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Comment   Roberto Rigobon

I enjoyed reading this paper. It is well written and worth spending time on. It is the first attempt (as far as I know) to explain the output collapse that we observed in the recent Asian turmoil.

Calvo's paper is motivated by four empirical facts distinctive of recent currency crises: These attacks have been accompanied by large output collapses. The financial sector has played an important role in the transmission of the crises. The crises were not predicted. Capital flows seemed to overreact to the fundamentals. In addition to these empirical facts, the paper has three theoretical motivations: First, Calvo models the financial sector as a transmission channel of external shocks, and not as the residual. Second, he studies the relation between prior capital inflows and output collapse. Third, he asks, What is the relevance of the current account sustainability literature to the crises?

This paper is an example of a pure Calvo paper. It has, as expected, a continuum of sections, each of them with a continuum of interesting insights. Hence, it is impossible to summarize in a finite number of pages. In this discussion, I concentrate on the aspects that I find either more interesting or weak.

The paper can be divided in two broad parts: First, sections 3.2 and 3.3 study extensions of the standard speculative attack model. This part has two main objectives—to show that a currency crisis is possible in the absence of a prior current account deficit and to study the interaction between sovereignty and capital flows. The main results indicate that the introduction of sovereignty into a model of speculative attacks raises the possibility of multiple equilibria and self-fulfilling attacks. More important, these events can occur even in the absence of a current account deficit.

Second, in sections 3.4 to 3.10, given the previous framework, the model is extended to introduce the banking sector along with another ingredient, either time to build or trade credit. The objective is to explore the causes

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of the output collapse. In these sections, Calvo explains the loss in output as either the halting of investment in a time-to-build model or in the vanishing of trade credit. Both channels can account for important output losses. The paper treats them separately in simple and intuitive frameworks.

Balance-of-Payments Crises in the Absence of Current Account Deficits

The paper starts by extending the standard speculative attack model to show that it is possible to have a balance-of-payments crisis even if there is no current account deficit prior to the attack. Calvo's motive is to show that this possibility exists at least theoretically. The main implication of this finding is that the current account by itself is an imperfect measure of the true fundamentals. This casts doubts on the usefulness of the current account sustainability literature. I tend to agree with this general conclusion. I do not, however, share Calvo's assumptions that drive the result.

The intuition of this result is summarized easily in a model in which there is Ricardian equivalence. Assume the only available tax is inflation, or assume it is the marginal instrument that the government uses to collect taxes. In this case, when the central bank pegs the currency, it reduces current taxation, which will have to be offset by future increases in the inflationary tax. Agents anticipate this and therefore save what the government is dissaving. At the aggregate level, there is no change in total savings, the current account remains in equilibrium, and a perfectly predictable change in the peg is anticipated. Hence, a currency crisis.

Formally, in a standard neoclassical framework with money in the utility function, the government solves the following maximization problem:

$$\max \int e^{-\rho t} u(c_t, m_t),$$

$$\dot{b}_t = \rho b_t + y + g - c_t - i_t m_t,$$

where output and expenditure are assumed to be exogenous (for simplicity, assume they are constant). Additionally, assume that there is perfect capital mobility, that all goods are tradable, and that the law of one price holds.

In this model, the interest rate (i) is equal to the rate of depreciation plus the international interest rate (assumed to be equal to the discount rate, ρ). The first-order conditions of this model are

$$u_c = \lambda,$$

$$u_m = i_t \lambda.$$

By total differentiation it is possible to solve for the change in consumption due to a change in the peg (remember that a change in the peg involves a one-to-one change in the domestic nominal interest rate):

$$\frac{\partial c_t}{\partial i_t} = -\frac{u_c u_{cm}}{u_{mm} u_{cc}} \frac{1}{1 - (u_{cm})^2 / (u_{mm} u_{cc})}.$$

