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Trade Reforms of Uncertain Duration and Real Uncertainty: A First Approximation

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This paper examines trade reforms of uncertain duration in economies affected by real shocks. These reforms induce consumption booms regardless of their duration and of the degree of intertemporal substitution. A recession may follow the boom, depending on the outcome of the reform and on whether government transfers offset wealth effects of tariffs. Observed booms in reforming economies are a noisy indicator of credibility because they reflect both policy uncertainty and real shocks, and the credibility component is determined in part by the properties of real shocks. Lack of credibility produces generally smaller fluctuations than those induced by real disturbances. [JEL F13, F41, E61]

> NAFTA provides the regulatory framework to encourage both Mexicans and foreign investors to believe that economic reforms are here to stay. If it is ratified, this reassurance will prove at least as powerful as the growth in trade that will result.
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IN THE AFTERMATH of the debt crisis, many developing countries introduced far-reaching programs of stabilization and structural reform. A key feature of these programs was the liberalization of international trade. The implementation of radical measures to reduce tariff and

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nontariff trade barriers, and to eliminate several other exchange restrictions, signaled a fundamental departure from the protectionist, import-substitution philosophy that dominated economic policy for decades. However, experience has shown that the process of adjustment in response to trade liberalizations, and other reforms that accompanied them, is a complex phenomenon.

The fact that economic agents, after years of suffering the consequences of macroeconomic mismanagement, question the credibility of new policies, makes the dynamics of reform programs difficult to study. In particular, a surge in consumption and imports, a deterioration of the trade balance, and an appreciation of the real exchange rate followed the implementation of adjustment programs both in countries where these programs succeeded and in those where they failed (see Végh (1992) and Reinhart and Végh (1992)). Thus, it is unclear whether adjustment-induced booms are a warning signal that an adjustment program lacks credibility or that it is about to fail.

This paper examines implications of imperfect policy credibility for an economy in which agents face two sources of uncertainty. The first source is conventional random shocks that reflect "fundamental" uncertainty regarding real variables such as productivity or the terms of trade. The second source is lack of credibility. The government reduces tariffs as of some date t, but agents attach some probability to the reversal of trade liberalization at date $t + 1$. Unlike real uncertainty, which is never completely resolved, uncertainty with regard to trade policy is resolved in one period.

We examine the case in which tariff revenue is rebated to consumers and the case in which it finances unproductive government expenditures, both under the assumption of incomplete insurance markets. The case of tariff rebates represents an environment in which tariffs finance government transfer payments for social security, health care, and other similar programs. This case is also relevant because the rebates limit the distortions of trade restrictions to affect only relative prices and not wealth, so that "credibility effects" are governed by intertemporal substitution. For this reason, the majority of the existing literature on credibility assumes some form of revenue rebates. The case in which tariff revenue is not rebated characterizes a situation in which that revenue does not have any productive use, thus introducing wealth effects that alter significantly the implications of lack of credibility.

The growing literature on credibility of economic policies provides innovative insights into the analysis of the dynamics of adjustment programs. Early theoretical work examined cases in which reforms are introduced at a point in time and agents know with certainty of a future

date when reforms are reversed (Calvo (1986) and (1987) and Djajić (1987)). Forward-looking agents formulate optimal plans anticipating future price increases following the reversal of policies, and hence a consumption boom, a widening trade deficit, and a real appreciation are predicted for the period during which the reforms are in place. Credibility effects are stronger the larger the intertemporal elasticity of substitution in consumption and the shorter the period of liberalization.

The empirical analysis of credibility has become an important policy issue because of the possibility that observed consumption booms and falling saving rates in reforming economies could be attributed to lack of credibility. Recently, some researchers estimated the intertemporal elasticity of substitution and used their estimates to simulate the perfect-foresight credibility framework so as to examine its ability to match observed consumption booms (see, for example, Reinhart and Végh (1992) and Bufman and Leiderman (1992)). The models are consistent with the data from a qualitative standpoint, although pure intertemporal substitution cannot fully account for observed boom-recession cycles. To substantiate these results, however, it is necessary to incorporate two important elements into the empirical research.

One natural extension is to examine a framework in which the exact timing of policy reversals is unknown. Some recent theoretical work has made progress in this area. A paper by van Wijnbergen (1992) examined a two-period model in which an abolition of tariffs in period 1 is expected to be reversed in period 2 with some exogenous probability and tariff revenue is not rebated. He concluded that if the intertemporal elasticity of substitution is higher than one, there is a surge in consumption and imports. Hopenhayn and Muniagurria (1993) examined growth effects of policy variability in a two-sector infinite horizon model with random investment subsidies. When the sector benefiting from the subsidy changes over time, an increase in policy variability may increase growth and welfare because of the presence of income effects. Calvo and Drazen (1993) explored an infinite-horizon framework in which the date of the policy reversal is a time-dependent random variable. In their framework, the predictions of the perfect-foresight analysis extend to an environment of complete insurance markets with tariff rebates and risk-neutral foreign participants. In contrast, if insurance markets are incomplete, the elasticity of substitution is less than unitary, and tariff revenue is not rebated, consumption rises during the period of liberalization until it collapses when the trade reform is reversed.

A second element that needs to be added to empirical analysis of credibility is the fact that, in addition to policy credibility, real shocks are also an important source of uncertainty, in addition to policy credibility.

For instance, terms-of-trade shocks are a major driving force of business cycles in the developing world (see Mendoza (1995)), and they have in fact coincided with trade reforms in many countries. Chile's reforms in the late 1980s were introduced in conjunction with a protracted increase in the real price of copper, while some of Mexico's reforms coincided with the sharp decline in oil prices of 1986. Since agents in these economies generally do not have the option to insure their income against fluctuations in world relative prices, terms-of-trade shocks induce strong wealth and substitution effects. These effects affect macroeconomic behavior and hence make it difficult to determine whether actual movements in consumption, net exports, or the real exchange rate truly reflect lack of credibility. It is therefore critical to examine the interaction between credibility and real uncertainty.

Borrowing from the savings-under-uncertainty models of Phelps (1962) and Levhari and Srinivasan (1969), we build a tractable dynamic stochastic equilibrium model in which the interaction between real and policy uncertainty is clearly illustrated in simple closed-form solutions. These solutions yield interesting analytical results and are used to produce quantitative simulations. The simulations shed some light on the potential empirical relevance of credibility as a source of business cycles. We view these simulations as a complement to further quantitative work based on a richer model, which captures several important transmission mechanisms identified in the credibility literature (such as capital accumulation, consumption of durable goods, labor supply decisions), but lacks the analytical clarity of closed-form solutions.

As in perfect-foresight credibility models, our closed-form solutions show that noncredible reforms cause consumption booms and widening trade deficits, generally, but not always, followed by recessions when policy uncertainty is resolved. Contrary to van Wijnbergen (1992), there is *always* a boom in response to a noncredible reform, regardless of the degree of intertemporal substitution, the duration of the reform, and whether or not tariff revenue is rebated. If revenue is rebated, the boom is *always* followed by a recession, and the amplitude of the cycle is larger the higher the probability of policy reversal. If revenue is not rebated, the initial boom may be sustained or reversed into a recession on the date policy uncertainty is resolved. In this case, the strength of income effects is inversely related to the probability of policy reversal. Similarly, welfare implications of uncertain reforms depend on whether tariff revenue is rebated or not, and in the latter case also depend on intertemporal substitution. If revenue is not rebated, income effects result in an increase in welfare relative to a regime with permanent tariffs, although the net welfare gain is always less than the one attained under a fully credible reform.

Real shocks induce booms and recessions through real-business-cycle transmission mechanisms. In addition, the mean and variance of real shocks affect the magnitude and direction of credibility effects. This interaction is found to be quantitatively small, however, because the model assumes that real and policy uncertainty are statistically independent. The noise introduced by real uncertainty implies that observed consumption booms cannot be directly attributed to credibility effects, and thus measures of credibility that do not separate components of the business cycle driven by credibility from those driven by fundamentals are biased.

If the probability of policy reversal is affected by the nature of real uncertainty, changes in the economic environment may affect the size of credibility effects even if policy makers do not alter their behavior. Thus, to establish the importance of credibility as a driving force of observed booms, it is important to examine the manner in which real shocks may influence the agents' perception of the sustainability of policies.

The paper is organized as follows. Section I presents the model and discusses competitive equilibria under free trade and permanent tariffs with rebated and nonrebated revenues. Section II examines imperfect credibility and the connection between this source of uncertainty and the uncertainty of real asset returns, in an environment in which tariff revenue is rebated. Section III studies the case in which tariff revenue is not rebated. Section IV concludes.

I. The Economic Environment

The Basic Model

The model we propose introduces policy uncertainty and exogenous terms-of-trade shocks into the savings-under-uncertainty models of Phelps (1962) and Levhari and Srinivasan (1969). We study a small open economy inhabited by infinitely-lived individuals that formulate optimal intertemporal plans for consumption of an imported good so as to maximize expected lifetime utility. Preferences are represented in the standard isoelastic, time-separable form

$$U(C) = E\left(\sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma}\right), \quad \gamma > 0, \quad 0 < \beta < 1. \tag{1}$$

C is a vector that represents the intertemporal allocation of consumption, β is the subjective discount factor, and γ is the coefficient of relative risk aversion (that is, $1/\gamma$ is the intertemporal elasticity of substitution).

