ISSN 1471-0498

DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

DEBT OVERHANG AND REAL EXCHANGE RATE OVERSHOOTING IN THE ASIAN CRISIS

David Vines and Gordon Douglas Menzies

Number 122

October 2002

Manor Road Building, Oxford OX1 3UQ

DEBT OVERHANG AND REAL EXCHANGE RATE OVERSHOOTING IN THE ASIAN CRISIS

Gordon Douglas Menzies* and David Vines**

September 2002

*Economic Research Department
Reserve Bank of Australia

**Dept. of Economics, Balliol College, Oxford University
Research School of Asian and Pacific Studies, Australian National University
Centre for Economic Policy Research

We wish to thank Dan Andrews, Jeremy Lawson, Chris Bliss, Rod Falvey, David Gruen, Donald Hay, Marion Kohler, Warwick McKibbin, David Myatt, Adrian Pagan, Michael Plumb and Alan Woodland. All remaining errors are our own.

Abstract

We develop a stylized real model of the Asian crisis where an adverse external shock can lead to real exchange rate overshooting. Domestic borrowers of foreign capital are bound by debt contracts even when the capital is unable to earn the world rate of return. Following an adverse shock, the requirement to honour these debt contracts leads to a debt overhang. In the long run, when capital becomes mobile, extra-marginal projects are shut down as capital departs, and the real exchange rate falls by more than the terms of trade shock. In the short run, the real exchange rate is partly determined by demand conditions by means of what we call the wage and overhang multipliers. For reasonable production and consumption parameters, the short run real exchange rate – driven by the wage and overhang multipliers – overshoots its long run value.

JEL Classification Numbers: F11, F31
Keywords: Asian crisis; exchange rate overshooting, multiplier, overhang

Table of Contents

DEBT OVERHANG AND REAL EXCHANGE RATE OVERSHOOTING IN THE ASIAN CRISIS

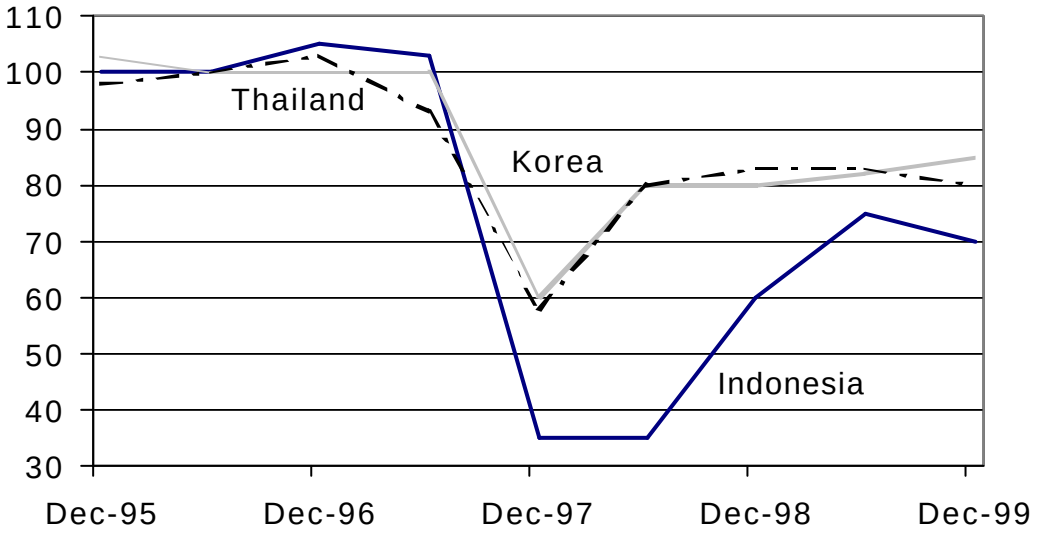
Gordon Douglas Menzies and David Vines

1. Introduction

The 1997 East Asian Financial Crisis was noteworthy for both the overshooting of real exchange rates in the region, and the widespread bankruptcies of private firms. Between end-1996 and end-1997, the Thai, Korean and Indonesian real effective exchange rates depreciated sharply, before recovering somewhat. The resultant gap between the world rate of interest and the reduced local returns led to severe financial distress for firms locked into debt contracts – a 'debt overhang' – in the affected economies.

Figure 1: Exchange Rate Overshooting

(Real effective exchange rates. June 1996=100)



(Source: Ghosh et al. 2002)

This paper presents a model in which real exchange rate overshooting and the debt overhang are intimately connected, following an external shock. We focus on the need to pay off the interest obligation on foreign-sourced capital when it is financed by debt rather than equity. The debt contract is onerous in the short run, defined by the assumption that capital is immobile. Firms have to accept a fall in the returns to capital since it cannot be moved to more productive projects. The wedge between the world interest rate and the local returns – the debt overhang - magnifies the depreciation of the real exchange rate that the external shock causes. For plausible production and consumption parameters the short run real exchange rate overshoots its long run value. In contrast, it is shown in the paper that if the capital is financed by equity, the short run exchange rate must *undershoot* its long run value.

