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Corner Solutions, Crises, and Capital Controls: A Theory and an Emphirical Analysis on the Optimal Exchang Rate Regime in Emerging Economies

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Abstract:

In a regime of free foreign exchange markets and free capital movements the reserve (hard) currencies are likely to substitute for the local soft currency in agents' portfolia that include currency as an asset. This argument implies a process of cumulative circular causation with currency substitution leading to devaluation of soft currencies which in turn induces further currency substitution. At the theoretical level, the "fundamentals model" of currency crisis is formally extended by incorporating currency substitution in an inter-temporally optimizing framework. Next the model is implemented empirically by constructing a currency-softness index as a causal proxy of currency substitution and it is tested in an international cross section sample of countries. Two empirical findings emerge. First, there is a negative relationship between the currency-softness index and the degree of nominal-exchange-rate devaluation. Second, there is a systematic negative relationship between the softness of a currency and the level of economic development. Hence, a unipolar corner solution of floating exchange rate would not be sustainable for low-income countries with soft currencies. Rather a unipolar regime with a hard fixed exchange rate or even a middle-ground solution of fixed but adjustable exchange rate becomes optimal as long as the mobility of financial capital is restricted. Moreover, the optimal choice of exchange rate regime should be systematically linked with the level of development.

JEL Classification: F31, F41, G15

Key words: Exchange-rate regime; financial crises; currency substitution; exchange rate and capital liberalization in developing countries

1. Introduction

Recent literature has identified a trilemma in open-economy macroeconomics that refers to the three important policy objectives, i.e., an independent monetary policy, a stable exchange rate, and free capital movement. Yet, only two of the three "policy trilemma" objectives can be achieved simultaneously, with the result being the "impossibility trinity" (Frankel, 1999). The currency-board found strong advocacy in the view that, under free capital mobility, a country cannot sustain intermediate exchange rate regimes between hard pegs and floating systems (Fischer, 2001). No sooner was this view launched that the collapse of Argentina's economy came to provide incontrovertible evidence that not even the hardest fixed exchange rate regime, buttressed by a constitutionally mandated currency board, was sustainable in a financial crisis. Given that Argentina's experience is not different from that of other countries that also had *de facto* fixed exchange rate regimes, yet they suffered the crises of the 1990s, it appears that the floating exchange rate system that reconciles free capital movements with monetary-policy autonomy is about to prevail by default. As a successor to the dollarization in Argentina the floating exchange rate has indeed made influential converts (Roubini, 2001). The combination of exchange rate stability and monetary policy autonomy, enabled by (partial) capital controls, has not even featured in the literature so far.

There is no a-priori reason why a single currency regime should be right for all countries or at all times (Frankel, 1999). Indeed, sweeping single solutions of exchange rate regimes, no matter how popular they are, cannot be optimal in all cases since not all currencies were created equal. In international transactions the reserve currency is commonly the medium of exchange. In an open economy there is a definite pecking order when it comes to holding currency as an asset: currencies occupy an international continuum from the reserve, to the hard, the soft, and the downright worthless.[1] Only reserve/ hard currencies are treated as store of value internationally, and they are preponderantly held by central banks in their foreign reserves. Given, then, an unrestricted choice of holding any currency, why should agents not hold the best currency there is – the reserve currency that the Central Bank also holds in reserves? A free currency market, therefore, sets off a systematic process of currency substitution: the substitution of the reserve/hard currency for the soft.[2] It results in an asymmetric demand from Mexicans to hold dollars as a store of value, a demand that is not reciprocated by Americans holding pesos as a hedge against the devaluation of the dollar! This can lead to a systematic devaluation of soft currencies. The policy implication of this argument is that, while the floating exchange rate side of the triangle may be appropriate in certain cases, the solution of (partial) capital controls that provides exchange rate stability and monetary policy autonomy has much to recommend itself in certain cases, to wit, in countries that have "soft currencies."

The argument above implies a process of cumulative circular causation. Currency substitution will lead to devaluation of soft currencies, which in turn induces further currency substitution and devaluation. This simple formulation is developed in the theoretical part of the paper in two steps. First, in an intertemporal optimization framework, we show that the

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[1] The parallel literature on "positional goods" identifies the social "pecking order" as "a shared system of social status," where, e.g., it becomes possible for an individual (a good) to have a positive amount of prestige (reputation) such as a feeling of superiority, only because the other individuals (other goods) have a symmetrical feeling of inferiority, i.e., negative reputation (Hirsch, 1976; Frank and Cook, 1976; Frank, 1985; Pagano, 1999). In extending this literature and viewing foreign exchange as a "positional good" we postulate that in a free currency market, the simple fact that reserve currencies exist, implies that there are soft currencies which are shunned for some (asset-holding) purposes.

[2] Our definition of currency substitution is not the only one employed in the literature. In fact the concept of currency substitution is rather ambiguous in economics. For a survey of different definitions, see Giovannini and Turtelboom (1994).

likelihood that devaluation happens induces currency substitution unambiguously, regardless of the adjustment speed of goods prices. This result is intuitively straightforward since it captures the substitution effect in the money demand function; a decrease in the relative price of domestic currency induces substitution of the foreign currency for the domestic.

Second, in order to show the process of devaluation induced by the currency substitution, we extend the "fundamentals" ("first generation") models of currency crisis *a la* Krugman (1979) and Flood and Garber (1984) by incorporating explicitly the endogenous currency substitution effects. We thus meet the strand of the literature that extends the "first-generation models" by introducing various endogenous characteristics, such as risk premium (Flood and Marion, 2000) or an endogenous regime-switching of economic policy (Cavallari and Corsetti, 2000). We show that the more pronounced the currency substitution is in a country the earlier and the stronger is the tendency for the local currency to devalue.

The intuition behind the theory is straightforward. With strong currency substitution the demand for the domestic (soft) currency, relative to the foreign (hard) currency, declines. Given the stream of domestic money-supply growth, a decline in domestic money demand will increase the equilibrium domestic price level. This increased domestic price level will lead to devaluation of the nominal exchange rate.

Another novel feature of this paper is to show that, controlling for the fundamentals, the asymmetry via-a-vis the reserve/ hard currencies triggers systematic devaluations of the soft currencies of emerging economies and developing countries.[3] We also find empirically that there is a systematic negative relationship between the softness of a currency and the level of economic

[3] In a two-country general equilibrium model one could show the impact of asymmetric reputation as a zero-sum game (Pagano, 1999). For simplicity, we consider only one-sided reputation in this paper.

development. The important policy implication is that a *de facto* floating exchange rate would not be optimal for low-income countries with soft currencies. Rather, developing countries with soft currencies should adopt a hard peg while restricting carefully full capital mobility and thus the demand for foreign exchange for asset-holding purposes. Ultimately, Frankel (1999) has been right that one-size cannot fit all and the idiosyncrasies associated with underdevelopment and poverty ("country specificity") have to be taken into account when extending the successful experience of the developed countries to a global setting (Yotopoulos and Sawada, 2005).

The paper is organized as follows. Section 2 deals with the microeconomics of currency substitution by developing a utility maximization model with both domestic and foreign currency entering as assets and deriving the conditions for optimal substitution between the two. This is next fused within the "fundamentals" model of crisis to develop a monetary model of currency substitution and to derive the standard conditions of the collapse of the exchange rate with currency substitution as the principal actor. Section 3 on the empirical implementation employs a rather unique testing procedure that intends to identify the three components in devaluations and crises: the purchasing-power-parity exchange rate equilibrium, the currency-substitution-induced nominal exchange rate, and the role that capital controls and the black-market premium play in the process. Explanations of the data sets and the empirical results follow. Section 4 is on speculative attacks and draws the broader policy implications of the model. The concluding section 5 sets the model of currency substitution within the context of the theory of incomplete markets.

2. A Model of Currency-Substitution Triggered Crises

The paper builds on two strands of the literature. Krugman (1979) first developed a model of the balance of payment crisis due to speculative attacks on the fixed-exchange-rate regime. This model became the progenitor, especially in its linear version (Flood and Garber, 1984) of a crop of the "first generation" models that finger the deteriorating "fundamentals" of an economy as the trigger to currency crises (Eichengreen, Rose, and Wyplosz, 1994).

It seems this literature implicitly assumes that the important role of money is as a medium of exchange, since the models introduce the arbitrage equation of tradable goods prices or the purchasing power parity equation. This unidimensional treatment of money as a medium of exchange has a distinguished pedigree, going back to the formalization of the microeconomics of the money demand function, whether in the form of the cash-in-advance model (Clower, 1967; Lucas and Stokey, 1987) or that of the transactions model (Baumol, 1952; Tobin, 1956). However, money also serves as a store of value, and enters as such the utility function and the intertemporal budget constraint. Sidrauski (1967) first formulated the Ramsey optimal growth model with both consumption and real money balances in the utility function subject to an intertemporal budget constraint with money as an asset. This second strand of the literature is an important building block of the microeconomics of currency substitution since money held for asset purposes belongs in the utility function. Moreover, with the works by Feenstra (1986) and Obstfeld and Rogoff (1996: 530-532), the-money-in-utility-function formula can be regarded as a general formulation of the micro-foundations of the money demand function.

The novelty in our theoretical model lies in fusing and expanding both strands of the literature, the fundamentals models of financial crises and the microeconomics models of money demand, into a micro-macro-fundamentals model in which optimizing agents engage in currency substitution thus setting-off endogenously serial devaluations that can culminate into financial crises. If a country with a soft currency fixed its exchange rate initially, an expansionary fiscal and/or monetary policy will render the fixed exchange rate regime untenable, sooner or later. We proceed first with the analysis of the micro-fundamentals.

2.1 The Microeconomics of Currency Substitution

We first derive the optimal condition of currency substitution in a dynamic model of optimizing agents. Then we extend Krugman's (1979) model by introducing currency substitution effects while controlling for the fundamentals. Our focus is to model the role of money as an asset and a store of value. However in the real world, money as a store of value is dominated by several assets. To account for this we construct a dynamic optimization model of currency substitution, applying the basic setup of Obstfeld and Rogoff (1996: 551-553).