The production technology adopts the form of perfectly durable assets that yield a stochastic, nonstorable return each period. The return is an exportable commodity that agents exchange for imports in competitive world markets. The relative price of imported goods in terms of exports is also subject to random shocks. Markets of contingent claims are incomplete, and hence households maximize equation (1) subject to the constraint

$$A_{t+1} \leq R_t(A_t - p_t C_t), \tag{2}$$

given that $A_0 > 0$. A_t is the stock of assets in units of exportables, R_t is the gross domestic rate of return, and p_t is the price of imports in terms of exports, or the reciprocal of the terms of trade $\text{tot}_t = p_t^{-1}$. R_t and p_t are non-negative random variables such that the consumption-based interest rate $r_t \equiv R_t p_t / p_{t+1}$ is a log-normal i.i.d. process. Thus, $Ln(r_t)$ is i.i.d. with mean μ and variance σ^2, and the mean and variance of r_t are $\mu_r = \exp(\mu + \sigma^2/2)$ and $\sigma_r^2 = \mu_r^2(\exp(\sigma^2 - 1))$, respectively. At each date t, p_t is known but R_t and p_{t+1} are unknown.[1]

Free-Trade Competitive Equilibrium

Under free trade, households maximize equation (1) subject to equation (2). This maximization problem has the following dynamic programming representation:

$$V(A_t, p_t) = \max_{c_t, A_{t+1}} \left\{ \frac{C_t^{1-\gamma}}{1-\gamma} + \beta E[V(A_{t+1}, p_{t+1})] \right\}$$

$$\text{subject to } A_{t+1} \leq R_t(A_t - p_t C_t). \tag{3}$$

The first-order conditions are the constraint (2) and the Euler equation:

$$U'(C_t) = \beta E\left[\frac{R_t p_t}{p_{t+1}} U'(C_{t+1}) \right]. \tag{4}$$

The problem is solved by guessing that $V(.) = B(A_t/p_t)^{1-\gamma}$, for some constant B, and that C_t is a time-invariant fraction λ of wealth A_t/p_t. Optimal plans are

$$C_t^* = \lambda\left(\frac{A_t}{p_t}\right), \tag{5}$$

$$A_{t+1}^* = (1-\lambda) R_t A_t, \text{ and} \tag{6}$$

$$\lambda = \{1 - \beta^{1/\gamma}[E(r_t^{1-\gamma})]^{1/\gamma}\}. \tag{7}$$

[1] As in Levhari and Srinivasan (1969), feasible plans require that r_t satisfies the condition $E[(r_t)^{1-\gamma}] < \beta^{-1}$.

The explicit solution for indirect utility is

$$V^*(A_t, p_t) = \frac{\lambda^{-\gamma}}{(1-\gamma)}\left(\frac{A_t}{p_t}\right)^{1-\gamma}. \tag{8}$$

The marginal propensity to consume with respect to wealth is λ (that is, $1 - \lambda$ is the savings rate). Under the condition that $E[r_t^{1-\gamma}] < \beta^{-1}$, equation (5) implies that consumption is a positive fraction of the real value of asset holdings in units of importables. Because the terms of trade are known but the return on exportables is unknown when C_t is chosen, the actual realization of R_t does not affect consumption, but the actual realization of p_t does.

Following Phelps (1962) and Levhari and Srinivasan (1969), one can show that increased risk in real asset returns (measured as a mean-preserving increase in σ_r^2 due to increased variability in the domestic rate of return on exportables or the terms of trade) leads to an increased savings rate as long as the coefficient of relative risk aversion is higher than 1 ($\gamma > 1$),[2] or the intertemporal elasticity of substitution is less than 1 ($1/\gamma < 1$), and that an increase in the mean return has the opposite effects. These results are derived by expressing λ as a function of μ_r and σ:

$$\lambda(\mu_r, \sigma) = 1 - (\beta\mu_r^{1-\gamma})^{1/\gamma}\exp\left(-(1-\gamma)\frac{\sigma^2}{2}\right). \tag{9}$$

Equilibrium with Permanent Tariffs and Lump-Sum Rebates

If the government imposes a time-invariant import tariff τ and rebates tariff revenue to households as a lump-sum transfer T_t, the budget constraint is

$$A_{t+1} \leq R_t[A_t - p_t(1+\tau)C_t + T_t]. \tag{10}$$

In equilibrium, $T_t = p_t\tau C_t$. Thus, the optimality conditions in this case are the same as in the free-trade case, and hence optimal plans are as in equations (5) and (6). This is because rebates prevent the tariff from affecting wealth, and because the tariff is time-invariant, so there is no intertemporal price distortion.

Equilibrium with Permanent Tariffs and No Rebates

If tariff revenue is not rebated, the Euler equation (4) is unchanged, but a wealth effect resulting from the crowding out of private consumption is introduced. The budget constraint is

$$A_{t+1} \leq R_t[A_t - p_t(1+\tau)C_t]. \tag{11}$$

[2] For σ_r^2 to increase while keeping μ_r unchanged, it must be the case that σ^2 increases in such a way that μ is adjusted to keep $\mu + \sigma^2/2$ constant.

Optimal plans are

$$C_t^\tau = \lambda \left[\frac{A_t}{(1+\tau)p_t} \right] \text{ and} \tag{12}$$

$$A_{t+1}^\tau = (1-\lambda) R_t A_t. \tag{13}$$

Lifetime utility is

$$V^\tau(A_t, p_t) = \frac{\lambda^{-\gamma}}{(1-\gamma)} \left[\frac{A_t}{(1+\tau)p_t} \right]^{1-\gamma}. \tag{14}$$

The superscript τ is used to distinguish these allocations from those of the free-trade and tariff-rebates economies—λ is the same in all three cases.

II. Noncredible Trade Reforms and Real Uncertainty with Tariff Rebates

Consider a regime in which tariffs are abolished at date $t = 0$, but agents assign a probability π to the event that tariffs will be reinstated at $t = 1$. If tariffs are reinstated, they remain in place forever, and if free trade prevails, it also remains in place indefinitely. Thus, policy uncertainty is resolved between $t = 0$ and $t = 1$. The fact that real uncertainty is never resolved, while policy uncertainty ends at some date, or at least is significantly affected by policy actions, is the key difference between the two sources of uncertainty. For tractability, we adopt the simplest representation of this problem.

Competitive Equilibrium

Households maximize equation (1) subject to the following constraints:

$$A_1 \leq R_0 (A_0 - p_0 C_0),$$

$$A_{t+1} \leq R_t (A_t - p_t C_t) \; \forall t > 0 \text{ with probability } 1 - \pi, \text{ and}$$

$$A_{t+1} \leq R_t [A_t - p_t (1+\tau) C_t + T_t] \; \forall t > 0 \text{ with probability } \pi, \tag{15}$$

given $A_0 > 0$, τ, and T_t. In equilibrium, the government's budget constraint, $T_t = \tau p_t C_t$, holds for all states of nature in which tariffs are levied. Thus, for all dates and all states of nature, whether or not tariffs are present, the equilibrium resource constraint is the same as in the free-trade economy. There is, however, a distortion affecting the intertemporal relative price of consumption depending on the date considered. At any date other than 0 there is no distortion, regardless of whether tariffs

are present, and hence the Euler equation is like equation (4). At $t = 0$, however, the Euler equation is

$$U'(C_0) = \beta E\left[\frac{r_t}{1+\tau}U'(C_1)\right]. \tag{16}$$

Thus, the expected marginal gain of savings in the period of the credibility test is affected by the tariff. Lack of credibility acts like a tax on the return of savings that distorts intertemporal relative prices in favor of current consumption. Since π is time-invariant, and hence independent of realizations of r_t, we rewrite equation (16) as follows:

$$U'(C_0) = \beta\left(\frac{\pi}{1+\tau} + 1 - \pi\right)E\left[r_t U'(C_1)\right]. \tag{17}$$

Hence, the rate of the credibility tax is determined by τ and π.

Solving by backward recursion, using equations (5) and (6), yields the following:

$$C_0^{\pi,T} = \frac{\lambda}{\eta}\left(\frac{A_0}{p_0}\right), \tag{18}$$

$$A_1^{\pi,T} = \left(1 - \frac{\lambda}{\eta}\right)R_0 A_0, \text{ and} \tag{19}$$

$$\eta(\pi,\tau) \equiv \left(1 - \frac{\pi\tau}{1+\tau}\right)^{1/\gamma}. \tag{20}$$

The superscript π,T denotes that these are allocations for the economy with uncertain duration of the trade reform and tariff rebates. Optimal plans for any date $t > 1$ are given by equations (5) and (6) updated to the corresponding date and taking A_1 from equation (19). Lifetime utility as of the date the reform is announced is

$$V^{\pi,T}(\eta,\lambda,A_0,p_0) = \frac{1}{1-\gamma}\left[\left(\frac{\lambda}{\eta}\right)^{1-\gamma} + \left(\frac{1-\lambda}{\lambda}\right)^{\gamma}\left(1 - \frac{\lambda}{\eta}\right)^{1-\gamma}\right]\left(\frac{A_0}{p_0}\right)^{1-\gamma}. \tag{21}$$

Equations (18)–(21) provide the framework for examining effects of imperfect credibility and the interaction of these effects with real shocks. η represents the distortion introduced by policy uncertainty. Clearly, $\eta(0,\tau) = 1$, and hence a credible reform produces the free-trade equilibrium. In general, however, for $0 < \pi < 1$, η is a positive fraction in the range $(1+\tau)^{-1/\gamma} < \eta < 1$, and hence consumption at date 0 exceeds the level of consumption for the same period under credible free trade or

under a regime of permanent, rebated tariffs.[3] Moreover, considering equation (9), one can show that, for any given π, a rise in σ^2 (fall in μ_r) leads to a rise in imports and a decline in savings as long as $\gamma > 1$. Thus, a widening trade deficit and a falling saving rate may reflect lack of credibility, but can also reflect changes in the riskiness of savings.

