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LDC adjustment packages

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Summary

Developing countries have been hit by a fall in their terms of trade, high real interest rates on their external debt, and a drought in commercial lending from abroad. Their subsequent adjustment packages, often supported by loans from the IMF and World Bank, focused on a sharp real exchange rate depreciation to restore external balance and a host of microeconomic reforms to secure a simultaneous supply-side improvement. This paper examines the success of these 'adjustment with growth' packages in a large sample of developing countries.

We find these packages have been much more successful in LDCs which export manufactures than they have in those concentrating on primary exports (primarily low-income African countries); the latter have not resumed sustainable growth, and most of their external adjustment has arisen from expenditure reduction, not an increase in supply. The longer-term prospects for manufacturing exporters are also brighter: there we detect signs of increased efficiency and a smaller decline in investment than in primary exporters. But we also find that a high external debt burden and an unstable macroeconomic environment impede investment in all LDCs. In the longer term, adjustment with growth packages will succeed only if they are accompanied by a more stable macroeconomic environment and appropriate debt relief.

Adjustment, investment and the real exchange rate in developing countries

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1. Introduction

The developing countries have been in crisis since 1982. The combination of deteriorating terms of trade, rising real interest rates on their external debt and the drying up of commercial lending have forced them to pursue drastic economic adjustment policies. Faced with a sharp withdrawal of commercial bank funds that was only partly compensated by official lending, and unwilling to default, developing countries had to effect a positive transfer to developed countries. The crisis required a sharp adjustment: developing countries had to earn foreign exchange by exporting more or save it by importing less. It is now recognized that the brunt of adjustment fell on absorption, in particular on investment. In most developing countries, with the significant exception of East Asian countries, adjustment was achieved by cutting investment rather than by increasing saving. Both public and private investment fell. Admittedly, prior to 1982 many countries had embarked on overly ambitious investment programmes, partly because recycled petrodollars were all too readily available. Yet the fall in investment, particularly private investment, could have adverse implications for a sustained recovery.

In response to the debt crisis, the IMF increased its lending, and the World Bank responded by introducing quick-disbursing adjustment loans to help countries achieve both macroeconomic equilibrium and efficient structural adjustment. In many quarters, the crisis was viewed as an opportunity to carry out much-needed microeconomic reforms

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that would raise efficiency and allow adjustment to take place without a loss in growth despite the reduction in investment.

Whatever the differences in the depth of the crises affecting them, most developing countries have now been undergoing structural adjustment for almost a decade. What can be said overall about its success? In this paper, we evaluate adjustment packages by focusing on two key issues: did the sharp devaluation of the real exchange rate (advocated by international organizations) generate a supply response, and did microeconomic rationalization sufficiently raise the marginal efficiency of investment to compensate for the adverse effects of adjustment on the volume of investment? In other words, are there signs that the structural reforms are bearing fruit, and, if there is recovery, is it sustainable?

We term real output growth sustainable if it exceeds population growth. Sustainability has assumed particular importance because the sharp drop in living standards that has accompanied adjustment programmes in many countries has created tensions that affect investment decisions. Is this uncertainty preventing investment in countries that would otherwise attract investment precisely because of the lower real wages? If investors are waiting to see whether economic conditions will deteriorate, then their expectations could become self-fulfilling, and could lead to the abandonment of otherwise well-conceived adjustment packages.

To set the tone for our analysis, we need first to get a general sense of how adjusting countries are doing. Just as the severity of the crises differed widely across countries, so too has the burden of adjustment and its timing. No classification system for grouping countries can fully capture this diversity. Table 1 summarizes the latest available figures. Here we choose a country grouping based on economic structure: fuel exporters, manufacturing exporters, and, as a residual category, primary exporters. Period averages are taken for four macro-indicators: GDP growth, the share of investment in GDP, the ratio of debt service to exports and the real exchange rate.

Three facts stand out. One is that only manufacturing exporters (mostly the East Asian countries) have resumed growth at pre-crisis levels. Although the debt-service burden of this group is high (partly because of a few Latin American countries in the grouping), it has stabilized. Growth among the fuel exporters has deteriorated throughout the three periods. Primary exporters have recuperated most of their loss in growth, but they have not arrested a worsening trend in their external debt service.

The second significant fact is the universal, and pronounced, decline in the investment share in GDP. For the non-fuel groups, the share has

Table 1. Macroeconomic indicators (annual averages, %)

		Primary exporters	Manufacturing exporters	Fuel exporters
GDP growth	1978–81	2.8	4.8	6.6
	1982–86	1.4	2.4	2.0
	1986–88	2.4	4.9	0.9
Investment/GDP	1978–81	21	26	28
	1982–86	18	23	25
	1986–88	17	22	19
Debt service/exports	1978–81	15	25	18
	1982–86	20	28	25
	1986–88	29	29	39
Real exchange rate (1980 = 100)	1978–81	103	103	100
	1982–86	113	112	95
	1986–88	139	139	135

Notes: Unweighted averages of sample of 83 countries with population exceeding 1 mn. in 1980. Throughout the paper, an increase in the real exchange rate denotes a real exchange rate depreciation.

fallen by about 20%, while for fuel exporters the decline was even sharper, reaching 30%. To be sure, it can be argued that the overly ambitious investment programmes following the oil boom needed to be scaled down. But the declines for the primary and manufacturing exporters are very high and may cause concern about the prospects for sustained recovery.

The declining investment share in GDP and slower rate of growth, in spite of a sharp deterioration in the real exchange rate, is even more pronounced if we divide our sample of 83 countries into currently (i.e. in 1988) severely indebted countries and others. The 36 severely indebted countries had a decline in average growth from 3.1% per annum in 1978–81 to 2.5% in 1986–88 while the average share of investment in GDP fell from 22.3% in 1978–81 to 15.7% in 1986–88. For this severely indebted group of countries, the real exchange rate depreciation was 46%.

The third significant finding from Table 1 is the sharp real exchange rate depreciation. Six years into the cirisis, the real exchange rate had depreciated by close to 40% for all three country classifications. Some real exchange rate depreciation would have been required by any adjustment programme involving an increase in the net transfer from debtors to creditors, otherwise the required shift towards tradeable activities would not have materialized.

But there is more behind this sharp and universal depreciation in the real exchange rate. When the IMF and World Bank stepped in

to fill at least some of the financing gap left by the withdrawal of commercial lending, they offered 'adjustment-with-growth' packages that relied heavily on a sharp depreciation of the real exchange rate as a condition for obtaining funds. The real exchange rate is an endogenous variable that can never be fully under a country's policy control, but it is no exaggeration to say that achieving a sharp real exchange rate depreciation was the centrepiece of these adjustment packages.[1]

The failure of such a large number of countries to resume sustainable growth has given ammunition to the advocates of debt relief and to the critics of the adjustment-with-growth packages advocated by the IMF and the World Bank. The heavy emphasis on real exchange rate depreciation as a way to restore external balance and elicit a significant supply response has been at the centre of this controversy about the effectiveness of these packages. In the first part of the paper, we take a fresh look at the role of the exchange rate in the context of adjustment by distinguishing between the short-run supply effect of a real exchange rate depreciation and its long-run effect on growth of output through its impact on investment.

