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Trade Reforms of Uncertain Duration and Real Uncertainty:
A First Approximation 1/

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Abstract

This paper examines trade reforms of uncertain duration undertaken in economies subject to real foreign and domestic shocks. These reforms induce consumption and import booms regardless of whether they succeed or fail and of the degree of intertemporal elasticity of substitution. If tariff revenue is rebated, a recession follows the boom, but without rebates a boom or a recession may follow depending on the outcome of the reform. Consumption fluctuations reflect imperfect credibility and real shocks, and the credibility component depends on the mean and risk of real asset returns. Thus, observed booms are a noisy signal of imperfect credibility. Quantitatively, lack of credibility produces sizable consumption cycles, but generally smaller than those induced by real disturbances.

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    F13, F41, E61

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Summary

In recent years, many developing countries have implemented far-reaching trade liberalization programs signaling a departure from the protectionist import-substitution philosophy that had dominated trade policy for decades. However, adjustment in response to trade reform, and the reforms that accompanied it, is complex. Economic agents, after years of suffering the consequences of policy slippages, question the credibility of new policies, and this complicates the dynamics of reform programs. Consumption booms, widening trade deficits, and real exchange rate appreciation have followed both successful and unsuccessful reform programs. Thus, it is difficult to interpret macroeconomic co-movements as signals of the program's lack of credibility or weakness.

This paper examines the macroeconomic implications of trade reforms of uncertain duration in a framework in which policy credibility and real foreign and domestic shocks act as separate sources of uncertainty. Cases in which tariff revenue is rebated to consumers or used to finance unproductive government expenditure are studied, as are the effects of imperfect credibility and real shocks on deviations from trend consumption growth.

Noncredible trade reforms result in consumption booms and widening trade deficits, generally followed by recessions in the period when policy uncertainty is resolved. Contrary to findings in previous work, the results show that there is *always* a boom in response to an noncredible reform, regardless of the magnitude of the intertemporal elasticity of substitution, the duration of the reform, or whether tariff revenue is rebated. When revenue is rebated, the boom is *always* followed by a recession, and the higher the elasticity of substitution and the probability of policy reversal, the larger the amplitude of the cycle. If revenue is not rebated there are significant income effects, and the initial boom may be sustained or reversed into a recession at the date policy uncertainty is resolved. Similarly, the welfare implications of temporary trade reforms depend on whether tariff revenue is rebated or not, and, in the latter case, also depend on the elasticity of intertemporal substitution.

Real shocks induce consumption cycles through conventional transmission mechanisms. These cycles tend to be larger than those driven by a lack of credibility. In addition, the mean and risk characteristics of real asset returns affect the magnitude and direction of credibility effects--although this interaction is quantitatively small. Because of the noise introduced by real shocks, observed consumption booms cannot be uniquely attributed to credibility effects, and measures of credibility that do not separate components of the cycle driven by policy uncertainty from those driven by fundamentals are biased. If the probability of policy reversal is linked to real shocks, changes in the external economic environment may have an impact on credibility effects even if policymakers do not alter their behavior.

I.   Introduction

*"The thriftlessness of early times was in great measure due to the
want of security that those who made provision for the future
would enjoy it...the laborious and self-denying peasant who had
heaped up a little store of wealth only to see it taken from him
by a stronger hand, was a constant warning to his neighbors to
enjoy their pleasure and their rest when they could."*
$\qquad$ (Alfred Marshall, <u>Principles of Economics</u>, p. 226)

*"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."*
$\qquad$ (Mexico: Into the Spotlight, <u>The Economist</u>, February 13,
$\qquad$ 1993, Survey p. 6)

In recent years, many developing countries implemented far-reaching
programs of stabilization and structural reform. An important feature of
these programs was the liberalization of international trade. The
implementation of radical measures to reduce tariff and nontariff trade
barriers, and to eliminate several other exchange restrictions, signaled
a fundamental departure from the protectionist, import-substitution
philosophy that dominated economic policy in many countries for decades.
However, experience showed 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
the governments' new policies, is a key element that makes the dynamics of
reform programs difficult to study. In particular, it was observed that a
surge in consumption and imports, a marked 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 difficult to determine whether adjustment-induced
booms are a warning signal that an adjustment program lacks credibility or
is about to fail. Yet, resolving this issue is of interest not only in the
context of ongoing reform efforts in developing countries, but also in view
of deep structural changes taking place in transition economies.

This paper examines the implications of imperfect policy credibility
for an economy in which agents formulate optimal savings plans facing two
sources of uncertainty. The first source are conventional random shocks
that reflect "fundamental" uncertainty with regard to real variables such
as domestic productivity or the terms of trade. The second source of
uncertainty is policy temporariness. The government announces and
implements measures to reduce tariff barriers as of some date t, but private
agents attach some probability to the reversal of trade liberalization at
date t+1. Unlike real uncertainty, which can never be completely resolved,
the uncertainty with regard to trade policy is assumed to be resolved in one
period. We examine the case in which the revenue from tariffs is rebated to
consumers and the case in which revenues finance unproductive government
expenditures, both under the assumption of incomplete insurance markets.

The growing literature on the credibility and temporariness of economic policies has provided innovative insights into the analysis of the dynamics of adjustment programs. Early theoretical work examined cases of imperfect credibility in which reforms are introduced at a point in time, and agents know with perfect certainty of a future date when reforms are reversed (see, for example, Calvo (1986) and (1987) and Djajic (1987)). Forward-looking agents formulate optimal plans anticipating future price increases, following the reversal of policies, and hence a short-lived consumption boom, a widening of the trade deficit, and a real appreciation are predicted for the period during which the reforms are in place. If tariff revenue is rebated to households, so as to limit distortions of trade restrictions to affect only relative prices and not the level of wealth, the magnitude of such "credibility effects" is governed by the agents' willingness to substitute consumption intertemporally and by the perceived duration of trade reforms. Credibility effects are stronger the larger the intertemporal elasticity of substitution in consumption and the shorter the period of liberalization. For reasonable parameterizations, welfare costs of temporary policies are negligible, unless mechanisms to increase persistence of credibility effects--such as accumulation of durable imported goods--are introduced (see Calvo (1988)).

Given the possibility that observed consumption booms and falling saving rates in reforming economies could be attributed to policy temporariness, hence allowing policymakers to interpret these phenomena as signals of weakness in adjustment programs, the empirical analysis of credibility effects has become an important issue. Recently, some researchers estimated the parameters that characterize households' preferences in developing countries, particularly the intertemporal elasticity of substitution, and used these 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 potentially important missing elements into empirical research on policy temporariness.