Since η is decreasing in π, equations (18) and (19) imply that increased policy uncertainty (higher π) induces a stronger rise in consumption and a sharper fall in savings. This is consistent with the perfect-foresight credibility literature (Calvo (1987)) in which the boom is stronger the shorter the duration of the trade reform. Furthermore, contrary to van Wijnbergen (1992), $C_0^{\pi,T} > C_0^{\pi}$ or C_0^*, *regardless of the degree of risk aversion*.[4]

Cyclical Effects of Imperfect Credibility

We define business cycles as deviations from trend measured as logarithmic first differences. Since consumption fluctuates around an average growth rate given by $(1-\lambda)\mu_r$, logarithmic first differences render the consumption process stationary. Denote the log first difference of consumption as $\Delta C_t \equiv Ln(C_t) - Ln(C_{t-1})$, and define $Ln(r_t) \equiv \mu + \epsilon_t$, so that ϵ_t is the period$-t$ deviation of the log of the real interest rate from its mean. Then, at any date before the reform is introduced or after policy uncertainty is resolved,

$$\Delta C_t = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_{t-1}, \ \forall t > 1 \text{ or } t < 0. \tag{22}$$

The first two terms in the right-hand side of equation (22) define the trend of ΔC_t and the error term is the cyclical component. The variance of deviations from trend in consumption is given by σ^2. Thus, deviations from trend in consumption at $t = -1$, or before, and $t = 2$, or later, are determined only by real uncertainty. Note also that although whether γ is greater or less than 1 determines if changes in μ_r or σ^2 have positive or negative effects on the *level* of consumption, an increase in μ_r always induces an increase in the *trend* growth rate, regardless of the size of γ, and an increase in σ^2 induces faster consumption growth as long as $\gamma > 2$. Moreover, when $\gamma > 2$, an increase in risk increases growth but, since

[3] There is also a feasibility constraint $0 < \lambda/\eta < 1$, or $\lambda < \eta$.

[4] The difference is larger the lower the degree of risk aversion, but it is always positive.

welfare is declining in σ^2, welfare in high-risk, fast-growing economies is lower than in low-risk, slow-growing economies.[5]

Consumption behavior in periods affected by policy uncertainty is

$$\Delta C_0 = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_{-1} - Ln(\eta) \text{ and} \quad (23)$$

$$\Delta C_1 = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_0 + Ln\left[\frac{(\eta-\lambda)}{(1-\lambda)}\right]. \quad (24)$$

Thus, in the periods affected by lack of credibility, deviations from trend in consumption are jointly determined by real shocks and policy uncertainty. Real-uncertainty components of consumption fluctuations are ϵ_{-1} and ϵ_0, while policy-uncertainty components are the terms that include η. The credibility component is independent of the mean and variance of real shocks at date 0, but not at date 1, since λ is a function of μ_r and σ^2.

Equations (23)–(24) produce five important results:

(a) Policy uncertainty induces a boom at $t = 0$ and a recession at $t = 1$, regardless of the size of γ and of whether the reform succeeds or fails. This follows from the feasibility constraint $\eta > \lambda$ and the fact that, unless $\pi = 0$, $0 < \eta < 1$.

(b) The boom is weaker than the recession. $\eta > \lambda$ and $0 < \eta < 1$ imply that $-Ln(\eta)$, which measures the size of the boom, is smaller than $-Ln[(\eta - \lambda)/(1-\lambda)]$, which is the absolute value of the recession.

(c) The higher the probability of policy reversal, the larger the amplitude of the credibility-induced cycle (that is, the stronger the boom and the deeper the recession), because η is decreasing in π.

(d) The higher the degree of risk aversion γ, or the lower the intertemporal elasticity of substitution $1/\gamma$, the smaller the amplitude of the credibility-induced cycle. This is because η is increasing in γ.

(e) The noncredible reform is always socially costly, compared with either the free-trade regime or the regime with permanent tariffs. This is demonstrated by recalling that permanent rebated tariffs reproduce the free-trade equilibrium, differentiating equation (21) with respect to η, and noting that η is decreasing in π. The intuition is that the boom induces excessive consumption at $t = 0$ relative to Pareto-optimal plans

[5] A cross-country empirical analysis of the link between terms of trade and growth implied by this model is undertaken in Mendoza (1994).

in equations (5)–(6), and hence savings are insufficient to finance optimal consumption in the future.

Credibility Effects and Real Uncertainty

The link between real uncertainty and policy uncertainty is examined next. First we consider a policymaker planning to introduce a trade reform with knowledge of the mean and risk characteristics of asset returns and the structure of preferences and technology, but not knowing the subjective probability attached to policy reversal. In this case, expected values of equations (23)–(24) are used to analyze how changes in σ^2 and μ_τ affect credibility-induced cycles. This analysis produces two main results:

(i) An increase in μ_τ increases expected consumption growth through its effect on the trend components of equations (23)–(24), but it does not affect the deviation from trend at $t = 0$. In contrast, the recession at $t = 1$ is affected by the rise in μ_τ because λ is part of the credibility component of the cycle and λ depends on μ_τ. The direction of this effect depends on the size of γ. The recession is weaker (stronger) if $\gamma > 1$ ($\gamma < 1$) because the marginal propensity to consume falls (rises) when μ_τ rises, and the credibility-induced recession is positively related to the propensity to consume.

(ii) An increase in risk (that is, a rise in σ^2), increases trend consumption growth if $\gamma > 2$ and reduces it otherwise. The credibility boom at $t = 0$ is independent of σ^2, but the recession at $t = 1$ is not because σ^2 alters the credibility component of the cycle via its effect on λ. The recession is stronger when $\gamma > 1$ and weaker if $\gamma < 1$. The intuition is similar to that for the case of a rise in μ_τ.

These results suggest that, for the realistic case in which $\gamma > 1$, an increase in mean returns (that is, a permanent productivity gain or an improvement in the long-run growth of terms of trade) weakens the recession induced by a noncredible trade reform. In contrast, an increase in risk (that is, a mean-preserving increase in the variability of domestic productivity or the terms of trade) deepens the recession. The initial credibility-induced boom is not affected by changes in either expected returns or the level of risk.

It is of interest also to consider the possibility that the probability of success of a trade reform may depend on the properties of real shocks hitting the economy. In particular, if π is a decreasing function of mean returns and an increasing function of risk (i.e., $\pi(\mu_\tau,\sigma^2)$, with $\pi_1 < 0$ and $\pi_2 > 2$), the results are altered as follows. Since the magnitude of the

credibility distortion falls as π falls, the fall in π associated with an increase in μ_τ would reduce the amplitude of the credibility-induced cycle. Moreover, at $t = 1$ the rise in μ_τ has an additional effect on the credibility component of the cycle through its impact on the marginal propensity to consume, as described in result (i). If $\gamma > 1$, the weakening of the recession due to the fact that η rises as π falls is reinforced by the fall in λ. A similar analysis applies to the case of a fall in σ^2. Thus, if increases in average real returns or reductions in their variability, due to perceived productivity gains or expected improvements in the terms of trade, lend credibility to trade reforms, credibility-induced cycles are weaker than in economies where the probability of reversal is independent of μ_τ and σ^2.

Instead of the policymaker's problem, consider a researcher who has been given data on consumption, terms of trade, and real domestic rates of return for countries undertaking trade reforms, and who has been asked to assess the credibility of those reforms, or to measure credibility effects. The issue is to determine whether observed differences in consumption fluctuations are an indicator of lack of credibility. The researcher is assumed to know the preference and technology parameters with precision, so the problem is only to map unambiguously observed consumption patterns into values of π.

The researcher computes μ_τ and σ^2 and uses equations (22)–(24) to construct estimates of that portion of fluctuations in consumption determined by real uncertainty—namely, the component of fluctuations driven by "fundamentals." Define this component as ΔC_t^F. Then, it follows from equation (22) that for all $t < 0$ and $t > 1$ $\Delta C_t^F = \Delta C_t$, while equations (23)–(24) and result (a) imply that, if $\pi > 0$, $\Delta C_0{}^F < \Delta C_0$ and $\Delta C_1{}^F > \Delta C_1$. Thus, if a trade reform lacks credibility, consumption growth exceeds that predicted by fundamentals at the date the reform is introduced, followed by a fall below the level indicated by fundamentals at the date policy uncertainty is resolved. Moreover, using equations (20) and (23), and since τ is known, the researcher can reconstruct π from the observed ΔC_0 and the estimated $\Delta C_0{}^F$. In particular, if ΔC_0 and $\Delta C_0{}^F$ are small

$$\pi \approx \left[\frac{(1+\tau)}{\tau}\right]\left[1 - \left(\frac{1+\Delta C_0{}^F}{1+\Delta C_0}\right)_\gamma\right]. \tag{25}$$

This expression shows that larger deviations of consumption growth above the level caused by fundamentals reflect a higher value of π. The expression also shows, however, that if one only looks at the actual magnitude of the consumption boom, the estimate of π would be biased upward. The fraction of the business cycle attributed to real uncertainty must be isolated in order to measure lack of credibility accurately. An

economy undertaking a trade reform may display a stronger boom than another simply because its terms of trade are more volatile, and not because its reform is less credible.