In addition to the emphasis on a sharp depreciation of the real exchange rate, most adjustment packages introduced a host of productivity-enhancing microeconomic reforms. Typically the reforms included a rationalization of public sector recurrent and investment expenditures; a restructuring of public enterprises; and trade, fiscal and credit policy reforms to provide more nearly neutral and transparent incentives. While it is too early to see the full effects of microeconomic reforms, one could hope to detect some effects in the form of a greater efficiency of investment. In the second part of the paper, we analyse the behaviour of investment during adjustment, looking first into the efficiency and cost of investment. Can one attribute most of the decline in private investment to the rising cost of capital goods? Did the efficiency of investment improve during adjustment? Because investment decisions are at least partially irreversible, we look into the influence of the macroeconomic environment, particularly the debt overhang, on investment decisions.

In what follows, we address the evidence for a large sample of developing countries. In Section 2 we state succinctly the controversy surrounding the role of the real exchange rate in achieving external balance and restoring growth. Section 3 gives evidence on adjustment in the external balance and the supply-side effects of a real depreciation.

[1] See Edwards (1989b) and World Bank (1988) for a description of IMF-/World Bank-supported adjustment packages.

Section 4 looks at the effects on investment of real depreciation and other factors. Conclusions and implications for a sustained recovery are discussed in Section 5.

2. The controversy

A standard framework for analysing the effects of adjustment programmes is the two-sector dependent-economy model with exogenous terms of trade. Consider the situation prevailing before the crisis. Before 1981, many countries could run a trade deficit financed by external borrowing. When foreign borrowing was foreclosed or, at the least, greatly reduced, the absorption-income gap had to be reduced to reduce the current account deficit. (Many countries had to produce a trade surplus to service the increased payments on their external debt caused by higher real interest rates.)

When resources are initially fully and efficiently employed, closing the absorption-income gap by reducing absorption is often referred to as the *primary cost*, or inevitable cost, of reducing a current account deficit. If closing the gap also entails a reduction in resource use because of relative price (or other) rigidities, there is also a *secondary cost* of adjustment. Over the medium term, adjustment policies to reduce the external deficit would include both expenditure-reducing and expenditure-switching policies (e.g. a real exchange rate depreciation). In addition, if the adjustment package is introduced at a time of inflation, a cutback in demand is desirable to reduce inflationary pressures. When resources are not fully or not efficiently employed one can also expect a supply response to a depreciation of the real exchange rate.

The relative effectiveness of expenditure-reducing and expenditure-switching policies depends on the marginal propensity to consume tradeables and on supply responsiveness. The lower the marginal propensity to consume tradeables, the less external adjustment will be obtained from a given demand reduction. And the more difficult it is to shift existing resources from non-tradeable to tradeable activities, the greater the required relative price shift (real exchange rate depreciation).

To give some idea of the scope for substitution in demand, note that many countries, especially primary exporters, do not consume exports domestically. Also, close substitutes for imports are typically not available in the short to medium run. Data for a group of 40 developing countries indicates that the share of consumer good imports fell from 30% in 1980 to 25% in 1987. Such a shift toward the inelastic component of total imports is likely to reduce the effectiveness of expenditure-switching policies.

The traditional structuralist argument against devaluation is that it has a small impact on the trade balance because of low elasticities. This traditional argument has been buttressed by the contention that the redistributive mechanisms brought into play by devaluation (i.e., the shift from low savers to high savers) are contractionary from the demand side (Krugman and Taylor, 1977). Traditional stabilization packages reach the point of 'overkill' (Diaz-Alejandro, 1980; Dell, 1982) when it is further recognized that restrictive monetary policy may have a contractionary effect on supply through higher interest costs (Cavallo, 1977; Bruno, 1979).

These shortcomings did not go unnoticed within the international agencies. But it was not until the advent of adjustment lending in the early 1980s ($26 bn. from the IMF and $16 bn. from the World Bank during 1980–87) that these agencies made an explicit attempt to combine short-run stabilization goals with growth-oriented policies. In this new framework (see Corbo *et al.*, 1987, and Thomas *et al.*, 1990), devaluation of the real exchange rate still played an essential role, not only to restore external balance but also to achieve a more efficient resource allocation: the positive supply response to a real devaluation would dominate its contractionary demand effects.

This new emphasis on growth did not diminish the criticism, however. A 'new' structuralist critique pointed out that devaluation could be contractionary, this time from the supply side. The effect would come through the higher cost of imported inputs (Buffie, 1984); a lower volume of real credit (because of higher input prices with constant nominal credit) and consequently higher interest costs for firms (Van Wijnbergen, 1986); and, in the presence of widespread wage indexation, through higher labour costs. Finally, in the longer run, the negative effect on supply could be compounded if a real depreciation depressed investment because of a higher cost of imported capital equipment (Buffie, 1986).

Consider the following back-of-the-envelope calculation of the contractionary effects of a devaluation that increases the costs of intermediate inputs. For the countries in Table 1, the real exchange rate depreciated by approximately 25% between 1980 and 1987. Assuming an economy-wide value-added ratio of 0.5, imported intermediates at 30% of total intermediates, and long-run demand and supply elasticities of 1 and 2 respectively, the contractionary effect would be 5% of GDP. (In addition, the contractionary effects from the demand side could conceivably lead to excess supply among non-traded sectors.[2])

[2] Lizondo and Montiel (1989) give an exhaustive discussion of the various factors contributing to the contractionary effects of devaluation. Also see Edwards (1989a, chapter 8).

This 'new' critique assumes that a nominal devaluation results in a real devaluation on impact – as has been the case in the 1980s. The amount of the real devaluation will probably be less than the nominal devaluation, but it will be substantial, as the figures in Table 1 show. Over the longer term, as various studies have pointed out (e.g. Edwards, 1989a), there is a tendency for the real devaluation to erode because of wage indexation and other factors. The critique remains worthy of closer investigation, however, in view of the pronounced depreciation in the real exchange rate apparent from Table 1 and the difficulties many countries have had in resuming growth.

Finally, a related critique from the advocates of debt relief is that the resulting overkill from the extreme severity of adjustment programmes combined with a deteriorating external debt position has inhibited private investment. According to these critics, the debt overhang has acted as a tax on the proceeds of investment (Sachs, 1989) and uncertainty has created negative incentives for private investment (Rodrik, 1989; Dornbusch, 1988). As pointed out earlier, the criticism rests upon the consequences of uncertainty on the decision to invest in a world where the investment decision is at least partially irreversible. The argument here is that uncertainty about the future course of an adjustment package will lead potential investors to adopt a wait-and-see attitude. In the typical Latin American case, flight capital will not be repatriated for investment because uncertainty about the outcome of the ongoing adjustment package is high.

