introducing these modifications to the FH model is to permit a reasonable comparison of exchange rate regimes under circumstances in which external shocks to aggregate demand and capital flows are large and pervasive.[10] Indeed, such shocks would be most important for the types of countries that most often experience currency crises—smaller open economies that are dependent on foreign capital, such as Mexico.[11]

The theoretical model consists of the following equations, with all variables except the interest rate in logarithms:

$$m_t^d - p_t = -\alpha i_t + \gamma y_t \tag{1}$$

$$i_t = i_t^* + E_t s_{t+1} - s_t \tag{2}$$

$$y_t = \beta(p_t^* + s_t - p_t) - \lambda i_t + u_t \tag{3}$$

$$\beta(p_t^* + E_{t-1} s_t - p_t) - \lambda E_{t-1} i_t + E_{t-1} u_t = \bar{y} \tag{4}$$

---

8. Because capital flows increase the liquidity of the banking system, they could more directly affect aggregate demand by reducing credit constraints on higher risk borrowers.

9. Instead of making the foreign interest rate stochastic, a stochastic risk premium term could be included in the interest rate parity relation to capture, for example, shifts in investor confidence. Such a change, however, would not alter the basic results, only their interpretation.

10. Werner (1998) finds that a substantial portion of capital inflows to Mexico over the period 1988–1998 can be explained by movements in U. S. interest rates.

11. Our main interest in this paper is to compare the variability of output across exchange rate regimes in an economy faced with capital flow and export (or aggregate) demand shocks because such shocks are critical to open economies that are vulnerable to exchange rate crises. Therefore, to simplify the exposition, shocks to foreign prices and shocks to the government's borrowing requirements, which would be represented as shocks to domestic credit creation, are omitted. These shocks are included in the FH model. The foreign price shock, like an aggregate demand shock, would bias the results in favour of a flexible exchange rate. The domestic credit shock would have the opposite impact because it affects the domestic money supply, interest rate, and exchange rate. Hence, a flexible exchange rate would transmit the effect of the monetary shock to the real economy. Including this shock, therefore, would make our results more ambiguous.

$$m_t^s = \omega d_t + (1-\omega) r_t \quad (5)$$

$$d_t = \mu + d_{t-1} \quad (6)$$

$$i_t^* = i^* + x_t \quad (7)$$

The demand for real money balances, $m_t^d - p_t$, represented by equation (1), depends on the nominal interest rate, i_t, and real output, y_t. Equation (2) is the uncovered interest rate parity condition linking the domestic interest rate to the foreign interest rate, i_t^*, and the expected rate of depreciation, $E_t s_{t+1} - s_t$. Aggregate demand and output in equation (3) depend positively on the relative price of foreign to home goods, and negatively on the nominal interest rate. u_t is an aggregate demand shock, most likely due to shifts in export demand or government spending. Equation (4) describes the process of domestic price determination. At time $t-1$, the domestic price for period t is set in such a way that expected demand is equal to full employment output, $\bar{y}$. Equation (5) is a log-linear approximation to the central bank's balance sheet identity, where m_t^s is the monetary base, d_t is domestic credit, and r_t is net foreign reserves. Equation (6) describes the process of domestic credit creation. Domestic credit is assumed to grow at a constant rate, μ. The evolution of the foreign interest rate is represented by equation (7), where i^* is constant. The shocks u_t and x_t have zero means, are mutually and serially uncorrelated, and have constant variances, σ_u^2 and σ_x^2, respectively.[12]

2.2 Permanent exchange rate regimes

In a permanently flexible exchange rate regime with no central bank intervention, the exchange rate is endogenous and the level of international reserves exogenous. Using the money market equilibrium condition $m_t^d = m_t^s$ and the fact that $r_t = \bar{r}$ in a flexible exchange rate regime, we obtain from the model a first-order stochastic difference equation that can be solved for the flexible exchange rate, using the method of undetermined coefficients. The solution is:

$$s_t = k_0 + k_1 p_t^* + k_2 d_{t-1} + k_3 x_t + k_4 u_t \quad (8)$$

12. Allowing the two shocks to be correlated would complicate the analysis and produce few additional insights.

where,

$$k_0 = (1 + \alpha + \lambda/\beta)\omega\mu + (1 - \omega)\bar{r} + (\alpha + \lambda/\beta)i^* \tag{9}$$

$$k_1 = -1 \tag{10}$$

$$k_2 = \omega \tag{11}$$

$$k_3 = (\alpha + \gamma\lambda)/(\alpha + \gamma\lambda + \gamma\beta) \tag{12}$$

$$k_4 = (-\gamma)/(\alpha + \gamma\beta + \gamma\lambda)\,. \tag{13}$$

Equations (8) to (13) show that an increase in the price of foreign goods or a positive demand shock leads to a nominal and real exchange rate appreciation; an increase in (lagged) domestic credit and a foreign interest rate shock (consistent with a capital outflow) have the opposite effect.[13] Note that the movement of the exchange rate in response to the demand and interest rate shocks would tend to mitigate the effect of these shocks on output.

To explore the variability of output across exchange rate regimes, we follow Flood and Hodrick (1986) and consider the conditional variance of real output, $V_{t-1}(y_t) = E_{t-1}(y_t - E_{t-1}y_t)^2$, as a measure of output variability. To simplify the analysis, we assume that $E_{t-1}y_t = \bar{y} = 0$. This assumption and the definition of real output in equation (3) gives the following expression for the conditional variance of real output under a permanently flexible exchange rate regime:

$$\begin{aligned} V_{t-1}(y_t)\big|_{Flex} = {} & (\beta + \lambda)^2 V_{t-1}(s_t) + \lambda^2 V_{t-1}(x_t) + V_{t-1}(u_t) \\ & - 2(\beta + \lambda)\lambda C_{t-1}(s_t;x_t) + 2(\beta + \lambda)C_{t-1}(s_t;u_t) \end{aligned} \tag{14}$$

where $C_{t-1}(s_t;x_t)$ is the conditional covariance between the exchange rate and the foreign interest rate shock and $C_{t-1}(s_t;u_t)$ is the conditional covariance between the exchange rate and the demand shock. Thus, under a permanently flexible exchange rate regime, the variance of real output consists of the variance of the exchange rate, the variance of the foreign interest rate shock, the variance of the demand shock, the covariance between the exchange rate and the demand shock, and the covariance between the exchange rate and the foreign interest rate shock.

13. Under a fixed exchange rate regime, the exchange rate is exogenous but the level of reserves is endogenous. In principle, the model can be solved for the path of reserves in the fixed exchange rate system.

In a permanently fixed exchange rate regime, the variance of the exchange rate as well as the covariances between the exchange rate and the foreign interest rate and the demand shocks are zero. Therefore, the variance of real output under a permanently fixed exchange rate regime is simply,

$$V_{t-1}(y_t)\big|_{Fix} = \lambda^2 V_{t-1}(x_t) + V_{t-1}(u_t). \quad (15)$$

Given that the covariances between the flexible exchange rate and the two shocks are negative, it is not obvious from a comparison of equations (14) and (15) which exchange rate regime would generate a lower conditional variance for real output.

To explore this ambiguity further, we employ the solution for the flexible exchange rate, given by equations (8) to (13), and the definitions of the variances of the shocks to compute the variance of real output under both exchange rate regimes. This yields:

$$V_{t-1}(y_t)\big|_{Flex} = [\alpha/(\alpha + \gamma\lambda + \gamma\beta)]^2(\beta^2\sigma_x^2 + \sigma_u^2) \quad (16)$$

$$V_{t-1}(y_t)\big|_{Fix} = \lambda^2\sigma_x^2 + \sigma_u^2. \quad (17)$$

Comparing equations (16) and (17), it is now clear that we cannot say with certainty which regime has a higher output variance. If the only shock in the economy is a real demand shock, the flexible exchange rate regime has less volatile real output than the fixed exchange rate regime because the expression in square brackets in equation (16) is less than one. With *both* a foreign interest rate shock and a real demand shock, a sufficient but not necessary condition for the flexible exchange rate regime to have a lower real output variance is $\beta < \lambda$.[14] This condition guarantees that the covariance terms in equation (14) dominate the variance of the exchange rate. Thus, the variance of real output under a flexible exchange rate regime is less than the variance of real output under a permanently fixed exchange rate regime. Figure 1 plots the conditional variance of output as a function of λ for permanently fixed and flexible exchange rate regimes under different assumptions about the relative magnitudes of the money demand parameters (α and γ).[15] When α is less than or equal to γ, the conditional variance of output is lower under a flexible exchange rate regime for all positive values of λ. However, when α is greater than γ, the value of λ determines the exchange rate regime with higher output variance. In particular, for values of λ very close to zero, the conditional variance of output under a flexible exchange rate regime will be greater than that under a permanently fixed exchange rate regime. However, as λ increases, the conditional variance of out-

14. Intuitively, this condition is appealing because, under a permanently fixed exchange rate regime, the domestic and foreign interest rates are equal. Thus, any shock to the foreign interest rate will affect the domestic interest rate one for one and through λ, the variability of aggregate demand and output. Under a permanently flexible exchange rate, however, foreign interest rate shocks affect aggregate demand indirectly through the exchange rate, via β.

15. In the simulations, we used the same values for the parameters as Flood and Hodrick (1986).

put under a flexible exchange rate regime decreases while that of the permanently fixed exchange rate regime increases.