Differences in realizations of real shocks, represented by ϵ in equations (23) and (24), that may hit reforming economies at the time of implementing trade reforms also bias measures of credibility that do not separate real- and policy-uncertainty components. This bias differs depending on the duration of the shocks, as the following results show:

- A transitory fall in the terms of trade, or an increase in p_0 (that is, a negative shock ϵ_{-1} and a positive shock ϵ_0)[6] shortens the amplitude of cycles during an uncertain trade reform. $\epsilon_{-1} < 0$ weakens the boom at $t = 0$ and $\epsilon_0 > 0$ weakens the recession at $t = 1$.
- A permanent fall in the terms of trade, or an increase in p_t for all $t \geq 0$ (that is, $\epsilon_{-1} < 0$ but ϵ_t for $t \geq 0$ and μ_τ unchanged) reduces the boom but does not affect the subsequent recession.
- A secular decline in terms of trade that starts at $t = 0$,[7] or an increase in the rate of growth of p (that is, $\epsilon_{-1} < 0$ coincides with a decline in μ_τ for all $t \geq 0$) weakens the boom at $t = 0$ because $\epsilon_{-1} < 0$ reduces the real-uncertainty component of the business cycle. At $t = 1$, the fall in μ_τ affects the business cycle through its impact on the size and direction of the credibility effect, which in turn depends on whether γ is greater or less than 1 (see result (i) above). The fall in μ_τ also reduces the trend growth rate.

Numerical Results

We now study the potential magnitude of the effects described above by conducting some numerical experiments. The model is calibrated to create a benchmark that replicates roughly the situation in Latin America. Parameters are set as follows: $\sigma = 0.10$, $\gamma = 2.33$, $\beta = 0.95$, and $\mu_\tau = 1.07$. The value of γ is the estimate obtained by Ostry and Reinhart (1992), $\beta = 0.95$ is taken from Lucas (1987),[8] σ reflects the standard deviation of the log of the terms of trade for Latin America in Mendoza (1995), and μ_τ corresponds to the historical evidence documented in Mehra and Prescott (1985) for the mean real interest rate on

[6] Recall that $r_{-1} = R_{-1}p_{-1}/p_0$, $r_0 = R_0p_0/p_1$, and p is the inverse of the terms of trade.

[7] This experiment is interesting because trade reforms introduced in recent years coincided with a secular decline in real commodity prices.

[8] Evidence from Ostry and Reinhart (1992) suggests that β may actually be slightly higher. Increasing β does not affect our results significantly, except for estimates of welfare costs that increase sharply as β rises.

risky assets. Combining equation (22) with these parameters, and some slight variations, we produce average consumption growth rates between 1 and 2 percent, with a standard deviation around 10 percent, roughly consistent with the Latin American experience (see Mendoza (1995)). The benchmark also sets $\tau = 0.3$ and realizations of real shocks at $t = 0$ and $t = 1$ to zero.

Table 1 lists deviations from trend in consumption during a trade reform of uncertain duration for the benchmark case and alternative parameter structures, assuming different values of π. The first column reports results for the benchmark economy. If the reform is perfectly credible, there are no consumption cycles because a credible reform does not distort consumption plans, and also because there are no real shocks at dates 0 and 1. As π rises, credibility-induced cycles appear. Considering that, for $\sigma = 0.1$, deviations from trend driven by terms-of-trade shocks of up to 20 percent are within the 98 percent confidence interval, credibility-induced cycles—with booms between 2.5 and 11.3 percent and recessions between -2.7 and -11.9 percent depending on π—are not unusually large.

Lowering γ to 1/2 (that is, raising the intertemporal elasticity of substitution to 2) increases markedly the amplitude of credibility-induced cycles relative to the benchmark, by a factor of about 4.5, while setting $\gamma = 5$ (i.e., $1/\gamma = 0.2$) reduces the amplitude of the cycles by a factor of approximately 0.45. For $\pi > 1/2$, the low risk-aversion case produces cycles larger than those generated by real shocks, which are between -20 and 20 percent with a probability of 0.98. Consumption fluctuations are markedly more sensitive to reductions than to increases in γ when γ is initially around 2. Given the controversy surrounding estimates of γ, this result suggests that economies may display more consumption instability because agents may be less risk averse, even if only marginally, than in other economies, and not necessarily because trade reforms are less credible. Thus, parameter uncertainty may play a key role.

High- and low-tariff simulations illustrate a similar point. The higher the pre-reform tariffs, the larger the credibility-induced cycles. A country with $\tau = 0.7$ and $\pi = 0.25$ displays cycles as large as those of an economy with $\tau = 0.1$ and $\pi = 1$. Thus, given the dispersion of existing tariffs, actual differences in the level of tariffs being removed may also introduce noise into tests of lack of credibility based exclusively on the magnitude of consumption booms.

Simulations for economies with higher mean returns (μ_τ) and higher risk (σ^2) show that the effects of changes in μ_τ and σ^2 on credibility-induced cycles are small, reflecting the fact that real uncertainty and policy uncertainty are statistically independent. The credibility component of the boom at $t = 0$ is independent of changes in μ_τ and σ, but that

Table 1. *Fluctuations in Consumption During a Trade Reform in Economy with Tariff Rebates*

(Deviations from trend in percent)

Probability of reversal (Π)	Benchmark economy		Low risk aversion ($\gamma = 1/2$)		High risk aversion ($\gamma = 5$)		High tariff ($\tau = 0.7$)		Low tariff ($\tau = 0.1$)		Higher mean returns ($\mu_\tau = 1.1$)		Higher risk ($\sigma = 0.2$)		Transitory shock[a] $\epsilon_{-1} = -0.05$ $\epsilon_0 = 0.05$		Permanent shock[b] $\epsilon_{-1} = -0.05$ $\epsilon_0 = 0$		Secular decline[c] $\epsilon_{-1} = -0.05$ $\mu_\tau = 1.0593$	
	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$	$t = 0$	$t = 1$
0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	−5.0	5.0	−5.0	—	−5.0	—
0.25	2.55	−2.69	11.88	−12.37	1.19	−1.24	4.66	−4.92	0.99	−1.04	2.55	−2.74	2.55	−2.64	−2.45	2.31	−2.45	−2.69	−2.45	−2.68
0.50	5.26	−5.56	24.52	−25.58	2.45	−2.56	9.89	−10.47	2.00	−2.11	5.26	−5.65	5.26	−5.45	0.26	−0.56	0.26	−5.56	0.26	−5.53
0.75	8.16	−8.63	38.01	−39.79	3.80	−3.98	15.85	−16.81	3.03	−3.20	8.16	−8.77	8.16	−8.45	3.16	−3.63	3.16	−8.63	3.16	−8.58
1.00	11.26	−11.92	52.47	−55.14	5.25	−5.49	22.77	−24.20	4.09	−4.32	11.26	−12.13	11.26	−11.67	6.26	−6.93	6.26	−11.93	6.26	−11.85

[a] Transitory deterioration of the terms of trade by 5 percent at $t = 0$ (i.e., $P_0 = P(1 - 0.05)$ where P is the average of the terms of trade).

[b] Permanent deterioration of the terms of trade by 5 percent (i.e., $P_1 = P_o = P(1 - 0.05)$).

[c] Secular decline in the terms of trade that starts with a 5 percent fall at $t = 0$ and continues at an annual rate of 1 percent ($\mu_\tau = 1.0593 = 1.07 \times 0.99$).

component in the recession at $t = 1$ is not. However, even the impact on the recession is small. This is because, although changes in risk and mean returns affect λ, the impact of a change in λ on the credibility effect λ/η depends on how close η is to 1. The closer η is to 1, the smaller the distortion induced by lack of credibility. The benchmark values of γ and τ imply that the lowest value of η for the experiments in Table 1 is 0.89, when $\pi = 1$. Moreover, since η is decreasing in π, it also follows from this reasoning that an increase in μ_τ (σ^2) has a larger negative (positive) effect on consumption cycles relative to the benchmark the higher is π.

We turn now to the implications of realizations of terms-of-trade shocks that coincide with trade reforms. Table 1 examines the three cases discussed earlier; a transitory decline in terms of trade that rises p_0 only (that is, a fall in ϵ_{-1} and a rise in ϵ_0), a permanent decline in terms of trade rising p_t for all t (i.e., a fall in ϵ_{-1} that leaves ϵ_0 unchanged), and a secular deterioration of terms of trade that starts at 0 and continues permanently (that is, a fall in ϵ_{-1} that coincides with a fall in μ_τ). In the first two cases, terms-of-trade shocks are set to 5 percent, which is a small number given that shocks of up to 20 percent are in the 98 percent confidence interval. In the third case, the initial shock is also 5 percent, and the secular decline continues at 1 percent a year. These shocks induce consumption fluctuations through the real component of cycles ϵ, and not through credibility effects (except for the secular terms-of-trade deterioration, in which μ_τ alters the credibility effect in equation (24)).