By definition, a domestic representative agent's total money for asset-holding purposes, M, is composed of domestic currency, M_1 and foreign currency, M_F:

$$M_t = M_{1t} + \varepsilon M_{Ft}$$

where ε is the nominal exchange rate. Then the optimal allocation of money-holding between two different currencies can be solved as a dynamic optimization problem of a household with money-in-the-utility-function (Obstfeld and Rogoff, 1996: 551-553)). Assuming a small open economy and log-linear utility components of real balance, a representative household maximizes the following lifetime utility:

$$(1) \qquad U_t = \sum_{s=t}^{\infty} \rho^{s-t} \left\{ \theta u(C_s) + (1-\theta) \left[\gamma \log\left(\frac{M_{1s}}{P_s} \right) + (1-\gamma) \log\left(\frac{\varepsilon M_{Fs}}{P_s} \right) \right] \right\},$$

where $u(C)$ represents instantaneous utility from consumption and ρ is a discount factor. The parameters θ and γ are utility parameters and P_t represents the domestic price level. The household can accumulate foreign bonds and two kinds of monetary assets. The optimal consumption and money demand are determined by maximizing (1) subject to the following intertemporal budget constraint:[4]

$$(B_{t+1}-B_t)+\frac{(M_{1t}-M_{1t})}{P_t}+\frac{\varepsilon_t(M_{Ft}-M_{Ft-1})}{P_t}=rB_t+Y_t-C_t-T_t\,,$$

where B is the stock of foreign bonds or assets. Y and T represent the exogenously given income and lump-sum tax, respectively. Note that the left-hand side of the budget constraint contains three different factors for accumulating assets, i.e., bonds, real domestic money and real foreign money, all converted in the local currency, and by definition equal to the real surplus during the period t on the right-hand side. In order to derive a tractable analytical solution, we assume that there is no consumption-titling effect, i.e., $(1 + r)\rho = 1$. Then we obtain the following first-order conditions with regard to C, M_1, and M_F, respectively (see Appendix A):

(2) $$u'(C_t)=u'(C_{t+1})\,,$$

(3) $$\frac{(1-\theta)\gamma}{M_{1t}}+\frac{\rho\theta u'(C_{t+1})}{P_{t+1}}-\frac{\theta u'(C_t)}{P_t}=0\,,$$

(4) $$\frac{(1-\theta)(1-\gamma)}{M_{Ft}}+\frac{\rho\theta u'(C_{t+1})\varepsilon_{t+1}}{P_{t+1}}-\frac{\theta u'(C_t)\varepsilon_t}{P_t}=0\,.$$

For the purpose of deriving the optimal allocation condition of two different currencies in a regime of currency substitution, let us define the foreign-currency preference variable, α, as follows:

(5) $$M_{1t} = (1-\alpha_t)\, M_t$$

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[4] While Sawada (1994, 2001) finds that many Latin American Countries in the 1980’s violate the Non-

(6) $$\varepsilon M_{Ft} = \alpha_t M_t.$$

This foreign-currency preference, α, is the key variable since its value, as it rises from 0 to 1, activates progressively greater currency substitution. If $\alpha = 0$, there is no currency substitution effect and a consumer holds only the domestic currency as an asset. The condition $\alpha = 0$ is also satisfied in the case of non-convertibility of the domestic currency and strict capital control. In either case, foreign money-holdings are forced to zero. On the other hand, the case of $\alpha = 1$ indicates that domestic residents hold monetary assets exclusively in the form of foreign currency. This is the case of complete dollarization. Hence, the variable α reflects the degree of softness of a currency, defined as the proclivity for currency substitution for asset-holding purposes. The value of α then represents an inverse transformation of Gresham's law since, as it ranges from 0 to 1, it is the good (hard) currency that progressively drives out the bad.

Denote that $\varepsilon_{t+1}/\varepsilon_t = 1 + z_{t+1}$, where z_{t+1} is (future) devaluation rate. Then, combining equations (2), (3a), and (3b) yields (see Appendix B):

(7) $$\alpha_t = \frac{(1-\gamma)i_{t+1}}{i_{t+1} - \gamma z_{t+1}},$$

where i_{t+1} is the nominal interest rate, which is defined by the following expression: $i_{t+1} = (1+r)(P_{t+1}/P_t)-1$. We can easily show that $\partial\alpha_t/\partial z_{t+1} > 0$, indicating that exchange rate devaluation will induce currency substitution under the assumption of sticky prices. What happens when the prices adjust instantaneously? To see this, we assume that the purchasing power parity (PPP) condition holds given instantaneous and complete price adjustments. In this case, we have $P_t = \varepsilon_t P^*$, where P^* is the foreign price level which is assumed to be constant to avoid unnecessary

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Ponzi Game condition of the intertemporal budget constraint, this violation does not affect the argument below because our model relies only on the first-order necessary conditions.

complications.[5] Then equation (7) becomes:

$$\alpha_t = \frac{(1-\gamma)[r + z_{t+1}(1+r)]}{r + (1+r-\gamma)z_{t+1}}, \qquad (8)$$

where, as shown in Appendix B, the property, $\partial\alpha_t/\partial z_{t+1} > 0$, is satisfied in this case as well. This comparative statics result indicates that currency substitution is induced by (future) devaluation even under flexible prices. Expecting depreciation of the foreign exchange rate, households optimally switch their holdings of domestic currency to foreign currency in order to maximize their intertemporal utility. This result holds in general, regardless of the speed of price adjustment. It is summarized by the following proposition:.

Proposition 1 (Devaluation-induced Currency Substitution): *Regardless of the adjustment speed of goods prices, a* (*future*) *devaluation induces currency substitution unambiguously.*

Proof: See Appendix C.

Also, from equations (7) and (8), it is straightforward to show that $\partial\alpha_t/\partial\gamma < 0$ and $\partial(\partial\alpha_t/\partial z_{t+1})/\partial\gamma < 0$, indicating that strong utility preference towards the domestic currency decreases the effects of currency substitution by lowering its level and muffling the response toward devaluations. Alternatively, a particular utility preference toward foreign currency induces strong currency substitution as a behavioral consequence. These results are intuitively straightforward. Basically, proposition 1 captures the substitution effect of the money demand function: a decrease in the relative price of domestic currency induces substitution of the foreign

[5] Our qualitative results remain unchanged in the argument that follows even if we assume that P^* is not

currency for the domestic.

2.2 A Monetary Model with Currency Substitution

For the sake of expositional simplicity suppose for the time being that α_t is exogenously given – an issue that we will revisit later in section 2.3. We thus set aside the endogenous structure of equation (7) or (8). Now we draw on the first-generation models of Krugman (1979), as log-linearized by Obstfeld and Rogoff (1996), to model a small open economy with a foreign exchange rate that complies with purchasing power parity (PPP) and uncovered interest parity (UIP). This model assumes perfect adjustment in the goods (tradables) market and perfect capital mobility:[6]

(9a) $$p_t = e_t + p_t^*$$

(9b) $$i_{t+1} = i_{t+1}^* + E_t e_{t+1} - e_t,$$

where e is the logarithm of the nominal exchange rate of this economy. The log of the price level, P_t, is denoted by p, and the interest rate is denoted by i. Then, by using the foreign-currency preference variable, α, the *domestic* money market equilibrium condition, becomes:[7]

(9c) $$m_{1t} - p_t = \alpha_0 + \log(1-\alpha_t) + \phi c_t - \eta i_{t+1},$$

where m and c are the log of the money supply and the consumption, respectively. The first term in the RHS, α_0, is a constant term. The parameters, ϕ and η, are income elasticity and semi-interest elasticity of money demand, respectively.

Combining (9a), (9b), and (9c), we have a dynamic equation of the exchange rate which

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constant.

[6] This strong assumption will be released in the empirical implementation of the model below.

satisfies PPP, UIP, and money market equilibrium:

(9d) $$m_{1t} - e_t - \alpha_0 - \phi c_t + \eta i_{t+1}^* - p_t^* = \log(1-\alpha_t) - \eta(E_t e_{t+1} - e_t),$$

Under the assumption of the small open economy, foreign variables are exogenously given. In order to simplify the argument, we assume that $- \alpha_0 - \phi c_t + \eta i_{t+1}^* - p_t^* = 0$. Then we have a continuous version of the exchange rate dynamics under perfect foresight as follows:

(9e) $$m_t - e_t = \log(1-\alpha_t) - \eta \dot{e}_t$$

Introducing the role of the Central Bank in the monetary model we can represent the balance sheet of the Central Bank as

(10) $$B_H + \varepsilon A_F = MB$$

where B_H denotes the ownership by the Central Bank of domestic government bonds and A_F is its total foreign asset holdings, i.e., foreign bonds and reserve currency. The Central Bank's monetary base is $M_1 = \mu\, MB$, where $\mu > 1$ represents the money multiplier. Hence, Equation (10) gives

(11) $$M_1 = \mu (B_H + \varepsilon A_F).$$

2.3 From Currency Substitution to Financial Crisis

From Equation (9e), we can see that a fixed exchange rate regime generates

(12) $$m_{1t} - \bar{e} = \log(1-\alpha_t).$$

Suppose that the Central Bank is required to finance an ever-increasing fiscal deficit by buying government bonds thus expanding its nominal holdings of domestic government debt, B_H.

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[7] This equation is justified by assuming a continuous-time Cagan-type money demand function.

If the growth rate of domestic bond stock is constant at λ, we have

(13) $$\dot{B}_H = B_H \lambda.$$

Following Krugman (1979), we can calculate the shadow exchange rate under the flexible exchange rate assumption and no foreign reserves, i.e., $A_F = 0$. In this situation, the Central Bank's balance sheet equation (11) implies that

(14) $$m_{1t} = \log \mu + b_{Ht},$$

where b_H indicates the log of the Central Bank's bond holding. By combining Equations (13) and (14), it becomes obvious that the money supply increases at the constant rate λ after the collapse of the fixed exchange rate regime, i.e., $\dot{m}_{1t} = \lambda$. Moreover, from Equation (9e), we can easily see that $\dot{m}_{1t} = \dot{e}_t = \lambda$ along the balanced growth path. Therefore, inserting Equation (14) into Equation (9e), we obtain

(15) $$b_{Ht} - e_t = - \log \mu + \log(1-\alpha_t) - \eta\lambda$$

Finally, we can derive the log of the shadow exchange rate, which is defined as the floating exchange rate that would prevail if the fixed exchange rate regime collapsed, as follows:

(16) $$e_t = b_{Ht} + \log \mu - \log(1-\alpha_t) + \eta\lambda.$$

We can see that $\partial e_t / \partial \alpha > 0$. This indicates that the currency substitution effects due to agents' preference toward foreign currency will induce potential devaluation of the exchange rate over time. As a result, controlling for the fundamentals, the collapse of the fixed exchange rate would occur earlier. We can formally derive the time path to the collapse as follows. From Equation (12), we have

(17) $$b_{Ht} = b_{H0} + \lambda t,$$

where b_{H0} is the initial value of the Central Bank's government bond holding. Combining

Equations (16) and (17), together with $e_T = \bar{e}$, we can derive the time elapsed to the collapse of the fixed exchange rate regime as follows:

$$T = \frac{\bar{e} - b_{H0} - \log\mu + \log(1-\alpha_t)}{\lambda} - \eta.$$

Hence, we can easily inspect that $\partial T/\partial\alpha < 0$. Again, the softness of a currency is negatively related to the timing of the currency crisis. As indicated in Figure 1, e_T is the cross-over point from fixed to flexible exchange rate, the onset of devaluation. The equation and figure denote that currency substitution, is totally independent of the fundamentals; it is induced by a shift in the preference parameters, and it will lead to an early collapse of the stable exchange rate regime (Figure 1).[8] For example, such a change in the substitution parameter, α, can be induced by a preference shift from domestic currency to foreign currency, i.e., a decrease in γ (Equation 5a). It is important to note that even with a modest expansion in the level of government indebtedness, λ, a large currency substitution effect, α, can accelerate the onset of the crisis (Equation 15). This is applicable to the Asian crises of 1997 that transpired, the balanced government accounts and the otherwise solid fundamentals notwithstanding (Yotopoulos and Sawada, 1999).