Figure 2 shows the relationship between the variance of output and λ for different relative variances of the aggregate demand and foreign interest rate shocks. It shows that, when the foreign interest rate shock is relatively more important than the demand shock, the value of λ determines the exchange rate regime with the lower output variance. For very low values of λ, the variance of output under a flexible exchange rate regime is higher than under a fixed exchange rate regime. Similarly, when the demand shock is relatively more important than the foreign interest rate shock, the variance of output under a flexible exchange rate regime is lower than that of a fixed exchange rate regime. Clearly, these plots (Figures 1 and 2) show that setting γ and λ equal to zero—which is the case studied by Flood and Hodrick—biases the result in favour of the fixed exchange rate regime.

2.3 Collapsing exchange rate regimes

So far, we have assumed that the fixed exchange rate regime lasts forever. However, experience with fixed exchange rate regimes shows that they are vulnerable to speculative attacks and are often abandoned a few years after the inception of the regime.[16] To incorporate this idea into the analysis, we assume that the fixed exchange rate is temporary and obtain the conditional variance of real output under this assumption. When forming expectations about future exchange rates, agents take into consideration the positive probability that the peg might collapse some years into the future. To obtain this probability, we need to determine the flexible exchange rate that will prevail if the peg is abandoned, that is, the shadow flexible exchange rate.[17] To obtain an expression for the shadow flexible rate, suppose that the central bank abandons the peg if reserves reach a minimum level, $\tilde{r}$. Given this lower bound on reserves, we can show that the shadow flexible rate $\tilde{s}_t$ is:

$$\tilde{s}_t = \tilde{k}_0 + k_1 p_t^* + k_2 d_{t-1} + k_3 x_t + k_4 u_t, \tag{18}$$

where k_1, k_2, k_3, and k_4 are as defined earlier and,

$$\tilde{k}_0 = (1 + \alpha + \lambda/\beta)\omega\mu + (1-\omega)\tilde{r} + (\alpha + \lambda/\beta)i^*. \tag{19}$$

An attack is profitable when the shadow flexible rate is greater than the fixed rate. Therefore, the probability of a successful speculative attack is the probability that the shadow flexible

16. Obstfeld and Rogoff (1995) examine the duration of exchange rate pegs across countries.
17. We are assuming, as is common in the speculative attack literature, that when the peg is abandoned the economy moves to a floating exchange rate regime (see Krugman [1979]; Flood and Garber [1984]; and Agenor, Bhandari, and Flood [1992]).

rate will be greater than the fixed rate, that is, $\pi_{t-1} = Prob_{t-1}(\tilde{s}_t > \bar{s})$. Using the definition of the shadow flexible rate in equation (18), it can be shown that

$$\pi_{t-1} = Prob_{t-1}(\psi_t > v_{t-1}), \tag{20}$$

where $\psi_t = k_3 x_t + k_4 u_t$ and $v_{t-1} = \bar{s} - \tilde{k}_0 - k_1 p_t^* - k_2 d_{t-1}$. Given π_{t-1}, the expectation at time $t-1$ of the exchange rate at time t is a weighted average of the exchange rate when the peg is abandoned (the value of the shadow flexible rate) and when it is not abandoned (the current fixed exchange rate). The precise expression is

$$E_{t-1}s_t = (1-\pi_{t-1})\bar{s} + \pi_{t-1}E_{t-1}(\tilde{s}_t | C_t), \tag{21}$$

where $E_{t-1}(\tilde{s}_t | C_t)$ is the expectation at time $t-1$ of the exchange rate at time t conditional on a collapse at time t. The conditional variance of output under a fixed exchange rate regime that may collapse can be expressed as

$$\begin{aligned} V_{t-1}(y_t)\big|_{CFix1} = {} & (\beta+\lambda)^2 E_{t-1}(s_t - E_{t-1}s_t)^2 + \lambda^2\sigma_x^2 + \sigma_u^2 - \\ & 2(\beta+\lambda)[\lambda E_{t-1}(s_t x_t) - E_{t-1}(s_t u_t)] \end{aligned} . \tag{22}$$

For empirical purposes, a second definition of the conditional variance of output under a collapsing fixed exchange rate regime is useful. This is the conditional variance of output in a regime that is expected to collapse but has not collapsed yet. Intuitively, this variance would be estimated using a sample of observations for an exchange rate regime that eventually collapses, but the sample does not actually include the point of the collapse.

This is represented by

$$V_{t-1}(y_t)\big|_{CFix2} = (\beta+\lambda)^2 E_{t-1}(\bar{s}_t - E_{t-1}s_t)^2 + \lambda^2\sigma_x^2 + \sigma_u^2. \tag{23}$$

An estimate of the first definition (22) can be interpreted as an estimate of the asymptotic conditional variance of output under the collapsing regime; an estimate of (23) can be viewed as the small sample estimate. These interpretations are considered further below.

For tractability and ease of comparison, we follow Flood and Hodrick (1986) and report the conditional variance of output under the different exchange rate regimes when ψ_t is uniformly distributed. With a uniform distribution,

$$\begin{aligned} f(\psi_t) &= 1/2\eta, \qquad -\eta \le \psi_t \le \eta \\ &= 0 \qquad\qquad \text{otherwise} \end{aligned} \tag{24}$$

where the unconditional mean and variance as well as the probability density function of the random variable ψ_t are zero, $\eta^2/3$ and $f(\psi_t)$ respectively. Given the uniform distribution assumption, the probability of a speculative attack and an exchange rate collapse can be expressed as

$$\pi_{t-1} = (\eta - v_{t-1})/(2\eta), \qquad -\eta \le v_{t-1} \le \eta. \tag{25}$$

The conditional variance of output under a fixed exchange rate that may collapse is, therefore,

$$\begin{aligned} V_{t-1}(y_t)\big|_{CFix1} = {} & (\beta+\lambda)^2[-(\eta - v_{t-1})^4/(16\eta^2) + (\eta^3 - v_{t-1}^3)/(6\eta) - v_{t-1}(\eta - v_{t-1})/2] \\ & - 2(\beta+\lambda)(\eta - v_{t-1})/(2\eta)[\lambda k_3\sigma_x^2 - k_4\sigma_u^2] + \lambda^2\sigma_x^2 + \sigma_u^2 \end{aligned} \tag{26}$$

The conditional variance of output under a fixed exchange rate regime that is expected to collapse but has not collapsed yet is

$$V_{t-1}(y_t)\big|_{CFix2} = (\beta+\lambda)^2[(\eta - v_{t-1})^4/16\eta^2] + \lambda^2\sigma_x^2 + \sigma_u^2. \tag{27}$$

The conditional variance of output under a permanently flexible exchange rate for the uniform distribution is

$$V_{t-1}(y_t)\big|_{Flex} = (\beta+\lambda)^2\eta^2/3 + [\lambda^2 - 2\lambda k_3(\beta+\lambda)]\sigma_x^2 + [1 + 2k_4(\beta+\lambda)]\sigma_u^2. \tag{28}$$

To compare the variance of output under the different exchange rate regimes, we compute the variances for different values of v_{t-1}. Because v_{t-1} determines the probability of a collapse π_t through equation (25), we can also compute these variances for different values of π_t. Figure 3 shows the relationship between the probability of a collapse and the conditional variance of output under the different exchange rate regimes. The first panel shows that the variance of output in a fixed exchange rate regime that is expected to collapse (cfix1) lies between the variance of output in a flexible exchange rate regime and the variance of output in a permanently fixed exchange rate regime. In particular, for low (high) probabilities of collapse, the variance of output under a collapsing fixed exchange rate regime is close to the variance of output under a permanently fixed (flexible) exchange rate regime. The variance of output under this collapsing regime is essentially a weighted average of the variances under the two permanent regimes, with the weights being a monotonic but non-linear function of the probability of collapse.

The second panel shows that the variance of output under a fixed exchange rate regime that is expected to collapse but has not collapsed yet (cfix2) is greater than the variance of output in the permanently fixed and flexible exchange rate regimes. This is a consequence of the fact that, under a fixed exchange rate regime that is expected to collapse but has not collapsed yet, prediction errors increase as the probability of a collapse increases. These prediction errors, therefore, generate a price level that is relatively far from the one that would equate aggregate demand to the full employment level of output in equation (4). For example, if a collapse is expected—which implies the exchange rate will depreciate—then the domestic price level will be set higher to equate aggregate demand to the full employment level of output. But if the collapse does not occur, then the output gap will be positive and the trade balance will be reduced. Thus, the larger the prediction errors for the exchange rate, the greater the conditional variance of output. This result corresponds to the observation that just before a collapse—that is, when the probability of a collapse is high—many economic variables are far from their long-run equilibrium values. For example, domestic output is slumping, imports are increasing, and the trade balance deficit appears unsustainable.

The difference between these two variances of output under a collapsing rate is considered further in the empirical section of the paper as it is useful for interpreting the results from the counterfactual exercise.

3. Counterfactual exercise

3.1 Empirical implementation of theoretical model

In this section, we test the theoretical model by conducting a counterfactual exercise using monthly Mexican data from 1972 to 1995. The main implication or hypothesis of the theoretical model is that, under a flexible exchange rate regime, the conditional variance of real output would be less than under controlled exchange rate regimes that eventually collapse. A flexible exchange rate will serve to stabilize real output in the face of external demand and capital flow shocks, will prevent large disequilibrium deviations in relative prices and output, and will avert the contractionary effects associated with exchange rate crises and collapses.