The transitory terms-of-trade shock reduces the amplitude of the business cycle in the period of policy uncertainty. This shock has an adverse effect on consumption at $t = 0$ because it reduces wealth in units of importables, but increases the return on savings between $t = 0$ and $t = 1$ as the price of importables is expected to fall. These effects are quantitatively important because an economy undertaking a trade reform with a probability of failure as high as 50 percent would not display the booming behavior normally attributed to lack of credibility. Even when the boom is present, the surge in consumption in an economy where $\pi = 1$ and where a transitory terms-of-trade shock hits is similar in magnitude to that of an economy with stable terms of trade and $\pi = 0.5$. The same is true for economies experiencing a permanent terms-of-trade decline, except that a permanent shock does not have the weakening effect on the recession at $t = 1$. The secular fall in trade relative prices has the same large adverse effects on the consumption boom at date 0 as does a transitory shock, but at date 1 it results in a modest increase in consumption growth induced by the effect of μ_τ on λ and hence η. Thus, the effects of real shocks that coincide with noncredible reforms need to be carefully considered in order to assess credibility on the basis

of consumption behavior, even when the two sources of uncertainty are independent and policy uncertainty is resolved in one period.

The next task is to examine welfare implications. Welfare assessments need to be viewed with caution, given theoretical evidence that costs of credibility are marginal unless durable goods or other persistence mechanisms are considered (see Calvo (1988)). Tables 2 and 3 report the results of welfare analysis. Table 2 examines the costs of riskier real asset returns and of realizations of terms-of-trade shocks at $t = 0$ under alternative scenarios for π. The first case illustrates the overall welfare costs of consumption instability driven by real uncertainty. The second set of esti-

Table 2. *Welfare Costs of Real Uncertainty in Economy with Tariff Rebates*
(In percent of stationary consumption in risk-free economy)[a]

Panel A Overall risk			Panel B Terms-of-trade deterioration at $t = 0$					
				Welfare costs				
σ	Welfare cost	Average growth	ϵ	$\pi = 0$	$\pi = 0.25$	$\pi = 0.5$	$\pi = 0.75$	$\pi = 1$
0.0	0.0	0.70	−0.10	−0.52	0.50	−0.48	−0.46	−0.44
0.025	1.18	0.75	−0.05	−0.26	−0.25	−0.24	−0.23	−0.22
0.05	4.84	0.82	−0.025	−0.13	−0.13	−0.12	−0.12	−0.11
0.075	11.44	1.08	0.00	0.00	0.00	0.00	0.00	0.00
0.1	21.86	1.38	0.025	0.13	0.13	0.12	0.12	0.11
0.125	37.75	1.76	0.05	0.26	0.26	0.25	0.24	0.23
0.15	62.17	2.22	0.10	0.53	0.52	0.50	0.48	0.46

[a] Minus sign denotes a welfare gain and a terms-of-trade improvement.

Table 3. *Welfare Costs of Policy Uncertainty in Economy with Tariff Rebates*
(In percent of stationary consumption in economy with perfect credibility)

	Welfare cost of trade reform [a]								
	Benchmark economy			High risk aversion $\gamma = 5$			High tariff $\tau = 0.7$		
π	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	0.017	0.003	−0.011	0.015	0.001	−0.017	0.034	0.009	−0.017
0.4	0.039	0.011	−0.017	0.032	0.004	−0.033	0.089	0.038	−0.014
0.6	0.069	0.026	−0.017	0.053	0.010	−0.046	0.174	0.095	0.016
0.8	0.107	0.049	−0.009	0.076	0.018	−0.057	0.297	0.189	0.079
1.0	0.155	0.082	0.007	0.102	0.030	−0.064	0.472	0.334	0.193

[a] Minus sign denotes a welfare gain.
[b] *Minus sign denotes a terms-of-trade improvement.*

mates quantifies the costs of one-period realizations of real shocks that are a better point for comparison with the costs of policy uncertainty.[9]

Panel A of Table 2 shows that variability in domestic asset returns or in the terms of trade is very costly, even though it induces faster growth. As σ increases from 0 percent to 15 percent, the growth rate increases from 0.7 percent to 2.2 percent, but welfare costs rise from 0 to about 62 percent. Thus, in this example a high-risk economy grows faster than a low-risk economy, but faster growth represents lower welfare. The value $\sigma = 0.025$ induces a 1.2 percent welfare cost, and a more realistic $\sigma = 0.1$ results in a cost equivalent to 1/5 of the trend level of consumption in a risk-free economy.

These costs of consumption instability are significantly larger than those obtained by Lucas (1987). Most of the difference is due to the fact that consumption is modeled here as the outcome of an intertemporal expected utility maximization exercise in which uncertainty affects not just fluctuations of consumption around trend, but the trend growth rate itself. Lucas's experiment, in contrast, assesses the costs of an arbitrary consumption rule when growth and cycles do not interact.

Panel B of Table 2 reports the costs of realizations of terms-of-trade shocks at $t = 0$ ranging from -10 percent to 10 percent for various values of π. In general, these shocks produce welfare costs between -0.52 and 0.53 percent, and the costs are only marginally affected by the degree of policy uncertainty. This result reflects the fact that the processes driving real and policy uncertainty are independent. At the same time, however, the result also shows that even when the two uncertainties are independent, there is a link between costs of real uncertainty and lack of credibility. Note in addition that when the terms-of-trade shock is positive, the higher π is, the smaller is the welfare loss because the credibility tax reduces the intertemporal relative price of consumption at $t = 0$, and hence offsets the effect of the terms-of-trade deterioration.

Table 3 reports welfare costs of credibility-induced cycles for different realizations of terms-of-trade shocks and different values of π in the benchmark economy, as well as those for economies where $\tau = 0.7$ and $\gamma = 5$. The small magnitude of the costs reported in this table, compared with those reported in Panel B of Table 2, suggests that credibility is less

[9] Welfare costs are measured as percentage changes in stationary consumption paths that compensate households for the loss in lifetime utility resulting from existing distortions. For example, in the case of costs resulting from $\sigma = 0.025$, we compute equation (21) under $\sigma = 0.025$ and $\sigma = 0$, assuming $\pi = 0$, and use equation (1) to compute two time-invariant levels of C that represent the same expected utility.

costly than real shocks. This is true even in economies with a higher degree of risk aversion and higher initial tariffs than the benchmark. While costs resulting from terms-of-trade shocks range between -0.5 and 0.5 percent, those induced by policy uncertainty are only between -0.01 and 0.16 percent in the benchmark case. A higher γ results in even smaller welfare costs of policy uncertainty, while a higher τ results in larger costs, but comparable in size to those induced by real shocks only when π approaches 1 and terms of trade either improve or remain constant. We acknowledge that the introduction of persistence mechanisms, such as durable goods or capital accumulation, could result in larger welfare costs of lack of credibility, but it is also likely that these modifications would enlarge the costs of real uncertainty. Thus, it is unclear whether extending the model in this direction would reduce the difference between the welfare costs of real and policy uncertainty.

Real shocks have a small effect on the welfare costs of credibility, reflecting again the independence of the two sources of uncertainty. However, terms-of-trade declines that coincide with noncredible reforms offset the cost of credibility and weaken the credibility-induced boom because they make current consumption more expensive.

III. Noncredible Trade Reforms and Real Uncertainty Without Tariff Rebates

Competitive Equilibrium

This section studies an economy in which a trade reform is announced under the same conditions as before, except that tariff revenue is not rebated, but used to finance unproductive government expenditures. The competitive equilibrium is the solution to this dynamic programming problem:

$$V^{\pi,NT}(A_0,p_0) = \max\left\{\frac{C_0^{1-\gamma}}{1-\gamma} + \beta\pi\, E[V^{\tau}(A_1,p_1)] + \beta(1-\pi)\, E[V^{*}(A_1,p_1)]\right\}$$

$$\text{subject to } A_1 \leq R_0(A_0 - p_0 C_0),\ A_0 > 0. \tag{26}$$

Thus, when the reform is announced at $t=0$, agents choose C_0 and A_1, optimally attaching probability π to the scenario that the reform fails and the future stream of utility is $V^{\tau}(A_1,p_1)$, and probability $1-\pi$ to the

scenario that the reform prevails and hence future utility is $V^*(A_1,p_1)$. $V^*(A_1,p_1)$ and $V^\tau(A_1,p_1)$ are given by equations (8) and (14) updated one period respectively. If the reform prevails, optimal plans for all $t>0$ are as in equations (5)–(6), and if it fails plans are as in equations (12)–(13). At $t=0$, the solution of equation (26) implies that

$$C_0^{\pi,NT} = \frac{\lambda}{(1-\lambda)\theta+\lambda}\left(\frac{A_0}{p_0}\right), \tag{27}$$

$$A_1^{\pi,NT} = \left[\frac{(1-\lambda)\theta}{(1-\lambda)\theta+\lambda}\right] R_0 A_0, \text{ and} \tag{28}$$

$$\theta(\pi,\tau) \equiv \left[\frac{\pi}{(1+\tau)^{1-\gamma}} + 1 - \pi\right]^{1/\gamma}. \tag{29}$$

Lifetime utility as of the date of the reform is

$$V^{\pi,NT}(\theta,\lambda,A_0,p_0) = \left[\frac{\lambda}{(1-\lambda)\theta+\lambda}\right]^{-\gamma}\left(\frac{1}{1-\gamma}\right)\left(\frac{A_0}{p_0}\right)^{1-\gamma}. \tag{30}$$

The superscript π, NT denotes that these solutions correspond to the regime of a noncredible reform without transfers or rebates. $\theta(\pi,\tau)$ is the distortion due to lack of credibility ($\theta(0,\tau)=1$).