3. External adjustment and the real exchange rate

Developing countries responded to the shocks of the 1980s by depreciating their real exchange rate.[3] How effective has real exchange rate depreciation been? First, we analyse the evolution of the trade balance to see how much of the improvement in the trade balance was accounted for by real exchange rate depreciation after controlling for time trends and country-specific effects. Second, we look for evidence of supply response to the real exchange rate.

For each of the three country groupings in Table 1, we pool countries and correlate the trade balance-GDP ratio with absorption, the real exchange rate, country dummies and a time trend. Unfortunately,

[3] Real exchange rate depreciation was even stronger for recipients of World Bank/IMF adjustment loans. Thirty countries that did not receive adjustment loans with a major trade-reform component depreciated in real terms by less than 2% between 1980–82 and 1985–87 whereas 40 countries that received structural adjustment loans depreciated by 22% in real terms (see World Bank, 1988).

Table 2. Determinants of the trade balance (Dependent variable: the ratio of trade balance to GDP)

Effect of 1% increase in	Manufacturing exporters	Fuel exporters	Primary exporters
Real absorption	−0.16	−0.78	−0.49
	(0.07)	(0.76)	(0.12)
Real exchange rate	0.18	0.10	0.20
	(0.08)	(0.11)	(0.84)
Real exchange rate in previous year	0.07	0.15	0.08
	(0.07)	(0.12)	(0.09)

Notes: Estimated over 1965–85, excluding countries for which less than four observations. There are 20 manufacturing exporters, 11 fuel exporters and 18 primary exporters for which data is available. Standard errors of estimates shown in parenthesis. Equations estimated by instrumental variables using real money, and lagged values of absorption and the real exchange rate as instruments. Time trend and country-specific intercepts not reported.

because of lack of data, we are unable to separate out directly the effects of demand switching and supply response. Results are reported in Table 2. All coefficients for the real exchange rate are significant with the exception of that for fuel exporters, which is not surprising since natural-resource-based economies usually have price-insensitive supply structures. (Generally the lagged value of the real exchange rate is insignificant.) The coefficient on absorption is even more significant. For our sample, then, we conclude that the real exchange rate depreciation contributed to improving the trade balance.

We also re-estimated the same equation adding dummy variables for the post-1981 period on the coefficients of absorption and the real exchange rate. For the primary-exporter group a significantly negative value showed up for the real exchange rate dummy variable, suggesting no contribution of real exchange rate depreciation to trade balance improvements. This is consistent with other studies that have attempted to link the trade balance with the real exchange rate.

It is interesting to measure the relative contribution of changes in absorption and of the real exchange rate to the trade balance. The index $R = a_2/a_1$ (elasticity of the trade balance with respect to price/elasticity of the trade balance with respect to absorption) measures the relative impact on the trade balance of a reduction in absorption and of a real depreciation. For our three country groupings, this index is 1.13 for manufacturing exports, 0.13 for fuel exporters, and 0.41 for primary exporters. The exchange rate contributes to trade balance improvements most for manufacturing exporters. This is exactly what the 'old' structuralists would argue. For the rest of the developing world,

the relative effectiveness of expenditure-switching policies is very low indeed. Falling in this category are small low-income countries, which are at a relatively early stage of industrialization with a small and undiversified industrial sector. These countries have few opportunities for expanding exports, which are concentrated in a few primary commodities. The scope for export expansion is typically even more limited for natural-resource-based economies such as fuel exporters, although there may be room for adjustment on the import side if they have a larger share of consumer imports. These are the prototypical 'structuralist' economies (see Chenery, 1975; Taylor, 1982).

One can also use the estimates in Table 2 to see how much of the improvement in trade balance was accounted for by real exchange rate depreciation after controlling for country-specific effects and the time trend. For manufacturing exporters (primary exporters) the average trade balance-GDP ratio was 4.9 (2.3) percentage points higher in 1983–85 than in 1979–81. For manufacturing exporters real exchange depreciation accounted for a 2.1 percentage point improvement in the trade balance, while for primary exporters real exchange rate depreciation only accounted for a 0.8 percentage point improvement.

The limited scope for import substitution is also apparent from the evolution of the composition of non-fuel imports during the 1980s. The data (not shown here) indicates some import substitution in consumer goods with a rising share of intermediate goods in imports. But since the share of consumer goods in total imports was already low at the onset of adjustment (about 20%), it is likely that little supply response could be expected from the replacement of imports with domestically produced substitutes for the majority of developing countries.

Turn now to supply response. We assume that output supply at each point of time is a function of the capital stock, the cost of variable inputs, and, because adjustment takes time, of lagged supply. Because of lack of data for our large sample, we approximate the cost of variable inputs by the real exchange rate. This variable is also intended to proxy the costs of labour and, more importantly, the presumed supply-augmenting effects of adjustment programmes based on real exchange rate depreciation. As before, dummy variables capture country-specific effects. The country-classification is unchanged. After taking a quasi first difference of the supply equation, one obtains the reduced form of Table 3.

Interestingly, when it comes to the coefficient on the real exchange rate, one finds consistently a negative and significant contribution to supply (the lagged effects appear insignificant): a real depreciation (which increases our measure of the real exchange rate) reduces current output supply, other things equal. It must, of course, be recognized

Table 3. The real exchange rate and output supply (Dependent variable: logarithm of real output)

Effect of 1% increase in	Fuel exporters	Primary exporters	Manufacturing exporters
Output last year	0.44	0.31	0.21
	(0.15)	(0.07)	(0.11)
Output two years ago	−0.04	0.07	0.13
	(0.07)	(0.03)	(0.05)
Real exchange rate	−0.10	−0.17	−0.08
	(0.04)	(0.06)	(0.03)
Real exchange rate last year	0.07	0.15	−0.01
	(0.08)	(0.06)	(0.05)
Real gross fixed investment	0.12	0.11	0.16
	(0.03)	(0.01)	(0.02)
Diagnostic statistics:			
Wald test	477	853	82
Sargan test	5.4	4.6	0.9

Notes: Maximum sample 1965–85, countries with less than four years data excluded. Standard errors in parenthesis. Estimated by instrumental variables, using as instruments: world demand, real money, real GDP, real investment. The Wald test measures joint significance, the Sargan test the accuracy of the instrument set (see Arellano and Bond, 1988a). Both test statistics have five degrees of freedom.

that our simple reduced form is certainly a short-cut way of trying to capture the supply-enhancing effects of a real depreciation. In terms of the framework developed earlier, the results in Table 3 suggest that the presumed resource-switching towards tradeables elicited by the massive real exchange rate depreciation involved at least a temporary output loss. In a world where factor specificity plays an important role, switching policies would be expected to lead to some resource idleness. It may well be that non-tradeable activities used factors not easily transferable to tradeable activities. Probably the real exchange rate variable also captures other adjustment effects associated with terms-of-trade loss like lack of foreign exchange. Nonetheless, taken together, the results in Tables 2 and 3 give support, though perhaps only suggestive, to the concerns raised by the structuralist critique.