The intuition behind this result should be straightforward. A high degree of currency substitution results in shrinking the demand for the domestic currency (Equation 6b). Given the flow of money supply, a decline in money demand will increase the equilibrium price level. According to the PPP, Equation (7a), this increased price level will lead to devaluation. Although the devaluation rate itself will be the growth rate of the money supply, it is the currency substitution that shifts the locus of the shadow exchange rate toward the devaluation.

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[8] Note that the first-generation currency-crisis model *a la* Krugman (1979) is the special case of our model

So far, for the sake of tractability, we have assumed that the currency substitution variable, α, is exogenously given. Yet, equation (5b) and Proposition 1 indicate that this variable is endogenously determined by a household's dynamic optimization behavior. The trajectory of the exchange rate that will lead to equilibrium should also take into account this endogeneity of the currency substitution variable. Although we have imposed the perfect foresight assumption of the model so far, the future devaluation rate, z_{t+1}, should be treated as an expected variable in reality. For convenience, we denote an expected devaluation rate as $z_{t+1}{}^{e}$. A correct interpretation of Proposition 1 is that the foreign-currency-preference variable will increase in response to an *expected* devaluation, i.e., $\alpha_t = \alpha(z_{t+1}{}^{e})$ with $\partial\alpha_t/\partial z_{t+1}{}^{e}>0$, because of endogeneity of the currency substitution variable, α_t. Then once a country's currency behaves as a soft currency and is expected to devalue, the dynamic locus of the shadow exchange rate line, represented by Equation (16), will shift toward further devaluation (Figure 1). In this case, even if a country is initially at the point A', where the speculative attacks are not profitable without currency substitution, a currency substitution due to an expected devaluation can cause the immediate collapse of a fixed exchange rate regime. Hence, the expectation of devaluation can become a self-fulfilling prophecy. Note that this story does not depend on the usual assumption of the second generation model of currency crisis where the existence of speculative bubbles itself generates multiple-equilibria and a self-fulfilling expectation of speculative attacks (Obstfeld, 1996). Rather, in our model, the expectations of devaluation of optimizing domestic residents make the collapse of the fixed exchange rate regime inevitable.

Moreover, as is often pointed out both by theory and empirical work, there is habit-formation in relation to currency substitution (Uribe, 1997). The self-fulfilling expectation of

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with no currency substitution effects, i.e., $\alpha = 0$.

devaluation is likely to have hysteresis on currency substitution. This mechanism creates the possibility of self-validating devaluation spirals. An expected devaluation generates currency substitution by agents (Equation 5b). Currency substitution, in turn, leads to a further expected devaluation (Equation 16). Soft currencies depreciate systematically because of the currency substitution effect and crises occur more frequently. This is a formal representation of the Y-Proposition elaborated by Yotopoulos (1996, 1997).

3. Empirical Implementation

The concept of currency substitution is simple – the use of foreign exchange as an asset, i.e., for other than trade or capital transactions purposes. What is a soft currency, and becomes especially vulnerable to currency substitution, is also conceptually simple: one would recognizer it by seeing the tourists throwing it at trinkets instead of carrying it home on their return flight. Similarly the difference between using foreign exchange as an asset, as opposed, say, to using it for buying other assets, such as gold or works of art, is also clear. The negative entry in the balance of payments may be the same, but in the former case devaluation changes (distorts?) all prices of tradables, that trade in dollars, relative to nontradables, that trade in domestic currency and this may involve a real cost to the economy.[9] On the other hand, India, as the gold-jewelry-sink of the world, is no worse off except for a possibly higher domestic price of gold and a worse liquidity status of investors in gold.

Although simple concepts all, they are difficult to specify ex ante, and especially so in a regime of international financial intermediation with flexible exchange rates, convertibility of

[9] Yotopoulos (1996: 51, and Chapter 7) has identified such a distortion and has tested for it empirically.

currencies and free capital movements, whether for direct foreign investment or for financial investment purposes. In some extreme situations, of course, the identification of the currency substitution parameter is easy and the implications of the theoretical model are tangible. In the case of dollarization (Argentina) the currency substitution is complete and the disastrous end of the story should not have come as a surprise (Yotopoulos, 1996: 283-84). In the case of the handling of the financial crisis in Malaysia in 1997, restricting the ability to currency-substitute, even though after the fact, was bound to help the situation, as it did. In most cases of free currency market regimes, however, currency substitution relates to the intentions about the use of foreign exchange and the measurement of the variable becomes dubious. Conversion of domestic currency into foreign, which in turn ends up as a deposit in a foreign account abroad, becomes unidentifiable as currency substitution. It may be easier to recognize currency substitution if the converted domestic currency ends up in a foreign-exchange account at home, as, e.g., in the case of the Mexican tesobono deposits. A foreign deposit that ends up in a foreign-exchange account at home can be a capital transfer, or it can be a loan. But if the foreign exchange in the account is leveraged into a loan of domestic currency which, in turn, is again converted into foreign exchange, the transaction becomes a speculative game of mismatching assets and liabilities that contributes to inducing devaluation of the currency in order to reap the capital gains from the repayment of the domestic loan. Should foreign exchange be used to buy foreign Certificates of Deposit, the currency substitution becomes invisible or, if identifiable, it becomes foreign investment from the soft-currency country to the hard currency. Finally, in the most frequent and universal case, when people in impoverished countries hold their savings under the mattress in the form of U.S. dollars, the currency substitution also becomes invisible.

For an intuitive quantification of the extent of currency substitution we use a very imperfect proxy which still casts some light on the process and reveals some tentative links between devaluation and financial crises. Lacking data on foreign currency deposits, we define the proxy of the currency substitution variable, α_t, as the ratio of time, savings, and foreign-currency deposits in Deposit Money Banks to a broader measure of money, $M2$, which also includes time, savings, and foreign currency deposits.[10] Monthly data of these variables from January 1991 to September 2000 are extracted from *International Financial Statistics* of the International Monetary Fund. This measure of currency substitution can be regarded as the upper-bound of α_t since the data commingle in the numerator foreign currency deposits with other time and savings deposits.

Figure 2 represents the above ratio-proxy estimate of monthly currency substitution for Indonesia, Korea, Malaysia, and Thailand. From the beginning of the period, January 1991, there was no trend (except a slight upward trend in Indonesia). Starting in July 1997 there was a pronounced increase in the proxy variable. Casual observation suggests a synchronicity between the increase in the proxy variable and the currency devaluations of 1997 and 1998. This is consistent with our theoretical framework: substitution of the foreign currency for the domestic ratchets up to devaluation. In Korea, particularly, gradual currency substitution immediately preceded the massive devaluation of November 1997.

The message from our model is that currency substitution no longer is an issue of fundamentals. As long as currency used for asset-holding purposes is a positional good and the transaction costs for currency switching are negligible in a free currency market, it pays for agents to ratchet up by substituting the reserve/ hard currency for the soft. Agents' expectations

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[10] Note that the Deposit Money Banks comprise commercial banks and other financial institutions that accept transferable deposits.

for devaluation generate self-fulfilling prophesies. Expectations thus become important determinants of the devaluation outcomes.

3.1 The Empirical Model

The formal cross-country empirical implementation of the model rests on Equation (16) above which represents a modified version of Krugman's collapse of the fixed exchange rate regime, with e_T indicating the cross-over point from fixed to flexible exchange rate, denoting devaluation. The modifications consist of introducing currency substitution that impacts on the timing of the collapse of the exchange rate regime (Figure 1) and of releasing the strong assumption of perfect international capital mobility. We therefore rewrite Equation (16) to represent a hypothetical exchange rate under PPP and UIP:

(16a) $$e_t = b_{Ht} + \log \mu + \eta\lambda + \alpha_t + \beta_t,$$

where β is a parameter representing the degree of capital mobility.

In estimating Equation (16a) the following four components need be distinguished: First, recall that the first two terms of the RHS are equal to nominal money holdings, m_{1t}, that determine e_t when foreign exchange is used for transactions purposes only. In other words, these three terms are the monetary approach or reduced form representation of the PPP components of exchange rate due to trade in goods and services, combined with the money market equilibrium condition. The PPP exchange rate is determined by clearing the market for tradables, PPP_{Tt}.

Second, the third and fourth terms of Equation (16a) modify the PPP-determination of the exchange rate to reflect the additional splice on the demand for foreign exchange induced by currency substitution, α.

Third, the existence of effective capital control and rationing of the foreign exchange allocation is captured by the last term in Equation (16a) with $\beta > 0$. In this case the "equilibrium" exchange rate is overridden at a level higher than the level of the currency-substitution adjusted PPP. The resulting foreign exchange rate is the black market exchange rate, *BM*, which is higher than the equilibrium nominal exchange rate under perfect capital mobility:

$$\ln BM_t = \ln PPP_{Tt} + \alpha_t + \beta, \tag{16b}$$

where PPP_{Tt} is the fundamental PPP part and β represents the degree of capital control.

Finally, the official nominal exchange rate (*NER*) is often managed by the government, especially in soft-currency countries. There is a certain degree of discretion in setting the NER, and in any event it is lower than *BM* which is regarded as the logarithm of the black market exchange rate that reflects the existence of currency substitution by domestic residents and of foreign exchange market interventions of governments.

We can now subtract *NER* from both sides of (16b) in order to have the empirical model that yields currency substitution, or, expressed in another way, an operational index of the softness of the currency, α_{it}, as a residual:

$$\ln BM_{it} - \ln NER_{it} = \ln PPP_{Tit} - \ln NER_{it} + \beta D_{it} + \alpha_{it}, \tag{18}$$

where D is a dummy for the extent of capital control that is in effect.

For estimation purposes, let *BP* denote the black market premium relative to the nominal exchange rate. Then, by applying a first-order Taylor expansion around *BP*=0 to equation (18), we have

$$BP_{it} - \ln DNER_{it} = \beta D_{it} + \alpha_{it}, \tag{19}$$

where $\ln DNER_{it}$=1n $PPP_{Tit} - \ln NER_{it}$. If data sets are available, the currency softness index, α_{it}, can be derived as the residual of this empirical model, by regressing black market premium, BP_{it}, on the *NER* distortion index, ln PPP_{Tit} – ln NER_{it}, and the capital control indicator variable, D_{it}, which takes value of one if there are any foreign exchange controls and zero otherwise.