Note that to examine the implications of lack of credibility, these results must be compared with those for the regime with permanent tariffs, not against the free-trade regime. When tariff revenue is rebated, this distinction is irrelevant because free trade and permanent tariffs result in identical allocations. In the case without rebates, however, comparing allocations under imperfect credibility against free-trade allocations produces misleading results, especially with regard to the role of the intertemporal elasticity of substitution in determining credibility effects. In particular, after some manipulation one can show that $C_0^{\pi,NT} > C_0^\tau$, regardless of the value of γ, while $C_0^{\pi,NT} > C_0^*$ only if $\gamma > 1$. Thus, whether or not tariff revenue is rebated, a trade reform of uncertain duration always induces a boom if the economy starts from a regime with tariffs. This contradicts the result in van Wijnbergen (1992), which depends on γ.

Cyclical Effects of Imperfect Credibility

At any date $t<0$ or $t>1$, consumption fluctuations in the economy without rebates are the same as in the economy with rebates (given by equation (22)) because the tariff is time-invariant and, although the nonrebated tariff has a negative wealth effect, the valuation of wealth

A_t/p_t is affected uniformly by τ at any point in time. At $t = 0$, when the reform is implemented,

$$\Delta C_0 = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_{-1} + Ln(1+\tau) - Ln(\theta + \lambda(1-\theta)). \tag{31}$$

The first three terms in the right-hand side of this expression are the real components of consumption growth: the first two define the trend and the third is the cycle. These three terms have the same form as in the economy with rebates—except that μ_r should reflect the permanent tariff. The last two terms of equation (31) represent credibility-induced cycles.

At date 1, when policy uncertainty is resolved, ΔC_1 adopts one of two forms depending on whether the reform is reversed or not. In particular,

$$\Delta C_1 = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_0 - Ln(1+\tau) + Ln(\theta) \text{ if reform fails;} \tag{32}$$

$$\Delta C_1 = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_0 + Ln(\theta) \text{ if reform prevails.} \tag{33}$$

The expected value of ΔC_1 conditional on the realization of r_0 is

$$E(\Delta C_1 | r_0) = \frac{1}{\gamma}[Ln(\beta) + Ln(\mu_r)] - [(1-\gamma)+1]\frac{\sigma^2}{2} + \epsilon_0 - \pi Ln(1+\tau) + Ln(\theta). \tag{34}$$

Credibility and real-uncertainty effects are once again clearly separated.

The closed-form solutions (31)–(34) illustrate sharp differences in consumption dynamics between regimes with and without rebates. Impact effects at date 0 are qualitatively similar under the two regimes—both produce consumption booms. However, the presence of wealth effects in the economy without rebates tends to induce stronger booms than in the case with rebates. At date 1, when policy uncertainty is resolved, the two economies behave very differently; the economy with rebates experiences a recession milder than the initial boom, but the economy without rebates may experience a boom or a recession depending on whether the reform prevails and whether γ is greater or less than 1. Even if we compare expected growth rates conditional on the realization of r_0, ΔC_1 in the economy without rebates may be stronger or weaker

than in the economy with rebates. Welfare implications are also different. Welfare with or without rebates is decreasing in π, but when revenue is not rebated there are temporary reforms that improve welfare relative to an initial regime with permanent tariffs. With rebates this cannot occur because the regime with permanent tariffs reproduces the free-trade, Pareto-optimal equilibrium.

The results summarized in the previous paragraph can be established more formally as follows:[10]

- Imperfect credibility induces a boom at $t = 0$ regardless of the size of γ. The boom embodies a positive wealth effect represented by $Ln(1 + \tau)$, and a substitution effect captured by $-Ln(\theta + \lambda(1 - \theta))$. The latter is negative if $\gamma > 1$, but it can be positive if $\gamma < 1$ and θ is low enough so that $\theta + \lambda(1 - \theta) < 1$. Overall, however, the wealth effect always dominates.
- At $t = 1$, imperfect credibility induces a boom or a recession depending on whether or not the reform is reversed and on the size of γ. If tariffs are reinstated, there is a recession because the negative wealth effect induced by this action dominates the substitution effect. The magnitude of the recession depends on γ. If $\gamma > 1$, the recession is weaker than the initial boom; if $\gamma < 1$, the opposite is true; and if $\gamma = 1$, the boom and the recession are identical. If free trade prevails and $\gamma > 1$, the boom started at $t = 0$ continues because there is no negative wealth effect and the substitution effect favors a further expansion of consumption.[11]
- In terms of expected deviations from trend at $t = 1$ conditional on realizations of r_0 (i.e. equation (34)), credibility induces a recession if $\gamma \leq 1$, but for $\gamma > 1$ there are combinations of γ, π, and τ such that credibility effects induce a boom. However, $\gamma > 1$ alone is not sufficient to guarantee an expected boom.
- Since θ is increasing in π when $\gamma > 1$ and decreasing in π when $\gamma < 1$ (see equation (29)), the effects of an increase in π on the amplitude of credibility-induced cycles depend on γ. For $\gamma > 1$, an increase in π reduces the boom at date 0, weakens the recession at date 1 if tariffs return, and strengthens the boom at date 1 if tariffs do not return. There are two effects operating at date 1. The increase in π assigns more probability to the recession scenario of the policy reversal, and it increases the magnitude of the boom in case free trade continues. The first effect is associated with wealth, and hence tends to dominate.
- Given that θ is increasing in γ, an increase in γ has a positive effect

[10] Mathematical proofs are available from the authors.

[11] This result is consistent with the findings of Calvo and Drazen (1993) for the sustained boom of the reform of uncertain duration under incomplete markets and no rebates.

on consumption fluctuations at date 1, regardless of whether or not the reform fails. At date 0 there are two offsetting effects because a higher γ induces, in addition to an increase in θ, a fall in the propensity to consume, λ, and the credibility effect at $t = 0$ is a function of θ and λ. For $\gamma > 1$, the credibility effect is weaker the larger is γ, so the boom falls as γ rises. Thus, an increase in γ tends to reduce the amplitude of credibility-induced cycles.

- Welfare of the reforming economy, as given by equation (30), is decreasing in π. However, because of the wealth effect induced by the absence of rebates, trade reforms of uncertain duration are not always socially costly, compared with the level of welfare of the economy with permanent tariffs. $\gamma > 1$ is sufficient for welfare under a temporary trade reform to exceed that of the regime with permanent tariffs.

Credibility Effects and Real Uncertainty

In the economy without rebates, the implications of changes in the risk and return characteristics of domestic assets for consumption fluctuations and credibility effects also differ from those of the economy with rebates. In particular, the timing of cyclical effects is reversed as follows:

- μ_τ does not affect the credibility component of consumption fluctuations at date 1 (see equations (32)–(34)), but at date 0 an increase in μ_τ affects the credibility-induced boom through its effect on the propensity to consume λ. If $\gamma > 1$ ($\gamma < 1$), the boom is stronger (weaker) because λ is decreasing (increasing) in μ_τ.
- An increase in risk (that is, an increase in σ^2) affects the magnitude of the credibility effect at date 0, but not at date 1. If $\gamma > 1$ ($\gamma < 1$), the boom is weaker (stronger) because λ is increasing (decreasing) in σ^2.

For the researcher attempting to document evidence on credibility using data on consumption and asset returns, the situation is also different without rebates. The "fundamental" component of business cycles driven by real factors, ΔC^F, is still given by equation (22). Equation (31) implies that $\Delta C_0 > \Delta C_0^F$ for economies introducing trade reforms at date 0. However, equations (32)–(34) imply that, even with real uncertainty unchanged, the data may show ΔC_1 greater or lower than ΔC_1^F depending on the outcome of the reform and on the degree of risk aversion. In countries where the reform is reversed, $\Delta C_1 < \Delta C_1^F$ for any value of γ, but in countries where free trade is maintained the opposite is observed if $\gamma > 1$. Thus, if econometric estimates suggest that $\gamma > 1$, the researcher should find booms in excess of those explained by funda-

mentals at dates 0 and 1 in free-trade economies, while in economies where reforms fail a boom-recession cycle should be observed.

The previous result is critical because it implies that a boom-recession cycle is not the only signal of lack of credibility. For example, suppose that Countries A and B introduce trade reforms under identical conditions of lack of credibility (i.e., π is the same in both countries). In Country A there are transfer payments programs equivalent to tariff revenue rebates, while in Country B tariff revenue finances the operation of inefficient enterprises or other unproductive expenditures. If trade reforms in the two countries succeed, Country A goes through a boom-recession cycle, but Country B experiences two consequent booms. The absence of the recession in Country B does not imply that the reform was more credible when announced, it reflects instead the agent's perception of the overall stance of fiscal policies.