4. Investment, the real exchange rate and the debt overhang

The sharp fall in the share of investment in GDP in developing countries (Table 1) does not bode well for a consolidation of adjustment achievements to date in the absence of a significant increase in the efficiency of investment. Lower investment not only reduces future productive

capacity, it also engenders lowered expectations for future growth. These expectations may be socially destabilizing. In addition, lower investment limits the scope for resource reallocation in response to reforms throughout the economy. Yet it is resource reallocation to the new set of incentives created by the reforms that is expected to play a crucial role in most adjustment-with-growth programmes.

The disappointing investment rate in developing countries may be attributable to the extreme economic and financial distress of the most recent period, or it may be attributable to the design of adjustment policies. Two components of the adjustment-with-growth programmes may have been responsible for the investment slump. The first has to do with the effects of a real depreciation; the second with the micro-economic reforms that were part of the conditionality provisions of the adjustment packages supported by the World Bank. Consider again the impact of a real depreciation. It has been argued (e.g. Blejer and Khan, 1984), that the availability of foreign exchange exerts a powerful influence on investment both because it is needed to purchase mostly foreign-produced capital goods and because it may permit a less restrictive monetary policy. A real exchange rate depreciation is expected to promote investment by increasing the availability of foreign exchange. This may not happen, however, since a real exchange rate devaluation may substantially raise the real cost of capital goods (Buffie, 1984).

The second way in which adjustment programmes may have contributed to the slump in investment comes from the cut in public expenditures required by IMF stabilization programmes and by the strong public-sector management-reform component in World Bank structural adjustment programmes. Structural adjustment programmes aimed at restoring growth not only by rationalizing fiscal and financial incentives through economy-wide market and financial-sector reforms, but also by strengthening public-sector management. Many structural adjustment packages required a combination of divestiture of some public enterprises and a freeze on the creation of new ones and on employment levels in existing ones – in other words, a reduction in public-sector expenditure. It was hoped that private-sector investment would move in to replace public-sector investment and that, as a result of the policies aimed at rationalizing price incentives and reforming public-sector management, the overall marginal efficiency of investment would rise.

To evaluate the proximate causes of the fall in the investment share in GDP, we collected time-series data on public-sector investment for a sample of 32 countries. The data can be used to provide a rough breakdown of total investment by public- and private-sector components. The remainder of the paper is based on analysis of these data.

Table 4. Investment efficiency and the cost of capital (Annual averages, unweighted averages in country groups)

	Manufacturing exporters			Primary exporters			Developed countries		
	70–74	75–82	83–86	70–74	75–82	83–86	70–74	75–82	83–86
Investment/GDP									
private (%)	13	15	12	15	14	11	21	19	18
public (%)	6	8	7	6	7	6	4	4	3
total (%)	19	23	19	21	22	17	25	23	21
ICOR									
private	1.1	2.1	1.9	1.3	1.5	1.5	2.1	2.2	1.9
total	1.6	3.4	2.7	1.8	2.3	2.3	2.5	2.6	2.2
Cost of capital (1975–82 = 100)	54	100	233	38	100	158	76	100	152

Notes: Developed country data for the G-7: US, UK, France, Germany, Japan, Italy and Canada. The incremental capital-output ratio is the ratio of real investment to real output growth. Real GDP growth is the denominator in both the private and total ICOR. Thus a higher total ICOR implies a lower efficiency of investment. The real cost of capital is measured by (nominal interest rate + depreciation rate − rate of price increase of investment goods) multiplied by the price of investment goods relative to the GDP deflator.

4.1. Efficiency of investment and the cost of investment

The longer-term trends (1970–86) of public and private investment rates are displayed by sub-period for the manufacturing and primary exporter groups in Table 4. Comparable trends for the G-7 countries are also provided as a reference. Broadly similar trends apply to developed and to developing countries. For all country groupings, private and public investment falls in the post-1982 period, and the cost-of-capital index rises. Fluctuations, however, are more pronounced for developing than for developed countries.

For developing countries, four stylized facts emerge. First is an increase in the share of public investment during the period of 'easy' credit, when there was ample liquidity in the world capital markets following the first oil price rise. Second is a sharp downward shift in the share of private investment in GDP after the crisis, especially for primary exporters. Third is a steady increase in the real cost of capital. Fourth is a sharp swing in the incremental capital output ratio (ICOR) for manufacturing exporters, with an improvement during 1983–86, when the ICOR fell and the efficiency of investment increased, whereas the ICOR for primary exporters remained stable.

On the basis of these broad trends, one would be tempted to conclude that adjustment programmes were largely successful, at least for manufacturing exporters. For this group, the fall in public- and

private-sector investment was accompanied by an increase in the efficiency of total investment. It could also be argued that the reduction in the size of the public sector's capital expenditures weeded out the most inefficient investments and that the rationalization of public-sector investments raised the marginal efficiency of public investment.

Also, by emphasizing the need for a real exchange rate depreciation, adjustment programmes compounded the increase in the cost of capital. It was hoped that the higher cost of capital would increase the efficient use of capital. And, helped by financial-sector reforms, distortions in factor prices favouring capital-intensive production techniques would be eliminated. In the final analysis, this means that the same growth rates can now be achieved with a smaller investment effort if the efficiency-augmenting effects are sufficiently strong.

These findings and interpretations are at best suggestive, but certainly not conclusive. The fall in the ICOR may reflect a higher rate of capacity utilization of a slowly increasing (or perhaps even shrinking) volume of capacity. It may also reflect a cutback of projects with long gestation lags (particularly public investment projects), or in investment in maintenance. In both cases the decline in the ICOR may not be sustainable and is likely to be reversed. Better information (like a breakdown of GDP into public- and private-sector components) would be needed for a sounder verdict.[4] We can, however, go a bit further and verify whether the real exchange rate depreciation was a cause of the increase in the real cost of investment. We can also verify whether the major cause of the decline in private investment was the increase in the cost of investment or other factors such as depressed demand.

We start with the cost of capital goods. Table 5 displays estimates of the elasticity of the relative price of capital goods in terms of the real exchange rate. The results show that a real exchange rate devaluation significantly increases the relative price of investment. The effect is stronger for manufacturing exporters than for primary exporters. At first sight this appears paradoxical. However, the result is less surprising when we consider that the share of construction in total investment is usually higher in lower-income countries (see Chenery, Syrquin and Robinson, 1986). In sum, the results in Tables 4 and 5 suggest that our data are at least consistent with the 'new' structuralist critique, namely, that depreciation of the real exchange rate will have some contractionary

[4] Because of the impossibility of distinguishing between the public- and private-sector components of GDP in our sample, the ICOR calculations in Table 4 are at best suggestive of trends in the efficiency of investment. Also, these rough calculations do not account for changes in capacity utilization. For alternative calculations that indicate an increase in the efficiency of investment during the 1980s see Easterly and Wetzel (1989).