Equation (19) calls for imposing coefficient restrictions. We thus estimate Equation (19) with coefficient restriction on the *NER* distortion index, ln *DNER*, by using OLS with the Huber-White robust standard error. Finally, we obtain the currency softness index, α_{it}, as the estimated residuals of Equation (19) with the coefficient restriction.[11]

3.2 The Data Set

Three variables and one dummy variable are needed for estimating the regression equation (19): the nominal exchange rate, *NER*; the black-market premium expressed relative to the NER, *BP*; the *NER* distortion index, as defined on the right-hand side of equation (18)[12], 1n *DNER*; and qualitative information about foreign capital controls.

First, the data for the black market premia on the foreign exchange rate are widely available from various sources. We utilized a comprehensive annual cross-country panel data set of black market premia which is compiled by Adrian Wood (1999). This data set covers 42 countries over a period of ten years (Table A2).

Second, consistent annual panel information on exchange rate restrictions is reported in Ernst & Whinney (various years)[13]. The data denote restrictions on equity capital; debt capital; interest; dividends and branch profits; and royalties, technical service fees, etc. Based on this information we construct a binary variable of foreign capital controls (Table A2).

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[11] We also add time effects in this regression.
[12] Cf. also formulation in Equation (21) below.

Obtaining the appropriate *NER* distortion index that the theory requires is more difficult. The empirical version of the *NER* distortion index that is broadly used for gauging a currency's tendency to appreciate or depreciate is supposed to measure the deviation of the nominal exchange rate (*NER*) from the ideal world where *PPP* holds and the prices of tradables tend to converge internationally (McKinnon, 1979). The empirical application of the index, however, whether it relies on the differential rate of inflation or other shortcut methods, reflects the prices of both tradables and nontradables. Measuring the deviation of the *NER*, which is formed exclusively in the world of tradables, by using a (*PPP*-deflated) general price index introduces a distortion that makes the resulting index of questionable value. This shortcoming is remedied by utilizing the prices of tradables alone in the data set that Yotopoulos (1996) has developed separating prices of tradables and nontradables for each country in the sample.

Yotopoulos' point of departure is the *PPP* exchange rate that is constructed from the price-parity (micro-*ICP*) data of the Penn World Tables (Summers and Heston, 1991; Kravis, Heston, and Summers, 1982). The familiar expression that gives purchasing power parity, *PPP*, for country I as the geometric average of the k *GDP*-exhaustive commodity categories, is

(20) $$PPP_I = \prod_{i=1}^{k} \left(\frac{P_i^I}{P_i^W} \right)^{Q_i^I \Big/ \sum_{i=1}^{k} Q_i^I}$$

where P_i^I and P_i^W are the prices of *i* homogeneous commodity for country *I* and for the numeraire country (world), and *Q* are the quantity weights. The *PPP* indexes in equation (21) are expressed in local currency per US (numeraire country) dollar.

Different aggregations of Equation (20) can lead to alternative price indexes, such as the national price level of consumption or of government expenditure. For the Yotopoulos (1996,

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[13] Ernst and Whinney since 1989.

Chapter 6) application the normalized index of the prices of tradables is constructed by aggregating in Equation (20) from $i = N+1\ldots T$ and ignoring commodities $i = 1\ldots N$, with the former sum representing the prices of tradables and the latter of nontradables. The empirical classification of commodities as tradables and nontradables adopts the standard definition of openness in an economy (the ratio of imports and exports to *GDP*) with the cut-off rule for designating as tradable any commodity group that participates in international trade (exports plus imports) with a value of more than 20 percent of the total share of that commodity's expenditure in *GDP*.[14] The data for the definition of tradability come from the United Nations, *Yearbook of International Trade Statistics*.

Let a variable *NER* represent a country's nominal exchange rate (*NER*) expressed in local currency/US dollar. A country *i*'s tradable goods price at time t is represented by PPP^T_{it}. Let PPP^T denote the *PPP* level of tradable goods, as in equation (21). Then, as we have discussed already, we can define a *NER* distortion index, *DNER*, as follows:

$$DNER_{it} \equiv \frac{PPP_{it}^T}{NER_{it}}, \qquad (21)$$

where *T* is a superscript for tradables. The ratio of tradable prices represents an implicit long-run equilibrium purchasing power parity of tradable prices. Therefore, $DNER_{it}$ represents the nominal exchange rate distortion, which is defined as the deviation of *NER* from the *PPP* for tradable goods, i.e., the long-run equilibrium exchange rate. We can then formulate formally:

Proposition 2 (NER Misalignment): *If* $DNER_{it}>1$ or $\ln DNER_{it}>0$, *then the NER is overvalued*

[14] By distinguishing a large number of commodity groups and by weighting both prices and the participation of each individual commodity into tradability by actual expenditure weights, the arbitrariness of the criterion has been blunted.

relative to the purchasing power parity level; and if $DNER_{it}$<1 or ln $DNER_{it}$<0*, then it is undervalued. If there are no time-specific and country-specific distortions, then absolute PPP holds among tradables.*

Proof: From Equation (22), if $DNER_{it} > 1 \Leftrightarrow NER_{it} < PPP_{it}^{T}$, *NER* is overvalued, and if $DNER_{it} < 1 \Leftrightarrow NER_{it} > PPP_{it}^{T}$, *NER* is undervalued. Moreover, if $DNER_{it} = 1 \Leftrightarrow NER_{it} = PPP_{it}^{T}$.

Q.E.D.

Therefore, we can simply estimate this *NER* distortion index from Equation (21) by taking the ratio of the relative price level of tradables to the *NER*, i.e.,

(21a) $$\ln DNER_{it} = \ln\left(\frac{PPP_{it}^{T}}{NER_{it}}\right).$$

Note that the index takes the value of zero if there is no *NER* distortion. In order to quantify this measure of distortion, we take advantage of Yotopoulos' (1996) estimates of PPP^{T}/ε that rely on the price parities (micro-*ICP*) data set.[15] The resulting estimates of *NER* distortions are also presented in Appendix Table A1.

3.3 Estimation Results of the Currency Softness Index.

[15] The resulting estimates of *NER* distortions are available from the authors upon request. Yotopoulos and Sawada (2005) formulate and implement a new empirical procedure to examine the degree of *NER* distortions in the long-run for 153 countries by using the familiar cross-country data set of Heston, Summers, and Aten (2002).

The summary statistics of the empirical estimation are presented in Table 1. The negative value (in the logs) of the Yotopoulos exchange rate distortion index indicates that the NER, the denominator of Equation (21), is higher than the PPP exchange rate, denoting that the countries in the sample had, on the average, relatively "undervalued" exchange rates with the premium α for currency substitution coming into play. On the other hand, currency controls have moderated, again on the average, the demand for foreign exchange that would have resulted otherwise from currency substitution alone. The intuition is that under capital controls the "speculator" has to pay an additional (black market) premium in order to hedge the local currency asset holdings against devaluation. The higher that premium is, the less currency substitution will take place (price closure at PPP_T instead of *BM*). The estimating equation in Table 2 gives also a positive and highly significant coefficient for the capital control variable. Another result from the same equation is the positive and significant coefficient for the dummy for 1985. It probably represents the impact of the sizeable appreciation of the US dollar in the early 1980s and reflects the resultant systematic depreciation of other countries' currencies. The coefficient of the NER distortion index is constrained to 1.

The immediate objective of Equation (19) is the derivation of the currency softness index, the values of which are summarized in Table A2. This statistic, besides revealing important country- and time-specific information, could also be used for investigating causality in various episodes of currency crisis. Unfortunately the data set and the episodes of currency crises are not rich enough to rigorously investigate causality hypotheses. However, we can still examine empirically the relevance of the currency softness index to financial crises by other methods. In order to give an ordinal characterization of the currency softness, we employ two different approaches.

First, the relationship between the softness measure and the currency distortion index is represented in Figure 3. The softness measure, representing the residuals around the fitted line of the estimating equation, are plotted against the NER distortion index, the log value of which is centered on zero since the estimating equation constrains it to one. The figure clearly indicates a negative relationship between the constructed currency softness index and the degree of *NER* overvaluation. The fact that soft currencies are more likely to be undervalued (i.e., too many pesos to the dollar) is consistent with the theoretical expectation of the model. The operational difference between a hard and soft currency is that the exchange rate for the latter reflects not only the demand and supply of foreign exchange for transaction (balance-of-payments) purposes, but includes also an additional splice of “precautionary” demand for foreign exchange to be held as an asset. This additional demand for hard currency will lead to devaluation of the exchange rate for the soft currency as long as the hard-currency-country residents do not need to hedge their domestic-money-asset holdings by accumulating soft currency. The tendency then for soft currencies to have “high” nominal exchange rates (NER in Equation 22) drives the *DNER* values below 1 (and to negative territory) thus indicating a perennially undervalued domestic currency. This is consistent with the findings of Yotopoulos (1996: Chapter 6) in the original study of exchange rate parity relying on *micro-PPP* data.

The second empirical finding relates to the negative relationship between the currency softness index and per capita real *GDP* as is verified in Figure 4.[16] To examine this relationship statistically, we regressed the estimated currency softness index on real per capita *GDP*. We also included the year dummy variables in order to control for a potential bias due to year-specific systematic effects. The estimation results are presented in Table 3. The coefficient of per capita *GDP* is negative and highly significant. This result confirms that there is a systematic relationship between the credibility ("reputation") of a currency and the level of economic development. The more developed a country is, the harder is its currency. Symmetrically, less-developed countries are more likely to be subjected to systematic devaluations due to reputation-challenged, i.e., soft, currencies. This finding is further informed by examination of the binary capital-control variable that is superimposed in Figure 4. As one would have expected it is mostly the high-income countries that operate without capital controls since they have generally reputable currencies, as reflected in low-softness indices. On the other hand, the few low-income countries in the sample that have abolished capital controls are clustered at the high-end of the softness index. The introduction of the capital control variable points to a possible circular causation between a currency's softness and a country's low level of economic development. Unconstrained by controls, residents in a poor economy prefer holding the dollar because the domestic currency is reputation-challenged. A poor country, in turn, finds it difficult to establish its currency's reputation because of the low level of economic development. This two-way causality could conceivably turn into a poverty trap for a country at a low stage of economic development.

Another informative way of looking at Figure 4 is to ignore the vertical axis and consider the distribution of capital-controlled and capital-liberalized countries on incomes per capita. The figure turns into a testimonial for the Washington Consensus: the appropriate policy for handling undervalued currencies, and plausibly underdevelopment itself, is less intervention, more liberalization, and abolition of all currency controls. Once, however, one reinstates the vertical

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[16] Data on per capita real GDP is extracted from Summers and Heston (1991) Penn World Tables.

axis and a currency's reputation is viewed as a buffer in cases of market incompleteness, the reverse causality in the neo-conventional wisdom is identified. It amounts to putting the cart in front of the horse if one expected a currency to become hard by having it behave like a hard currency, i.e., by trading freely in the world's exchange markets. There is an appropriate sequence in the process of economic liberalization. Freeing the foreign exchange market comes towards the end of this process when the main business of development has been done (Yotopoulos, 1996: Chapter 11).