Two mechanisms transmit the external shock to the short run real exchange rate, and cause it to overshoot. First, a so-called *wage multiplier* magnifies the initial effects of a fall in wages arising from an adverse external shock. Lower wages lead to a fall in demand for non-traded goods (that the workers consume). This, in turn, leads to a fall in labour demanded by the producers of non-traded goods. The wage falls to clear the labour market, completing the first round of the multiplier process. The fall in the demand for non-traded goods also causes an increase in the debt overhang for those who invest in this sector. Second, there is what we call an *overhang multiplier* if the debt contract is honoured. In this case, a tax raised from workers further curtails demand for the non-traded good, leading to a further fall in wages, and so on. At the heart of both mechanisms is the property that in the short run demand has a role in determining the real exchange rate.

Our model can be compared with other so-called third generation crisis models. These focus on the problem of debt being denominated in foreign currency and on the feedback between foreign-currency denominated external debt and the exchange rate (Krugman 1999). In these models, the depreciating nominal exchange rate increases the local-currency value of debts and erodes wealth. This, in turn, limits available collateral, and causes a decline in investment. This then

feeds back onto the exchange rate as aggregate demand falls. In contrast, our model focuses on the existence of extra-marginal projects trapped in the economy, following an external shock. These projects cause a decline in consumption demand for the non-traded good, driven by the wage and overhang multipliers. It is this decline in non-traded consumption demand, rather than any fall in investment, that causes the short run real exchange rate to overshoot.

The paper is organized as follows. In Section 2 we begin the exposition by focusing on the long run, where capital is mobile. This describes both the initial and the final equilibrium. Section 3 describes the crisis setup, and contains the main theoretical contribution of this paper. In Section 3.1, we consider the adjustment of the economy with fixed capital, if the returns to capital are flexible.[1] In Section 3.2, we discuss the case where this is not so. In Section 4, we quantify the importance of the overhang multiplier, assuming that the workers are fully committed to paying the creditor. Section 5 concludes.

The Model

Our model is a real two-factor two-sector neoclassical trade model, with one non-traded good. This model differs from a standard Heckscher-Ohlin model in two main ways.

First, we have a different treatment of the ownership, allocation of, and rewards to capital. We assume that all capital is foreign owned, with the returns to capital paid overseas by a set of intermediaries who own the domestic firms.[2] These intermediaries can be thought of as a financial sector. They obtain machines from their foreign owners and costlessly install them. In the long run capital is internationally mobile and competition amongst financial intermediaries ensures

[1] That is, if the creditor only receives the marginal product of capital in place, despite the banks' contractual obligations.

[2] The basic solution structure also exists for a model with an extra traded sector, which has a domestically owned fixed factor. The solution is available from the authors on request.

that it earns an internationally required rate of return in both sectors. But in the short run the stock of capital is fixed in each sector. We take this short run to be the period in which 'crisis' occurs.

Second, there is a non-traded good with an endogenous market-clearing price. The demand for this is driven by domestic incomes and thus (since all capital is foreign owned) by wage incomes. Any shock that depresses the local wage will therefore reduce demand in the non-traded sector and thus the price of the non-traded good. We take the price of the non traded good to be our measure of the real exchange rate.[3]

The setup of the model is as follows. Technology is Cobb-Douglas in the two sectors.

$$Q_X = K_X^{\alpha_X} L_X^{1-\alpha_X} \qquad (1)$$

$$Q_n = K_n^{\alpha_n} L_n^{1-\alpha_n} \qquad (2)$$

We assume that the export sector is capital intensive, so that $\alpha_x > \alpha_n$. For simplicity we also assume that there are no domestic capitalists and so all returns to capital are paid overseas, and that consumers' tastes are Cobb-Douglas over the non-traded good and an imported good (not produced locally).[4]

---

[3] We take the real exchange rate to be the ratio of non-traded to traded good prices, and use the import price as the relevant traded good.

[4] Including the export good in the consumption bundle complicates the expression for the real exchange rate, but does not add any insight to the analysis. If it were included, all proportional changes in the real exchange rate in this paper would have an additional identical term added to them, namely the weight of the export good in the traded good index times the

$$U = Q_n^{\theta} Q_m^{1-\theta} \qquad (3)$$

Capital is elastically available at a fixed real required rate of return. By contrast, there is a fixed endowment of labour, denoted by a bar.[5] The wage clears the labour market.

$$\bar{L} = L_X + L_n \qquad (4)$$

In the sections that follow, we solve the model and subject it to a terms of trade shock by reducing p_x relative to p_m (which remains unchanged at unity). We model the external shock in this way, despite the fact that a decline in export demand was as important as the decline in price in the Asian crisis.[6] We seek the simplest possible representation of the crisis that gives the basic story outlined in Section 3.2. That is, extra-marginal projects weakened non-traded demand, thereby causing a decline in the real exchange rate.

In the long run model we show that a fall in the export price leads to an outflow of capital until the point is reached where the return again equals this required rate, and we show that the real exchange rate falls by more than the fall in the terms of

absolute value of the terms of trade shock. Since all proportional changes would have this term added, any statements about overshooting would still stand.

[5] Flexible non-traded prices clear the market for non-traded goods, and flexible wages clear the labour market. Despite their underdevelopment in some areas, a number of Asian economies have very flexible labour markets (eg. Indonesia).