As can be seen, if the cross derivative (u_{cm}) is zero, then the level of consumption is not affected by the choice of monetary policy. This is the case because, under a strong separable utility, the inflationary tax is non-distortionary; only the equivalent annuity of expected taxes is relevant to the consumer's decision, not their path. The intuition is as follows: A reduction in the peg reduces tax collections. The fiscal deficit increases, and it is financed with reserves. Agents know that when reserves reach zero, a change in regime is required because the source of financing is no longer there. Agents anticipate the change in regime, and a speculative attack (à la Krugman) occurs, cleaning out the reserves of the central bank. From then on, the interest rate is higher, which implies that taxes are higher too. In this model, reserves and government debt have the same interest rate (ρ); thus the change in the path of taxes generates the same net present value of tax collections. Therefore, there is neither an income nor a substitution effect.[1]

First, if inflation is a distortionary tax, and in particular, if money and consumption are complements, then all currency crises are accompanied by current account deterioration. This is because a decrease in the nominal domestic interest rate implies an increase in consumption. Given that output and expenditure are constant, this increase in consumption causes a current account deficit. The second assumption is that expenditure is exogenous or does not depend on the peg. However, in reality, both primary and secondary fiscal budgets are indeed affected by the depreciation rate. In general, if this assumption is relaxed, a current account deficit should be expected.[2] Finally, the model assumes that there are perfect credit markets. Relaxing this assumption will also drive a current account deficit. For example, if there are problems of credibility of the peg, the interest rate faced by the government is higher than the discount rate. The reduction in the depreciation rate generates a substitution effect against future consumption.

The question, then, would not be whether there exists a model that can account for a balance-of-payments crisis without a current account imbalance, but whether there exists such a model whose underlying assumptions are relevant to explain the observed events. In this sense, Calvo's assumptions are not realistic.

I tend to agree, however, with Calvo's conclusion that in recent attacks

1. The same result is obtained for more general models in which nontradable goods are considered. Again, if there is strong separability between money and composite consumption, inflation is a nondistortionary tax and Ricardian equivalence prevails.

2. In fact, later in the paper Calvo relaxes this assumption and endogenizes policy to model self-fulfilling crises.

the current account deficits, prior to the crises, did not reflect the required adjustment these economies had to make after abandoning their currency regimes: the current account was a noisy signal of the true fundamental.[3] The challenge posed by the paper is to explain what makes the current account such a poor signal. The model developed in the paper provides an answer, which is nevertheless preliminary. Other types of informational problems might have the same implications and could be based on more realistic assumptions. Further research in this area is therefore required.[4]

Calvo finishes these sections by studying the relation between sovereign governments, capital flow reversals, and balance-of-payments crises. He shows that the fact sovereign governments can implement any policy they like makes multiple equilibria possible. The intuition is that the sovereignty of governments increases the risk of long-term debt, generating a portfolio reallocation toward short-term instruments. This increases the exposure of both the government and the financial sector. And more important, it increases the chances of a self-fulfilling attack because it makes the country, as a whole, more vulnerable to capital outflows.

In the model, flexibility on the side of the government always goes in one direction: it is always bad. This is an assumption and not a result of the model. In principle, we could conjecture that in a pure neoclassical framework, a benevolent government with more instruments is likely to smooth external shocks better than one with fewer instruments; for example, a devaluation might avoid an unnecessary financial crisis.[5] Thus it is crucial for the results that the government have a different objective function than consumers. This is not modeled in the paper. It is important to improve the understanding of the circumstances in which this possibility can arise in order to model this problem explicitly.

Financial Sector, Capital Flows, and Output Collapse

Calvo's motive in sections 3.4 to 3.7 is to study the interaction between the credit market and output collapse. The idea is that the credit market is an amplifier of external shocks, along the lines of the financial accelerator literature (Kiyotaki and Moore 1997).

3. E.g., a current account deficit of x percent was expected and only y percent was observed (where y is smaller than x).

4. Rigobon (1998) is an attempt to formalize the effects of informational problems on the path of speculative attacks. There I assume that the current account is an imperfect signal, and I study the implications of this problem for the path of capital flows.

5. An interesting example is the case of the financial crises in the mid-1980s in Texas. In 1986, oil dropped to historical lows, and most of the banks in Texas had problems. At the same time, Venezuela, which has an economy similar to Texas's in terms of size and dependence on oil, devalued and avoided a financial crisis. I am sure the reason why the banks in Venezuela survived is *not* better regulation. Evidence has shown the contrary (1994). In this case, the fact that the country could devalue and recognize the losses due to the external shocks reduced the pressure on the financial sector.