4. Speculative Attacks and Policy Implications

The first-generation models of financial crises have focused on balance-of-payments disequilibria and the collapse of the fundamentals of an economy. Our model, on the other hand, predicts that even under a prudent fiscal policy and with pristine economic fundamentals, strong currency substitution precipitates a devaluation that may turn into a financial crisis. The analytical distinction between the two approaches lies in the economic function of money that has been incorporated in each. By focusing on the balance of payments, the extant models of financial crises consider the function of money as a medium of exchange in the (international) market for goods and services. The currency substitution hypothesis considers also the role of money as a store of value. While all currencies can do service, better or worse, for transaction purposes, when used as store of value they are ranked in a definite pecking order from the reserve/hard, to the soft, and to the worthless currency in a decreasing order of usefulness. There is a positional continuum in holding currency as an asset based on its reputation. Reputation in this specific case means that there is a credible commitment to stability of currency prices relative to some other prices that matter – and this commitment is more credible, the closer a currency is to the reserve currency. Their inherent asset value places reserve currencies in central banks' reserves, and also makes them safe havens for international capital movements. By the same token, the demand for foreign exchange – and especially for reserve and hard currencies - becomes an important component in a representative agent's utility function regardless of the motivation for holding such assets, whether it is for portfolio diversification, speculation or hedging.

The underlying asymmetry in reputation between soft and hard currency implies a corresponding asymmetry in the determination of their respective exchange parities in a free currency market. While transactions demand for foreign exchange is the principal determining factor of the price of both hard and soft currencies, in the case of the latter the demand for foreign exchange for asset-holding purposes plays an important role in decreasing the price of the currency (devaluation) and in exacerbating exchange rate instability. Asymmetrically, the same demand by a soft-currency country drives the price of the hard currency to appreciation – and appreciation, if it becomes problematic, is easier to combat than depreciation. Soft currencies, as a result, are likely to be more "undervalued" (and more difficult to remedy) than hard currencies that may tend to become "overvalued." Herein lays the emblematic difference between the currency substitution hypothesis and the extant interpretations of currency crises. In the mainstream view, devaluation always retains its salutary healing effects by matching supply and demand and storing up the current account, thus eventually improving the fundamentals. In the currency substitution alternative, on the other hand, devaluation will increase the value of the parameter $\partial\alpha_t / \partial z_{t+1}{}^e > 0$ (in Section 2.1 and Appendix B) thus leading to an increased demand of foreign exchange for asset holding purposes. In this view, competitive price-setting of foreign exchange for a soft currency represents "bad competition" and can lead to "a race for the bottom," i.e., to further serial devaluations. It becomes intuitively clear that this interpretation of the foreign exchange market for a soft currency amounts to a market incompleteness because of asymmetric reputation. This case corresponds fully to the parallel literature of incomplete credit markets for reasons of asymmetric information (Stiglitz and Weiss, 1981). The empirical implications of the two types of market incompleteness are also concordant. The policy implication of rationing foreign exchange and imposing a mildly repressed exchange rate replicates the need for credit controls for circumventing the "bad competition" and the "race for the bottom" that competitive price-setting implies for the credit market. Capital controls become expedient in the case of an incomplete foreign exchange market only to the extent that the inflow of financial capital contributes to fanning (on the cheap) currency substitution of the soft local currency. Otherwise, there is no need for imposing restrictions on direct foreign investment inflows or on outflows for the purpose of settling current account imbalances, or of repatriation of capital and profits (Yotopoulos, 1996, 1997; Yotopoulos and Sawada, 1999).

The case of speculative attacks on a currency, as made in the literature, is related to financial capital flows in the form of "hot money." This is a special case of the currency-substitution-induced devaluation in the model where unregulated inflows of financial capital can increase the value of the parameter α_t. In a free currency market, where devaluation may happen, or it may not, the holder of the soft currency is offered a one-way-option: by substituting the hard currency for the soft, there is a capital gain to be reaped if devaluation happens, while there is not an equivalent loss if it does not. This one-way bet is also offered to the "speculator" who can sell short the soft currency. It is especially attractive to foreign fund managers who can borrow the soft currency locally by leveraging a few million dollars' deposit into a peso loan with the proceeds, in turn, converted into dollars. This play of draining the Central Bank's reserves makes the devaluation of the peso a self-fulfilling prophecy. And when devaluation comes, the international investor can pay back the loan in cents on the dollar and take his hot money on the other side of the Rio Grande.[17] The entire process is initiated by taking advantage of the free currency market to convert a soft-currency monetary asset into hard currency, thus asymmetrically increasing the asset-demand for the latter and leading to the depreciation of the former.

The testable implication of this view of the role that financial capital can play in devaluations and financial crises relates to the timing of capital outflow. The currency substitution hypothesis would predict that the outflow of capital takes place after the devaluation happens and once the capital gains from selling the soft currency short have been captured. This expectation is confirmed from IMF data indicating that in the case of the East Asian crises the outflow of capital happened in the fourth quarter of 1997, instead of the third quarter when the crises were being staged. In the final quarter of 1997 the flight of capital from Korea amounted to $89 billion, or 18.9 percent of GDP, compared to a net inflow of capital of 0.7 percent of GDP for the third quarter. The same pattern held for the other crisis-countries also (in percent of GDP, with the third quarter figures in parentheses): Indonesia, -15.8 (3.3); Thailand -22.1 (-15.1)[18]; the Philippines –6.1 (9.0) – with Malaysian data lacking due to the exchange and capital controls that

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[17] A variant of this approach, fine-tuned for the existence of a Monetary Board, was used by fund managers in Hong Kong in September 1998. By selling short the Hang Seng stock market index and at the same time converting HK dollars into US dollars they helped deplete the Monetary Board's reserves thus forcing a monetary contraction. The increase in interest rates that followed fuelled a shift in assets from stocks to bonds, and a sharp decline in the stock market that rewarded the speculators with profits on their shorts. The scheme came to an abrupt end when the Hong Kong authorities intervened in support of the stock market (Yotopoulos and Sawada, 1999).

[18] It should be noted that Thailand was the first victim of the Asian crises, very early in the third quarter of 1997; the heavy capital outflow therefore in (late) third quarter conforms to the hypothesis.

were imposed in August 1997 (Cho and Rhee, 1999; Yotopoulos and Sawada, 1999).

The literature advocating capital controls has emphasized the unpredictability of international financial flows that consist largely of short-term bank deposits where a sudden reversal of the inflows may quickly result in bank insolvencies and failures (e.g., Calvo, Leiderman, Reinhart, 1993). The policy recommended for controlling financial capital inflows envisions ratcheting the reserve requirements up to 100 percent for the shortest-maturity capital flows. The cost of dis-intermediation in capital flows that this intervention entails is more than offset by decreasing banks' exposure. In the currency-substitution view such intervention prevents the formation of an avalanche of one-way-options against the soft currency that is bound to lead to a financial crisis. Thus the cost of disintermediation in capital flows is further decreased.

Financial capital flows notwithstanding, the use of reserve requirements as an appropriate financial-sector reform has been widely discussed in the literature (Cole and Slade, 1998; Calvo, Leiderman, and Reinhart, 1993). Inappropriately low reserve requirements encourage domestic banks to undertake risky projects that ultimately may result in bank insolvencies. On the other hand, prudent reserve requirements contribute to reducing the risks of private banks through imposing high capital-to-risk asset ratios and thus inducing banks to hold low-risk assets. Moreover, the central bank can use the rents created by reserve requirements to cover capital deficiencies in the event that banks became insolvent and need arises to have them be merged, sold, or liquidated. Such policy recommendations are consonant with the model of currency substitution that champions a conservative fiscal and monetary policy for avoiding a currency-substitution-led devaluation. To verify the importance of this intervention note that a lower money multiplier will put off the timing of the collapse of the fixed exchange rate regime since

$\partial T/\partial \mu < 0$ (Section 2.3). Recall that the money multiplier is defined as $\mu = (c+1)/(c+r_D+d)$, where c, r_D, and d represent the currency-deposit ratio, the required reserve ratio, and the excess reserve-deposits ratio, respectively. Therefore, we can easily see that increasing the required reserve ratio will postpone the BOP crisis.

6. Conclusions

Since 1980 three-quarters of the member-countries of the IMF, developed, developing, and emerging alike, have been hit by financial crises. In the 1990s financial crises became especially virulent occurrences. In this setting, the "fundamentals" models can still do service in explaining financial crises only with an increasing dose of willing suspension of disbelief.

This paper extends the first-generation models of financial crises to allow for a systematic devaluation of soft currencies that is independent of the fundamentals of an economy. In a globalized world of free markets for foreign exchange and free capital movements, the demand for racheting up the quality of a currency used as an asset increases. Currency substitution in favor of the reserve currency (currencies) becomes an endogenous factor relating to currency as a positional good, and leads to systematic devaluation of the soft currency – and eventually to crises.

The seemingly simple extension that we introduce into the "fundamentals model" of financial crises has empirical and policy implications that can prove germane in approaching "speculative attacks" on currencies and in assessing the dioramas for the "new architecture" of the international financial system. In the fundamentals approach to financial crises devaluation has remedial effects on the balance of payments and a transfusion of foreign capital helps shore up the reserves of the central bank and restore confidence in the currency. Devaluation and fresh capital inflows are the remedies to financial crises. In our extension of the fundamentals model, on the other hand, devaluation can be the validation of a systematic substitution of the foreign currency for the domestic in agents' liquid asset-holdings. Should this be the case, devaluation will further increase the tendency for currency substitution; and emergency lending for shoring up the currency is likely to end up in portfolia of maximizing agents, whether under the mattress or in foreign tax havens. In the latter case abrogating the free market for currency to be used for asset-holding purposes becomes an orthodox macroeconomic tool that can stymie the tendency of "speculators," let alone of local kleptocrats, to funnel emergency loans of foreign exchange into their offshore bank accounts.