[6] The export price declines were not spectacular. The year-on-year decline in $US unit value export prices between 1996 and 1997 for Thailand, Korea and Indonesia was 4, 15 and 5 per cent. One year later, the change compared with 1996 had become larger (approx. 20-30 per cent for all three) (IMF 2002).

trade. In the short run, with fixed capital, a negative terms of trade shock leads to a fall in returns below the world rate. We first compute the extent to which this shock causes the real exchange rate to fall, if owners of capital can be paid these lower returns. We show that the real exchange rate falls in proportion to the terms of trade, establishing that equity financing leads to exchange rate undershooting. But if intermediaries contracted before the shock, to pay the owners of capital the world rate of interest on installed capital, then a 'debt overhang' is created. We study the effects of a levy to pay this, and show how this can lead to the short run real exchange rate overshooting the long run value.

2. Preliminary: The Long-run Effects of a Fall in Export Prices[7]

In the long run capital is internationally mobile. In comparison with the Heckscher-Ohlin model, two endogenous returns w and p_n are determined (in part) by one exogenous world price (p_x) and one exogenous return (r).

2.1 Wages, Prices and the Real Exchange Rate

To solve for the wage, we use the capital-labour ratio implied by the marginal product of capital condition for the export sector

[7] This model can be found in Chapter 4 of Obstfeld and Rogoff (1996). Those authors do not use it to examine the case of a crisis as discussed in the next section.

$$\frac{K_X}{L_X}=[\frac{a_X p_X}{\bar{r}}]^{\frac{1}{1-a_X}}$$

and substitute it into the marginal product of labour condition for the export sector. We obtain

$$w = p_X^{\frac{1}{1-a_X}} (\frac{1}{\bar{r}})^{\frac{a_X}{1-a_X}} \{(1-a_X)\, a_X^{\frac{a_X}{1-a_X}}\}. \qquad (5)$$

This shows that the wage falls proportionately more than p_x.

Non-traded prices p_n also depend positively on p_x, as follows. For the non traded sector we may obtain an analogous expression to *(5)*.

$$w = p_n^{\frac{1}{1-a_n}} (\frac{1}{\bar{r}})^{\frac{a_n}{1-a_n}} \{(1-a_n)\, a_n^{\frac{a_n}{1-a_n}}\}.$$

This, together with equation (5), gives

$$p_n = [\frac{1}{r}]^{\frac{a_x - a_n}{1-a_x}} (p_x)^{\frac{1-a_n}{1-a_x}} \{(\frac{1}{a_n})^{a_n} (\frac{1-a_x}{1-a_n})^{1-a_n} a_x^{\frac{a_x(1-a_n)}{1-a_x}}\} \quad (6)$$

Comparison of *(5)* and *(6)* reveal that the relationships between factor returns and prices normally associated with the Stolper-Samuelson theorem hold here as well. In particular, if p_x falls then the real wage, however measured, must fall, since w falls by more than both p_x and p_n (and the import price numeraire). This reflects the fact that the eventual departure of capital following a terms-of-trade shock depresses the marginal product of labour, as we will show in *2.2*. Importantly, the real exchange rate (measured by non-traded goods' price) falls by more than the terms of trade. This follows from (6) because the export sector is capital intensive. The reason is that the export sector is assumed to be more capital intensive; in the long run sustaining the initial return to capital in the light of a fall in the export price means that the wage must fall. With a lower capital to output ratio in the non-traded sector this means that price in the non-traded sector which just covers costs will fall by more than the export price.

Notice that equations (5) and (6) do not depend upon labour usage, or preferences. Thus, this model exhibits the property that the long run real exchange rate is independent of demand, which merely allocates labour and output in the way described in the subsection that follows (See Obstfeld and Rogoff 1996). As we shall see in Section 3, this is not true in the short run.

2.2 Demand, Quantities, and Factor Usage

The solutions for factor usage in the long run are as follows. The first order condition for the consumers' utility maximization problem gives the demand for non-traded goods as

$$Q_n^d = q\left(\frac{w}{p_n}\right)\bar{L}. \tag{7}$$

In contrast to the Specific Factors Model, the non-traded price moves to clear the market for non-traded goods.

$$Q_n = Q_n^d \tag{8}$$

Equating the marginal product of labour to the real wage in the non-traded sector gives the supply of non-traded goods as

$$Q_n = \frac{w}{p_n}\frac{L_n}{1-a_n}. \tag{9}$$

Thus, from *(7)* through *(9)* we obtain the non-traded labour usage.

$$L_n = (1 - a_n) q \bar{L} \qquad (10)$$

The solution for L_x immediately follows from the full employment condition.

$$L_x = \bar{L} - (1 - a_n) q \bar{L} \qquad (11)$$

To derive the capital stocks, we set the value-of-marginal-product of capital in each sector equal to the (fixed) required rate of return. Rearranging gives an expression for the capital-labour ratio in each sector as a function of the required rate of return, and the output price. Then, we substitute in the solutions for L_x, L_n and p_n, giving us K_x and K_n.

$$K_x = (\bar{L} - (1 - a_n) q \bar{L}) [\frac{a_x p_x}{\bar{r}}]^{\frac{1}{1 - a_x}} \qquad (12)$$

$$K_n = (a_n \bar{L} q (1 - a_x) a_x^{\frac{a_x}{1 - a_x}}) [\frac{p_x}{\bar{r}}]^{\frac{1}{1 - a_x}} \qquad (13)$$

Equations *(12)* and *(13)* show that a decline in export prices causes capital employed in both sectors to fall. Since neither of the solutions for L_x or L_n (*(10)* and *(11)*) vary with p_x, the capital-labour ratio will be lower in both sectors, leading to a fall in the marginal product of labour, as claimed in *2.1*.

