Capital Account Liberalization and Disinflation in the 1990s

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This paper addresses the potential link between two relatively surprising international economic trends of the 1990s. The first is global disinflation. Why did inflation fall so quickly, even in countries with long histories of high inflation? Latin America's average inflation rate, for example, fell from over 400% in 1990 to under 10% in 1999. A second puzzle is why so many countries opened their capital accounts in the 1990s, despite warnings regarding the risk of currency and banking crises. Are these two developments related? Does capital account liberalization facilitate disinflation by raising the penalties for excess money creation? David Romer (1993) explores a similar hypothesis for openness to trade. But whereas trade shares evolve slowly, even a landlocked country can liberalize its capital account more or less overnight. Did countries that opened their capital accounts in the 1990s find it easier to disinflate, and why? These are the key questions addressed in this paper.

Bartolini and Drazen (1997) and Laban and Larraine (1997) suggest governments may liberalize their capital accounts to boost foreign and domestic investor confidence. Their willingness to accept the punishment of capital outflows signals their commitment to policy reform.[1] When it comes to monetary policy, however, capital account liberalization is more than a signal of good intentions. It directly raises the penalty for loose monetary policy. Easier access to foreign exchange raises the elasticity of demand for money and makes the central bank vulnerable to rapid reserve losses—sometimes termed currency substitution. Reserves are less of an issue for flexible rate regimes, but rapid currency depreciations can also be inflationary. By raising the penalties for excess money creation, central banks can alter private sector expectations regarding future monetary policy. The temptation to print money is reduced and the time consistent inflation rate falls as in the well-known models of Barro and Gordon (1983).

There is now substantial empirical evidence of a negative correlation across countries and over time between output growth and inflation. Any policy that facilitates disinflation therefore has important indirect benefits for growth and poverty reduction.[2] That capital account opening may facilitate disinflation is also important because many question the wisdom of capital account

[1] Bartolini and Drazen (1997) and Laban and Larraine (1997) also emphasize the policy signaling potential of capital account opening. However, these papers focus primarily on private investment rather than inflation. They argue capital account liberalization can induce higher capital inflows as governments signal future policy changes that imply higher profits and/or more easily reversible investment decisions.

[2] High inflation appears to reduce growth-- see De Gregorio (1993), Barro (1997) and Easterly and Robelo (1992)-- and increase poverty see Cardoso (1992), Lustig and McLeod (1997) and Romer and Romer (1998).

liberalization. Rodrik (1998), for example, argues that capital inflows undermine central bank efforts to control inflation and asserts that there is no evidence that greater capital account convertibility is associated with lower inflation.[3] McKinnon and Mathieson (1981) recommend capital controls as inflation reducing in financially repressed economies. Lowering the interest elasticity of demand for domestic currency by reducing currency substitution opportunities reduces the inflation rate necessary to generate a given amount of seigniorage revenue. Others argue large external shocks may undermine the credibility of monetary authorities or lead to sudden reversals of capital inflows—again leading to devaluations and higher inflation.

In some respects, this paper simply extends Romer's (1983) argument regarding inflation and trade openness to the capital account—particularly among small open economies. In the model of the next section, capital account liberalization reduces the inflation rate that maximizes seigniorage and increases the reserve loss penalties for excess money creation. Inflation falls because the private sector anticipates the tighter monetary policy necessary to prevent currency substitution and reserve losses. Section 2 provides cross-section evidence on capital account liberalization, both for the Romer (1993) sample of 112 countries and for a subgroup of developing countries. We exploit the wave of capital account liberalizations in the first half of the 1990s to test for liberalization effects on the pace of disinflation. Appendix A provides econometric tests of the capital account openness index constructed for this paper and Table A-1 provides the composite index for 112 countries.