Appendix A: Derivation of the first-order conditions

We can solve the maximization problem of (1) subject to the intertemporal budget constraint by setting up the following Lagrange function:

(A1)
$$L_t = \sum_{s=t}^{\infty} \rho^{s-t} \left\{ \theta u(C_s) + (1-\theta)\log\left(\frac{M_{1s}}{P_s} + \frac{\varepsilon_s M_{Fs}}{P_s} \right) \right\} + \sum_{s=t}^{\infty} \lambda_s \left[(1+r)B_s + \frac{M_{1s-1}}{P_t} + \frac{\varepsilon_s M_{Fs-1}}{P_s} + Y_t - C_t - B_{s+1} - \frac{M_{1s}}{P_t} - \frac{\varepsilon_s M_{Fs}}{P_s} \right],$$

where λ's denote Lagrange multiplier. Then we obtain the following first-order conditions with respect to C_t, C_{t+1}, B_{t+1}, M_{1t}, and M_{Ft}, respectively:

(A2)
$$\theta u'(C_t) = \lambda_t ,$$

(A3)
$$\rho\theta u'(C_{t+1}) = \lambda_{t+1} ,$$

(A4)
$$(1+r)\lambda_{t+1} = \lambda_t ,$$

(A5)
$$\frac{(1-\theta)}{M_{1t} + \varepsilon_t M_{Ft}} + \frac{\lambda_{t+1}}{P_{t+1}} - \frac{\lambda_t}{P_t} = 0 ,$$

(A6)
$$\frac{(1-\theta)\varepsilon_t}{M_{1t} + \varepsilon_t M_{Ft}} + \frac{\lambda_{t+1}\varepsilon_{t+1}}{P_{t+1}} - \frac{\lambda_t \varepsilon_t}{P_t} = 0 .$$

Combining (A2), (A3), and (A4), together with no-consumption tilting condition, $(1 + r)\rho = 1$, we have a standard Euler equation.

(A7)
$$u'(C_t) = u'(C_{t+1}) .$$

We can rewrite (A5) by using (A2), (A3), and (A7):

(A8a)
$$\frac{(1-\theta)}{M_{1t} + \varepsilon_t M_{Ft}} + \frac{\rho\theta u'(C_t)}{P_{t+1}} - \frac{\theta u'(C_t)}{P_t} = 0 ,$$

This equation (A8a) gives the aggregated money demand function:

(A8b)
$$\frac{M_{1t} + \varepsilon_t M_{Ft}}{P_t} = \left(\frac{1-\theta}{\theta} \right) [u'(C_t)]^{-1} \left(\frac{1+i_{t+1}}{i_{t+1}} \right),$$

where i is nominal interest rate, i.e., $i_{t+1} = (1+r)(P_{t+1}/P_t)-1$. Similarly, from (A6) combined with (A2), (A3), and (A7) we obtain

(A9a)
$$\frac{(1-\theta)\varepsilon_t}{M_{1t} + \varepsilon_t M_{Ft}} + \frac{\rho\theta u'(C_t)\varepsilon_{t+1}}{P_{t+1}} - \frac{\theta u'(C_t)\varepsilon_t}{P_t} = 0 .$$

which gives the foreign money demand function as follows:

(A9b)
$$\frac{M_{1t} + \varepsilon_t M_{Ft}}{P_t} = \left(\frac{1-\theta}{\theta} \right) [u'(C_t)]^{-1} \left(\frac{1+i_{t+1}}{i_{t+1} - z_{t+1}} \right)$$

where z_{t+1} is (future) devaluation rate, i.e., $\varepsilon_{t+1}/\varepsilon_t = 1 + z_{t+1}$.

Appendix B: Derivation of the currency substitution variable

Combining equations (A8b) and (A9b) yields

(B1)
$$\alpha_t = \frac{\varepsilon_t M_{Ft}}{\varepsilon_t M_{Ft} + M_{1t}} = \frac{\dfrac{1-\gamma}{i_{t+1} - z_{t+1}}}{\dfrac{1-\gamma}{i_{t+1} - z_{t+1}} + \dfrac{\gamma}{i_{t+1}}} = \frac{(1-\gamma) i_{t+1}}{i_{t+1} - \gamma z_{t+1}},$$

where i_t is the nominal interest rate, which is defined by the following expression: $i_{t+1} = (1+r)(P_{t+1}/P_t)-1$. We can easily show that $\partial\alpha_t/\partial z_{t+1} > 0$, indicating that exchange rate devaluation will induce currency substitution under the assumption of sticky prices. What happens when the prices adjust instantaneously? To see this, we assume that the purchasing power parity (PPP) condition holds because of the instantaneous and complete price adjustments. In this case, we have $P_t = \varepsilon_t P^*$, where P^* is the foreign price level which is assumed to be constant to avoid unnecessary complications, while our qualitative results will not change in the following relevant argument even if we assume that P^* is not constant. Then equation (5) becomes

(B2)
$$\alpha_t = \frac{(1-\gamma)[(1+r)(1+z_{t+1})-1]}{[(1+r)(1+z_{t+1})-1] - \gamma z_{t+1}} = \frac{(1-\gamma)[r + (1+z_{t+1})]}{r + (1+r-\gamma) z_{t+1}}$$

Then we can show that

(B3)
$$\begin{aligned}\frac{\partial \alpha_t}{\partial z_{t+1}} &= \frac{(1-\gamma)(1+r)}{r + (1+r-\gamma) z_{t+1}} - \frac{(1-\gamma)\left[r + (1+r) z_{t+1}\right]}{\left[r + (1+r-\gamma) z_{t+1}\right]^2}(1+r-\gamma) \\ &= \frac{(1-\gamma)(1+r)\left[r + (1+r-\gamma) z_{t+1}\right] - (1-\gamma)\left[r + (1+r) z_{t+1}\right](1+r-\gamma)}{\left[r + (1+r-\gamma) z_{t+1}\right]^2} \\ &= \frac{(1-\gamma)\left\{(1+r)\left[r + (1+r-\gamma) z_{t+1}\right] - \left[r + (1+r) z_{t+1}\right](1+r-\gamma)\right\}}{\left[r + (1+r-\gamma) z_{t+1}\right]^2} \\ &= \frac{(1-\gamma)\left\{(1+r)r - r(1+r-\gamma)\right\}}{\left[r + (1+r-\gamma) z_{t+1}\right]^2} \\ &= \frac{(1-\gamma) r \gamma}{\left[r + (1+r-\gamma) z_{t+1}\right]^2} > 0\end{aligned}$$

This comparative statics result indicates that currency substitution is induced by (future) devaluation. Facing fears of depreciation of the foreign exchange rate, households optimally switch their domestic currency to foreign currency, in order to maximize their intertemporal utility.

Appendix C: Proof of the proposition 1

The above comparative statics results hold in general, regardless of the speed of price adjustment. It is summarized by the following proposition:.

Proposition 1 (Devaluation-induced Currency Substitution): *Regardless of the adjustment speed of goods prices, a* (*future*) *devaluation induces currency substitution unambiguously.*

Proof: Let ω represents the speed of goods price adjustments, where $1 \geq \omega \geq 0$. Then, assuming P^* is constant, the domestic inflation rate in equation (3b) can be represented as a weighted average of devaluation rate and domestic inflation rate, i.e., $P_{t+1}/P_t = (1\text{-}\omega)(1+z_t)+(1\text{-}\omega)(P_{t+1}/P_t)$. Note that $\omega=1$ is the case of instantaneous price adjustment, while $\omega=0$ represents the case of completely sticky price. In this case, the currency substitution parameter becomes:

$\alpha_t = \dfrac{(1-\gamma)\{(1+r)[\omega(1+z_{t+1})+(1-\omega)(P_{t+1}/P_t)]-1\}}{\{(1+r)[\omega(1+z_{t+1})+(1-\omega)(P_{t+1}/P_t)]-1\}-\gamma z_{t+1}}$. Let $\Pi_{t+1} \equiv \omega(1+z_t)+(1-\omega)(P_{t+1}/P_t)$.

Then, it is straightforward to show that

$$\frac{\partial \alpha_t}{\partial z_{t+1}} = \frac{(1-\gamma)(1+r)\omega}{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}} - \frac{(1-\gamma)[(1+r)\Pi_{t+1}-1][(1+r)\omega-\gamma]}{\{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}\}^2}$$

$$= \frac{(1-\gamma)(1+r)\omega\{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}\}-(1-\gamma)[(1+r)\Pi_{t+1}-1][(1+r)\omega-\gamma]}{\{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}\}^2}$$

$$= \frac{(1-\gamma)\{-(1+r)\omega\gamma z_{t+1}+[(1+r)\Pi_{t+1}-1]\gamma\}}{\{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}\}^2} .$$

$$= \frac{(1-\gamma)[(1+r)(\Pi_{t+1}\gamma-\omega\gamma z_{t+1})-\gamma\}}{\{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}\}^2}$$

$$= \frac{(1-\gamma)\gamma\{(1+r)[\omega+(1-\omega)(P_{t+1}/P_t)]-1\}}{\{[(1+r)\Pi_{t+1}-1]-\gamma z_{t+1}\}^2} > 0,$$

given $z_{t+1} \geq 0$ and $P_{t+1}/P_t \geq 1$. *Q.E.D.*

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Table 1
Summary Statistics

Variable Name	Mean (Standard deviation)
Black market premium (%)	4.03 (.57)
Yotopoulos' exchange rate distortion index	-0.171 (0.304)
Per capita GDP	6781.64 (3884.00)
Number of observations	75

Table 2
Estimation of the Currency Softness Index

[Equation (19a)]
Dependent Variable:
Black market premium (*BP*) - *NER* distortion index (ln*DNER*)

Variable Name	**Coefficient (t-statistics)**
Capital control dummy (=1 if foreign capital is controlled)	0.458 (7.70)***
Year dummy for 1980	0.018 (0.23)
Year dummy for 1985	0.293 (3.90)***
Constant	-0.118 (1.863)*
Number of Observations	75
R-squared	0.491

Note 1) + indicates the coefficient is constrained to be one
Note 2) *** and * indicate statistical significance at 1% and 10%, respectively

Table 3
The Relationship between the Softness Index and Income Level

Dependent Variable = the currency softness index [Equation (20)]

Variable Name	**Coefficient (t-statistics)**
Summers and Heston (1991``) Real GDP per capita (thousand dollars)	-0.025 (3.765)***
Year dummy for 1980	-0.007 (0.097)
Year dummy for 1985	0.061 (0.89)
Constant	0.153 (1.983)*
Number of observations	75
R-squared	0.140