Calvo starts by looking at the consequences of capital flow reversals in the framework previously developed. The first implication is the possibility of self-fulfilling crisis, à la Diamond and Dybvig (1983). Capital flows are the source of a liquidity shock that generates a bank run.

A liquidity shock can take several forms. It can be reflected in a creditor's unwillingness to roll over debt, or in the endogenous repudiation of debt (Cole and Kehoe 1996). Or more specifically, it can cause the elimination of trade credit, in the spirit of Kiyotaki and Moore (1996), Blanchard and Kremer (1997), and Calvo and Coricelli (1994). In all these cases, capital outflows can have large output effects.

The paper develops a simple model based on the time-to-build aspect of investment. This model accounts for the concurrence of output collapse, currency crisis, and financial crisis. The intuition is that a capital flow reversal dries up liquidity, generating a bank run. The fall in credit forces to a stop investment in projects that were financed before. The liquidation value of those projects is low (or zero), which generates a loss in output. In this instance, there is a current account deficit that requires a real depreciation to return to equilibrium; hence, a currency devaluation occurs. The intuition is clear and appealing.

The model is interesting because it gives a framework in which other questions can be asked: How much of the output collapse can the financial crisis explain? What else is required to account for the fall in output? What are the policy implications for recoveries and for managing external flows? And so on.

In the rest of this comment I offer some preliminary evidence on the model. I concentrate on its financial accelerator implications. The model makes two predictions: First, all things equal, the financial accelerator in developing economies should be larger than in developed economies. Second, crises are different from tranquil periods in the sense that the financial accelerator is larger under attack. This is the same point regarded from two different perspectives. The intuition is as follows: Calvo's model (sections 3.6 and 3.7) implies that during periods of capital outflow, the change to the bad equilibrium is reflected in a more than proportional change in credit. In a time-series view, countries that have had this type of crisis should experience larger financial accelerators.

Measuring the Financial Accelerator

One way to test the model is to measure the financial accelerator directly as the elasticity of domestic credit with respect to changes in capital flows. However, there are two main problems with this formulation: First, there is a problem of endogeneity between domestic credit and capital inflows. Second, these variables are likely to have spurious correlation if the country is going through a process of financial reform. The first problem is known and not discussed. The second, however, requires some explana-

tion. The process of financial reform usually involves measures that are intended to free currency denominations of liabilities, as well as restrictions on credit. The first measure tends to increase capital inflows, while the second tends to increase credit as a whole. In this sense, there is no causal relation between the expansion of credit and the recomposition of liabilities.

An alternative is to test the dual of this quantity multiplier: other things equal, countries that have larger financial multipliers should have larger real exchange rate appreciations for the same capital inflows. This specification does not solve the problem of endogeneity. However, it helps with the second problem. Financial liberalization increases capital inflows and generates a more efficient use of resources. The first effect generates a real exchange rate appreciation, while the second can generate a real exchange rate depreciation if it is biased toward the nontradable sector.[6] The specification does not fully solve the problem, but it diminishes it.

The following real exchange rate equation is estimated:

$$\Delta RER_t = \beta_0 + \beta_1 \Delta RER_{t-1} + \beta_2 TOT_t + \beta_{3,i} CF_t + \beta_4 G_t$$
$$+ \beta_5 \Delta GDP_t + \varepsilon_t,$$

$$\beta_{3,i} = \alpha_{11} + \alpha_{12} Cre_i \quad \text{if } i \in A_c,$$

$$\beta_{3,i} = \alpha_{21} + \alpha_{22} Cre_i \quad \text{if } i \notin A_c,$$

where ΔRER is the change in the real exchange rate, TOT is the logarithm of the terms of trade, CF is capital flows as a proportion of GDP, G is government expenditure divided by GDP, Cre is domestic credit expansion divided by GDP, and ΔGDP is GDP growth.