We now come to the short run in which we freeze capital. As we shall see this introduces demand effects on the real exchange rate, p_n .

3. The Crisis Setup

The long run discussed above applies when capital has been withdrawn from the economy in response to the change in export prices. The short run is the period of time over which no such reallocation occurs; the capital stocks are given by their initial level. In our study 'crisis' pertains to this period, under the alternative assumptions of equity financing or debt contracts. Under equity financing the parties write a contract specifying the amount of machines to be borrowed. The lenders of capital earn exports equivalent to the marginal product of that capital. If an adverse shock reduces the marginal product of capital, the creditors bear the loss. Under a debt contract the parties write a contract specifying *both* the amount of machines to be borrowed and the amount of exports earmarked for payment, *regardless of any shocks revealed through the period*.

Under the assumption of equity financing, we show in Section 3.1 that a fall in the export price causes the rate of return of the trapped capital in the export sector, r_x, to fall. However, this not only happens to r_x, *but also to the return in the non-traded sector*, r_n, because of a fall in the price of non-traded goods. Under the assumption of debt contracts, although the last installed units of capital in both sectors can no longer 'pay their way' the owners of capital will continue to be paid the world rate of interest, even though this is bigger than the return on capital. This creates a 'debt overhang'. In Section 3.2, we derive a solution in which this overhang is honoured.

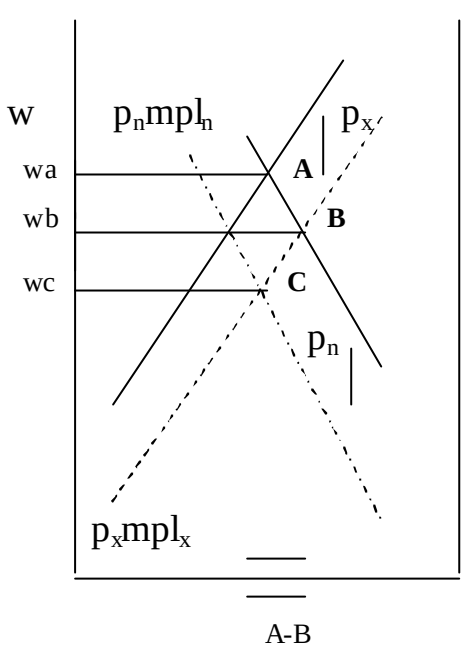
3.1 Fixed Capital and Free Rates of Return – Equity Financing

As before, we begin with technology, tastes and endowments. These are identical to the long-run model except that there are now fixed capital endowments, given by the initial solutions to *(12)* and *(13) before* any change in the export price. In this section we place a bar above K_x and K_n, to denote that they are fixed at their initial level.

Equations *(7)* through *(9)* still apply in this setup. It is therefore follows that the labour solutions are identical to *(10)* and *(11)*.

How can the labour solutions remain unchanged in the face of a fall in the export price? The reason is that p_n falls. The mechanism for this is that the wage falls, eroding the demand for the non-traded good (from *(7)*). Absent the option to trade away net demand (removed by *(8)*), the price of the non-traded good *must* fall. In this model, the resultant fall in the wage and the non-traded goods price acts so as to block *any* migration of labour to the export sector. This complete offset depends upon Cobb-Douglas tastes and constant returns to scale production, as is demonstrated in the Appendix. Nevertheless, there would be a similar wage multiplier process with other taste assumptions. In general, *the decline in the wage necessary to clear the labour market after an adverse shock itself erodes revenues in the non-traded sector*. The solution here contrasts with that in the familiar Specific Factors (SF) model, where a terms-of-trade shock reduces the output of the shocked sector and expands the output of the non-shocked sector. This process is displayed in Figure 2.

Figure 2



With p_n fixed, a decline in the price of the exported good would create unemployment in that sector at w_a. The wage falls to clear the labour market. Sector *n* expands. The SF model equilibrium moves from A to B.

However, if p_n falls, it counteracts the forces that expand the *n* sector. It falls so much that L_n (and hence Q_n) return to their original levels. The wage falls by further than it does for the SF model. Equilibrium moves from B to C.

It is clear from the diagram that the wage and the non-traded price fall by exactly the same proportion as the export price, given unchanged labour. Algebraic solutions are as follows. The equilibrium labour solutions are shown with a star, to indicate that they are unchanged with respect to changes in p_x.[8]

$$p_n = \frac{1-a_x}{1-a_n}\left(\frac{\overline{K_x}}{L_x^*}\right)^{a_x}\left(\frac{L_n^*}{\overline{K_n}}\right)^{a_n} p_x$$

[8] The real exchange rate and the wage are now related to the specification of demand, since the equations both depend, via the labour solutions L_x* and L_n*, on preferences (see *(10)* and *(11)*). An exogenous decrease in non-traded demand, given algebraically by a decline in *q* will reduce the wage and depreciate the real exchange rate as the non-traded value of marginal product schedule shifts leftward.

$$w = (1 - a_X)(\frac{\overline{K_X}}{L_X^*})^{a_X} p_X$$

The returns to capital in both sectors are as follows. . The marginal conditions for capital use in the export and non-traded sectors are shown in the following pair of equations.

$$r_X = a_X(\frac{\overline{K_X}}{L_X^*})^{a_X - 1} p_X$$

$$r_n = a_n(\frac{\overline{K_n}}{L_X^*})^{a_n - 1} p_n.$$

Given that that the solution for p_n is proportional to p_x, it is clear that both returns to capital deflate proportionately with the export price.