Note: *** and * indicate statistical significance at 1% and 10%, respectively

Figure 1

Timing of the Crisis

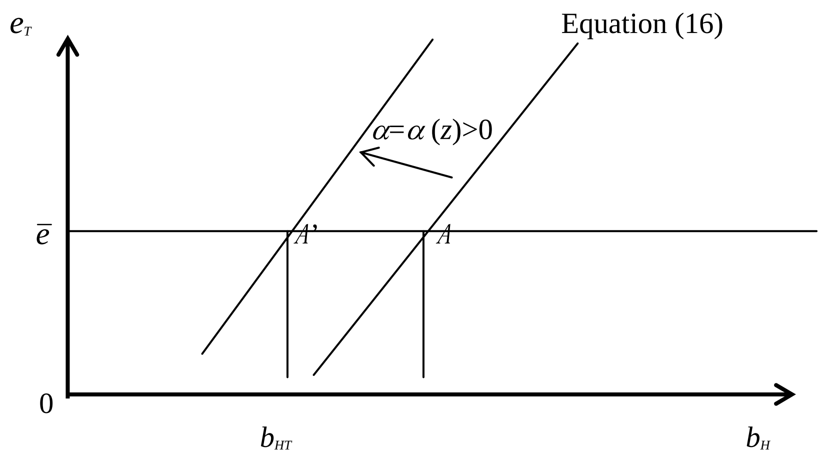
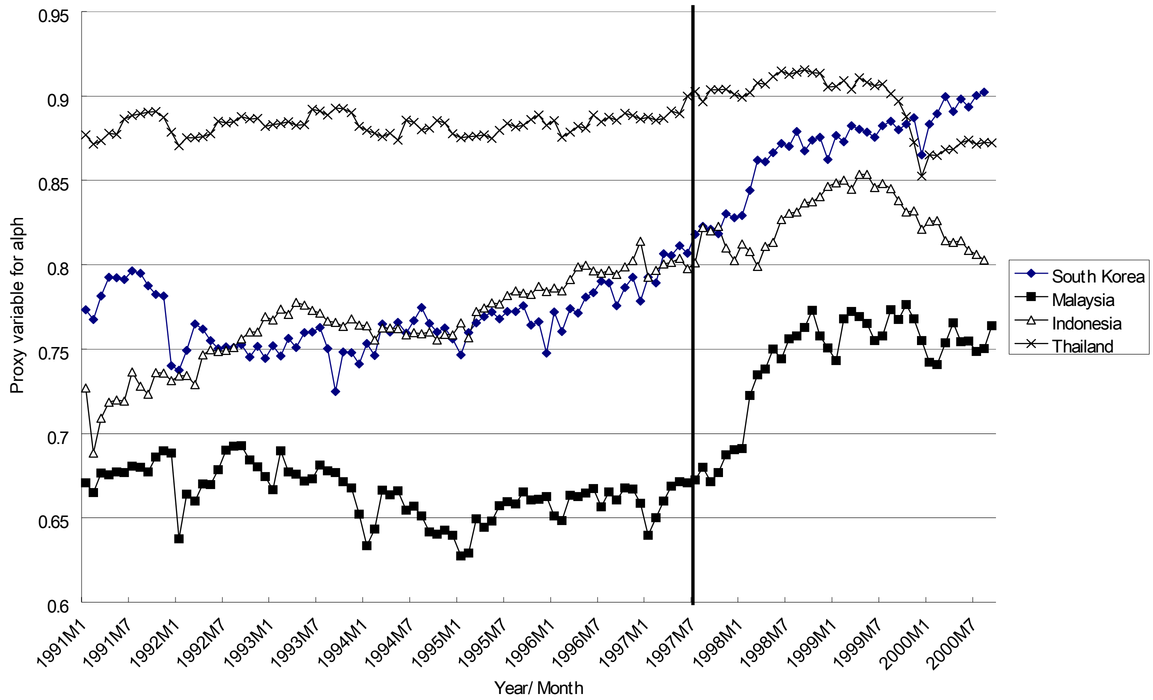


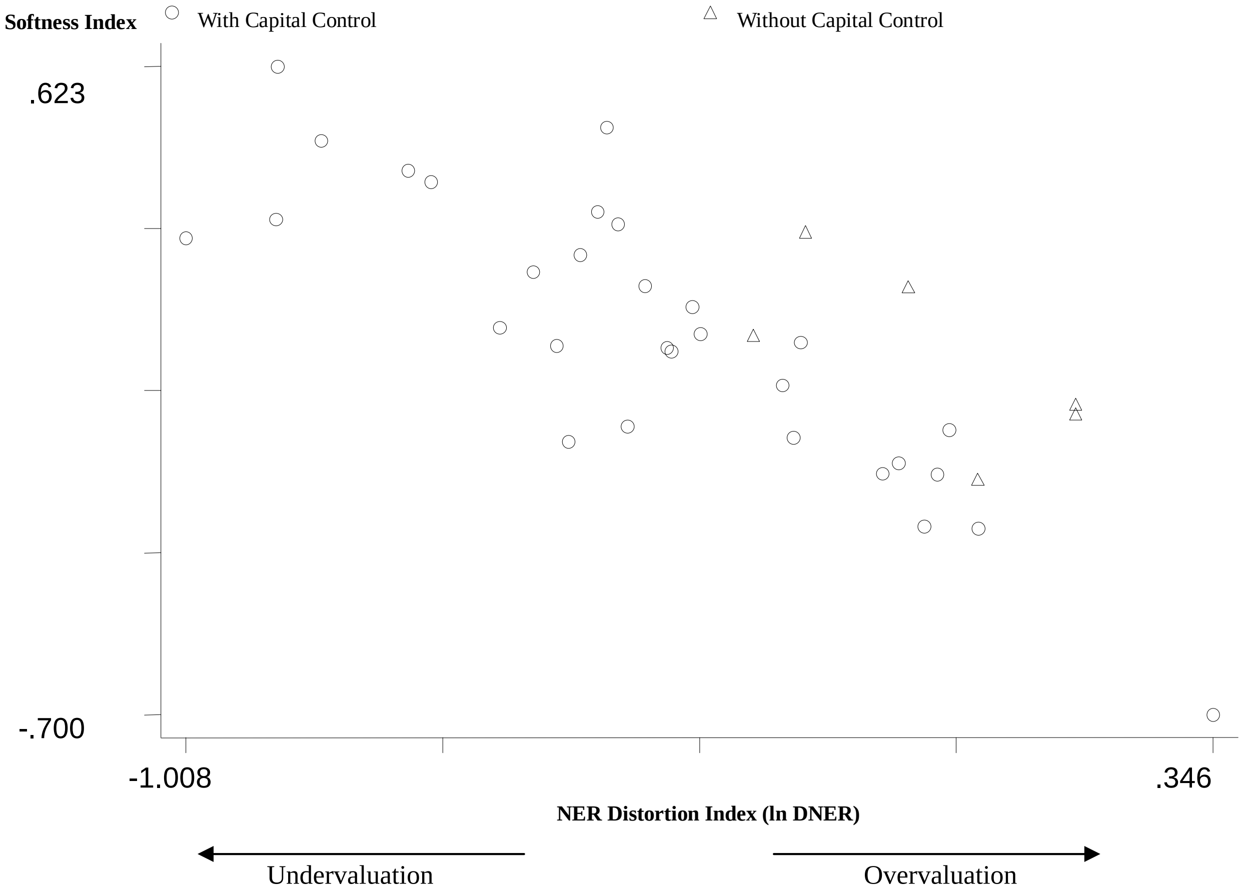
Figure 2

Estimated Currency Substitution Variable



Data Source: IMF, *International Financial Statistics*.

Figure 3
Currency Softness Index and Nominal Exchange Rate Distortion Index
(Pooled data of 1975, 80, and 85)



Note: The above table does not contain the samples with BP=0. In these cases, the softness index and the NER distortion index are linearly dependent by construction.

Figure 4
Currency Softness Index and Level of Economic Development
(Pooled data of 1975, 80, and 85)

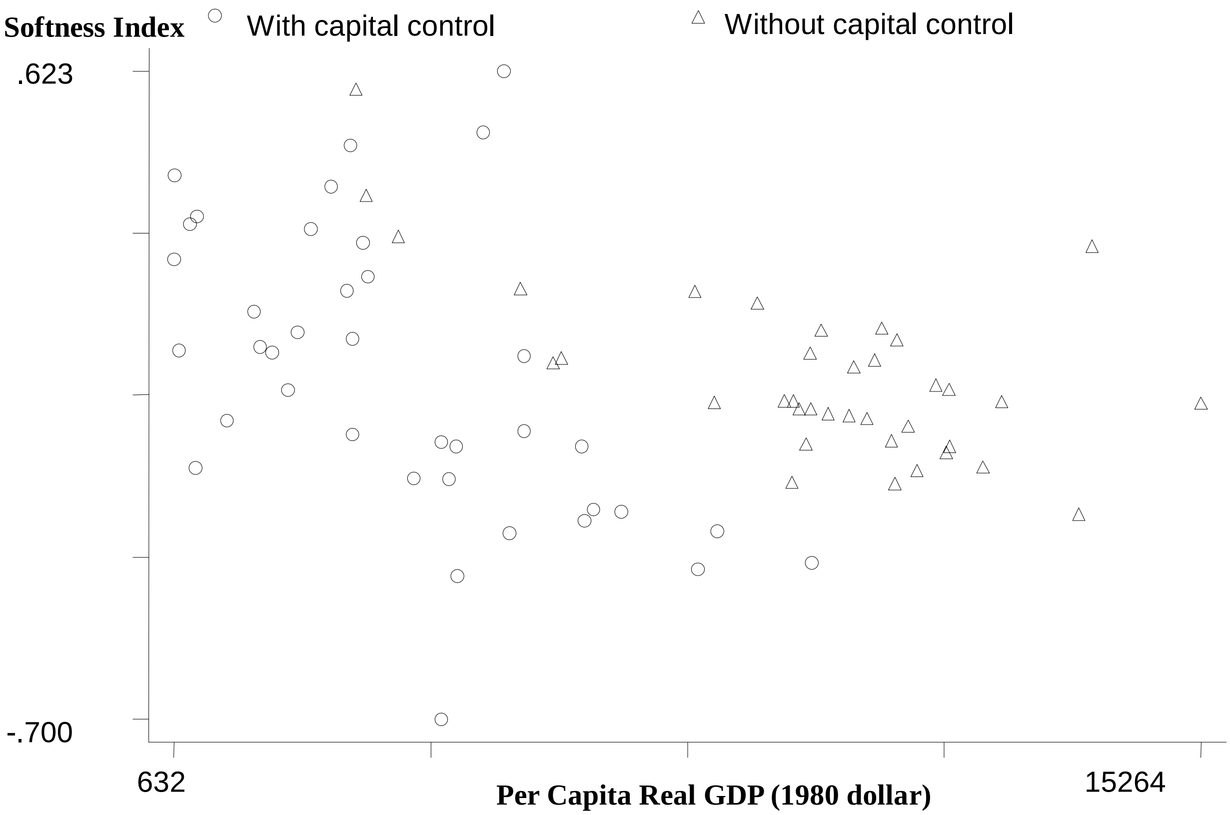


Table A1
Basic Data Based on Micro ICP

Country (Data Quality)		**YEAR**	**Relative Price Level for Tradables**	**NER dist.**	**Per capita GDP**
			PPP^T/e	ln DNER	RGDPCH
Australia	A-	1985	0.884	-0.123	12422.6
Austria	A-	1985	0.824	-0.194	10322.2
Belgium	A	1985	0.811	-0.209	10617.4
Canada	A-	1985	0.887	-0.120	15264.4
Denmark	A-	1985	0.968	-0.033	11685
Finland	A-	1985	1.017	0.017	11221.2
France	A	1985	0.854	-0.158	11489.8
Germany	A	1985	0.862	-0.149	11671.8
Greece	A-	1985	0.653	-0.426	5614
Hungary	B	1985	0.412	-0.887	5328
India	C	1985	0.595	-0.519	696.6
Ireland	A-	1985	0.816	-0.203	6031
Jamaica	C	1985	0.552	-0.594	2393
Japan	A	1985	1.037	0.036	10907
Kenya	C	1985	0.411	-0.889	859
Netherlands	A	1985	0.771	-0.260	10937
New Zealand	A-	1985	0.763	-0.270	9848.6
Norway	A-	1985	1.112	0.106	13521
Poland	B	1985	0.507	-0.679	3844
Portugal	A-	1985	0.604	-0.504	4643
Spain	A-	1985	0.696	-0.362	6605
Sweden	A-	1985	1.01	0.010	12158
Turkey	C	1985	0.365	-1.008	3317
Uk	A	1985	0.76	-0.274	10715