One natural extension is to examine a framework of imperfect credibility in which the timing of policy reversals is not known with certainty. Some recent theoretical work has made progress in this area. van Wijnbergen (1992) examined consumption planning in a two-period framework in which an abolition of tariffs in period 1 is expected to be reversed in period 2 with some exogenous probability π, and tariff revenue is not rebated. He concluded that, when the intertemporal elasticity of substitution is higher than 1, uncertainty with regard to future tariffs induces a surge in consumption and imports for any given expected value of those tariffs; while for an elasticity of substitution less than unitary the opposite is true. Hopenhayn and Muniagurria (1993) examined growth effects of policy variability in a two-sector infinite horizon model with random investment subsidies. They found that, when the sector benefitting

from the subsidy changes over time, an increase in policy variability may increase growth and welfare because of the presence of income effects, even when subsidies are financed by lump-sum taxation. Calvo and Drazen (1993) explored an infinite-horizon framework in which the date of the policy reversal is a time-dependent random variable. They concluded that, while predictions of the perfect-foresight framework extend to an environment of complete insurance markets with tariff rebates and risk-neutral foreign participants, in the case in which insurance markets are incomplete, the elasticity of substitution is less than unitary, and tariff revenue is not rebated, consumption follows an increasing path during the period of liberalization until it collapses at the date trade reforms are reversed.

A second element that is relevant to add to the analysis of policy temporariness, which has not been taken into account in the existing literature, is the fact that the credibility of the policymakers, or the duration of the free-trade regime, is not the only source of uncertainty affecting economic decisions. In many developing countries, real foreign and domestic shocks are an important source of uncertainty. For instance, terms-of-trade shocks are a key factor behind the propagation and transmission of business cycles in the developing world (see Mendoza (1992)), and they have in fact accompanied reform efforts 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 observed in 1986. In general, structural reforms introduced during the 1980s coincided with a sustained decline in most real commodity prices (see Reinhart and Wickham (1994)). Given that agents in developing economies generally do not have the option to insure themselves against world relative price shocks, these disturbances induce strong wealth and substitution effects. These effects affect observed macroeconomic behavior, and hence make it difficult to determine whether actual movements in consumption, net exports, or the real exchange rate signal lack of credibility or reflect the impact of real shocks. It is therefore necessary to examine the interaction between credibility and real uncertainty, as we propose in this paper.

Borrowing from the literature on savings under uncertainty-- particularly Phelps (1962) and Levhari and Srinivasan (1969)--we examine closed-form solutions in which, as in perfect-foresight studies of imperfect credibility, the implementation of noncredible trade reforms results in consumption booms and widening trade deficits, generally followed by recessions in the period when policy uncertainty is resolved. Booms and recessions are defined explicitly as positive and negative deviations from trend consumption growth. We also take advantage of the closed-form solutions to provide some quantitative evidence on the magnitude of credibility effects relative to the effects of real shocks.

Contrary to the findings of van Wijnbergen (1992), we show that there is *always* a boom in response to an noncredible reform, regardless of the magnitude of the intertemporal elasticity of substitution, of the duration of the reform, and of whether tariff revenue is rebated or not. When

revenue is rebated, the boom is *always* followed by a recession, and the amplitude of the credibility-induced cycle is larger the higher the elasticity of substitution and the higher the probability of policy reversal. If revenue is not rebated there are significant income effects at work, and the initial boom may be sustained or reversed into a recession at the date policy uncertainty is resolved. In this case, the strength of income effects is inversely related to the intertemporal elasticity of substitution and to the probability of policy reversal. Similarly, welfare implications of temporary trade reforms depend on whether tariff revenue is rebated or not, and in the latter case also depend on the elasticity of intertemporal substitution. When revenue is not rebated, strong income effects may result in an increase in welfare relative to a regime with permanent tariffs, although the net welfare gain is always inferior to the one that can be attained under a fully-credible trade reform.

Real foreign and domestic shocks induce booms and recessions through conventional real-business-cycle transmission mechanisms. Moreover, despite the statistical independence of real and policy uncertainty assumed in the model, the mean and risk characteristics of real asset returns affect the magnitude and direction of credibility effects--although this interaction between real and policy uncertainty is found to be quantitatively small. Because of the noise introduced by real uncertainty, observed consumption booms cannot be directly attributed to credibility effects, and measures of imperfect credibility that do not separate components of the business cycle driven by credibility problems from those driven by fundamentals are biased. Given some knowledge regarding the properties of real shocks and the structure of the economy, we construct an unbiased metric of the subjective probability of policy reversal.

If one assumes that the probability of policy reversal is linked to the mean and variance of real shocks, as well as to their actual realizations when trade reforms are introduced, changes in the external economic environment may have sizable impact on credibility effects even if policy makers do not alter their behavior. These results suggest, therefore, that in order to establish the importance of imperfect credibility as a driving force of observed booms, it is important to examine the role of real shocks, as well as the manner in which these shocks may influence the agents' perception of government's policies.

We view the conclusions derived in this paper only as rough first approximations. Our objective is to keep the model simple so as to derive analytical solutions that characterize the interaction between policy temporariness and real uncertainty, with an eye to future empirical work that examines the implications of capital accumulation, consumption of durable goods, labor supply decisions, and persistence and co-movement between real shocks and policy uncertainty. These are important elements in the analysis of policy temporariness, as theoretical work has shown, but they are also elements that render even simple models analytically intractable. The empirical analysis, in contrast, provides insights into the model's ability to mimic observed dynamics in developing countries,

but does not provide a clear illustration of the economic forces behind macroeconomic co-movements.

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

II. The Economic Environment

This section describes the model and derives equilibrium processes that characterize consumption and savings under a regime of free trade with perfect credibility and a regime of permanent tariffs. The model extends the work of Phelps (1962) and Levhari and Srinivasan (1969) on savings under uncertainty to introduce policy uncertainty and exogenous relative price shocks representing terms-of-trade disturbances.

1. The basic model

Consider a small open economy inhabited by rational, 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:

$$U(C) = E\left[\sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma}}{1-\gamma}\right] \tag{1}$$

$$\gamma > 0, \quad 0 < \beta < 1$$

where 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 (i.e. $1/\gamma$ is the intertemporal elasticity of substitution).

The production technology adopts the simple form of a perfectly durable asset that yields a stochastic, nonstorable return each period, as in the partial-equilibrium models of savings by Phelps (1962) and Levhari and Srinivasan (1969) and in Lucas' (1978) general-equilibrium model of asset pricing. The return is an exportable commodity that agents exchange for importable goods in a perfectly competitive world market. The relative price of imported goods in terms of exports is also subject to random disturbances. Markets of contingent claims are incomplete, and hence households cannot insure away country-specific shocks resulting from changes in real returns or the terms of trade. Thus, households maximize utility subject to a period-by-period resource constraint of the form:

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

Given $A_0 > 0$. A_t is the stock of wealth in units of exportables, R_t is the gross domestic rate of return on savings, and p_t is the relative price of imports in terms of exports, or the reciprocal of the terms of trade $tot_t = p_t^{-1}$. 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 hence the mean and variance of r_t are $\mu_r \equiv \exp(\mu + \sigma^2/2)$ and $\sigma_r^2 \equiv \mu_r^2(\exp(\sigma^2-1))$ respectively. At each date t, p_t is known but R_t and p_{t+1} are unknown. 1/

2. Free trade competitive equilibrium

Under free trade, the optimal intertemporal consumption allocation C^* is the one that maximizes (1) subject to (2). This maximization problem has the following dynamic programming representation:

$$V(A_t, p_t) = \max_{C_t, A_{t+1}} \left[\frac{C_t^{1-\gamma}}{1-\gamma} + \beta E[V(A_{t+1}, p_{t+1})] \right] \tag{3}$$
$$s.t. \quad A_{t+1} \le R_t(A_t - p_t C_t)$$

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 savings and consumption plans are:

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

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

1/ As in Levhari and Srinivasan (1969), we impose certain properties on the stochastic process of r_t so as to produce feasible plans. In particular, r_t must satisfy the condition $E[(r_t)^{1-\gamma}] < \beta^{-1}$.