What we have seen is that the overall effect of the wage multiplier is to deflate all endogenous prices and returns in the economy in proportion to the terms-of-trade shock. The real exchange rate, p_n, thus falls in proportion to the export shock in the short run with equity financing. Given that the real exchange rate falls by more than the export price in the long run (from *(6)*), we have exchange rate *undershooting*.

3.2 Fixed Capital and Fixed Rates of Return – Debt Contracts

The above solution has shown that returns to capital fall in both sectors. If, however, debt contracts require that the fixed world rate of interest be paid on capital in place, then there is a debt overhang equal to the gap between the payments required and the lower value-of-marginal-revenue product for capital (in both sectors) that now obtains. The size of this debt overhang W is the stock of capital that was contracted to earn the world rate, multiplied by the decline in the marginal product of that (fixed) capital. This is endogenous since it depends upon the endogenous value-of-marginal-revenue product of capital in both sectors.

$$\Omega = \left|(\bar{r} - r_n)\overline{K_n} + (\bar{r} - r_x)\overline{K_x}\right| \qquad (14)$$

We assume that the repayment of the overhang can be enforced.[9] For simplicity, we assume that the required transfer is effected by an 'intermediary rescue tax' t on labour incomes.

Extracting purchasing power from labour sets in train an additional *overhang multiplier* process that further contracts the non-traded sector. The wage, the demand for the non-traded good, and the price of the non-traded good follow each other downward.

The demand function for non-traded goods is now as follows.

$$p_n Q_n = q\, w(1-t)\bar{L} \qquad (15)$$

[9]This crucial assumption sidesteps all bargaining issues; the more debt is written down the less the features described here will hold.

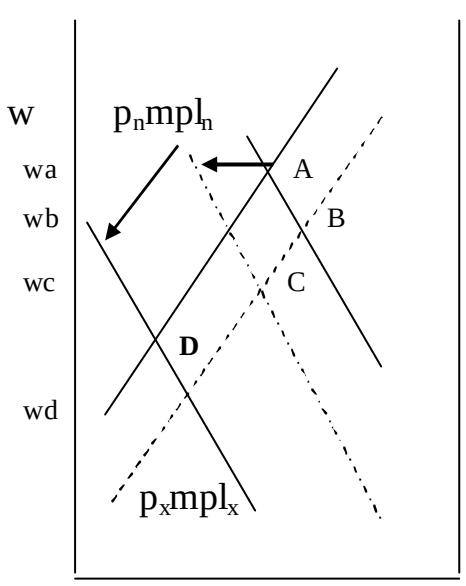
Also, the bank rescue tax rate *t* must be high enough to pay off the overhang. That is:

$$w\bar{L}t = \left[(\bar{r} - r_n)\overline{K_n} + (\bar{r} - r_x)\overline{K_x}\right] \qquad (16)$$

The overhang multiplier process can be described with equations *(15)* and *(16)*. From equation *(16)*, the bank rescue tax rate must be positive, following a negative external shock, so as to compensate producers for the decline of the marginal revenue products of capital. As a result, from equation *(15)*, the demand for the non-traded good must fall relative to what it would have done had the foreign owners of capital 'taken a haircut' (covered the loss) as they did in the previous section with equity financing. This will lead to a further fall in the price of the non-traded good, and a fall in demand for labour in the non-traded sector at the prevailing wage. The (pre-tax) wage falls to clear the labour market and, from *(15)*, the demand for the non-traded good falls again, and so on.

Compared with Figure 2, there is an extra stage in the adjustment process (in addition to the wage multiplier already discussed), where p_n falls so much that it forces labour out of the non-traded sector and into the export sector. As it does so, the fall in p_n further raises the size of the overhang that has to be paid. The process eventually stops because the addition of labour to the export sector raises the return to capital there, as the capital-labour ratio falls. That is, the rise in r_x eventually reduces the size of the overhang more than the fall in r_n increases it.

Figure 3



With p_n fixed, the SF model equilibrium moves from A to B, as before.

The lower wage at B w_b sets in train the *wage multiplier*. The wage and p_n follow each other down to C, where the wage is w_c. The real return to capital falls in both sectors, as before.

In the additional stage, workers pay a tax. This reduces the demand for the non-traded good, and therefore its price. As p_n falls, so does the wage, in turn depressing p_n. The economy moves to D under the additional influence of the *overhang multiplier*.

The system consists of equation *(16)* for t, and the following equations for L_n, L_x, w, p_n, r_x and r_n.

The labour solutions are obtained as before. Equation *(9)* still applies in this model, but *(7)* and *(8)* are replaced by *(15).* This gives the following.

$$L_n = (1-a_n)(1-t)q\,\bar{L} \equiv L_n(t) \qquad (17)$$

$$L_x = \bar{L} - L_n(t) \equiv L_x(t) \qquad (18)$$

These two equations confirm what is obvious from the diagram; the larger *t*, the greater the contraction in the non-traded sector.