Table 5. The real exchange rate and the relative price of investment goods (Dependent variable: logarithm of price of investment goods relative to the GDP deflator)

	Manufacturing exporters	Primary exporters
Effect of 1% devaluation	0.46 (0.07)	0.26 (0.07)

Notes: Data and country classification as in Table 4. Estimated by instrumental variables, using lagged real exchange rate, real money, public investment and country intercepts as instruments. Standard errors in parenthesis. Country intercepts not reported.

effects on supply in the medium to long term. Of course, the undesirable effects of these contractionary pressures must be balanced against any efficiency-enhancing effects resulting from less distortion in the cost of capital.

We turn next to the causes of the decline in private investment. A contributing factor must have been the income loss that resulted from the combination of worsening terms of trade and higher debt-service payments. For the same group of countries as those in Table 1, Faini *et al.* (1990) estimate a loss in income of 2.5% of the average GDP between 1978–81 and 1982–86 (period averages). To sort out further the effects on private investment of demand-side shocks and of the cost of capital, we estimate a standard accelerator model in which the growth of absorption and the expected cost of capital are the main determinants of investment demand. The simplicity of the accelerator model makes it attractive for separating the effects on investment due to the combined effects of changes in the level of aggregate demand and changes in the expected cost of capital. We also examine whether the different components of the cost of capital (the real interest rate and the real price of investment goods) affect investment differently.[5] Finally, we look for any significant impact on private investment of foreign exchange availability (measured as the sum of export receipts and non-monetary capital flows) and of public investment.

As expected, private investment is positively related to real GDP growth and negatively related to the cost of capital (Table 6). The long-run elasticity of the investment rate with respect to the cost of capital is 0.16 for manufacturing exporters and 0.12 for primary exporters. Foreign exchange availability exerts a positive, but statistically weak, impact for primary exporters and no effect at all for manufacturing exporters. Public-sector investment never proved to be statistically

[5] We also tested for a separate and/or different effect of the real exchange rate but found none.

Table 6. Investment determinants: output and substitution effects (Dependent variable: ratio of private investment to GDP)

Effect of unit increase in	Manufacturing exporters	Primary exporters
Private investment/GDP, last year	0.61	0.39
	(0.11)	(0.11)
Output growth	0.12	0.17
	(0.06)	(0.06)
Output growth last year		0.15
		(0.08)
Capital cost last year	−0.06	−0.07
	(0.03)	(0.03)
Depreciation	−1.43	−1.03
	(0.46)	(0.46)
Depreciation last year		−1.11
		(0.53)
Foreign exchange/GDP		0.01
		(0.007)
Diagnostic statistics		
Wald test	84 (4)	84 (7)
Sargan test	56 (43)	34 (59)

Notes: Standard errors in parenthesis. Country intercepts not reported. Estimated by instrumental variables. Capital cost defined as (real interest rate + depreciation rate) multiplied by price of investment goods relative to GDP deflator. (Depreciation rate taken as 7% p.a.) Depreciation defined as depreciation rate times relative price of investment goods. Degrees of freedom in parenthesis.

significant in any of the equations. Our data were unable to detect any significant complementarity (or substitutability) between public and private investment once we control for the real interest rate and the cost of capital. This may be because our data did not distinguish between investment in infrastructure and investment by public enterprises.

It is instructive to apply the estimates in Table 6 to the investment and cost-of-capital figures of Table 4 to calculate the portion of the decline in investment between 1975–82 and 1983–85 accounted for by variations in the cost of capital. This estimate is obtained by multiplying the long-run elasticity of investment with respect to the various components of the cost of capital by the change in the average value of these components between the two periods. The calculation indicates that only a relatively small fraction of the fall in private investment is attributable to increases in the cost of capital, even for manufacturing exporters, where investment is more sensitive to changes in the cost of capital. We find that 34.6% of the decline in private investment is

attributable to increases in the cost of capital. Comparable figures for primary exporters are 24.2% of private investment. We, therefore, conclude that the output (and other) effects were a more important contributing factor to the decline in investment than the substitution effect.

4.2. Investment and the debt overhang

While the accelerator model is useful for sorting out the contribution of demand shocks and of changes in the cost of capital, the calculations presented above suggest that other factors must have played an important role in explaining the recent dramatic decline in investment among developing countries. To explore these other factors, we now turn to a forward-looking approach to the investment decision. Clearly, entrepreneurs consider the future before committing long-term resources to production, basing their decision on their expectations about the future path of the main determinants of the investment's return.

In a context where investment is at least partially irreversible once capital is installed, the decision to invest is intrinsically tied to the level of uncertainty about the future evolution of the economy. A high level of uncertainty will reduce the propensity to invest: it increases the possibility that highly productive capacity installed today will be of no use tomorrow if economic conditions deteriorate sharply. Under these circumstances, entrepreneurs would prefer to wait for the uncertainty to dissipate rather than make the decision to invest today. In turn, low investment today increases the probability of economic deterioration tomorrow, making the initial prophecy self-fulfilling (Rodrik, 1989). The economy becomes trapped in an inefficient, low-investment equilibrium.

This outcome is not simply a theoretical quibble. The scenario we have just sketched matches the situation in many developing countries, where the debt overhang and widespread symptoms of adjustment fatigue provide a gloomy outlook for the recovery of private investment. A recent World Bank report (1988) concludes that the long-run sustainability of the adjustment effort is threatened by low investment rates, persistent debt overhang, worsening income distribution and burgeoning fiscal deficits. Under these circumstances, it is no wonder that forward-looking entrepreneurs are quite reluctant to sink resources into nearly-irreversible activities.

To model the forward-looking nature of the investment decision, we assume that the representative firm is constrained by a putty–clay technology and operates in an imperfectly competitive output market. (The model is derived in the appendix.) Production techniques are

Table 7. Investment and the macroeconomic environment (Dependent variable: the adjusted ICOR)

Effect of unit increase in	Investment	
	Private	Total
Debt/exports	1.01	1.34
	(0.21)	(0.62)
(Debt/exports)×(value ICOR)	−0.74	−0.40
	(0.15)	(0.28)
Value ICOR	2.74	2.17
	(0.35)	(0.60)
Real exchange rate, last year	−2.56	−2.66
	(1.07)	(1.91)
(Real exchange rate, last year)×(value ICOR)	3.00	2.60
	(0.90)	(0.87)
Foreign exchange/GDP	−1.11	−2.76
	(0.69)	(0.84)
(Foreign exchange/GDP)×(value ICOR)	−0.10	0.11
	(0.38)	(0.34)

Notes: Sample pools manufacturing and primary exporters. Standard errors in parenthesis, country intercepts not reported. The adjusted ICOR at time t is defined as

$$(q\,IC/p)_t-(1-d)/(1+r)_t(q\,IC/p)_{t+1}$$

where q is the price of investment goods, p the GDP deflator, IC the ICOR, d the depreciation rate and r the real interest rate. The value ICOR is simply $(q\,IC/p)$.

flexible *ex ante* but, once chosen, they cannot be changed in response to subsequent variations in factor prices. Capital-market imperfections are summarized by an agency cost function in which a high leverage is associated with higher costs for the firm. Only debt and retained earnings are available as sources of investment finance. Finally, we dispense with the assumption that the interest rate and the entrepreneur's discount rate are identical. Market imperfections prevent such equalization. The risk premium (i.e., the difference between the discount rate and the interest rate) is assumed to be a function of the macroeconomic environment. The resulting first-order condition (see the appendix) relates the quasi-forward difference in the marginal capital-output ratio (multiplied by the ratio of the investment to the output deflators) to the determinants of the risk premium.