To test this hypothesis, we follow the theoretical model and compare estimates of the conditional (rather than the unconditional) variances of Mexican real output under the historical controlled exchange rate regimes and under a counterfactual flexible exchange rate regime. The comparison of conditional variances is appropriate because a comparison of the estimated unconditional variance of historical real output to the estimated variance of a generated real output series under the shadow flexible rate would necessarily be biased. The former unconditional variance would include the variance of output due to unexpected shocks. However, in the counterfactual case, the estimated variance would be a conditional variance and thus would not incorporate the variability due to such shocks. To see this, consider the following equation, $y_t = E_{t-1}y_t + \varepsilon_t$, where ε_t is the forecast error due to unexpected shocks. Historical output would be y_t and the counterfactual estimate of output under the shadow flexible rate obtained using a regression model would be $E_{t-1}y_t$.

The counterfactual flexible exchange rate in the theoretical model is the shadow flexible rate. For the estimation, we will use an adjusted black or parallel market exchange rate as a proxy for the shadow flexible rate over this period.[18] Over the sample period, both black and legal parallel foreign exchange markets were in existence. However, the legal parallel market came into existence sometime in the latter half of the 1980s. In addition, there were periods in the sample in which an official "free market" exchange rate existed. However, its accuracy as a proxy for a shadow flexible exchange rate is not obvious because the degree of government control is uncertain. The exchange rate data used to measure the shadow flexible rate is obtained from sampling both black and legal parallel markets. For simplicity, this rate will be referred to as the parallel market rate because it encompasses both illegal black and legal parallel market rates.

To obtain sample estimates of the conditional variances of output under the two regimes, a vector autoregression (VAR) model is estimated. It is used to obtain one-period-ahead forecasts of real output by applying the Kalman filter. To perform the counterfactual exercise, the parallel market exchange rate is used to calculate the real exchange rate. The conditional variances are estimated with the sample variances calculated from the one-period-ahead forecasts of output under the two regimes.

An important issue is the interpretation of the estimated conditional variance of real output under the historical controlled exchange rate regimes. In particular, is it an estimate of $V_{t-1}(y_t)|_{CFix1}$ or $V_{t-1}(y_t)|_{CFix2}$, or some combination of the two? Clearly, while there are five major collapses in the sample, this number may not be sufficient to represent the underlying distribution from which agents base their forecasts of the collapse of the controlled regime. This issue is essentially another example of the "peso problem" in which the sample may be too small to consistently estimate the probability distribution of a collapse. The sample contains roughly 300 monthly observations and includes only five major collapses. It is therefore likely that our estimate of the conditional variance under the historical controlled regime is an estimate of some combination of the two conditional variances for a collapsing fixed regime derived in the theoretical model. Thus, from Figure 3, the theoretical model predicts that the estimate of the conditional variance of output under the historical controlled regime should be much larger than under the counterfactual flexible regime.

A key assumption in the counterfactual exercise is that monetary policy would not have changed under a flexible exchange rate regime. Two arguments could be made to support this assumption. First, the driving force behind Mexican monetary policy over this period was the financing of fiscal deficits. It is unlikely that the course of fiscal policy would have been significantly altered had Mexico been on a floating exchange rate. Second, under a flexible exchange rate regime, monetary policy is less constrained by the need to maintain the controlled exchange rate. Thus it can be used to offset macroeconomic shocks and limit the variability of output. Hence, by

18. Grosse and Pechman (1994) define a black market for foreign exchange as an illegal market that operates parallel to the official market. They also provide an overview of the recent operation of these markets in Latin America.

assuming monetary policy would not have changed under a flexible rate, we are biasing the results of the counterfactual exercise against the hypothesis that a flexible exchange rate would have reduced the variability of output.[19]

3.2 Data

This section reviews some of the more interesting issues surrounding the data used for the counterfactual exercise. A detailed description of the data and their sources is given in the Data Appendix. Our original intention was to employ monthly data on Mexico for a period beginning in the late 1960s or early 1970s, estimate the model until the end of 1975 (a period of relative economic stability) to obtain starting coefficient values, and then use the Kalman filter to generate forecasts of output from 1976 onwards. Thus, the forecast period would encompass the five major collapses in the Mexican peso. Unfortunately, the quality of the Mexican data available prior to 1975 is poor relative to that in the rest of the sample. We were therefore forced to alter the estimation period from 1973 to 1977 and apply the Kalman filter over the remainder.

The key variable for the counterfactual exercise is the parallel market exchange rate series because it is used to proxy the shadow flexible exchange rate. The controlled and parallel market real exchange rate series are plotted in Figure 4. Before 1976, the two series are virtually identical, primarily reflecting the relative stability of the Mexican economy, especially the low inflation rate, over this period. However, after 1976, the parallel market rate series is much more variable. Although variability in a flexible free market rate is not unexpected and is presumed in the derivation of the theoretical results, the sources of this variability need to be considered because the parallel market exchange rate is an imperfect measure of the shadow flexible rate.

The parallel market rate moves not only when the underlying shadow flexible rate changes, but also when transactions costs of dealing in the parallel market vary. Although both types of parallel markets for U.S. dollars—illegal (black) and legal—have existed in Mexico at different times over the period of this study, the levels of activity in each market and the premiums over the official rate have varied. In particular, the black market was most active during the period in which Mexico adopted a comprehensive set of foreign exchange controls in August 1982, which restricted private sector access to foreign exchange.[20] These controls were lifted in November 1991. From Figure 4, it appears that the impact of these controls was to raise the parallel market premium, although the controls also coincided with a relatively unstable period in Mexico's economic history. Thus, for

19. A counter-argument could be made that, by removing the disciplining impact of a fixed exchange rate, the monetary authorities would have managed monetary policy under a flexible rate in a manner that would have destabilized output. However, there is no clear evidence that a fixed exchange rate regime actually serves as a disciplining device, especially in countries like Mexico that have experienced several exchange rate crises, primarily due to inflationary monetary policy.

20. It is important to note that illegal black markets are often less liquid than legal markets. Thus, part of the reason for the variability of the parallel market exchange rate during the foreign exchange controls period may have been the lack of liquidity in the black market. We do not attempt to model this effect because we have no information on trade volumes in the black market.

the parallel market rate to be used as a measure of the shadow flexible rate, it will be necessary to adjust this rate to reflect the transactions costs associated with these controls.

We also observe from Figure 4 that, in the periods before and after the foreign exchange controls, the parallel market and controlled rates are reasonably close. These periods were marked by relative economic stability, a more flexible official exchange rate, and in the latter period, the existence of a legal parallel market among exchange houses. However, it is more significant for the purpose of the counterfactual exercise that, during these episodes, the parallel market exchange rate is never below the controlled rate. In other words, this rate never has an appreciated value relative to the controlled rate. This censoring of the series is a result of using the parallel market rate to proxy the shadow flexible rate. In theory, it is likely that the shadow flexible exchange would be below the controlled rate for extended periods of time. (Recall that, in the theoretical model, a speculative attack takes place only when the shadow flexible rate exceeds the fixed rate.) In practice, however, foreign exchange dealers in a black or parallel market would never sell foreign currency for less than the official controlled rate because they could always sell the foreign currency to a bank at the higher official rate. The parallel market exchange rate is a potentially reasonable measure of the shadow flexible rate only when the shadow flexible rate is at or exceeds the official controlled rate. Therefore, a further adjustment of the parallel market exchange rate is necessary so that it would reflect the shadow flexible rate more accurately during periods in which the flexible rate might have an appreciated value relative to the controlled official rate.

To perform these adjustments, the percentage spread between the parallel market rate and the controlled rate (the parallel market premium) is regressed on the following independent variables: two dummy variables for the foreign exchange control period (the controls were less binding for the period March 1990 to November 1991), the change in reserves of the Bank of Mexico and the trade balance. As noted above, the period of the controls was one of economic instability in Mexico. Therefore, simply regressing the spread on the control dummies would have biased upwards the impact of the controls on the premium. Thus, the percentage rate of change in reserves is included because, according to the theoretical model, reserves fall when the shadow flexible rate is above the controlled rate. The trade balance is also included because it provides additional information about the equilibrium exchange rate, especially since the reserve series is relatively noisy.

The regression is estimated over periods in the sample in which the parallel market premium is relatively large and persistent (i.e., greater than 2 per cent for three months or more). Using the whole sample period would have produced biased estimates because of the censored data problem discussed earlier. The regression results are given in Table 1. All of the estimated coefficients have the expected signs. Foreign exchange controls increased the premium while movements in reserves and the merchandise trade balance are inversely related to it. In addition, all the estimated coefficients, except those for the foreign exchange control dummy variables, are statistically significant. As noted, multi-colinearity may have reduced their significance. However, there are strong economic arguments that these controls should be reflected in the premium; indeed, the coefficient estimates indicate they are responsible for approximately 2 to 3 percentage points of the spread. This estimate of the impact of the controls seems plausible, although perhaps a little low, given that the average premium is 22.5 per cent over the economically unstable period of controls, as opposed to 2.8 per cent when the controls were not in place.