Source: Background estimation of Yotopoulos (1996), Summers and Heston (1991)

Table A1
Basic Data Based on Micro ICP (continued)

Country (Data Quality)		YEAR	Relative Price Level for Tradables	NER dist.	Per capita GDP
			PPP^T/e	ln DNER	RGDPCH
Argentina	C	1980	1.414	0.346	4437
Austria	A-	1980	1.163	0.151	9453.4
Belgium	A	1980	1.198	0.181	10248.4
Bolivia	C	1980	0.82	-0.198	1852
Canada	A-	1980	0.847	-0.166	13713.8
Chile	C	1980	0.914	-0.090	4045
Colombia	C	1980	0.577	-0.550	3392
Costa Rica	C	1980	0.826	-0.191	3827
Dom Rep	C	1980	0.801	-0.222	2250
Ecuador	C	1980	0.668	-0.403	3092
El Salvador	C	1980	0.7	-0.357	1898
France	A	1980	1.224	0.202	11088.8
Germany	A	1980	1.26	0.231	10850.4
Greece	A-	1980	1.038	0.037	5408
Guatemala	C	1980	0.645	-0.439	2574
Honduras	C	1980	0.766	-0.267	1376
Hungary	B	1980	0.636	-0.453	5034
India	C	1980	0.489	-0.715	641
Ireland	A-	1980	1.065	0.063	6150
Israel	B	1980	0.966	-0.035	8369
Italy	A	1980	1.023	0.023	9714
Japan	A	1980	1.181	0.166	9534
Kenya	C	1980	0.628	-0.465	951
Korea Rp	B-	1980	0.719	-0.330	3174
Mexico	C	1980	0.692	-0.368	5621
Netherlands	A	1980	1.179	0.165	10503.2
Norway	A-	1980	1.292	0.256	11635.8
Panama	C	1980	0.763	-0.270	3368
Peru	C	1980	0.436	-0.830	3141
Philpnes	C	1980	0.688	-0.374	2026
Portugal	A-	1980	0.813	-0.207	4439
Spain	A-	1980	0.939	-0.063	6476
U.K	A	1980	1.054	0.053	9696.4
Venezuela	C	1980	0.921	-0.082	7000
Yugoslavia	B	1980	0.983	-0.017	4551

Source: Background estimation of Yotopoulos (1996), Summers and Heston (1991)

Table A1
Basic Data Based on Micro ICP (continued)

Country (Data Quality)		**YEAR**	**Relative Price Level for Tradables**	**NER dist.**	**Per capita GDP**
			PPP^T/e	ln DNER	RGDPCH
Austria	A-	1975	1.186	0.171	8331.6
Belgium	A	1975	1.183	0.168	9326.2
Colombia	C	1975	0.504	-0.685	2861
Denmark	A-	1975	1.397	0.334	9433.2
France	A	1975	1.214	0.194	9950.6
Germany	A	1975	1.293	0.257	9634.2
India	C	1975	0.614	-0.488	632
Ireland	A-	1975	0.941	-0.061	5568.2
Italy	A	1975	1.055	0.054	8088.6
Jamaica	C	1975	0.998	-0.002	3174
Japan	A	1975	0.946	-0.056	8053
Kenya	C	1975	0.933	-0.069	938
Malaysia	C	1975	0.626	-0.468	3217
Mexico	C	1975	1.07	0.068	4671
Netherlands	A	1975	1.179	0.165	9702.8
Philippines	C	1975	0.711	-0.341	1764
Spain	A-	1975	0.821	-0.197	6434.6
U.K	A	1975	0.969	-0.031	8943
Yugoslavia	B	1975	0.901	-0.104	3689

Source: Background estimation of Yotopoulos (1996), Summers and Heston (1991)

Table A1
Basic Data Based on Micro ICP (continued)

Country (Data Quality)		**YEAR**	**Relative Price Level for Tradables**	**NER dist.**	**Per capita GDP**
			PPP^T/e	ln DNER	RGDPCH
Belgium	A	1970	0.863	-0.147	7764.8
France	A	1970	0.913	-0.091	8458.8
Germany	A	1970	0.974	-0.026	8506.2
India	C	1970	0.57	-0.562	648
Italy	A	1970	0.874	-0.135	6817.8
Japan	A	1970	0.802	-0.221	6544
Kenya	C	1970	0.514	-0.666	801
Korea	B-	1970	0.502	-0.689	1712
Malaysia	C	1970	0.445	-0.810	2435
Netherlands	A	1970	0.827	-0.190	8362
Philippines	C	1970	0.617	-0.483	1499
U.K.	A	1970	0.745	-0.294	7992.4

Source: Background estimation of Yotopoulos (1996), Summers and Heston (1991)

Table A2
Basic Data for Estimating the Relationship between Income Level and Currency Softness

Country	**Black Market Premium (%)**	**Year**	**NER Distortion Index**	**Per Capita Real GDP**	**Dummy for Capital Control**	**Currency Softness Index**
Country	bmp	year	ln DNER	Rgdpch	Control	alpha
Argentina	0.33	1980	0.346	4437	1	-0.70
Australia	0.00	1985	-0.123	12422.6	0	-0.05
Austria	0.00	1975	0.171	8331.6	0	-0.05
Austria	0.00	1980	0.151	9453.4	0	-0.05
Austria	0.00	1985	-0.194	10322.2	0	0.02
Belgium	0.00	1975	0.168	9326.2	0	-0.05
Belgium	0.00	1980	0.181	10248.4	0	-0.08
Belgium	0.00	1985	-0.209	10617.4	0	0.03
Bolivia	22.00	1980	-0.198	1852	1	0.06
Canada	0.00	1980	-0.166	13713.8	0	0.27
Canada	0.00	1985	-0.12	15264.4	0	-0.06
Chile	5.90	1980	-0.09	4045	1	-0.21
Colombia	4.26	1975	-0.685	2861	1	0.39
Colombia	1.14	1980	-0.55	3392	1	0.20
Costa Rica	-0.48	1980	-0.191	3827	0	0.29
Denmark	0.00	1975	0.334	9433.2	0	-0.22
Denmark	0.00	1985	-0.033	11685	0	-0.14
Dom Rep	10.74	1980	-0.222	2250	1	-0.03
Ecuador	13.00	1980	-0.403	3092	1	0.18
Finland	0.00	1985	0.017	11221.2	0	-0.19
France	0.00	1975	0.194	9950.6	0	-0.08
France	0.00	1980	0.202	11088.8	0	-0.10
France	0.00	1985	-0.158	11489.8	0	-0.02
Germany	0.00	1975	0.257	9634.2	0	-0.14
Germany	0.00	1980	0.231	10850.4	0	-0.13
Germany	0.00	1985	-0.149	11671.8	0	-0.03
Greece	7.43	1980	0.037	5408	1	-0.32
Greece	9.61	1985	-0.426	5614	1	-0.11
Guatemala	22.00	1980	-0.439	2574	1	0.30
Honduras	0.00	1980	-0.267	1376	1	-0.09
Hungary	40.34	1980	-0.453	5034	1	0.50
Hungary	36.96	1985	-0.887	5328	1	0.62
India	9.06	1975	-0.488	632	1	0.24
India	5.30	1980	-0.715	641	1	0.41
India	16.66	1985	-0.519	696.6	1	0.05

Table A2 (continued)

Basic Data for Estimating the Relationship between Income Level and Currency Softness

Country	**Black Market Premium (%)**	**Year**	**NER Distortion Index**	**Per Capita Real GDP**	**Dummy for Capital Control**	**Currency Softness Index**
Country	bmp	year	ln DNER	Rgdpch	Control	alpha
Ireland	0.00	1980	0.063	6150	0	0.04
Ireland	0.00	1985	-0.203	6031	0	0.03
Ireland	0.00	1975	-0.061	5568.2	0	0.18
Israel	0.66	1980	-0.035	8369	1	-0.32
Italy	0.00	1975	0.054	8088.6	1	-0.39
Italy	0.00	1980	0.023	9714	1	-0.38
Jamaica	21.98	1975	-0.002	3174	1	-0.12
Jamaica	12.86	1985	-0.594	2393	1	0.09
Japan	-0.05	1975	-0.056	8053	0	0.17
Japan	0.00	1980	0.166	9534	0	-0.07
Japan	-0.82	1985	0.036	10907	0	-0.22
Kenya	8.35	1975	-0.069	938	1	-0.19
Kenya	21.91	1980	-0.465	951	1	0.33
Kenya	5.53	1985	-0.889	859	1	0.31
Korea Rp	10.47	1980	-0.33	3174	1	0.08
Malaysia	0.00	1975	-0.468	3217	0	0.59
Mexico	0.00	1975	0.068	4671	1	-0.41
Mexico	3.18	1980	-0.368	5621	1	0.04
Netherlands	-1.90	1975	0.165	9702.8	0	-0.07
Netherlands	-2.13	1980	0.165	10503.2	0	-0.09
Netherlands	-1.05	1985	-0.26	10937	0	0.07
New Zealand	0.00	1985	-0.27	9848.6	0	0.09
Norway	0.00	1980	0.256	11635.8	0	-0.16
Norway	0.00	1985	0.106	13521	0	-0.28
Panama	0.00	1980	-0.27	3368	0	0.37
Peru	-0.05	1980	-0.83	3141	1	0.47
Philippines	13.18	1975	-0.341	1764	1	0.13
Philippines	3.29	1980	-0.374	2026	1	0.05
Portugal	1.62	1980	-0.207	4439	1	-0.13
Portugal	-1.35	1985	-0.504	4643	1	-0.14
Spain	0.00	1975	-0.197	6434.6	1	-0.14
Spain	0.00	1980	-0.063	6476	1	-0.29
Spain	0.00	1985	-0.362	6605	1	-0.27
Sweden	0.00	1985	0.01	12158	0	-0.19
Turkey	-10.15	1985	-1.008	3317	1	0.27
U.K.	0.00	1975	-0.031	8943	0	0.15
U.K.	0.00	1980	0.053	9696.4	0	0.05
U.K.	0.00	1985	-0.274	10715	0	0.10
Venezuela	0.00	1980	-0.082	7000	1	-0.28
Yugoslavia	13.14	1980	-0.017	4551	1	-0.21