Where:

$$\lambda \equiv \left[1 - \beta^{\frac{1}{\gamma}} \left[E(r_t^{1-\gamma}) \right]^{\frac{1}{\gamma}} \right] \qquad (7)$$

And the explicit solution of the value function is:

$$V^*(A_t, P_t) = \frac{\lambda^{-\gamma}}{(1-\gamma)} \left[\frac{A_t}{P_t} \right]^{1-\gamma} \qquad (8)$$

The constant λ is the marginal propensity to consume with respect to wealth (i.e. $1-\lambda$ is the saving rate). Under the condition that $E[r_t^{1-\gamma}] < \beta^{-1}$, (5) implies that consumption in each period is a positive fraction of the real value of asset holdings in units of importables, and (6) states that savings are a positive fraction of the gross return on initial asset holdings. Because the terms of trade are known but the return on exportables is unknown at the time C_t is chosen, the actual realization of R_t does not affect consumption, while the actual realization of P_t does.

Following Phelps and Levhari and Srinivasan, it is easy to show that increased risk in real asset returns (measured as a mean-preserving increase in σ_r^2 due to increased variability in either the domestic rate of return on exportables or the terms of trade) leads to a reduced saving rate as long as the coefficient of relative risk aversion is higher than 1 ($\gamma > 1$), or the intertemporal elasticity of substitution in 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: 1/ 2/

$$\lambda(\mu_r, \sigma) \equiv 1 - \left(\beta \mu_r^{1-\gamma} \right)^{1/\gamma} \exp\left[-(1-\gamma) \frac{\sigma^2}{2} \right] \qquad (9)$$

3. Equilibrium with permanent tariffs and lump-sum rebates

Suppose the government imposes a time-invariant import tariff τ, the revenue of which is rebated to consumers as a lump-sum transfer T_t. Households maximize (1) subject to the following budget constraint:

1/ 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.
  2/ This expression is obtained by displacing the expected value $E[r_t^{1-\gamma}]$ using the properties of log-normal i.i.d. distributions.

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

In equilibrium, $T_t = p_t \tau C_t$. Thus, the optimality conditions for this maximization exercise are the same as in the case of free-trade competitive equilibrium, and hence consumption and savings plans are as in (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. 1/

4. Equilibrium with permanent tariffs and no rebates

If tariff revenue is not rebated but the tariff is still time-invariant, the Euler equation (4) is unchanged, but a wealth effect resulting from the crowding-out of consumption to finance unproductive government expenditures is introduced. The budget constraint is:

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

The guess is now that consumption is a constant fraction of post-tax wealth $A_t/(1+\tau)p_t$. Optimal consumption and savings plans are:

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

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

And 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 the three cases.

1/ This also implies that an optimal tariff in this model is one that takes any value as long as it is constant over time.

III. Noncredible Trade Reforms and Real Uncertainty with Tariff Rebates

We now extend the basic model, in which consumption instability is
driven by persistent real uncertainty, to consider a regime in which tariffs
are abolished at date t=0, but agents assign a time-invariant 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. In our view, the fact that real uncertainty can never be
resolved, while policy uncertainty can end at some date, or at least be
significantly affected by policy actions, is a key difference between the
two sources of uncertainty. We acknowledge, however, that for the sake of
tractability we have adopted a very extreme representation of the problem.

1. Competitive equilibrium

Households maximize (1) subject to the following constraints:

$$A_1 \le R_0[A_0 - p_0 C_0]$$

$$A_{t+1} \le R_t[A_t - p_t C_t] \ \forall \ t > 0 \ with \ probability \ 1-\pi \qquad (15)$$

$$A_{t+1} \le R_t[A_t - p_t(1+\tau)C_t + T_t] \ \forall \ t > 0 \ with \ probability \ \pi$$

Taking as 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 tariffs are
present or not, the equilibrium resource constraint is the same as in
(2)--i.e. the resource constraint is that of the free-trade economy because
of the rebates. There is, however, a distortion affecting the intertemporal
relative price of consumption depending on the date considered. There is no
distortion at any date other than 0, regardless of whether tariffs are
present, and hence the Euler equation is like (4). At t=0, however, the
Euler equation is:

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

Thus, the expected marginal gain of an extra unit 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. This is
a general result that can be obtained with conventional lifetime utility
functions and standard resource constraints. However, without the structure
on preferences, technology, and uncertainty introduced in the last section,
it is difficult to obtain closed-form solutions.

Since π is time-invariant, and hence independent of realizations of
r_t, we rewrite (16) as follows:

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

Thus, the rate of the credibility tax is determined by both the size of the expected tariff, τ, and the subjective probability of policy reversal, π.

A simple backward-solution technique allows us to solve for the competitive equilibrium. 1/ Optimal plans for t=0 are:

$$C_0^{\pi,T} = \frac{\lambda}{\eta} \left[\frac{A_0}{P_0} \right] \tag{18}$$

$$A_1^{\pi,T} = \left[1 - \frac{\lambda}{\eta} \right] R_0 A_0 \tag{19}$$

With:

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

The superscript π,T is used to denote 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 (5) and (6) updated to the corresponding date and taking A_1 from (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,

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1/ For all dates t>0, solutions (5) and (6) hold. Given those solutions, we determine the value of A_1 coming out of the period of the credibility test, which is implicit in the solution for C_0. To find C_0, we impose (5) updated one period in the right-hand side of (17), displace A_1 using the resource constraint for t=0, and solve for C_0.

$\eta(0,\tau) = 1$, and hence a perfectly credible reform produces the free-trade competitive 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. 1/ Since η is decreasing in π, it also follows that increased policy uncertainty (i.e. higher π) induces a stronger increase in consumption and a sharper decline in savings. This result reflects the prediction that the surge in consumption is stronger the shorter the duration of a trade reform obtained in the perfect-foresight credibility literature (Calvo (1987)). Note also that, contrary to van Wijnbergen (1992), $C_0^{\pi,T} > C_0^{\tau}$ or C_0^* *regardless of the degree of risk aversion.* 2/ Moreover, considering (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.