These regression results were employed to adjust the parallel market exchange rate as an estimate of the shadow flexible rate in two ways. First, the impact of the foreign exchange controls was removed using the estimated coefficients on the dummy variables. Second, fitted values generated by the regression equation were used to estimate the shadow flexible rate during periods in which the shadow flexible rate may have had an appreciated value relative to the controlled rate.

Figure 5 shows the adjusted parallel market or estimated shadow flexible rate. Unlike the parallel market rate, the estimated shadow flexible rate has an appreciated value relative to the controlled rate in the late 1970s and early 1990s, which were periods of significant capital inflows. Also, the estimated shadow exchange rate has three dramatic peaks in the 1980s around crisis periods in which the controlled rate was collapsing. We will return to this point in the next section when we discuss the results of the counterfactual exercise.

3.3 Counterfactual results

To perform the counterfactual exercise, we employ a VAR model consisting of two equations, one for Mexican output (measured by the cyclical component of industrial production), and one for the real exchange rate (the nominal rate, controlled or flexible), double deflated by Mexican and U.S. consumer price indices.[21] The two real exchange rate series and the output series are displayed in Figures 5 and 6. The output series is highly variable, although the recessions associated with the 1976, 1982, 1985, 1987, and 1994 crises are clearly evident. The flexible real exchange rate is not only more variable than the controlled rate but experiences extreme values during these crisis periods. This is a potential problem because it is not clear the flexible rate would have behaved in this manner without the crises. These extreme values primarily reflect the flight into U.S. dollar assets during the crises and the possible lack of liquidity in the parallel markets.

Because the data used in the estimation are monthly, 12 lags of each of the two endogenous variables are included to allow for possible J-curve effects in the relationship between output and the real exchange rate in order to dissipate and to capture any remaining seasonal effects. The exogenous variables included in the model are measures of Mexican fiscal policy (the fiscal deficit as a percentage of nominal GDP) and monetary policy (domestic credit of the banking system as a percentage of nominal GDP), U.S. output and short-term real interest rates, and the real price of oil. One lag of each of these variables is also included.

21. An equation for the Mexican interest rate was not included in the model because a consistent data series for this variable is not available. The cyclical component of output was obtained using a Hodrick-Prescott filter.

To obtain starting values for the Kalman filter, the VAR model is estimated over the period, 1973:1 to 1977:12, using the controlled real exchange rate series for the real exchange rate variable. These results are summarized briefly in Table 2. The Kalman filter was then applied for the period 1978:1 to 1995:12 to generate forecasts of real output under both the historical controlled exchange rate regime and the counterfactual flexible exchange rate regime. The resulting two series are shown in Figure 7. From this graph, it is clear that forecasted output under the counterfactual flexible rate regime is much less variable than under the controlled rate regime. Sample variances of these forecasts were calculated to estimate the conditional variance of output under the two regimes. These are given in Table 3. The estimated conditional variance of output under the counterfactual flexible exchange rate regime is approximately half of that under the controlled regime over the entire forecast period. This difference increases when the crisis periods are removed because the impact of the extreme values of the flexible exchange rate are reduced. Both these differences are found to be statistically significant at the 1 per cent level, using the standard two-population F-test for the equality of variances.[22]

In summary, strong evidence is found to support the main hypothesis of the theoretical model that a flexible exchange rate would generate less variable output than a collapsing controlled rate. However, counterfactual empirical exercises are always subject to criticism. In this case, the two most serious concerns are the accuracy of our adjusted parallel market rate as a proxy for the shadow or counterfactual flexible exchange rate and a Lucas-type critique of the impact of a change in regimes. With respect to the first problem, although alternative adjustments to the parallel rate could be made or flexible rate proxies other than the parallel market rate could be tried, they are unlikely to reverse the strong results that we have obtained. Moreover, we have argued that a flexible exchange rate would probably have generated fiscal and monetary policy that stabilized output to a greater degree. By leaving fiscal and monetary policy unchanged, we have biased the counterfactual exercise against the flexible exchange rate case. In addition, the empirical model does not fully capture the large negative impact on output of a crisis and collapse of the controlled rate. As a rough measure of this effect, we could compare the variance of forecasted output under the counterfactual flexible rate regime to actual (not forecasted) output under the controlled rate regime. Over the entire sample period, actual output is seven times more variable than forecasted output under the counterfactual regime. Therefore, while the Lucas-type critique has merit, it is unlikely to upset the qualitative results of the counterfactual exercise.

22. Note that this test requires that the populations from which the samples are drawn be normally distributed. To check the robustness of our results to the normality assumption, we performed two non-parametric tests, the Ansari-Bradley and Moses tests. In both cases, we were able to reject the null hypothesis, that the controlled regime has a lower output variance than the flexible regime, at the 1 per cent significance level.

4. Concluding remarks

Our theoretical model demonstrates that, for an economy facing capital flow and export demand shocks, the variability of output will generally be less under a flexible exchange rate regime than under a collapsing fixed exchange rate regime and, in most circumstances, under a permanent fixed exchange rate regime. These results depend primarily on the relative magnitude of shocks and the response of aggregate demand to changes in the interest rate. In particular, when the capital flow (foreign interest rate) shock is relatively more important than the demand shock, the response of aggregate demand to changes in the interest rate determines the exchange rate regime with a lower output variance. If this response is small (close to zero), the flexible exchange rate regime has a higher output variance. If the response is large, the fixed exchange rate regime has a higher output variance. However, when the demand shock is relatively more important than the foreign interest rate shock, a flexible exchange rate will generally dominate a permanent fixed rate in terms of generating a lower variability of output. Moreover, if there is a possibility that the fixed exchange rate could collapse, the case for a flexible exchange rate is stronger. This is because a collapsing fixed exchange rate regime that has not collapsed yet has a higher output variance than the permanently fixed and flexible exchange rate regimes. The FH result that a collapsing fixed exchange rate regime may have a lower output variance than a flexible exchange rate regime is shown to be a special case in our model—it assumes that the interest rate does not affect aggregate demand and the income elasticity of money demand is zero.

In addition, it is important to recognize that this theoretical model does not capture the severe contractionary effects normally associated with fixed exchange rate crises and collapse. Monetary and fiscal policies are generally tightened before and after a collapse, first to defend the rate and later to restore confidence and exchange rate stability. Also, sharp exchange rate and interest rate movements and the abrupt halt in capital inflows usually cause widespread financial distress among domestic banks and other firms dependent on stable credit for their operations. If a flexible exchange rate can prevent such crises from occurring, the argument in favour of adopting a flexible rate for the purpose of maintaining macroeconomic stability would be that much stronger.

The empirical counterfactual exercise on Mexico for the period 1973 to 1995 provides strong support for the hypothesis of the theoretical model: that the conditional variance of output should be less under a flexible exchange rate regime rather than under a collapsing fixed or controlled exchange rate regime. Using a two-equation (output, real exchange rate) VAR model, we find that the variance of output would have been reduced by half if Mexico had been on a floating rate.

Consistent with this result is the assessment of Werner (1998) who finds that Mexico's flexible rate has performed reasonably well since the crisis of 1994. In particular, he argues that one of the benefits of a flexible exchange rate is that it absolves the government from making a political commitment to maintain the level of the exchange rate. Instead, the flexible exchange rate forces the private sector to either bear or hedge the exchange rate risk inherent in longer-term international transactions.

Although the trend for most developing countries appears to be towards more flexible exchange rates (Collins [1996]; Caramazza and Aziz [1997]), it is unfortunate that many countries make the switch too late, after a crisis and collapse have forced their hand. Indeed, the lesson that should be learned from these very costly mistakes is that a flexible exchange rate should be adopted when export demand and capital inflows are strong and the economy is performing relatively well, not the other way around.

Table 1: Exchange rate spread regression results

Independent variable	Coefficient	Standard error
Constant	12.71	1.971
Foreign exchange control Dummy #1 (1982:8–1990:2)	3.285	3.745
Foreign exchange control Dummy #2 (1990:3–1991:10)	2.332	4.156
Percentage change in reserves	-0.152**	0.056
Percentage change in reserves (-1)	-0.211**	0.057
Percentage change in reserves (-2)	-0.195**	0.055
Merchandise trade balance (as a percentage of GDP)	-2.534**	0.387
	$\bar{R}^2$ = 0.371	D.W. = 0.803

Notes:
1. Dependent variable: % spread between black market and controlled exchange rates.
2. ** denotes significance at the 1% level.
3. Longer lags of the percentage change in reserves and the merchandise trade balance were found to be statistically insignificant.
4. A full description of the data and its sources is given in the Data Appendix.
5. Sample: 1976:5–1977:4, 1979:6–1979:8, 1980:5–1991:12, 1994:12–1995:2 (240 observations).

Table 2a: VAR regression results

Endogenous variables: Mexican output and controlled real exchange rate
Sample period: 1973:1–1977:12

Dependent variable	Output	Real exchange rate
R^2	0.65	0.92
$\bar{R}^2$	-0.05	0.75
D.W.	1.89	1.78
F tests: (significance level)		
Lagged output	0.634	0.140
Lagged real exchange rate	0.410	0.001

Notes:
1. Exogenous variables: Mexican domestic credit/nominal GDP, U.S. real GDP, Mexican fiscal balance/nominal GDP, U.S. real treasury bill rate, and the real price of oil.
2. Each equation in the VAR model contains 12 lags of the endogenous variables, the contemporaneous and lagged values of the exogenous variables and a constant.