The wage is equal to the value of marginal product in the export sector.

$$w = (1-a_X)\left(\frac{\overline{K_X}}{L_X(t)}\right)^{a_X} p_X \equiv w(t) \qquad (19)$$

The equation for p_n follows by noting that the wage is also equal to the value of marginal product in the non-traded sector. Equation *(19)* is then substituted for the wage, and the resultant expression solved for p_n.

$$p_n = \frac{1-a_X}{1-a_n}\left(\frac{\overline{K_X}}{L_X(t)}\right)^{a_X}\left(\frac{L_n(t)}{\overline{K_n}}\right)^{a_n} p_X \equiv p_n(t) \qquad (20)$$

The solutions for r_x and r_n follow from the marginal product of capital conditions in the two sectors, with (20) substituted for p_n.

$$r_X = a_X\left(\frac{\overline{K_X}}{L_X(t)}\right)^{a_X-1} p_X \equiv r_X(t) \qquad (21)$$

$$r_n = a_n\frac{1-a_X}{1-a_n}\left(\frac{\overline{K_X}}{L_X(t)}\right)^{a_X}\frac{L_n(t)}{\overline{K_n}} p_X \equiv r_n(t) \qquad (22)$$

Equations (16) to (22) thus represent the full system.

It is obvious that all these equations are implicit functions of t.[10] We obtain the following equation for t, where p_{x0} is the initial value of export prices.

$$1+\frac{\left(1-a_X-q\,(a_n-a_X)\right)}{a_X+q\,(a_n-a_X)}\,t=\frac{p_{x0}}{p_X}\left[\frac{1-(1-a_n)(1-t)q}{1-(1-a_n)q}\right]^{a_X} \quad (23)$$

It is not possible to solve *(23)* explicitly for t, though it can be shown that t is increasing in a_x, and unaffected by a_n and q in the neighborhood of $t=0$. The variables L_n, w, p_n and r_n are all decreasing in t, while L_x and r_x are increasing in it.

What this section has shown is that the diminution of the wage, the real exchange rate, and the non-traded sector is now larger than if the foreign capitalists suffered the fall in the return on their capital, as in Section 3.1. In this process there is a secondary burden on the real exchange rate: first, there is the tax itself, but then there is an induced extra decline in p_n caused by the fall in the wage. The decline in the before-tax wage resulting from the tax increase requires a further increase in the tax rate to cover the overhang, and so on.

[10] Thus, the most straightforward solution method is to solve for t first by simplifying *(16)*, and then solving *(17)* through *(22)*. In equation *(16)*, equations *(21)* and *(22)* are substituted for the value-of-marginal-product of capital, *(19)* for the wage, and *(12)* and *(13)* for the fixed stocks of capital.

The following section shows how large the effects on the exchange rate could be.

4. The Strength of the Overhang Multiplier

4.1 An Analytical Benchmark

We begin by solving the above system for a benchmark case $a_x = a_n = 0.5$ and $q = p_{x0} = 1$. These parameters are chosen to allow an explicit solution for *(23)*.

As a preliminary step, the solution for the long run model with mobile capital follows from *(5)* through *(13)*. Of interest to us, is the long run exchange rate, from *(6)*.

$$p_{n\,Long\ Run} = p_x$$

However, with capital stocks fixed in the short run (crisis) set up, a terms of trade decline will deflate returns to capital in both sectors by the same proportion, creating an overhang.

We now solve *(23)*, obtaining the tax rate required to clear the overhang.

$$t = \left(\frac{1}{p_x}\right)^2 - 1$$

That is, the tax rate increases quadratically with the terms of trade shock. To see why, we note that $q = 1$ implies that all of the exportable good is exported, and that export revenue is equivalent to the interest payment to foreign creditors.

$$p_X \bar{K}_X^{0.5} L_X^{0.5} \quad = \quad p_X Q_X \quad = \quad \bar{r}[\bar{K}_X + \bar{K}_n]$$

Paying the overhang means that this fixed payment must be maintained even if p_x falls. But the labour coefficient of 0.5 implies a quadratic increase in L_x to generate the offsetting increase in export volumes. Finally, we note from *(18)* that the proportional change in labour usage in the export sector is approximately equal to the tax rate.

$$L_X(t) = \bar{L}[1-(1-a_n)(1-t)q] \quad = \quad (\bar{L}/2)[1+t]$$

Thus, a quadratic increase in labour usage, to generate sufficient exports, implies a quadratic increase in the tax rate. If a_x were higher, and the labour coefficient lower, the increase in labour usage required to maintain the debt payments would be even higher, implying a higher tax rate. This production-based intuition here must be consistent with the demand-based overhang multiplier story. A large transfer of labour to the export sector must coincide with a decline in demand for the non-traded good. In equilibrium, this decline in demand comes about as the wage and p_n both fall together, in response to the overhang multiplier.

Next, the short run exchange rate is obtained from *(20)*.

$$p_{n\,Short\,Run} = \left(\frac{1-t}{1+t}\right)^{0.5} p_x \approx (1-t)\, p_{n\,Long\,Run}$$

That is, the exchange rate overshoots by approximately the tax rate required to clear the overhang. The intuition is given by *(15)*, which determines p_n in the short run.

$$p_n = \frac{w(1-t)\bar{L}}{Q_n}$$

The wage multiplier implies that the export price decline is fully reflected in the wage in the short run (see Figure 3), so *w* falls by the export price shock. Then there is the additional fall in P_n due to the tax rate.[11]

The following calibration exercise demonstrates the plausibility of overshooting for more realistic parameters.