2. Cyclical effects of imperfect credibility

In order to characterize formally the cyclical effects of uncertain duration of reform, and their interaction with real shocks, we provide an explicit definition of business cycles based on deviations from trend measured as logarithmic first differences. Since consumption fluctuates randomly 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, ΔC_t is:

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

(22)

The first two terms in the right-hand side of (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. Equation (22) also describes consumption cycles in the free-trade economy, or in the economy with permanent tariffs and rebates. 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 a 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

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

2/ The difference is larger the lower the degree of risk aversion, but it is always positive.

induces faster consumption growth as long as $\gamma > 2$. Moreover, when $\gamma > 2$, an increase in risk increases growth but, since welfare is declining in σ^2, welfare in high-risk, fast-growing economies is lower than in low-risk, slow-growing economies. 1/

Consumption behavior in periods affected by policy uncertainty is:

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

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

Thus, at the two dates affected by lack of credibility, deviations from trend in consumption are jointly determined by real shocks and policy uncertainty. Real- and policy-uncertainty components of business cycles are clearly identified in (23) and (24). Real-uncertainty components 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. Moreover, if a trade reform coincides with changes in μ_r and σ^2, there are also changes affecting the trend level of consumption growth.

ΔC_0 and ΔC_1 in (23)-(24) produce five important results:

(i)   Policy uncertainty induces a boom-recession cycle (i.e. 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 $\pi = 0$, $0 < \eta < 1$.

(ii)   The boom is weaker than the recession. $\eta > \lambda$ and $0 < \eta < 1$ imply that $-Ln(\eta)$, which measures the boom as a deviation from trend in percent, is smaller than $-Ln((\eta-\lambda)/(1-\lambda))$, which is the absolute value of the recession.

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

(iv)   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.

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

(v)   The noncredible reform is always socially costly, compared to 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 (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, relatively to Pareto-optimal plans in (5)-(6), and hence savings are insufficient to finance optimal consumption in the future.

3.   Credibility effects and real uncertainty

In order to examine the link between real uncertainty and policy uncertainty, we study ex-ante and ex-post implications of the equilibrium laws of motion (23)-(24). Ex-ante, we consider a policymaker planning to introduce a trade reform with knowledge of the mean and risk characteristics of real asset returns and the structure of preferences and technology, but not knowing the subjective probability attached to policy reversal. Expected values of (23)-(24) provide a framework for analyzing how changes in σ^2 and μ_r affect credibility effects. In this ex-ante environment, there are two results linking credibility effects to real uncertainty:

(vi)   An increase in μ_r associated with a trade reform increases expected consumption growth via its positive effect on the trend components of (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_r because λ is part of the credibility component of the cycle and λ depends on μ_r. The direction of the 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_r rises, and the credibility-induced recession is positively related to the propensity to consume.

(vii)   An increase in risk (i.e. 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 affected by the increase in risk 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_r.

Thus, (vi) and (vii) show that, for the realistic case in which the intertemporal elasticity of substitution is less than unitary (i.e. $\gamma>1$), an increase in mean returns (i.e. 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, while an increase in risk (i.e. a mean-preserving increase in the variability of domestic productivity or the terms of trade) strengthens it.

It is of interest to consider also the possibility that the probability of success of a trade reform may depend on the properties of real domestic or external shocks hitting the economy. In particular, if π is a decreasing function of mean returns and an increasing function of risk (i.e. $\pi(\mu_r, \sigma^2)$, 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_r would reduce the amplitude of the credibility-induced cycle. Moreover, at t=1 the rise in μ_r has an additional effect on the credibility component of the cycle via its impact on the marginal propensity to consume, as described in Result (vi) above. 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 for the case of a reduction in risk (i.e. a fall in σ^2). Thus, if agents' perception of the risk and return characteristics of domestic investments improve in response to exogenous developments or to the introduction of trade reforms, and if this improvement lends credibility to the reforms, credibility-induced cycles are weaker than in economies where the probability of reversal is independent of μ_r and σ^2.

The link between real and policy uncertainty also has important implications for ex-post measurement of credibility effects. Consider a researcher who has been given data on consumption for countries undertaking trade reforms, as well as information on terms of trade and real domestic rates of return, and who has been asked to assess the credibility of reforms. The issue is to determine whether observed differences in consumption fluctuations are an indicator of lack of credibility. Assume the researcher knows preference and technology parameters with precision, so the problem is to map unambiguously observed consumption patterns into measures of credibility (i.e. values of π).

Given data on real returns, the researcher computes μ_r and σ^2, and, given estimates of β and γ, he uses (22)-(24) to construct estimates of that portion of fluctuations in consumption determined by real uncertainty--i.e. he isolates the component of fluctuations driven by "fundamentals." Define this component as ΔC_t^F. Then, it follows from (22) that for all t<0 and t>1 $\Delta C_t^F = \Delta C_t$, and from (23)-(24) and Result (i), if $\pi>0$, it follows that $\Delta C_0^F < \Delta C_0$ and $\Delta C_1^F > \Delta C_1$. Thus, if the 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 (20) and (23), and since r is known, the researcher can reconstruct π from the observed ΔC_0 and the estimated ΔC_0^F. In particular, if ΔC_0 and ΔC_0^F are small, π is:

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

This expression indicates, as shown earlier, that larger deviations of consumption growth above the level attributed to fundamentals reflect a higher probability of policy reversal. The expression also shows that if the researcher only looked at the actual magnitude of the consumption boom at date 0, the resulting estimates of π would be biased upwards. The fraction of the business cycle attributed to real uncertainty must be taken

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into account in order to measure lack of credibility with accuracy. Among two economies undertaking trade reforms, one may display a stronger consumption boom than the other simply because its terms of trade are more volatile, and not because reforms are less credible.

Differences in realizations of terms-of-trade or productivity shocks, represented by ϵ in (23) and (24), that hit reforming economies at the time of implementing trade liberalizations may also bias measures of lack of credibility that do not separate real- and policy-uncertainty components. The bias is different depending on the duration of the shocks, as the following results show:

(viii) A transitory fall in the terms of trade, or an increase in p_0 (i.e. a negative shock ϵ_{-1} and a positive shock ϵ_0)1/ shortens the amplitude of deviations from trade during an uncertain trade reform. $\epsilon_{-1}<0$ weakens the boom at t=0 and $\epsilon_0>0$ weakens the recession at t=1.

(ix) A permanent fall in the terms of trade, or an increase in p_t for all $t \geq 0$ (i.e. $\epsilon_{-1}<0$ but ϵ_t for $t \geq 0$ and μ_r unchanged) reduces the boom but does not affect the subsequent recession.

(x) A secular decline in terms of trade that starts at t=0,2/ or an increase in the rate of growth of p (i.e. $\epsilon_{-1}<0$ coincides with a decline in μ_r 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_r affects the business cycle via 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 (vi)). The fall in μ_r also reduces the trend growth rate.