Table 2b: Likelihood ratio tests for the VAR system

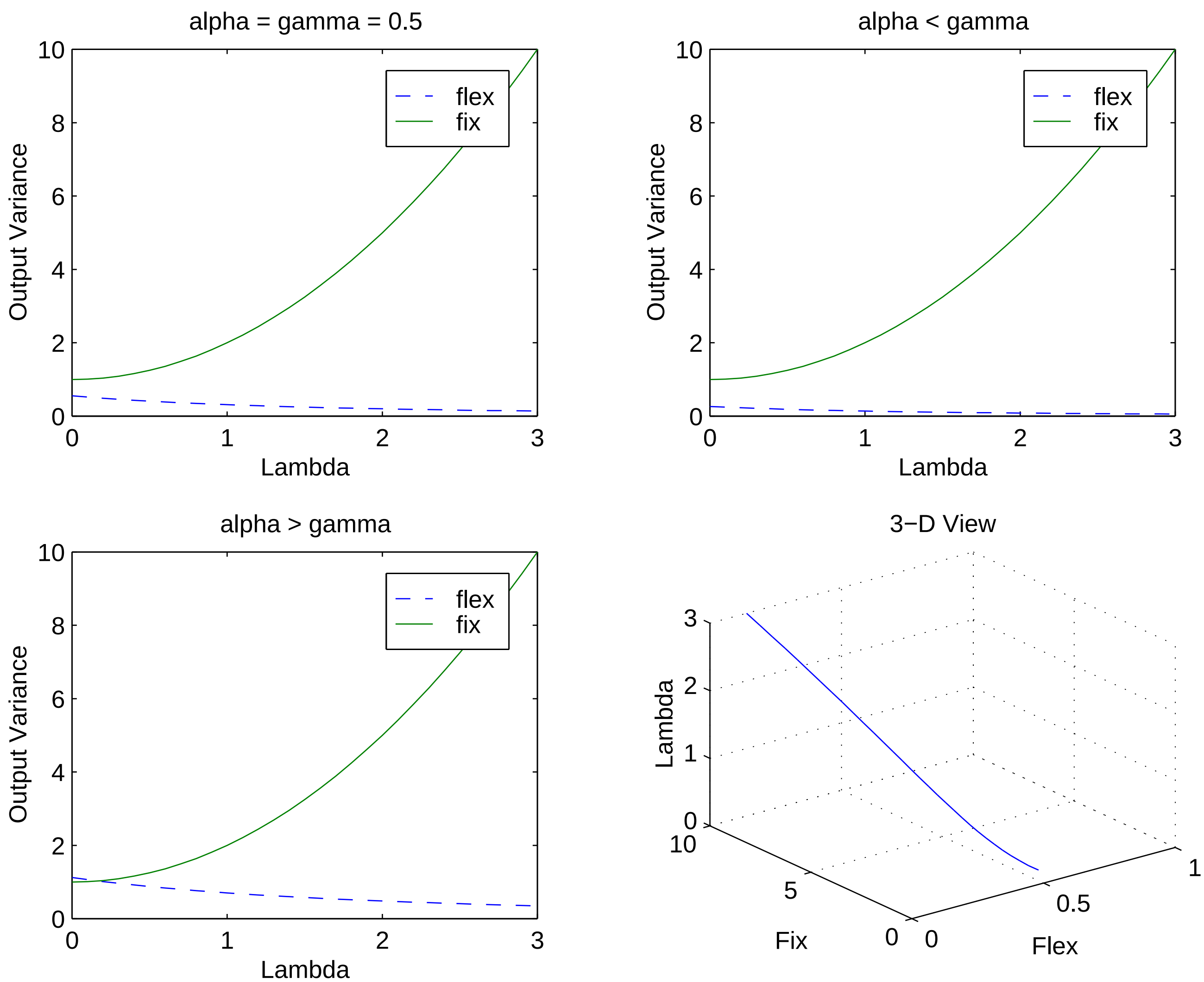
Null hypothesis (Coefficients are zero)	Significance level
Lags 7 to 12 of endogenous variables	0.011
Domestic credit/GDP	0.005
Fiscal deficit/GDP	0.489
U.S. output	0.061
U.S. real T-bill rate	0.387
Price of oil	0.077

Table 3: Estimated conditional variances of output

	Entire sample 1978:1–1995:12	Entire sample, excluding crisis periods*
Actual controlled regime	2.263	2.227
Counterfactual flexible regime	1.077	0.969
F-Statistic for test of equal variance	2.101	2.298
P-Value**	0.000	0.000

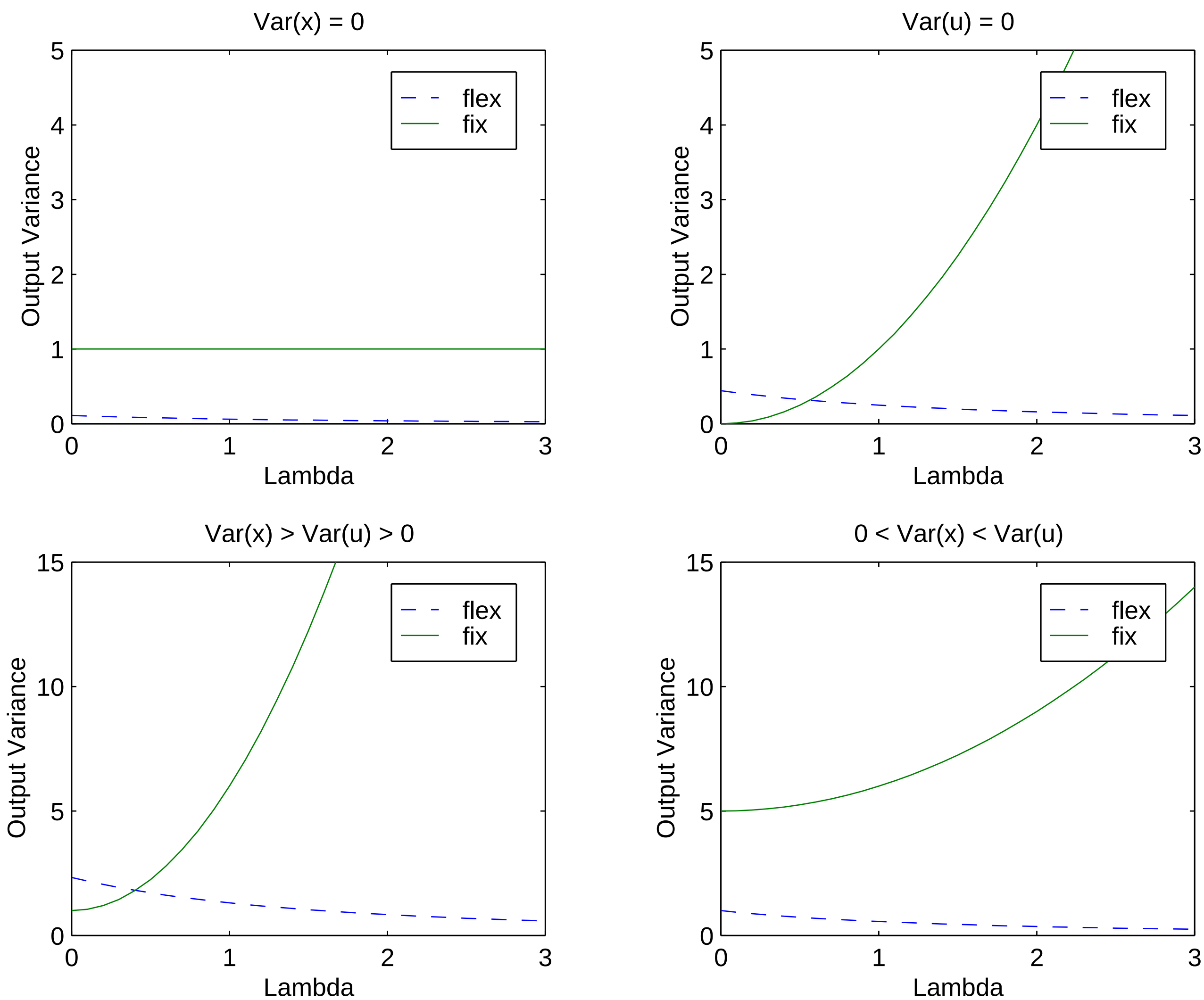
Notes:
* Crisis periods: 1982:8–1983:3, 1987:11–1988:01, 1994:12–1995:3
** The null hypothesis is that the two series have the same variance while the alternative is that the actual controlled regime has higher variance than the counterfactual flexible regime.