4.2 Calibration

This section calculates numerical solutions for *(23)*, and then equations *(17)* through *(22)*, for a range of (a_x, a_n) pairs. We consider parameters ranging from *0.5* to *0.7*, with an average value of *0.6*. This is higher than the economy-wide

[11] Although the wage will fall further under the influence of the overhang multiplier, the fall in Q_n - as exports expand - will tend to offset this.

capital coefficient estimate for, say, the US of *0.25* (Branson 1989).[12] The reason we experiment with higher coefficients is the low value of labour share of income in developing countries. If production functions are Cobb Douglas - as assumed here - then this labour share is equal to $(1-a)$ and the only way that this can be low is if a is high. Evidence for Thailand suggests an economy-wide capital coefficient of *0.68* (Warr 1993) supporting our choice of relatively high values. In keeping with conventional trade theory we assert that $a_x > a_n$ (see, for example, Feldman 1991), and let the non-traded consumption share be *0.7*, based on data from Indonesia.[13] We consider the extent of overshooting for a twenty per cent terms of trade decline. In the benchmark case, we would obtain a tax rate of just over 50 per cent ($(1/0.8)^2-1 = 0.5625$), and, an overshot exchange rate of approximately the same magnitude ($[1-.5625)/(1+.5625)]^{0.5} = .53$).

Table 1: Overshooting of the Real Exchange Rate

a_x	a_n	**Long run depreciation (%)**	**Equity depreciation (%)**	**Debt depreciation (%)**	**Overshoot* (%)**	**t (%)**
0.7	0.6	26	20	89	242	95
	0.5	31	20	68	119	75
0.6	0.5	24	20	51	113	50

* Overshoot = (% debt - % long-run)/(% long-run)

[12] A panel study of 118 economies by Young (1994) implies an economy-wide capital coefficient of 0.45.

[13] Data are from an IMF country report (IMF 1999), table 17. Assuming half of 'clothing' and 'miscellaneous' consumption is imported, and exportables enter with a weight of .2, the consumption share of non-tradables is around 0.7.

The first two columns show the (a_x, a_n) pairs. Column 3 gives the long run real depreciation, while Columns 4-7 relate to the short run. In Column 4 the real exchange rate falls by 20 per cent – matching the terms of trade shock - since equity financing implies a proportional fall in the short run. Column 7 shows the tax rate required to pay the overhang in the event of debt financing, and Column 5 shows the resultant real exchange rate decline when the overhang multiplier is having its impact. Column 6 shows the extent of the overshooting (the percentage change between Column 5 and Column 3) in the event of debt financing.

It is apparent by comparing Columns 3 and 4 that extra-marginal capital getting 'stuck' in the economy holds up the real exchange rate *providing that the debt overhang is borne by the creditor*. In that case there is exchange rate *undershooting* ($p_{n\ equity} > p_{n\ LR}$). This makes sense, since the extra-marginal capital raises the productivity of labour in the economy, and workers do not have to pay for the overhang. However, if they do have to pay for it this result is overturned, as a comparison of Columns 3 and 5 reveals, and there is overshooting ($p_{n\ Debt} < p_{n\ LR}$).[14]

An examination of Table 1 confirms that the benchmark model generally understates the impact of the terms of trade shock for these parameter values. For two out of three calibrations, the tax rate is higher than in the benchmark (56.25 per cent) and the extent of overshooting is larger than 53 per cent. The other noteworthy feature of Table 1 is that higher capital shares lead to more overshooting.[15] This is intuitive; a debt overhang is only a problem to the extent that one has a lot of capital requiring interest payments.

---

[14] Sensitivity analysis confirms that overshooting survives for lower capital coefficients down to about 0.3. For example, if the traded and non-traded capital shares are 0.4 and 0.3, the exchange rate overshoots by 6 per cent. However, very low values can stop the overshooting property. If the non-traded capital share goes as low as 0.1, mild undershooting emerges.

[15] This result was foreshadowed for the traded sector when we discussed the benchmark. However, the table shows it is true for the non-traded sector as well.

5. Conclusion

As the dust settles after the East Asian Economic Crisis, economic theory is wrestling with difficult questions concerning the role of the exchange rate as an adjustment tool. In our model, the real depreciation following an adverse shock creates serious difficulties for policy makers. These difficulties boil down to not being able to earn the world required rate of return on overseas borrowing, in the presence of debt contracts. Attempts to pay this debt put further pressure on the real exchange rate, via the overhang multiplier. The contribution of the paper is to set this process in a parsimonious framework.

We recognize the limitation of such a simplified approach. In particular, we have modelled a bundle of shocks by a terms of trade decline, and, we have limited our attention to a two-sector model, without any domestic capitalists. Nevertheless, what has been gained by the exercise is a clearer picture of how one aspect of the Asian Crisis – namely the existence of extra-marginal projects – could be linked to the phenomena of exchange rate overshooting. The analysis also highlights the difficulties for crisis countries of having the full debt overhang 'wrung out of them' by international creditors.

Appendix A:

This appendix adopts a less restrictive functional form for production in both sectors. It shows that Cobb-Douglas preferences are crucial for some results, whereas Cobb-Douglas production could be replaced by the less restrictive constant-returns-to-scale assumption.

Production in the export sector is constant-returns-to-scale $F(K_x, L_x)$, with $f(.)$ as the intensive form. That is, $f(k_x) \equiv F(K_x/L_x, 1)$, where $k_x = K_x/L_x$. Analogous definitions of $G(.)$, $g(.)$ and k_n are used in the non-traded sector. Given constant returns to scale, the standard relationships between the capital-labour ratio and marginal products hold.