4. Numerical results

We now undertake some numerical experiments to study the potential magnitude of the effects examined above. The model is calibrated to create a benchmark economy that conforms roughly to some empirical evidence for Latin America. Parameters are set as follows: $\sigma=0.10$, $\gamma=2.33$, $\beta=0.95$, and $\mu_r=1.07$. The value of γ is the estimate obtained by Ostry and Reinhart (1992) for Latin America in an optimizing model. $\beta=0.95$ is the value that Lucas (1986) used to calculate welfare losses of consumption instability. We use it so as to compare some of our results with his, although evidence from Ostry and Reinhart (1992) suggests that it may be biased downwards. Increasing β does not affect significantly our results, except for estimates of welfare costs that are sharply increased as β rises. Thus, a lower β provides optimistic scenarios in terms of welfare analysis.

1/ Remember that $r_{-1}=R_{-1}p_{-1}/p_0$ and $r_0=R_0p_0/p_1$ and p is the reciprocal of the terms of trade.

2/ This experiment is interesting because trade reforms introduced in recent years were accompanied by a secular decline in the relative price of commodities in terms of manufactures (see Reinhart and Wickham (1994)).

The value of σ is the standard deviation of the log of the terms of trade for Latin American countries reported in Mendoza (1992). The real interest rate at 7 percent reflects historical evidence documented in Mehra and Prescott (1985) for the mean real interest rate on risky assets. Combining (22) with these parameters, and some slight variations, we produce average growth rates of consumption between 1 and 2 percent, with a standard deviation around 10 percent, roughly consistent with the Latin American experience regarding real per-capita consumption growth over the last 30 years in units of importables (see Mendoza (1994)). In the benchmark case we also set $\tau=0.3$ 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 fluctuations in consumption because, as (18) and (20) show, a credible reform does not distort consumption plans since $\eta(0,\tau)=1$, and also because there are no real shocks occurring at dates 0 and 1. As π rises, credibility-induced cycles appear. Considering that, given $\sigma=.1$, deviations from trend driven by terms-of-trade shocks of up to 20 percent are a two-sigma event (i.e. they 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 the size of π--are not unusually large.

Lowering γ to 1/2 (i.e. rising the intertemporal elasticity of substitution to 2) increases significantly the amplitude of the 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. Note also that consumption fluctuations are markedly more sensitive to reductions in γ than to increases when γ is initially around 2. Given the controversy in the econometric literature 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 an important role.

High- and low-tariff simulations illustrate a similar point. When initial tariffs are high the economy displays larger credibility-induced cycles than when tariffs are low. A country with $\tau=.7$ and $\pi=.25$ displays cycles about as large as those of an economy with $\tau=.1$ and $\pi=1$. Thus, given the dispersion of existing tariffs among reforming countries, actual differences in the level of the tariffs being removed may also introduce noise into tests of lack of credibility based exclusively on the magnitude of consumption booms.

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

(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 ($\phi=0.7$)		Low tariff ($\phi=0.1$)		Higher mean returns ($\mu_r=1.1$)		Higher risk ($\sigma=0.2$)		Transitory shock 1/ $\epsilon_{-1}=-0.05$ $\epsilon_0=0.05$		Permanent shock 2/ $\epsilon_{-1}=-0.05$ $\epsilon_0=0$		Secular decline 3/ $\epsilon_{-1}=-0.05$ $\mu_r=1.0593$	
	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

1/ 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).
2/ Permanent deterioration of the terms of trade by 5 percent (i.e., $P_1 = P_0 = P(1-0.05)$).
3/ 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 ($\mu_r = 1.0593 = 1.07 \times 0.99$).

Simulations for economies with higher mean returns and higher risk illustrate that, since real and policy uncertainty are independent of each other, and the latter is resolved in one period, the effects of changes in μ_r and σ on credibility-induced cycles are small. As shown before, the credibility component of the boom at date 0 is independent of changes in μ_r and σ, but that component in the recession at date 1 is not. However, the impact on the recession is small because, although changes in risk and mean returns affect λ, the impact of the 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, and hence the smaller the effects of changes in λ on the credibility component of the business cycle. The benchmark values of γ and r imply that the lowest value of η is 0.89, when $\pi=1$. Moreover, since η is decreasing in π, it also follows from this reasoning that the increase in μ_r (σ^2) has a larger negative (positive) effect on consumption cycles relative to the benchmark the higher is π.

Consider now 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 (i.e. a decline in ϵ_{-1} and an increase in ϵ_0), a permanent decline in terms of trade rising p_t for all t (i.e. a decline in ϵ_{-1} that leaves ϵ_0 unchanged), and a secular deterioration of terms of trade that starts at 0 and continues permanently (i.e. a decline in ϵ_{-1} that coincides with a fall in μ_r). 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 a two-sigma event. In the third case the initial shock is also 5 percent, and the secular decline continues at 1 percent per annum. 1/ These shocks induce consumption fluctuations via the real component of deviations from trend ϵ, and not via credibility effects (except for the case of the secular terms-of-trade deterioration in which μ_r alters the credibility effect in (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 since it lessens the value of wealth in units of importables, but it also has a positive effect on consumption growth at t=1 because it increases the return on savings in units of importables between those two dates (since 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 there is a transitory terms-of-trade shock 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 deterioration, except that a permanent shock does not have the weakening effect on the recession at

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1/ Given the original μ_r at 1.07, this still allows for positive growth to continue on average, resulting in a new value of μ_r set at 1.0593.

t=1--relative to the benchmark--that is observed when the shock is transitory. The secular fall in trade relative prices has the same large adverse effects of a transitory shock on the deviation from trend in consumption at date 0, but at date 1 it results in a modest increase in consumption growth induced by the effect of μ_r on λ and hence η. Thus, the results of these exercises suggest that effects of real shocks that coincide with noncredible trade reforms need to be carefully considered in order to assess credibility on the basis of observed 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 some welfare implications. However, welfare assessments need to be viewed with caution given the existing theoretical evidence showing that costs of credibility tend to be marginal unless durable goods or other persistence mechanisms are considered (see Calvo (1988)). Tables 2a and 2b report results of welfare analysis. Table 2a examines costs of higher risk on real asset returns and costs of realizations of terms-of-trade shocks at t=0 under alternative scenarios for π. The first case illustrates overall welfare costs of consumption instability driven by real uncertainty. The second set of estimates quantifies costs of one-period realizations of real shocks that serve as a better point for comparison with costs of policy uncertainty, which is also resolved in one period. 1/

The first panel in Table 2a shows that variability in domestic asset returns or in the terms of trade is very costly, even though it induces faster growth. As σ varies from 0 to 15 percent, the average growth rate increases from 0.7 percent to 2.2 percent, but welfare costs rise from 0 to around 62 percent. Thus, in this example a high-risk economy grows faster than a low-risk economy, but faster growth represents lower welfare. $\sigma=.025$ induces a 1.2 percent welfare cost, and a more realistic $\sigma=.1$ results in a cost about 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). Some of the difference is accounted for by the smaller standard deviations in Lucas' experiments. However, most of the difference is due to the fact that consumption is modelled here as a competitive equilibrium stochastic process in which uncertainty affects not just fluctuations of consumption around trend, but the trend growth rate

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1/ Welfare costs are computed as percentage variations 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 (21) under $\sigma=0.025$ and $\sigma=0$, assuming $\pi=0$, and then use (1) to compute two time-invariant levels of C that represent the same expected utility. The welfare cost is the difference between the two consumption levels in percent of the one corresponding to the economy with $\sigma=0.025$.