This framework is convenient for investigating whether variables such as the debt ratio, foreign exchange availability, the real exchange rate and public investment have a significant bearing on the investment decision through their impact on the macroeconomic environment.

Table 8. Investment and macroeconomic stability
(Dependent variable: country-specific fixed effects of investment in Table 7)

	Total investment	Private investment
Constant	1.69	1.45
	(0.29)	(0.21)
Standard deviation of real exchange rate	−0.30	−0.15
	(0.12)	(0.09)

Notes: OLS cross section on 20 countries, standard errors in parenthesis.

Estimation of the optimality condition helps isolate the effect of the macroeconomic environment on investment by controlling for the more direct impact that these variables have on investment through other channels such as the cost of capital.

We estimate this model for a smaller sample that combines manufacturing and primary exporters. Table 7 indicates several important results. First, an increase in the debt–export ratio is associated with a lower propensity to invest, possibly because of a higher risk premium. Second, a depreciated real exchange rate and a greater availability of foreign exchange both promote investment.

We also investigated whether the debt–export ratio became more significant during the crisis period. Tests for in-sample stability show that the debt–export ratio has a significantly higher coefficient after 1982.

The picture that emerges from these estimates is that the macroeconomic environment is likely to have had a significant impact on investment. The sample of 20 countries is smaller than one would wish ideally, and the assumption of continuous optimization by agents is a strong one. Yet the results support the often-heard contention that a credible macroeconomic environment is a prerequisite for a sustainable recovery.

Further support for this hypothesis is given in Table 8, which reports the results of regressing the fixed country effects of Table 7 on the standard deviation of the real exchange rate, σ. If fluctuations in the real exchange are a good proxy for macroeconomic instability, then the results in Table 8 confirm the view that investment responds positively to a stable macroeconomic environment.[6] Taken together,

[6] The sample is the same as that in Tables 4–6 except that countries with negative ICORs have been eliminated.

the results in Tables 7 and 8 suggest that the state of the macroeconomic environment explains much of the cross-country variation in investment.[7]

5. Looking ahead

Six years into the crisis that hit developing countries, three facts stand out. First, only manufacturing exporters have resumed growth to pre-crisis levels and stabilized their debt-service burden. Second, the investment share in GDP has declined substantially. Third, the real exchange rate has depreciated sharply, by about 40% compared with its level around 1980. Arguably, a sharp real exchange rate depreciation was called for by the need to service higher interest payments. However, a substantial depreciation was also clearly at the heart of the adjustment-with-growth packages supported by the IMF and World Bank.

Complemented by microeconomic reforms for rationalizing incentives and by other measures aimed at mobilizing resources, depreciation of the real exchange rate was expected to help remove long-standing distortions in factor markets that favoured capital-intensive projects and distortions in goods markets that penalized the production of tradeables, notably exports. The evidence shows that for most countries, adjustment occurred mainly through a reduction in expenditures. To say the least, the econometric evidence is certainly consistent with structuralist arguments that real depreciation elicits little supply response in the short run.

A sustainable recovery requires that income growth exceed population growth. For low-income countries, population growth is around 2% a year. Per capita income growth was still negative during 1986–88 for fuel exporters and positive but less than 0.5% for primary exporters. These countries have not yet achieved sustainable recovery in the strong sense of a growth in per capita income of 1% or more a year. Since adjustment also worsened income distribution in many countries because of the combination of capital flight and plummeting real wages, a sustainable recovery has not yet been achieved.

Yet there is evidence that sustainable growth may be within reach if productivity-raising microeconomic reforms can be sustained long enough. This has been clearly demonstrated by the successful adjustment experience of the East Asian countries during the recent crisis and the spectacular increases in total factor productivity growth they

[7] Alesina and Tabellini (1989) analyse the effects of macroeconomic instability in terms of political decisions.

achieved during a 20-year period of outward orientation. The calculations presented in this paper show signs, in the form of a higher efficiency of investment, that productivity is rising. However, up to now, this effect has been quantitatively small. We also show that only a small part of the decline in investment can be accounted for by the substitution effect arising from the higher cost of investment associated with the sharp real exchange rate depreciation. We therefore conclude that in spite of some investment efficiency improvements, especially among manufacturing exporters, much of the decline in private investment must be accounted for by factors other than the cost of capital. The impact of lower investment on growth was significant. Indeed, if one applies end-of-period ICORs to the estimated elasticities of investment with respect to the real cost of capital, one finds a yearly loss in growth of 1.8% for primary exporters and 1.1% for manufacturing exporters from the lower investment levels that is not caused by a higher cost of capital.

The decline in real income caused by the unfavourable external environment also contributed to the decline in private investment. However, the evidence also supports the contention that, in a world where capital is at least partially sunk once installed, uncertainty about the future course of the economy will lead investors to wait. Econometric evidence from a forward-looking model of investment behaviour shows that investment was negatively related to debt and foreign exchange availability indicators. Therefore, contrary to what has often been asserted, debt relief would raise investment as well as consumption. Evidence was also found that investment was negatively affected by real exchange variability, a proxy for macroeconomic instability.

Two lessons emerge for the design of adjustment programmes. First, in low-income, primary-exporting countries the large real exchange rate devaluation that is central to the adjustment-with-growth strategy may not be effective for a number of reasons. These include the attendant rise in the cost of (mostly) imported capital inputs and the general lack of supply-responsiveness to the real exchange rate depreciation. Second, the microeconomic reforms that have been at the heart of many recent adjustment packages may not bear fruit if there is uncertainty about the sustainability of the stabilization effort. Investors will wait for the uncertainty surrounding a stabilization programme to be resolved, and low investment, in turn, will increase the probability of future economic deterioration. Under these circumstances, there is a high pay-off for achieving macroeconomic stability by taking appropriate measures for partial debt relief and postponing microeconomic reforms if successful implementation is jeopardized by the uncertainty investors feel about the economy. At the same time, the use of funds

available from debt relief should be monitored so as to improve the position of both the creditors and the debtors. As argued by Sachs (1989) and by Claessens and Diwan (1990), debt relief should come with enhanced conditionality to provide the country with the incentive to adjust and, perhaps more crucially, to avoid the resumption of unsustainable macroeconomic policies.