Figure 1: Output variance under permanent regimes (Case I)



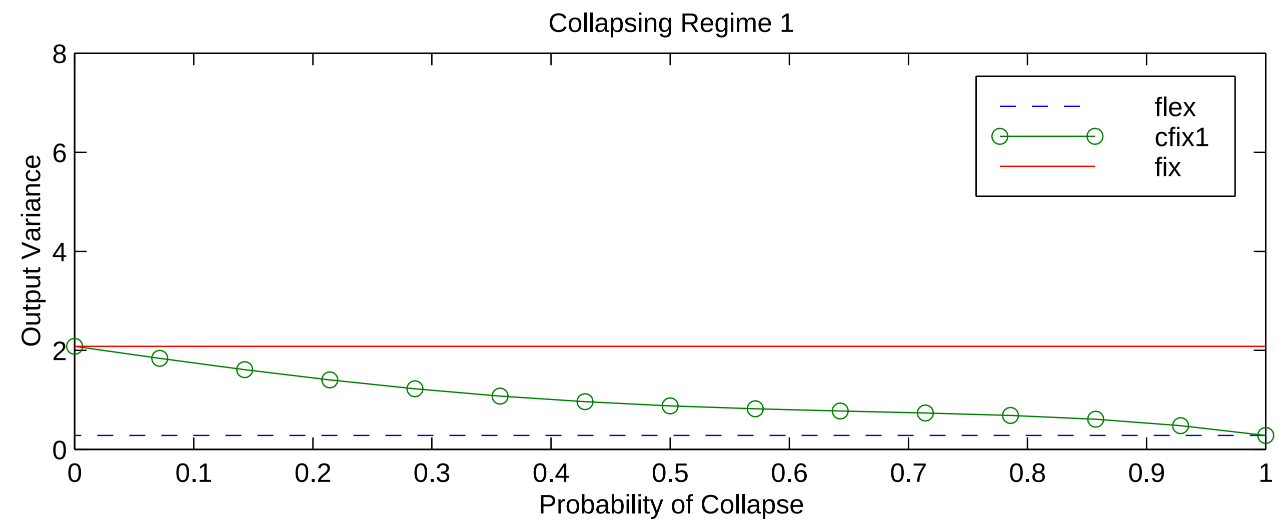
Parameters: $\beta = 2$; and $\sigma_u^2 = \sigma_x^2 = 1$

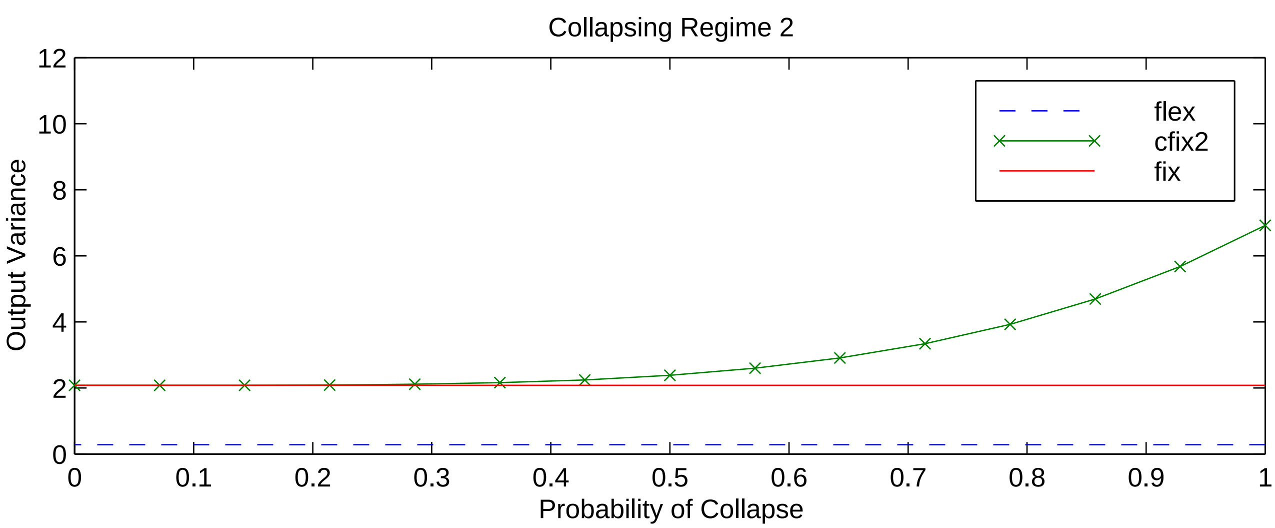
Figure 2: Output variance under permanent regimes (Case II)



Parameters: $\beta = 2$ and $\alpha = \gamma = 0.5$

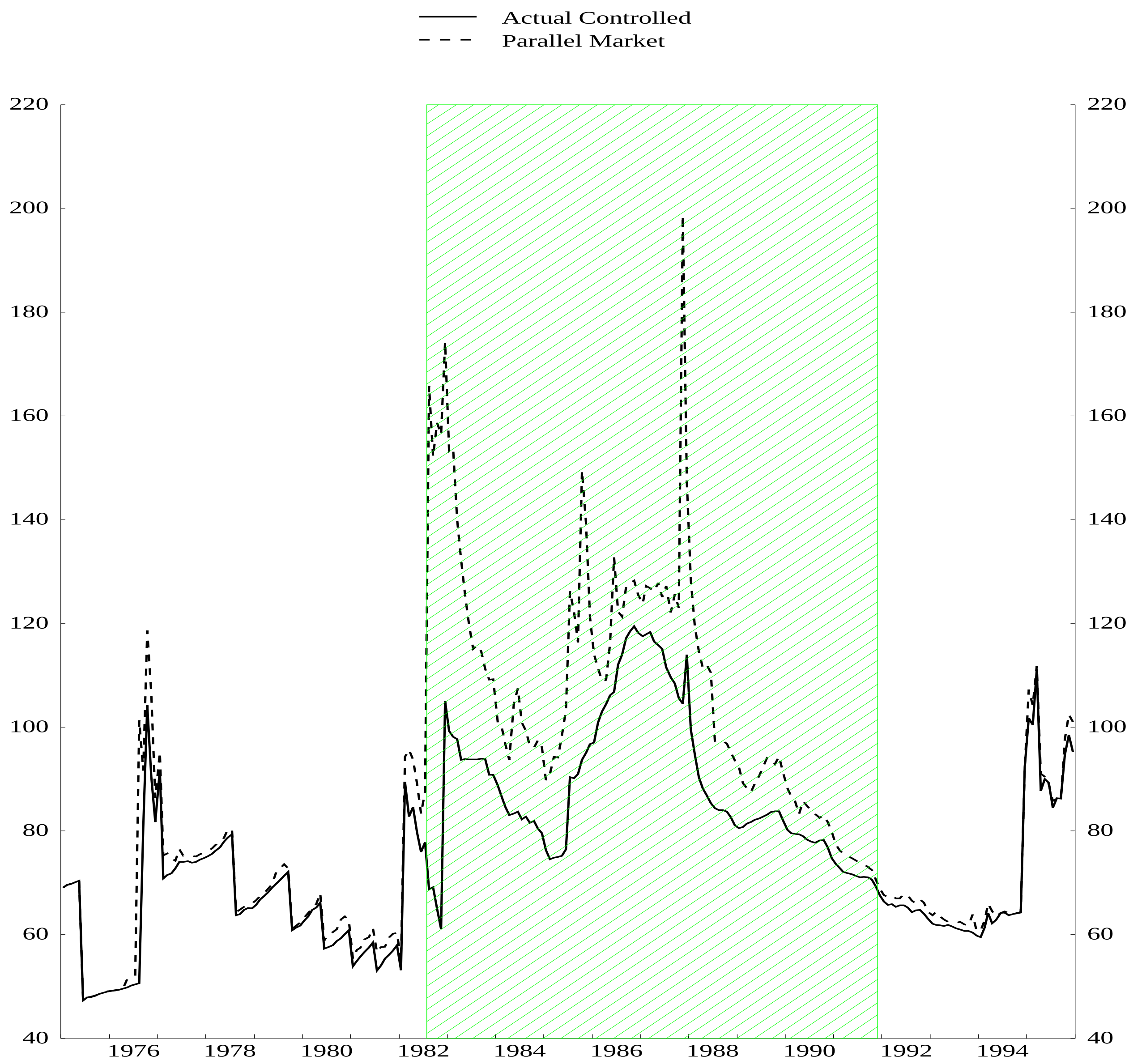
Figure 3: Output variance under collapsing regimes





Parameters: $\beta = 2$; $\eta = 1$; $\sigma_u^2 = \sigma_x^2 = 2$; $\lambda = 0.2$ and $\alpha = \gamma = 0.5$