Preliminaries; Section 2

The model here is essentially four equations, solved for k_x, k_n, p_n and w.

$$\left.\begin{aligned} & p_X f'(k_X) = \bar{r} \\ & p_X[f(k_X) - f'(k_X)k_X] = w \\ & p_n g'(k_n) = \bar{r} \\ & p_n[g(k_n) - g'(k_n)k_n] = w \end{aligned}\right\} \quad k_X, k_n, p_n, w \qquad (A1)$$

The first equation solves for k_x. When this is substituted into the second equation, w is obtained. Thus the wage is determined in the export sector, as is the export capital-labour ratio. Armed with the solution for the wage, the last two equations can then be solved simultaneously for the non-traded capital-labour ratio, and p_n. The impact of export prices on non-traded prices can be ascertained from the zero

profit conditions. The pronumeral q_{ij} refers to the optimal cost share of factor i in the production of j. A hat refers to a proportional change.

$$\left.\begin{aligned}\hat{p}_X &= q_{kx}\hat{r} + (1-q_{kx})\hat{w}\\ \hat{p}_n &= q_{kn}\hat{r} + (1-q_{kn})\hat{w}\end{aligned}\right\} \qquad (A2)$$

Assume a decline in the export price (with an unchanged required rate of return), the conditions clearly imply that falling export prices depress the wage, and then the non-traded price.

$$\begin{aligned}\hat{p}_X &= 0 + (1-q_{kx})\hat{w}\\ \hat{p}_n &= 0 + (1-q_{kn})\hat{w}\end{aligned}$$

Thus, these results can be derived without having to assume Cobb-Douglas technology. The value-added of the Cobb-Douglas assumption is that an explicit solution for the optimal capital stock can be derived, showing capital flight as a consequence of a fall in p_x (or a rise in the required rate of return).

The Crisis Setup with Equity Financing; Section 3.1

The main result of Section 3.1 is that all prices and returns in the economy deflate in proportion to the export price shock. (Recall that, with fixed capital and no debt contracts, the returns are free to differ from the world rate). This only requires constant returns to scale in production, but it does require *Cobb-Douglas* preferences. The latter implies $p_nQ_n=cw$, where c is a constant.

Taking log changes implies that $\hat{Q}_n = \hat{w} - \hat{p}_n$. Now fixed capital implies a one-to-one mapping of output changes onto labour changes. That is, increased (decreased) output necessitates increased (decreased) labour input. Furthermore, profit-maximizing firms equate the real wage to the marginal product of labour. That being so, the above equation states that labour changes and marginal product changes are *positively* related. Yet this seems impossible, since adding labour to fixed capital will reduce the capital-labour ratio, thereby reducing the marginal product of labour (from the constant-returns-to-scale assumption). Symmetric reasoning shows that the equation cannot describe a decrease in labour. The only way out of this conundrum is to recognize a third possibility, that there is *no* change in labour.

If there is no change in labour there can be no change in the capital-labour ratio in either sector. That being the case, all the real returns are unchanged in both sectors. Therefore a decline in the export price will result in an equi-proportionate decline in the wage (keeping the marginal product of labour in the export sector constant). The zero profit condition in the export sector then demands an equi-proportionate decline in the return to capital in that sector.

$$\hat{p}_X = q_{kx}\hat{r}_X + (1 - q_{kx})\hat{w}$$

As the wage declines, the non-traded price must decline by the same proportion (keeping the marginal product of labour in the non-traded sector constant). Again, the zero profit condition in the non-traded sector demands an equi-proportionate decline in the return to capital in that sector.

$$\hat{p}_n = q_{kn}\hat{r}_n + (1 - q_{kn})\hat{w}$$

When we come to Section 3.2, it becomes necessary to assume Cobb-Douglas production for the purposes of calibration, and to solve the system with an endogenous tax rate. As it is necessary at that point to assume a particular functional form, we use Cobb-Douglas in the earlier parts of the text for clarity and consistency.

References

Branson, W. (1989), *Macroeconomic Theory and Policy*, New York, Harper and Row.

Feldman, D. (1991), 'Economic Policy and the Relative Price of Services in LDCs', *World Development,* 19 (10), pp 1381-1389.

Ghosh, A., Lane, T., Schulze-Ghattas, M., Bulir, A., Hamann, J. and A. Mourmouras (2002), 'IMF-Supported Programs in Capital Account Crises', IMF Occasional Paper no. 210, Washington D.C.

IMF (1999), 'Indonesia: Statistical Appendix', IMF Report no. 99/39, 5 May 1999, Washington D.C.

IMF (2002), 'International Financial Statistics', February 2002, Washington D.C.

Krugman, P. (1999), 'Balance Sheets, the Transfer Problem and Financial Crises', in Jr. P. Isard, A. Razin and A. Rose (eds), *International Finance and Financial Crises; Essays in honor of Robert P. Flood*, Kluwer Academic, Boston, pp 31-44.

Obstfeld, M. and K. Rogoff (1996), *Foundations of International Macroeconomics*, MIT press, Cambridge, Massachusetts.

Warr, P. G. (1993), 'The Thai Economy', in P. G. Warr (ed.) *The Thai Economy in Transition*, Cambridge University Press, Cambridge, pp 1-80.

Young, A. (1994), 'Lessons from the East Asian NICs: A Contrarian View', *European Economic Review*, 38, pp 964-973.