Table 2a. Welfare Costs of Real Uncertainty in the Economy
with Tariff Rebates

(In percent of stationary consumption in the risk-free economy) 1/

| | Overall Risk | | | Terms-of-trade Deterioration at t=0 | | | | |
| | Welfare | Average | | | | Welfare costs | | |
σ	cost	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

1/ A minus denotes a welfare gain and a terms of trade improvement.

Table 2b. Welfare Costs of Policy Uncertainty in the Economy
with Tariff Rebates

(In percent of stationary consumption in the economy
with perfect credibility)

	Welfare Cost of Trade Reform 1/								
	Benchmark Economy			High Risk Aversion $\gamma=5$			High Tariff $\phi=0.7$		
π	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$
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

1/ A minus denotes a welfare gain.
2/ A minus denotes a terms-of-trade improvement.

itself. Lucas' computations, in contrast, are not based on a solution of the competitive equilibrium and abstract from growth effects of σ.

The second panel in Table 2a reports costs of realizations of terms-of-trade shocks at t=0 ranging from -10 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--by about as much as 1/10 of a percentage point as π rises from 0 to 1 and the shock moves between -0.1 and 0.1. This weak dependence on π reflects the fact that the processes driving real and policy uncertainty are independent. At the same time, however, this illustrates that even when the two uncertainties are independent, there is a link between costs of real uncertainty and lack of credibility. Note also that when the terms-of-trade shock is positive, the welfare loss is smaller the higher π 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 2b reports welfare costs of policy uncertainty. Costs of credibility-induced cycles in the benchmark economy for different realizations of terms-of-trade shocks and different values of π are reported, as well as those for economies where $\tau=0.7$ and $\gamma=5$. The small magnitude of the costs reported in this Table, compared to those reported in the second panel of Table 2a, suggests that credibility is less 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 depending on realizations of real shocks. 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. Real shocks have a small effect on welfare costs of credibility, reflecting again the independence of the two sources of uncertainty. Note, however, that 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. For low values of π, welfare may even improve slightly.

IV. <u>Noncredible Trade Reforms and Real Uncertainty without Tariff Rebates</u>

1. <u>Competitive equilibrum</u>

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

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

$$\text{s.t.} \quad A_1 \leq R_0(A_0 - p_0 C_0)$$

$$A_0 > 0 \tag{26}$$

Where $V^*(A_1, p_1)$ and $V^{\tau}(A_1, p_1)$ are given by (8) and (14) updated one period respectively. If the reform prevails, optimal plans for all t>0 are as in (5)-(6), and if it fails plans are (12)-(13). 1/ At t=0 optimal plans are:

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

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

Where:

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

The superscript π,NT denotes that these solutions correspond to the regime of a noncredible reform without rebates. $\theta(\pi,\tau)$ is the term that introduces the distortion due to lack of credibility ($\theta(0,\tau)=1$). The solutions (27)-(28) can be combined with (8) and (14) to produce a closed-form solution for (26):

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

These results are compared to 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 equilibrium allocations. In the case without rebates, however, comparing allocations under imperfect credibility against free-trade allocations produces misleading results, specially with regard to the

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1/ Given solutions for V^* and V^{τ}, and the resource constraint at t=0, (26) is a straightforward maximization exercise.

role of the intertemporal elasticity of substitution in determining the direction of 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, consumption under a temporary trade reform always exceeds consumption under a permanent tariff, but it exceeds free-trade consumption only if the intertemporal elasticity of substitution is less than unitary. A trade reform of uncertain duration always induces a boom if the economy starts from a regime with tariffs; contrary to the result in van Wijnbergen (1992), which depends on whether γ is greater or less than 1.

2. Cyclical effects of imperfect credibility

Proceeding as before, we focus on deviations from trend in consumption. At any date $t<0$ or $t>1$, cycles of consumption in this economy are the same as in the case of 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, ΔC_0 is:

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

The first three terms in the right-hand side of this expression represent the real component of consumption growth; the first two define the trend and the third is the cycle. These three real elements have the same form as in the economy with rebates--except that μ_r is reduced by the effect of the permanent tariff. The last two terms represent deviations from trend due to policy uncertainty, which are different from those obtained with rebates.

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:

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

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

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

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

Credibility and real-uncertainty effects are once again clearly identified in equations (32)-(34).

Given (31)-(37), six results can be established: 1/

(i)   Imperfect credibility induces a boom at t=0 regardless of the size of γ. This boom embodies a positive wealth effect resulting from tariff reduction, represented by $Ln(1+\tau)$, and an intertemporal substitution effect captured by $-Ln(\theta+\lambda(1-\theta))$. The latter is always 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, it can be proved that the wealth effect always dominates.

(ii)   At t=1 imperfect credibility induces a boom or a recession depending on whether the reform is reversed or not and on the size of γ. If tariffs are reinstated there is a recession, regardless of the value of γ. This follows from the negative wealth effect induced by the reintroduction of tariffs, which dominates the substitution effect. The magnitude of the recession depends on γ; if $\gamma>1$, the recession is weaker than the boom at t=0, if $\gamma<1$ the opposite is true, and if $\gamma=1$ the boom and the recession are identical. If free trade prevails at t=1 and $\gamma>1$, the boom started at t=0 continues because there is no negative wealth effect and the substitution effect favors the expansion of consumption. 2/

(iii)   In terms of expected deviations from trend at t=1 conditional on the realization of real shocks (i.e. (34)), credibility induces a recession if $\gamma\leq1$, but, as we show numerically later, for $\gamma>1$ there are combinations of γ, π, and τ such that credibility effects induce a consumption boom. However, $\gamma>1$ is not sufficient to guarantee an expected boom.

(iv)   Since θ is increasing in π when $\gamma>1$ and decreasing in π when $\gamma<1$ (see (29)), an increase in the probability of reversal has different effects on the amplitude of credibility-induced cycles depending 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, while it also increases the magnitude of the boom in case

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1/   Formal proofs are straightforward noting the following inequalities:

$$\gamma \begin{array}{c} > \\ = \\ < \end{array} 1 \quad \Rightarrow \quad \theta \begin{array}{c} > \\ = \\ < \end{array} 1 \tag{1}$$

$$1+\tau > \theta + \lambda(1-\theta) \quad \forall \ \gamma>0 \tag{2}$$

$$1+\tau > \theta \quad \forall \ \gamma > 0 \tag{3}$$

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

free-trade continues. The first effect is associated with wealth, and hence tends to dominate.