Discussion

Richard Baldwin
Columbia Business School, NBER and CEPR

This paper examines the adjustment of developing countries (LDCs) to the external shocks of the 1980s. The size and scope of the sample are impressive. The authors use a variety of empirical techniques to shed light on the effects on aggregate supply and investment of two typical components of adjustment packages: significant real exchange rate depreciation and microeconomic reforms.

Table 1 studies the determinants of the trade balance. Although the authors are careful to draw only weak conclusions from the evidence, it is worthwhile pointing out some problems with these findings. Consider briefly the theory behind this regression. An accounting identity together with a semi-log approximation imply that:

$$\left(\frac{TB}{GDP}\right)_t = \alpha + (-1)\ln A_t + \ln GDP_t + \gamma_t$$

where γ is the approximation error. Assuming that GDP is a function of the real exchange rate gives us the Table 1 equation. Theory tells us that the coefficient on $\ln A$ should be exactly minus one; the fact that the estimates are consistently greater suggests that the instrumental variables have not fully dealt with the simultaneity problem. For instance, a Keynesian relationship between demand and output could account for the estimated coefficients. If lower demand lowered output as well as improving the trade balance, the coefficient on $\ln A$ would be upward biased. The fact that the estimate is consistently too high casts doubt on the estimation procedure; all the estimates are likely to reflect the impact of the RER. Since the coefficients are all undoubtedly biased it is probably best to think of them as multiple-correlation coefficients. We can therefore say no more than that depreciations are positively correlated with trade-balance improvement in this sample. Table 2 does not shed any light on whether this comes from the contractionary effects of devaluation on demand or its impact on aggregate supply.

The easiest way to avoid confounding supply and demand considerations is directly to estimate the impact of RER on output as is done in Table 3. Here we see that in fact devaluations are correlated with *lower* output; they appear to have a negative supply effect. Of course, as the authors mention, it is difficult to interpret even the signs of coefficients in such a simple estimation of the GDP function.

The evidence in Table 4 suggests that adjustment programmes have improved the aggregate efficiency of LDCs' investment. But since the private ICOR of developed countries (DCs) improved as much as that of the LDCs it is not at all evident that the improvement can be attributed to the adjustment programmes. And although the LDCs' public ICOR improved more than the DCs', this may again be for a large number of reasons. In particular, since the improvement is for only four years, 1983–86, it is very possible that this represents a reduction of public investment which does not directly contribute to GDP, rather than a weeding out of inefficient projects. For example, postponing maintenance on roads and bridges, reduced education expenditures and elimination of long-term public health projects would tend to boost the public ICOR yet may not represent efficiency gains.

The most convincing evidence in the paper is presented in Table 7. The regression results are for a well-specified model of the investment decision. The table presents evidence that devaluation promotes investment, yet a greater debt-to-export ratio discourages investment. Although this is not directly related to the effects of depreciation and microeconomic reforms on supply, it does address an important issue. It suggests that a sustainable macroeconomic environment is important for growth and that acquiring debt to stabilize the economy may be a self-defeating policy.

Charles Bean
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This stimulating and provocative paper seeks to marshall econometric evidence from a panel of developing countries on the wisdom or otherwise of the 'adjustment with growth' packages forced on many of them over the last decade. While I have sympathy with many of the arguments the authors advance, the econometric results are sometimes not as convincing as one would like, and their case might usefully have been buttressed by case studies of individual countries.

My first comment is perhaps more appropriately directed at the IMF and the World Bank than at the authors of this paper. A key feature in these adjustment packages has been real exchange rate depreciation, and Faini and de Melo follow this line of thinking by treating the real

exchange rate as a largely exogenous variable under the control of the authorities. But how are such real depreciations achieved? In the short run a monetary relaxation i.e. a nominal devaluation/depreciation, will do the trick, but in the medium term one would expect the consequent improvement in competitiveness to be whittled away as domestic wages and prices adjust. In the long run a real exchange rate depreciation can be sustained only if it is accompanied by other real changes such as a fiscal contraction or a successful incomes policy. The effect on the economy will differ depending on the nature of the supporting policies (the latter is supply enhancing; the former is generally not), and the authors fail to control for this.

Turning next to the results of Tables 2 and 3 in Section 3, I must confess to some unease at the rather cavalier treatment of the question of identification, with the real money supply, surely an endogenous variable, playing a major instrumental role. Faini and de Melo admit that they cannot sort out whether their trade balance equation reflects demand switching or a supply response. But I do not see why their supply equation should be any more successfully identified, especially since for lack of data it omits important supply-side variables such as the capital stock and own-product wages (for which the real exchange rate seems likely to be a poor proxy). This may not matter too much if the equations are used for reduced form 'historical accounting' exercises such as those to which the trade balance equation is put, but should make one wary of making policy recommendations based on an assumed channel of response.

The discussion of the adverse effect of a real exchange depreciation on the cost of capital and thence investment provides an interesting counterpart to the literature on European unemployment which has identified the terms of trade deterioration following OPEC I and II as a potential source of wage pressure and adverse supply-side developments in the 1970s and early 1980s. However, the results suggest that increases in the cost of capital account for only a third (quarter) of the decline in private investment in manufacturing (primary) exporters. Since virtually all of the action comes from variations in the real interest rate rather than the price of capital goods (see Table 4), it would appear that the impact on investment of the real depreciations via the cost of capital is essentially negligible.

The authors then go on to consider a more structural model of investment in which the impact of the macroeconomic environment can be more directly assessed. Although the main text makes much of the effect of uncertainty and irreversibility in leading to a 'wait-and-see' attitude on the part of entrepreneurs, the model of the appendix does not explicitly incorporate this feature (it is in fact valid only under point

expectations). Instead there is an *ad hoc* risk premium which depends on macroeconomic variables such as the debt–export ratio and the availability of foreign exchange. The results in Table 7 suggest that these variables are statistically important. Unfortunately, because the estimated equation is an intertemporal optimality condition it is not easy to gauge their quantitative significance, which requires solving the full optimization problem facing the entrepreneur. It would have been useful if the authors had given the reader some guidance here.

Finally, the discussion sometimes confuses the issue of macroeconomic uncertainty with the question of the credibility of economic policies (when the reader is told, for example, that the results 'support the often-heard contention that a credible macroeconomic environment is a prerequisite for a sustainable recovery'). A set of announced policies can be completely 'incredible' i.e. unsustainable, and consequently the path of future policy instruments entirely predictable. By contrast a set of announced policies can be 'credible' i.e. sustainable, but there can be considerable uncertainty about whether the government will actually stick to them. Identifying an adjustment programme that is both credible and successful is child's play *ex post*; identifying it *ex ante* is another matter entirely!