As before, the researcher can use the data to reconstruct the value of π associated with the pattern of consumption. In particular, if the trade reform is abandoned at $t = 1$, the following holds:[12]

$$\pi = \frac{(1+\tau)^{1-\gamma}\left\{\left[\frac{\Delta C_1}{\Delta C_1^F}(1+\tau)\right]^{\gamma} - 1\right\}}{1-(1+\tau)^{1-\gamma}}. \tag{35}$$

This expression indicates that in the economy without rebates, as in the economy with rebates, accurate measures of π require that the influence of real uncertainty be properly considered.

The effects of transitory and permanent falls in the terms of trade (i.e., negative shocks to p_t) are identical to those obtained in the economy with rebates. A secular deterioration in the terms of trade that starts at $t = 0$ has different effects, however, because the fall in μ_τ weakens the credibility effect at $t = 0$. In the economy with rebates this effect is independent of μ_τ.

Numerical Results

This section provides results of numerical simulations that illustrate the quantitative implications of eliminating tariff rebates. Table 4 lists consumption fluctuations during a noncredible trade reform in the benchmark economy and some alternative specifications. Since, in the absence of rebates, consumption fluctuations at the date policy uncertainty is

[12] If the trade reform prevails, the term $(1 + \tau)$ inside the brackets of equation (35) disappears.

Table 4. *Fluctuations in Consumption During a Trade Reform in Economy Without Tariff Rebates*[a]

(Deviations from trend in percent)

Probability of reversal (Π)	Benchmark economy		Low risk aversion ($\gamma = \frac{1}{2}$)		High risk aversion ($\gamma = 5$)		High tariff ($\tau = 0.7$)		Low tariff ($\tau = 0.1$)		Higher mean returns ($\mu_\tau = 1.1$)		Higher risk ($\sigma = 0.2$)		Transitory shock[b] $\epsilon_{-1} = -0.05$ $\epsilon_0 = 0.05$		Permanent shock[c] $\epsilon_{-1} = -0.05$ $\epsilon_0 = 0$		Secular decline[d] $\epsilon_{-1} = -0.05$ $\mu_\tau = 1.0593$	
	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$	$t=0$	$t=1$
0.00	26.24	—	26.24	—	26.24	—	53.06	—	9.53	—	26.24	—	26.24	—	21.24	5.00	21.24	—	21.24	—
0.25	22.19	−2.30	33.24	−12.80	18.93	1.06	43.76	−3.47	8.18	−0.96	22.17	−2.30	22.11	−2.30	17.19	2.70	17.19	−2.30	17.17	−2.30
0.50	18.51	−4.98	38.43	−25.81	13.64	0.01	36.16	−8.77	6.87	−1.96	18.47	−4.98	18.36	−4.98	13.51	0.02	13.51	−4.98	13.47	−4.98
0.75	15.12	−7.98	44.80	−39.02	9.49	−2.23	29.73	−15.32	5.60	−3.00	15.06	−7.98	14.91	−7.98	10.12	−2.98	10.12	−7.98	10.06	−7.98
1.00	11.99	−11.26	51.38	−52.47	6.07	−5.25	24.16	−22.77	4.37	−4.09	11.92	−11.26	11.73	−11.26	6.99	−6.26	6.99	−11.26	6.92	−11.26

[a] For $t = 1$, the table lists the expected deviation from trend conditional on the realization of real disturbances (i.e., the value resulting from computing equation (33)).

[b] Transitory deterioration of the terms of trade by 5 percent at $t = 0$ (i.e., $P_o = P\,(1 - 0.05)$ where P is the average of the terms of trade).

[c] Permanent deterioration of the terms of trade by 5 percent (i.e., $P_1 = P_o = P(1 - 0.05)$).

[d] Secular decline in the terms of trade that starts with a 5 percent fall at $t = 0$ and continues at an annual rate of 1 percent ($\mu_\tau = 1.0593 = 1.07 \times 0.99$).

resolved depend on the outcome of the reform, we report expected deviations from trend for $t = 1$, conditional on realizations of real shocks. In general, the larger magnitude of fluctuations in Table 4 relative to those in Table 1 reflects the wealth effects present in the economy without rebates.

Fluctuations in consumption in the benchmark case are significant, particularly the booms induced by trade reforms. As π varies from 0 to 1, the boom at $t = 0$ ranges between 12 and 26 percent, which exceeds recessions at $t = 1$ that range between 0 and 11 percent. Recessions are similar in magnitude to those obtained with rebates, but booms are much larger, especially for low values of π. Unlike with rebates, there is a boom even if the reform is fully credible, as the economy jumps to the free-trade equilibrium. Moreover, and also contrary to what is observed with rebates, the boom is stronger the lower the probability of reversal, as this induces agents to expect the gain in wealth to be more permanent. Thus, whether tariffs are rebated is important not only for the magnitude of credibility-induced cycles, but also for the credibility ranking to be assigned to countries on the basis of observed consumption patterns.

Changes in the degree of risk aversion have large effects on credibility-induced cycles. With $\gamma = 0.5$ the amplitude of the cycles increases significantly, and the resulting booms and recessions generally exceed the 20 percent limit that contains the 98-percent confidence interval of cycles driven by real shocks. When $\gamma = 5$, the booms at $t = 0$ fall by 4 to 6 percentage points, but still remain significant, and the recessions at $t = 1$ are weakened markedly—in fact for $\pi < 1/2$ there is an expected boom at $t = 1$. Changes in initial tariffs also have large effects, although similar in proportion to those obtained with rebates.

Changes in μ_τ and σ without rebates have the opposite effects compared to with rebates. Without rebates, the mean and riskiness of asset returns have no impact on consumption cycles at date 1, while at date 0 increases in μ_τ or σ^2 weaken, albeit only slightly, the consumption boom. In contrast, transitory, permanent, and secular negative realizations of terms-of-trade shocks have similar cyclical implications with or without rebates—if we abstract from considering the deviation from trend driven by the initial positive wealth effect at $t = 0$.

Tables 5–7 report welfare costs of real uncertainty, imperfect credibility, and temporary trade reforms for the economy without rebates. In this case credibility and temporariness need to be separated. Costs of imperfect credibility result from the fact that when the reform is enacted, households attach a nonzero probability to its reversal, and this prevents the economy from reaching the free-trade, welfare-maximizing equilibrium. In contrast, the costs, or gains, of temporary reforms result

Table 5. *Welfare Costs of Real Uncertainty in Economy Without Tariff Rebates*
(In percentage of stationary consumption in risk-free economy)[a]

Overall risk			Terms-of-trade deterioration at $t = 0$					
				Welfare costs				
σ	Welfare costs	Average growth	ϵ	$\pi = 0$	$\pi = 0.25$	$\pi = 0.5$	$\pi = 0.75$	$\pi = 1.0$
0.00	0.00	0.70	−0.10	−0.52	−0.50	−0.48	−0.46	−0.45
0.025	1.18	0.75	−0.05	−0.26	−0.25	−0.24	−0.23	−0.23
0.05	4.84	0.87	−0.025	−0.13	−0.12	−0.12	−0.12	−0.11
0.075	11.44	1.08	0.00	0.00	0.00	0.00	0.00	0.00
0.10	21.86	1.38	0.025	0.13	0.13	0.12	0.12	0.11
0.125	37.75	1.76	0.05	0.26	0.25	0.24	0.24	0.23
0.15	62.17	2.22	0.10	0.53	0.51	0.49	0.48	0.46

[a] Minus sign denotes a welfare gain and a terms-of-trade improvement.

Table 6. *Welfare Costs of Policy Uncertainty in Economy Without Tariff Rebates*
(In percentage of stationary consumption in economy with perfect credibility)

Welfare cost of trade reform[a]									
	Benchmark economy			High risk aversion			High tariff		
				$\gamma = 5$			$\tau = 0.7$		
π	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.2	5.90	5.89	5.97	7.88	7.85	7.82	14.29	14.24	14.20
0.4	11.69	11.65	11.62	14.28	14.24	14.18	27.94	27.89	27.77
0.6	17.36	17.31	17.26	19.73	19.67	19.59	41.09	40.96	40.82
0.8	22.94	22.87	22.80	24.50	24.42	24.32	53.80	53.63	53.45
1.0	28.43	28.34	28.25	28.75	28.67	28.55	66.15	65.93	65.71

[a] Minus sign denotes a welfare gain.
[b] Minus sign denotes a terms-of-trade improvement.

Table 7. *Welfare Costs of Policy Uncertainty Relative to Permanent Tariffs in Economy with Tariff Rebates*[a]
(In percentage of stationary consumption in economy with permanent tariffs)

	Benchmark economy			High risk aversion			High tariff		
				$\gamma = 5$			$\tau = 0.7$		
π	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$	$\epsilon = -0.1$[b]	$\epsilon = 0.0$	$\epsilon = 0.1$
0.0	−23.08	−23.08	−23.08	−23.07	−23.08	−23.08	−41.18	−41.18	−41.18
0.2	−18.54	−18.55	−18.56	−17.02	−17.04	−17.06	−32.77	−32.80	−32.82
0.4	−14.09	−14.11	−14.14	−12.09	−12.13	−12.17	−24.74	−24.79	−24.85
0.6	−9.72	−9.76	−9.80	−7.90	−7.95	−8.01	−17.01	−17.08	−17.16
0.8	−5.43	−5.48	−5.54	−4.23	−4.29	−4.34	−9.53	−9.63	−9.73
1.0	−1.21	−1.28	−1.35	−0.96	−1.03	−1.12	−2.27	−2.39	−2.53

[a] Minus sign denotes a welfare gain.
[b] Minus sign denotes a terms-of-trade improvement.

from comparing the welfare attained by implementing the reform, even if it lasts one period only, with welfare under the initial regime with permanent tariffs.[13]

The costs of real uncertainty with and without tariff rebates, reported in Tables 2 and 5, respectively, are virtually identical. This reflects the fact that the interaction between real and policy uncertainty is weak. The costs of changes in σ are the same because the overall risk of real shocks is independent of π. Costs of terms-of-trade shocks at $t = 0$ ranging between -10 and 10 percent, for π between 0 and 1, are also similar to those obtained without rebates. These costs fall as π rises because of the offsetting influence of the credibility tax.