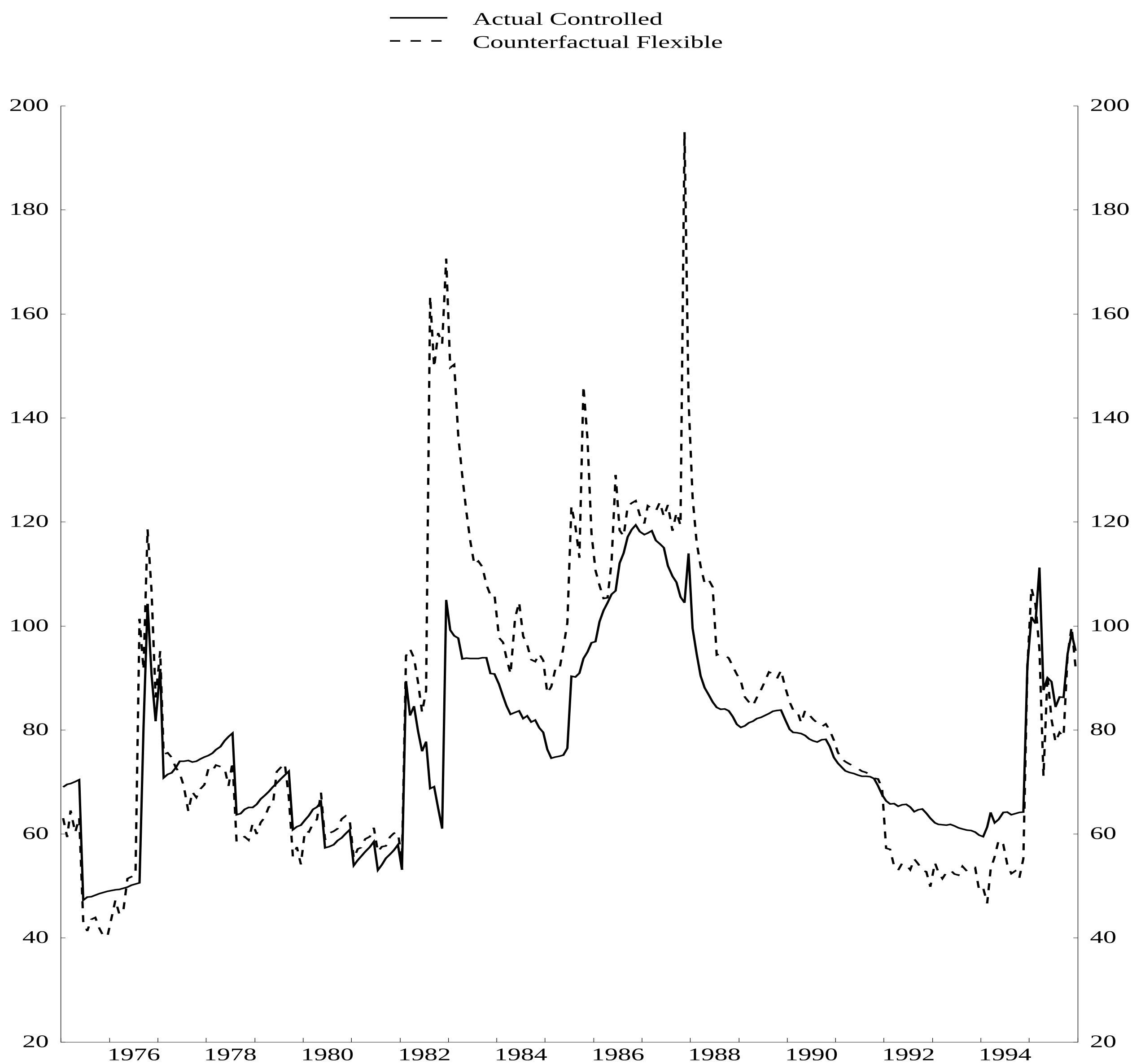
Figure 4: Controlled and parallel real exchange rates (1975:1–1995:12)



Source: See Data Appendix.

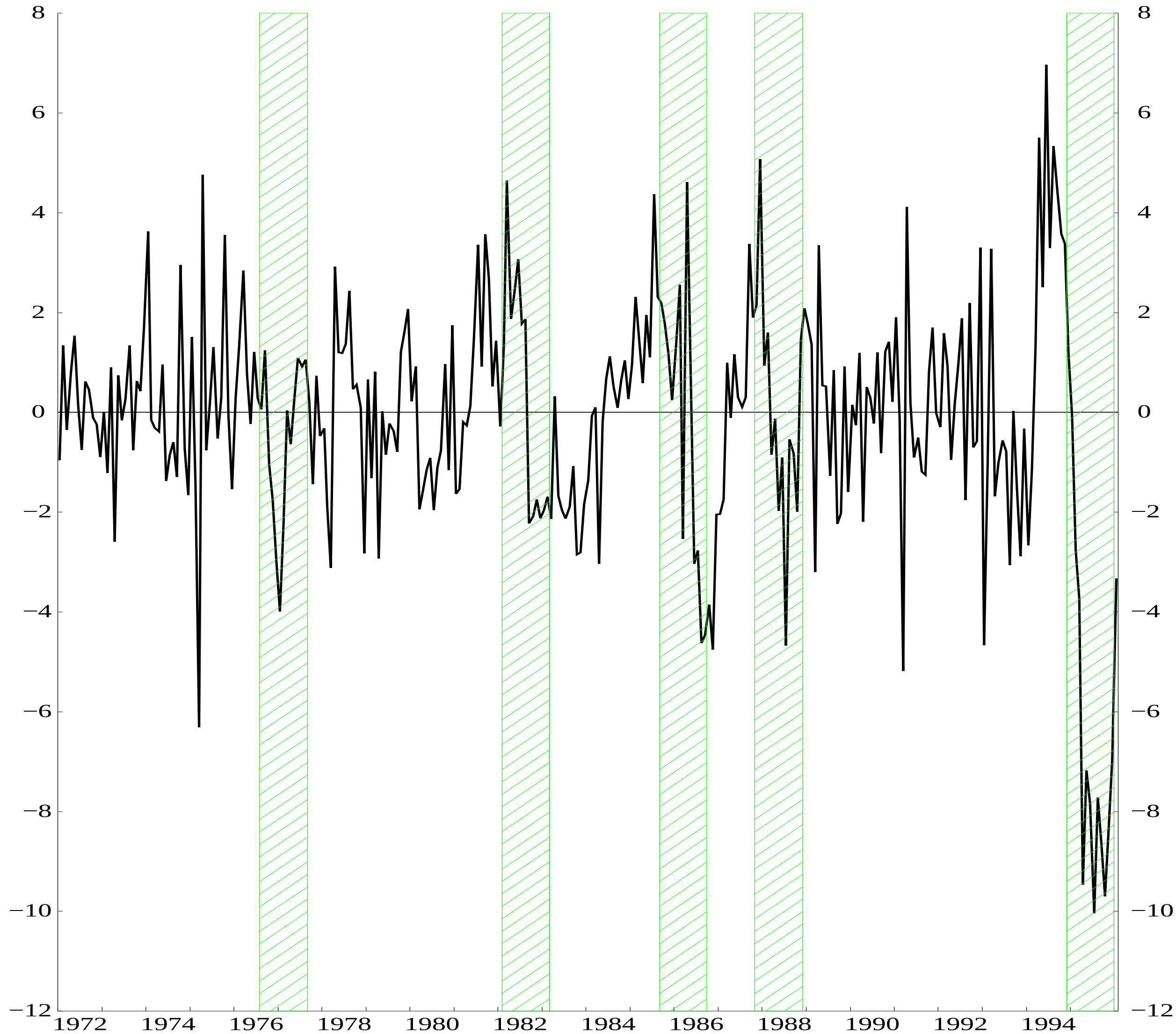
Note: Shaded area represents the period of capital controls: 1982:8–1991:10.

Figure 5: Controlled and adjusted parallel real exchange rates (1975:1–1995:12)



Source: See Data Appendix for the source of actual controlled rate. Adjusted parallel market rate was obtained as described in the text.

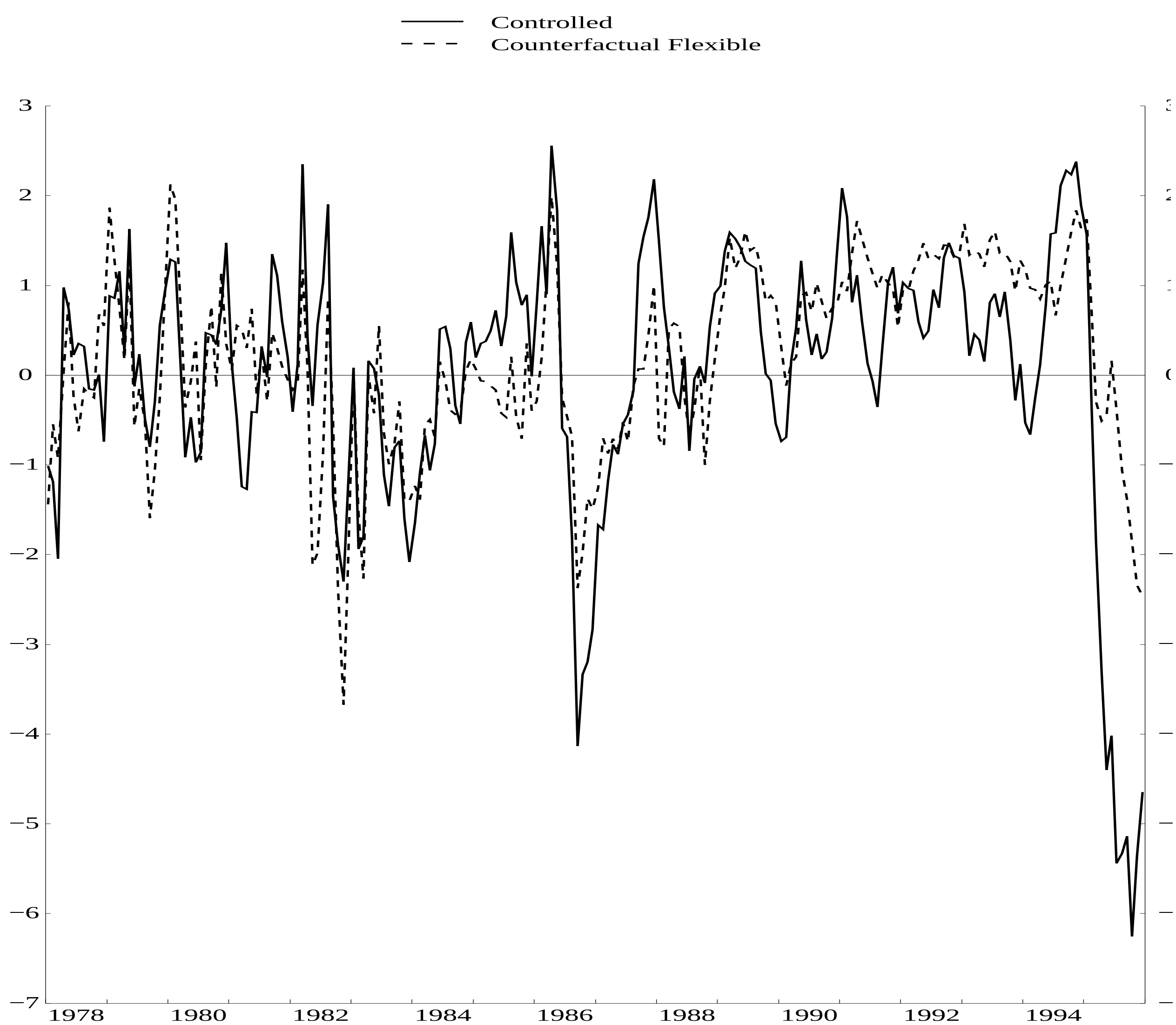
Figure 6: Mexican output (cyclical component)
(1972:1–1995:12)



Shaded areas represent 12 months after the crisis

Source: See Data Appendix.