General discussion

Many panelists focused on the difficulty of interpreting regression equations at this degree of aggregation. In particular, it was hard to know how best to capture the effect of uncertainty: Jean-Paul Lambert thought that some measure of the variability of export prices might be more appropriate for many primary commodity exporters. Horst Siebert pointed out that microeconomic determinants of uncertainty (such as the probability of expropriation) had been changing significantly in many countries during the period under consideration. He also thought it important to control explicitly for unanticipated changes in fiscal and monetary policy. Daniel Cohen was unhappy with the interpretation given to the debt–export ratio, which could represent many different influences on investment.

There was some discussion also of policy implications. David Newbery pointed out that primary commodity exporters faced a serious difficulty: if the elasticity of demand for their products was less than unity, an expansion of exports along the lines demanded in structural adjustment programmes might lead to their becoming worse off overall. Paul Seabright suggested that devaluation meant very different things for primary commodity and for manufactured exporters: for the former,

a devaluation would have little effect on the foreign currency price of their exports but would change mainly the relative domestic price of tradeables and non-tradeables; it was unsurprising that dramatic effects were hard to find in the short term. For manufactured exporters, however, devaluations changed the prices of their goods relative to competing products and could be expected to yield appreciably greater results in the short term.

Appendix. A forward-looking model of investment

The representative firm is assumed to be constrained by a putty–clay technology and to operate in an imperfectly competitive output market. Imperfections in capital markets constrain the financing choice of the firm. There is no well-functioning stock market. There are, as a result, only two sources of finance: (short-term) debt and retained earnings. Entrepreneurs discount future returns at a rate, i, which is assumed to be larger than the risk-free interest rate, r (otherwise firms would accumulate financial assets). Therefore, debt is the privileged source of finance (perhaps also because of its favoured tax status). However, an internal solution to the optimal debt decision is obtained by assuming that higher outstanding debt relative to the firm's capital is associated with increasing agency costs.

The firm's problem can be written as:

$$\max \sum \left(\frac{1}{1+i}\right)^t [p_t(Q_t)Q_t - w_t N_t - q_t I_t + B_t - B_{t-1} - r_t B_{t-1} - A[(B_t, p_t(\cdot)Q_t)] \tag{A1}$$

s.t.

$$Q_t = \sum_{v=t-L}^{t} (1-\delta)^{v-t} I_v f(k_v)/k_v \tag{A2}$$

$$N_t = \sum_{v=t-L}^{t} (1-\delta)^{v-t} I_v/k_v \tag{A3}$$

where Q_t, N_t, and I_t represent output, employment and investment, respectively, $p_t(Q_t)$ is the inverse demand function, and w_t and q_t are labour and investment costs, respectively. On the financial side, r_t is the risk-free interest rate and $A(B_t, p_t(\cdot)Q_t)$ with $A_1 > 0$, $A_2 < 0$ and $A_{11} > 0$ is the agency cost function. Equations (A2) and (A3) define the production and the labour demand function for a putty–clay technology, where L is the average life of capital goods, δ denotes their depreciation rate, and $f(k_v)$ and k_v represent the *ex ante* production function (in intensive form) and the capital-labour ratio.

The first-order conditions for output and debt are:

$$g(q_t, \bar{w}_t) - \frac{1-\delta}{1+i} g(q_{t+1}, \bar{w}_{t+1}) = MR_t - MR_t A_2 \tag{A4}$$

$$(1+i)(1-A_1) - (1+r) = 0 \tag{A5}$$

where MR_t denotes marginal revenue and $g(\ )$ is an increasing function of factor prices (Nickell, 1979). The function g represents the present discounted value over a lifetime of marginal costs of installed capacity for a machine after allowing for depreciation. At an optimum, the cost of an extra unit of capacity today is equated to marginal revenue plus the discounted saving of not having to install more capacity tomorrow. The variable $\bar{w}$ represents the present discounted value of labour costs over the lifetime of a machine. Even after parameterizing the agency cost function and the *ex ante* production function, one cannot estimate (A4) since $\bar{w}$ is not observable. We can, however, substitute out for $\bar{w}$ by using the first-order condition for k_v (not reported in the text), which relates the marginal rate of substitution between labour and capital in the *ex ante* production function to $q_t/\bar{w}_t$. We find that $g(\ ) = q_t/f'(k_t)$.

For the purpose of estimation, we assume that $f(k_t)$ is Cobb–Douglas and $A(\ )$ is quadratic, i.e.:

$$A(B_t, p_t(\ )Q_t) = a/2\left[\frac{B_t^2}{(p_t Q_t)^2} - C\right] p_t Q_t \tag{A6}$$

Substitution and manipulations yield:

$$\frac{q_t IC_t}{p_t} - \frac{1-\delta}{1+i^r}\frac{q_{t+1} IC_{t+1}}{p_{t+1}}$$

$$= \frac{(\varepsilon-1)\alpha}{\varepsilon}[1/2a(i-r)^2/(1+i)^2 + 1 + ac/2] \tag{A7}$$

where IC_t denotes the incremental capital-output ratio, i^r is the real interest rate, $[1+i^r = (1+i)p_t/p_{t+1}]$ and ε and α represent the price elasticity of demand and the capital elasticity of output, respectively. The right-hand side of (A7) is equal to $MR_t(1-A_2)$ after substituting from (A5) and (A6) and multiplying by α/p_t. To interpret the left-hand side of (A7) notice that a large value of IC indicates a relatively more capital-intensive technique on the latest vintage which in turn must be attributed, for a given q, to a relatively high level of $\bar{w}$, i.e. of the present discounted value of labour costs over the lifetime of machine. As a result the present value of marginal costs associated with a machine (the function $g(\ )$) will be also large and lead, as indicated by (A4), to a lower capacity output. For a given value of δ, (A7) could have been

estimated had we assumed that $i = r$. Suppose though that $1+i = (1+r)(1+\rho)$, where ρ is a multiplicative risk premium that depends on the macroeconomic environment. Multiply (A7) by $1+\rho$ and bring the unobservable terms from the left-hand to the right-hand side. We then assume that ρ can be expressed as a function of the state of the macroeconomic environment.

Equation (A7) provides the basis for estimation. We experiment over different values of δ. Notice that if ρ is not equal to zero, then the lagged value of $q(IC/p)$ should belong on the right-hand side of the equation. Fixed-effect estimation under these circumstances would be problematic: the speed of convergence is a function of the number of observations per country. To circumvent this problem, we rely on a modified Anderson–Hsiao (1982) procedure. To eliminate the fixed effect, we take first differences of the original equation. By doing so, however, the error term, if it was white noise to begin with, is transformed into a first-order unit-root moving average process which is correlated with the first difference of $q(IC/p)$. Therefore, we use an (efficient) instrumental variable procedure by exploiting all the orthogonality restrictions between the error term and $q(IC/p)_{t-i}$ where $i > 1$. This generalized method of moments estimator was implemented in the DPD programme developed by Arellano and Bond (1988b).

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