Tables 6 and 7 list costs of credibility and temporariness for the benchmark economy, for an economy with higher risk aversion ($\gamma = 5$), and for an economy with higher tariffs ($\tau = 0.7$). In the benchmark case, credibility costs are larger than those obtained in the case with rebates, reflecting the magnitude of wealth effects at work in the economy without rebates—the costs range from nearly 6 percent when $\pi = 0.2$ to more than 28 percent when $\pi = 1$, and are not very sensitive to the size of terms-of-trade shocks occurring at the same time as the reform. These costs are still small compared with costs of higher overall real uncertainty (i.e., higher σ), but they are larger than costs associated with one-period terms-of-trade shocks. Increasing γ increases the welfare costs relative to the benchmark case, contrary to what is observed in the economy with rebates.

The costs of temporariness reported in Table 7, which are all negative, indicate that temporary reforms improve welfare relative to the economy with permanent tariffs. A credible reform ($\pi = 0$) produces a gain equivalent to an increase of 23 percent of the long-run level of consumption under permanent tariffs for the benchmark and the high γ cases, and about 41 percent for the high τ case. If the reform is completely noncredible ($\pi = 1$), so that wealth effects are minimized, welfare gains decline to about 1–1.3 percent for the benchmark and high risk-aversion economies, and 2.3 percent for the high tariff economy.

Welfare costs in Tables 6 and 7 can be combined and interpreted as follows. If $\tau = 0$ and $\pi = 0$, the long-run consumption level after a trade reform reaches the free-trade level and is 23 percent higher than in the equilibrium with permanent tariffs. If $\pi = 1$, consumption stays 28 percent below the free-trade equilibrium, but 1.3 percent above the equilibrium under permanent tariffs.

[13] In the case with rebates, both the free-trade economy and the economy with permanent tariffs produce the same welfare, and hence the difference between credibility and temporariness is immaterial.

IV. Concluding Remarks

This paper examines macroeconomic implications of trade reforms of uncertain duration in a framework in which policy uncertainty and real foreign and domestic shocks act as separate sources of uncertainty. Cases in which tariff revenue finances transfer payments programs, as if revenue were rebated to households or used to finance unproductive expenditures are studied. We borrow from the savings-under-uncertainty literature to build a model with closed-form solutions describing competitive equilibria, and use the solutions to derive analytical results and to construct numerical examples.

A noncredible trade reform under a regime with rebates induces a consumption boom when announced, followed by a recession at the date policy uncertainty is resolved—regardless of the success of the reform and the degree of intertemporal substitution. This credibility-induced cycle results from the fact that imperfect credibility acts like a tax on savings. The boom is always weaker than the recession, the amplitude of the cycle increases with the probability of policy reversal and with the elasticity of intertemporal substitution, and the noncredible reform is socially costly.

The interaction between credibility and real uncertainty is weak because the two are assumed to be statistically independent. Still, the mean and risk characteristics of real asset returns, reflecting fluctuations in productivity or the terms of trade, affect the magnitude of credibility-induced cycles through their impact on the savings rate. In addition, real shocks cause consumption cycles via conventional real-business-cycle mechanisms. Because a fraction of consumption instability reflects real uncertainty, it is not possible to map a cross-country ranking of consumption booms into a credibility ranking. However, if sufficient information about real uncertainty and the structure of the economy is available, the fraction of business cycles due to real uncertainty can be isolated, and hence the credibility-induced cycle and the subjective probability of policy reversal can be estimated.

Numerical examples show that credibility-induced cycles are not as large as cycles generated by real shocks. Welfare costs of imperfect credibility—which is a source of uncertainty that is resolved in one period—are small compared with costs of persistent terms-of-trade uncertainty. However, credibility costs are not as small compared with one-period realizations of terms-of-trade shocks. Costs of consumption instability resulting from real uncertainty are much larger than existing measures because changes in the variance of real shocks affect not only deviations from trend consumption growth, but also the trend growth rate itself.

The effects of noncredible trade reforms in a regime without tariff rebates differ because of the influence of wealth effects that rebates eliminate. There is still a boom on the date the reform is announced regardless of the size of intertemporal elasticity of substitution, but on the date policy uncertainty is resolved, a boom or a recession may follow, depending on whether or not the reform is reversed and on the elasticity of substitution. If the reform is reversed there is a recession, but if free trade is sustained and the elasticity of substitution is less than one, the initial boom continues. An elasticity of substitution less than one also ensures that welfare under a temporary reform exceeds that of a regime with permanent tariffs.

Numerical simulations showed that the economy without rebates produces a larger credibility boom, although the boom is a decreasing function of the probability of policy reversal. Welfare costs attributed to policy uncertainty have two components: the welfare gain of a temporary tariff reduction and the cost of a tariff reduction expected to be reversed relative to a credible reform. A fully credible trade reform implies a net welfare gain of about 23 percent, whereas a trade reform that is assigned a 60 percent probability of reversal implies a net loss of 7 percent (a 17 percent cost relative to perfect credibility and a 10 percent gain relative to permanent tariffs).

This study derives basic results providing the foundation for further work on the empirical relevance of credibility effects as a driving force of actual business cycles in reforming economies. Analytical tractability imposes many unrealistic simplifications that are important to modify. In particular, the model abstracts from the durability of consumer goods, capital accumulation, labor supply decisions, and statistical dependence between policy uncertainty and real uncertainty. Further work will relax these assumptions and apply numerical solution methods to simulate a richer dynamic equilibrium model.

REFERENCES

Bufman, Gil, and Leonardo Leiderman, "Simulating an Optimizing Model of Currency Substitution," *Revista de Analisis Economico*, Vol. 7 (June 1992), pp. 109–24.

Calvo, Guillermo A., "Costly Trade Liberalizations: Durable Goods and Capital Mobility," *Staff Papers*, International Monetary Fund, Vol. 35 (September 1988), pp. 461–73.

———, "On the Costs of Temporary Policy," *Journal of Development Economics*, Vol. 27 (October 1987), pp. 245–61.

———, "Temporary Stabilization: Predetermined Exchange Rates," *Journal of Political Economy*, Vol. 94 (December 1986), pp. 1319–29.

Calvo, Guillermo, and Allan Drazen, "Uncertain Duration of Reform: Dynamic Implications," IMF Seminar Series, No. 1993–40 (Washington: International Monetary Fund, August 26, 1993).

Calvo, Guillermo, Carmen M. Reinhart, and Carlos A. Végh, "Targeting the Real Exchange Rate: Theory and Evidence" (unpublished; Washington: International Monetary Fund, 1993).

Djajić, Slobodan, "Temporary Import Quota and the Current Account," *Journal of International Economics*, Vol. 22 (May 1987), pp. 349–62.

Hopenhayn, Hugo A., and Marie E. Muniagurria, "Policy Variability and Economic Growth," Economics Working Papers Series, No. 81 (Barcelona: Universitat Pompeu Fabra, February 1995).

Levhari, D., and T.N. Srinivasan, "Optimal Savings Under Uncertainty," *Review of Economic Studies*, Vol. 36 (April 1969), pp. 153–63.

Lucas Jr., Robert E., *Models of Business Cycles* (New York: Basil Blackwell, 1987).

Mehra, Rajnish, and Edward C. Prescott, "The Equity Premium: A Puzzle," *Journal of Monetary Economics*, Vol. 15 (March 1985), pp. 145–61.

Mendoza, Enrique G., "The Terms of Trade, The Real Exchange Rate, and Economic Fluctuations," *International Economic Review*, (forthcoming; February 1995.

———, "Terms-of-Trade Uncertainty and Economic Growth: Are Risk Indicators Significant in Growth Regressions?" (unpublished; Washington: Board of Governors of the Federal Reserve, 1994).

Ostry, Jonathan D., and Carmen M. Reinhart, "Private Saving and Terms of Trade Shocks: Evidence from Developing Countries," International Monetary Fund, *Staff Papers*, International Monetary Fund, Vol. 39 (September 1992), pp. 495–517.

Phelps, Edmund S., "The Accumulation of Risky Capital: A Sequential Utility Analysis," *Econometrica*, Vol. 30 (October 1962), pp. 729–43.

Reinhart, Carmen M., and Carlos A. Végh, "Nominal Interest Rates, Consumption Booms, and Lack of Credibility: A Quantitative Examination," (unpublished; Washington: International Monetary Fund, 1992).

Végh, Carlos A., "Stopping High Inflation: An Analytical Overview," *Staff Papers*, International Monetary Fund, Vol. 39, (September 1992), pp. 626–95.

van Wijnbergen, Sweder, "Trade Reform, Policy Uncertainty, and the Current Account: A Non-Expected Utility Approach," *American Economic Review*, Vol. 82 (June 1992), pp. 626–33.