(v)   Given that θ is increasing in γ, an increase in γ (i.e. a decline in the intertemporal elasticity of substitution) has a positive effect on deviations from trend at date 1, regardless of whether the reform fails or not. At date 0 there are two offsetting effects because higher γ induces, in addition to an increase in θ, a fall in 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 risk aversion rises. Thus, an increase in γ tends to reduce the amplitude of credibility-induced cycles.

(vi)   Welfare of the reforming economy, as given by (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 to the level of welfare of the economy with permanent tariffs. $\gamma>1$ is sufficient for welfare under the uncertain trade reform to exceed that of the regime with permanent tariffs.

These results 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 booms regardless of the degree of risk aversion. 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 may display very different behavior; in particular, while the economy with rebates experiences a recession milder than the initial boom, regardless of the actual outcome of the trade reform and regardless of the risk aversion parameter, the economy without rebates may experience a boom or a recession depending on both whether the reform prevails and whether γ is greater or less than 1. Even if we compare against expected growth 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. While welfare with or without rebates is decreasing in π, there are temporary reforms that improve welfare relative to an initial regime with permanent tariffs when revenue is not rebated. When revenue is rebated this cannot occur because the regime with permanent tariffs reproduces the allocations of the free-trade equilibrium.

3.   Credibility effects and real uncertainty

Consider now effects of changes in the risk and return characteristics of domestic assets when tariff revenue is not rebated:

(vii)   An increase in μ_r has positive growth effects at t=0,1 as in the case with rebates. The timing of cyclical effects, however, is reversed. There is no cyclical effect at date 1, as μ_r does not affect credibility components in (32)-(34), but at t=0 the increase in μ_r affects the credibility-induced boom via its effect on λ. If $\gamma>1$ ($\gamma<1$) the boom is stronger (weaker) because λ is decreasing (increasing) in μ_r.

(viii) An increase in risk (i.e. an increase in σ^2) has trend effects on ΔC at $t=0,1$ depending on whether $\gamma>2$ (as before, $\gamma>2$ implies that growth effects are positive). As in the case of the change in μ_r, an increase in risk affects credibility effects 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 from data on consumption and real asset returns, the situation is also different without rebates. The "fundamental" component of business cycles driven by real factors, ΔC^F, is once again given by (22). Equation (31), together with Result (i), implies that $\Delta C_0 > \Delta C_0^F$ for economies introducing trade reforms at date 0. However, (32)-(34) and Result (ii) imply that, even with real uncertainty unchanged, the data may show ΔC_1 greater or lower than ΔC_1^F depending on the final outcome of the trade 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 fundamentals at dates 0 and 1 in free-trade economies, while in economies where reforms failed a boom-recession cycle should be observed.

As before, the researcher can also use the data to reconstruct the value of π associated with a particular pattern of consumption behavior. In particular, given an economy where the trade reform was abandoned at $t=1$, the following relationship holds: 1/

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

This expression indicates that in the economy without rebates, as in the economy with rebates, accurate measures of π cannot be extracted from the data if the elements of real uncertainty are not properly considered.

The effects of transitory and permanent deteriorations in the terms of trade (i.e. negative shocks to p_t) are identical to those obtained in the economy with rebates, since these shocks operate exclusively through the channel of the real components of consumption growth, which are identical in the two economies. A secular deterioration in the terms of trade that starts at $t=0$ has different effects, however, because the decline in μ_r weakens the credibility effect. In the economy with rebates the credibility effect at $t=0$ is independent of μ_r.

1/ If the trade reform prevails, the term $(1+\tau)$ inside the square bracket of (35) disappears.

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4. Numerical results

We now provide some numerical results that illustrate the implications of eliminating tariff rebates. We use the same benchmark economy as before. Table 3 lists deviations from trend in consumption during a noncredible trade reform in the benchmark economy and some alternative specifications. Given the previous discussion on how deviations from trend at the date policy uncertainty is resolved depend on the outcome of the trade reform, we report expected deviations from trend for t=1, conditional on realizations of real shocks. In general, the larger magnitude of deviations from trend listed in Table 3, relative to those listed in Table 1, reflects 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, specially 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 absolute 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 majority of cycles driven by real shocks. When $\gamma=5$, the booms at t=0 fall by about 4 to 6 percentage points, but still remain significant, and the recessions at t=1 are weakened markedly--in fact for nonzero values of π under 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. Increasing τ to 0.7 widens the amplitude of the cycles by a factor of approximately 2, while lowering τ to 0.1 reduces the amplitude by a smaller factor.

Changes in μ_r and σ have the opposite effects without rebates than with rebates. Without rebates, the mean and riskiness of asset returns have no impact on deviations from trend at date 1, while at date 0 increases in μ_r or σ^2 weaken, albeit only slightly, the consumption boom. In contrast, realizations of terms-of-trade shocks that are transitory or permanent, or that represent a secular decline, 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.

Table 3. Fluctuations in Consumption During a Trade Reform in the Economy without Tariff Rebates 1/

(Deviations from trend in percent)

Probability of reversal (Π)	Benchmark economy		Low risk aversion (γ=½)		High risk aversion (γ=5)		High tariff (φ=0.7)		Low tariff (φ=0.1)		Higher mean returns (μ_r=1.1)		Higher risk (σ=0.2)		Transitory shock 2/ ϵ_{-1}=-0.05 ϵ_0 = 0.05		Permanent shock 3/ ϵ_{-1}=-0.05 ϵ_0 = 0		Secular decline 4/ ϵ_{-1}=-0.05 μ_r =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

1/ 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)).

2/ 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).

3/ Permanent deterioration of the terms of trade by 5 percent (i.e., P_1 = P_o = P(1-0.05)).

4/ 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 (μ_r = 1.0593 = 1.07 x 0.99).

Tables 4a-4c report welfare costs associated with real uncertainty, imperfect credibility, and temporary trade reforms for the economy without rebates. In this case, we distinguish credibility from temporariness. Costs of credibility are those resulting 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 are those that result 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. Thus, gains of temporariness measure how much the long-run level of consumption that represents welfare under the temporary reform exceeds the level under permanent tariffs; while costs of credibility measure how much this level of consumption is below the one that represents free-trade welfare. 1/

Tables 2a and 4a, which report costs of real uncertainty with and without rebates, are virtually identical, reflecting the fact that the interaction between real and policy uncertainty is not very strong. 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. As noted earlier, the costs fall as π rises because of the offsetting influence of the credibility tax.