Figure 7: Forecasts of output (cyclical component) under the actual controlled and counterfactual flexible exchange rate regimes (1978:1–1995:12)



Source: Generated by Kalman Filter, described in the text.

Data appendix

Mexico

1. Industrial production, monthly, International Financial Statistics (IFS), line 66
2. Consumer price index, monthly, IFS, line 64
3. Nominal exchange rate, monthly, IFS, line rf
4. Nominal parallel market exchange rate, monthly, *World Currency Yearbook* and special data request, published and provided by Currency Data and Intelligence, Inc.
5. Nominal gross domestic product, annual (1970–1980) and quarterly (1981–1995), IFS, line 99b. (Note: interpolated to monthly using industrial production growth rates)
6. Domestic credit of banking sector, monthly, IFS, line 32
7. Fiscal position, quarterly, IFS, line 80 (note: interpolated to monthly on a straight-line basis)
8. Total reserves minus gold of central bank, monthly, IFS, line 11d
9. Merchandise trade balance (export-imports), monthly, IFS, lines 70 and 71

United States

1. Industrial production, monthly, IFS, line 66c
2. Real gross domestic product, quarterly, IFS, line 99br (note: interpolated to monthly using industrial production growth rates)
3. Consumer price index, monthly, IFS, line 64
4. Treasury bill rate, monthly, IFS, line 99br

Other

1. Real price of oil, quarterly, Bank of Canada internal series, U.S. dollar price of oil divided by GDP deflator (note: interpolated to monthly data on a straight-line basis)

References

Agenor, P. R., J. S. Bhandari, and R. P. Flood. 1992. "Speculative Attacks and Models of Balance of Payments Crises." *IMF Staff Papers* 39: 357–394.

Aspe, P. 1993. *Economic Transformation the Mexican Way.* Cambridge, Mass: MIT Press.

Blanco, H. and P. Garber. 1986. "Recurrent Devaluation and Speculative Attacks on the Mexican Peso." *Journal of Political Economy* 94: 148–166.

Calvo, G. and E. Mendoza. 1996. "Mexico's Balance-of-Payment's Crisis: A Chronicle of a Death Foretold." *Journal of International Economics* 41: 235–264.

Caramazza, F. and J. Aziz. 1997. "Exchange Rate Arrangements and the Economic Performance in Developing Countries." *World Economic Outlook* (October): 78–97.

Cardoso, E. A. and S. Levy. 1988. "Mexico." In *The Open Economy,* edited by R. Dornbusch and L. Helmers, 348–369. Oxford: Oxford University Press.

Collins, S. 1996. "On Becoming More Flexible: Exchange Rate Regimes in Latin America and the Caribbean." *Journal of Development Economics* 51: 117–138.

Dornbusch, R. 1976. "Expectations and Exchange Rate Dynamics." *Journal of Political Economy* 84: 1161–1176.

Dornbusch, R. 1988. "Mexico." *Economic Policy* (October): 233–283.

Dornbusch, R. and A. Werner. 1994. "Mexico: Stabilization, Reform, and No Growth." *Brookings Papers on Economic Activity* 1: 253–297.

Edwards, S. 1997. "The Mexican Peso Crisis: How Much Did We Know? When Did We Know It?" NBER Working Paper 6334.

Flood, R. P. and P. Garber. 1984. "Collapsing Exchange Rate Regimes: Some Linear Examples." *Journal of International Economics* 17: 1–13.

Flood, R. P. and R. J. Hodrick. 1986. "Real Aspects of Exchange Rate Regime Choice with Collapsing Fixed Rates." *Journal of International Economics* 21: 215–232.

Gavin, M. 1996. "The Mexican Oil Boom: 1977–1985." Inter-American Development Bank Working Paper Series 314.

Goldberg, L. S. 1991. "Collapsing Exchange Rate Regimes: Shocks and Biases." *Journal of International Money and Finance* 10: 252–263.

Grosse, R. E. and C. Pechman. 1994. *Foreign Exchange Black Markets in Latin America*. Westport, Conn: Praeger.

Krugman, P. 1979. "A Model of Balance of Payments Crises." *Journal of Money, Credit, and Banking* 11: 311–325.

Laidler, D. 1999. "The Exchange Rate Regime and Canada's Monetary Order." Bank of Canada Working Paper 99-7.

Meigs, A. J. 1997. “Mexican Monetary Lessons.” *Cato Journal* 17 (Spring-Summer): 35–72.

Obstfeld, M. and K. Rogoff. 1995. “The Mirage of Fixed Exchange Rates.” *Journal of Economic Perspectives* 9: 73–96.

Osakwe, P. and L. Schembri. 1998. “Currency Crises and Fixed Exchange Rates in the 1990s: A Review.” *Bank of Canada Review (*Autumn): 23–38.

Otker, I. and C. Pazarbasioglu. 1996. “Speculative Attacks and Currency Crises: The Mexican Experience.” *Open Economies Review* 7: 535–552.

Werner, A. M. 1998. “Mexico’s Experience with Capital Inflows: Macroeconomic Effects and the Policy Response.” Banco de Mexico. Unpublished.

Bank of Canada Working Papers
Documents de travail de la Banque du Canada

Working papers are generally published in the language of the author, with an abstract in both official languages. ***Les documents de travail sont publiés généralement dans la langue utilisée par les auteurs; ils sont cependant précédés d'un résumé bilingue.***

1999

99-10	Real Effects of Collapsing Exchange Rate Regimes: An Application to Mexico	P. Osakwe and L. Schembri
99-9	Measuring Potential Output within a State-Space Framework	M. Kichian
99-8	Monetary Rules When Economic Behaviour Changes	R. Amano, D. Coletti, and T. Macklem
99-7	The Exchange Rate Regime and Canada's Monetary Order	D. Laidler
99-6	Uncovering Inflation Expectations and Risk Premiums from Internationally Integrated Financial Markets	B.S.C. Fung, S. Mitnick, and E. Remolona
99-5	The Quantity of Money and Monetary Policy	D. Laidler
99-4	An Intraday Analysis of the Effectiveness of Foreign Exchange Intervention	N. Beattie and J-F. Fillion
99-3	Forecasting GDP Growth Using Artificial Neural Networks	G. Tkacz and S. Hu
99-2	Capital Gains and Inflation Taxes in a Life-cycle Model	C. Leung and G.-J. Zhang
99-1	Dynamic Employment and Hours Effects of Government Spending Shocks	M. Yuan and W. Li

1998

98-23	Résultats empiriques multi-pays relatifs à l'impact des cibles d'inflation sur la crédibilité de la politique monétaire	P. St-Amant et D. Tessier
98-22	A Non-Paradoxical Interpretation of the Gibson Paradox	S. Coulombe
98-21	Une nouvelle méthode d'estimation de l'écart de production et son application aux États-unis, au Canada et à l'Allemagne	R. Lalonde, J. Page et P. St-Amant
98-20	Evaluating Alternative Measures of the Real Effective Exchange Rate	R. Lafrance, P. Osakwe, and P. St-Amant
98-19	Can a Matching Model Explain the Long-Run Increase in Canada's Unemployment Rate?	A. Hornstein and M. Yuan
98-18	The Sale of Durable Goods by a Monopolist in a Stochastic Environment	G. Srour
98-17	La politique monétaire a-t-elle des effets asymétriques sur l'emploi	L. Pichette
98-16	Consumer Attitudes, Uncertainty, and Consumer Spending	D. Côté and M. Johnson

Copies and a complete list of working papers are available from:
Pour obtenir des exemplaires et une liste complète des documents de travail, prière de s'adresser à:

Publications Distribution, Bank of Canada
234 Wellington Street Ottawa, Ontario K1A 0G9

Diffusion des publications, Banque du Canada
234, rue Wellington, Ottawa (Ontario) K1A 0G9

E-mail / Adresse électronique: publications@bank-banque-canada.ca
WWW: http://www.bank-banque-canada.ca/
FTP: ftp.bank-banque-canada.ca (login: anonymous, to subdirectory/pub/publications/working.papers/)