The sample is divided in two: developing countries (A_c) and developed countries. The regression is estimated using yearly data from *International Financial Statistics,* for forty-one countries, 1965–96. The data were divided in two ways: first, OECD versus not OECD and, second, the groups were constructed to maximize the maximum likelihood estimation. The results are shown in table 3C.1.

The first implication of the model is that the elasticity should be larger in developing economies. As can be seen, this hypothesis is rejected at the 5 percent confidence level.[7] The estimates show that $\alpha_{21} - \alpha_{11} > 0$. This means that developed economies have higher elasticities.

The second hypothesis is that the fragility of the banking sector increases the elasticity of the real exchange rate with respect to capital flows.

6. The evidence shows that this is the sector that has had the largest growth after financial liberalization.
7. This test has a mean value of 0.866 and a standard deviation of 0.438 in the first grouping.

Table 3C.1   **Results from Estimation**

Coefficient	OECD	MLE
α_{11}	0.389	0.352
	(1.630)	(1.736)
α_{12}	1.581	1.922
	(2.041)	(3.219)
α_{21}	1.255	0.766
	(6.274)	(2.215)
α_{22}	−0.398	0.075
	(−1.354)	(0.183)

Note: Numbers in parentheses are *t*-statistics.

In this case, table 3C.1 shows that in developing economies, when there is a credit expansion there is an increase in the elasticity. If credit expansions are interpreted as signals of financial fragility, as a large literature on the subject has suggested, then this evidence is consistent with Calvo's model. Note that $\alpha_{12} > 0$ while $\alpha_{22} < 0$—which is exactly what the model predicts. The results are similar in both groupings. Moreover, the results are robust to the inclusion of dummies related to reforms.

Measuring the Asymmetry

The second implication of the model is that the financial accelerator changes during periods of crisis. This is the consequence of the time-to-build aspect of the model. Liquidation value is only lost during periods of crisis, and it is not regained during periods of boom. Again, the test is done looking at the real exchange rate instead of at output directly or at credit due to the same reasons explained above.

One easy procedure to check this empirical implication is to test for asymmetries in the capital flow coefficient. The following regression is estimated:

$$\Delta RER_t = \beta_0 + \beta_1 \Delta RER_{t-1} + \beta_2 TOT_t + \beta_3 CF_t + \beta_{3a}|CF|$$

$$+ \beta_4 G_t + \beta_5 \Delta GDP_t + \varepsilon_t.$$

In this procedure the elasticity of the real exchange rate with respect to a positive capital flow is $\beta_3 + \beta_{3a}$, while the elasticity (in absolute value) is $\beta_3 - \beta_{3a}$ for negative capital flows. The test in this case is to check the sign of β_{3a}. If it is positive, then the real exchange rate is more sensitive to capital inflows, and if it is negative, the real exchange rate is more sensitive to capital outflows. The prediction of the model is that the real exchange rate has to be more sensitive to capital inflows. The estimate of β_{3a} is −0.112 (with a *t*-statistic of −2.097).

Conclusions

This paper is worth reading and investing time in. In these brief lines, I concentrated on those aspects of the paper that I found more interesting; thus several insightful sections were unfortunately left out. The paper offers a basic framework in which more questions can be asked and from which further understanding of recent speculative attacks can be drawn.

It is clear from my discussion that further research is required in several areas. First, the paper casts important doubts on the current account sustainability literature. I share this concern, even though I do not agree with the modeling device Calvo uses to achieve it. The assumptions are not realistic. Alternative routes should be explored. Second, the model with the financial accelerator has mixed empirical performance, on a first look. The results are preliminary but suggestive. I take this as positive performance of the model; in future research, richer implications with better data might increase support for the model. Finally, and probably a deeper concern with the model, is that the paper explains speculative attacks as a result of self-fulfilling prophecies. Recent evidence on the Asian crashes seems to suggest (at least by my reading) that there was something deeply wrong with those economies and that an attack was going to occur with probability one, the *timing* of which might have been driven by market sentiments (see Corsetti, Pesenti, and Roubini 1998). In this sense, Calvo's transmission mechanism continues exist, although what changes is the reason for the crises.

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