Tables 4b and 4c list costs of credibility and temporariness for the benchmark economy, for an economy with higher risk aversion (γ=5), and for an economy with higher tariffs (τ=0.7). In the benchmark case, credibility costs are larger than those obtained in the regime with rebates, reflecting the large magnitude of wealth effects at work in the economy without rebates--the costs range from nearly 6 percent, when π=0.2, to more than 28 percent, when π=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 real risk, but they are much larger than costs associated with one-period terms-of-trade shocks. Increasing the degree of risk aversion increases the welfare costs relative to the benchmark case, contrary to what is observed in the economy with rebates.

The costs reported in Table 4c, which are all negative, indicate that, under the parameter structures considered, temporary reforms improve welfare relative to the economy with permanent tariffs. If π=0 (i.e. if the reform is credible), the gain is 23 percent of the long-run level of consumption under permanent tariffs for the benchmark and the high risk-aversion

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1/ 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.

Table 4a.   Welfare Costs of Real Uncertainty in the Economy
without Tariff Rebates

(In percent of stationary consumption in the risk-free economy) 1/

| | Overall risk | | | Terms-of-trade deterioration at t=0 | | | | |
| | Welfare costs | Average growth | | | Welfare costs | | | |
σ			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

1/ A minus sign denotes a welfare gain and a terms-of-trade improvement.

Table 4b.   Welfare Costs of Policy Uncertainty in the Economy
without Tariff Rebates

(<u>In percent of stationary consumption in the economy with perfect credibility</u>)

	Welfare Cost of Trade Reform 1/								
π	Benchmark economy			High risk aversion $\gamma = 5$			High tariff $\phi = 0.7$		
	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$
0.0	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

1/ A minus denotes a welfare gain.
2/ A minus denotes a terms-of-trade improvement.

Table 4c. Welfare Costs of Policy Uncertainty Relative to Permanent
Tariffs in the Economy with Tariff Rebates 1/

(In percent of stationary consumption in the economy
with permanent tariffs)

Π	Benchmark Economy			High Risk Average $\gamma=5$			High Tariff $\phi=0.7$		
	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$	$\epsilon=-0.1$ 2/	$\epsilon=0.0$	$\epsilon=0.1$
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

1/ A minus sign denotes a welfare gain.
2/ A minus sign denotes a terms of trade improvement.

economies, and about 41 percent for the high tariff economy. If the reform is completely noncredible (i.e. $\pi=1$), 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 4b-4c can be combined and interpreted as follows. If $\tau=0$ and $\pi=0$, the long-run consumption level reaches the free-trade level and is about 23 percent higher than in the equilibrium with permanent tariffs. If $\pi=1$, then consumption stays 28 percent below the free-trade equilibrium, but still 1.3 percent above the equilibrium under permanent tariffs.

V. Concluding Remarks

This paper examines business cycle and welfare implications of trade reforms of uncertain duration in a basic framework in which policy uncertainty and real foreign and domestic shocks act as two separate sources of uncertainty. Cases in which tariff revenue is rebated to consumers or used to finance unproductive government expenditures are studied. We borrow from the literature on savings under uncertainty to build a model with closed-form solutions describing competitive equilibria, and use the solutions to derive analytical results and to construct some numerical examples. The analysis is based on examining effects of imperfect credibility and real shocks on deviations from trend consumption growth in a one-good intertemporal equilibrium model.

We found that a noncredible trade reform under a regime with rebates induces a consumption boom and a widening of the trade deficit when announced, followed by a recession at the date policy uncertainty is resolved--regardless of the success of the reform and of whether the intertemporal elasticity of substitution in consumption is greater or less than unitary. This credibility-induced cycle results from the fact that imperfect credibility acts like a tax on savings. It is also shown that 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 noncredible reforms are socially costly.

The interaction between credibility and real uncertainty is weak because the two are assumed to be independent sources of uncertainty. Nevertheless, the mean and risk characteristics of real asset returns, which are modelled to reflect fundamental uncertainty regarding domestic productivity or the terms of trade, affect the magnitude of credibility-induced cycles via their impact on the propensities to consume and save. Because a fraction of consumption instability reflects real uncertainty, it is not possible to map a cross-country ranking of consumption booms or trade deficits into a credibility ranking. However, if sufficient information about real uncertainty and the structure of the economy is available, one can isolate the fraction of consumption fluctuations

attributed to real uncertainty, and hence derive the implicit credibility-
induced cycle and the subjective probability of policy reversal.

Numerical examples show that credibility-induced cycles can be
significant, although not as large as cycles generated by real shocks.
Welfare costs of imperfect credibility--which is modeled as a source of
uncertainty that is resolved in one period--are small compared to costs of
persistent terms-of-trade uncertainty. However, credibility costs are not
as small compared to one-period realizations of terms-of-trade shocks. The
costs of consumption instability resulting from real uncertainty are much
larger than conventional measures obtained in business cycle analysis
because changes in the mean and variance of real shocks affect not only
deviations from trend consumption growth, but also the trend growth rate
itself.

The consequences of noncredible trade reforms in a regime without
tariff rebates are very different because of the influence of wealth
effects that rebates eliminate. However, it is still true that imperfect
credibility induces a boom at the date the reform is announced regardless
of the size of intertemporal elasticity of substitution. A boom or a
recession may follow on the date policy uncertainty is resolved, depending
on whether the reform is reversed or not and on the elasticity of
substitution. If the reform is reversed there is always a recession, but
if free trade is sustained the initial boom continues as long as the
elasticity of substitution is less than unitary. The presence of wealth
effects also implies that an elasticity of substitution in excess of
1 ensures that welfare under a uncertain trade reform exceeds that of a
regime with permanent tariffs. As in the case with rebates, the noise
introduced by real uncertainty implies that data on consumption fluctuations
cannot by itself be used to assess credibility. However, if the process
driving real shocks is known and there is information on the structure of
preferences and technology, it is possible to isolate the real component
of consumption fluctuations and measure the implicit probability of policy
reversal.

Numerical results for the model without rebates showed that this
economy produces larger credibility-induced booms, although the boom is now
a decreasing function of the probability of policy reversal. Welfare costs
attributed to policy uncertainty have two components; one measures the
welfare gain under a temporary tariff reduction relative to a regime with
permanent tariffs, and the second measures the cost of a tariff reduction
expected to be reversed with probability π relative to a fully-credible
abolition of tariffs. Wealth effects imply that these two components are
large. A fully credible trade liberalization 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 analytical results providing the foundation for further work aimed at examining the empirical relevance of credibility effects as a driving force of actual business cycles in developing economies introducing trade reforms. Analytical tractability forced many unrealistic simplifications that we believe to be important in order to assess the relevance of credibility effects; in particular, the model abstracts from durability and inventory accumulation of consumer goods, capital accumulation and labor supply decisions, and statistical dependence between policy uncertainty and real uncertainty. Further work will relax these assumptions and make intensive use of quantitative methods to document the potential for imperfect credibility to drive observed business cycles.

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