I. Capital Account Openness and Disinflation

How can a central bank with a poor record of monetary discipline convince the private sector that it has changed its ways? The literature on signaling monetary discipline has explored a number of institutional fixes: greater central bank independence, hiring a conservative central banker, setting up a currency board, joining a monetary union, fixing the exchange rate temporarily, etc. All of these institutional changes seek to reduce the inherent inflationary bias of discretionary monetary policy by either tying the hands of the monetary authorities or by increasing the penalties for excess money creation. Opening a country's capital account involves a range of considerations

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[3] Rodrik (1998) overlooks the evidence provided by Grilli and Milesi-Ferretti (1995) who find a significant negative relationship between capital account openness and inflation. Grilli and Milesi-Ferretti (1995) do not, however, examine the effect of changes in capital controls on inflation. Moreover, their study ends in 1989, before the capital account liberalization wave of the 1990s began. See also Davidson (2000), Krugman (1998) and Wade and Veneroso, 1998.
[4]

and a risk, but certainly one important by-product of enhanced convertibility is a more constrained monetary policy. Since the private sector understands these constraints it becomes easier for the Central Bank to credibly restrain money creation.

The model developed here focus on central bank behavior in a small open economy with a managed exchange rate. Romer (1993) and Lane (1997), in contrast, explore the impact of trade liberalization on inflation rates in large flexible exchange rate OECD economies. Romer (1993) models a large economy for which increased openness worsens the output inflation tradeoff. Central Banks in more open economies avoid monetary expansions because the resulting real depreciation of the exchange rate is more inflationary.

The small open economy considered here often experiences inflation rates too high to be explained by efforts to exploit an expectations-adjusted Phillips curve as in Romer (1993). Rather than seeking to exploit output inflation tradeoffs [5] the Central Bank succumbs to Treasury pressure to generate seigniorage revenue, as in Barro (1993). With tax revenue from other sources limited, the inflation tax becomes the path of least resistance for the fiscal authorities. Of course private agents seek to evade this tax and opening the capital account gives them more opportunities to do so. This is the core of the story explored here.

Seigniorage revenues are limited by the stock of local currency in circulation. Capital account openness raises the inflation elasticity of demand for local currency, allowing access to substitute currencies. Without an offsetting currency depreciation, higher inflation also worsens the trade balance potentially drawing down the Central Bank's foreign currency reserves. Inflation in excess of world rates may affect the speculative demand for dollars by private investors who fear a future devaluation. Thus the central bank faces a tradeoff between tax revenues and potential loss of reserves-- higher inflation raises tax revenues but risks destabilizing the currency.[6] With a flexible exchange rate the higher seigniorage revenue comes at the risk of potentially inflationary currency depreciation. We explore the "semi-fixed" exchange rate case[7] under which the Central Bank maximizes,

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[5] In small open economies real exchange rate depreciations may or may not be expansionary and inflation-output tradeoffs may not be exploitable in any case—see Agénor and Montiel (1999) for a review of the contractionary devaluation literature. Hence the model developed here also fits our sample of 112 countries since the majority of these countries are small open developing economies.

[6] McLeod and Welch (1993) use a similar setup to examine the choice of exchange rate regime.

[7] By semi-fixed exchange rate, we refer to a fixed rate regime where the Central Bank retains the option to devalue under certain circumstances—hence the value of reserves. A number of LDCs recently switched to "floating" exchange rates, but upon closer inspection reserves remain important even in these regimes. Mexico and Brazil, for example, claim to have "floating" exchange rates but still take pains to publish their reserve levels daily or weekly—Calvo and

(1) $U_{CB} = \theta_1 S(\pi^e) + \theta_2 \Delta R(\pi^e, \pi^*, \pi)$

with respect to the rate of money growth μ, subject to standard money demand and trade balance equations elaborated below. The value the Central Bank puts on seigniorage, $S(\pi^e)$ depends in part on the degree of central bank independence (CBI). Treasury pressures to raise revenue, θ_1 are balanced against the monetary authority's commitment, θ_2 to defend its semi-fixed exchange rate by maintaining a stock of reserves, R. For a semi-floating regime ΔR could be replaced with Δe with monetary authorities adverse to big changes in the nominal exchange rate. Agénor and Montiel (1999) work with a similar setup, but the CB balances seigniorage revenue against tax revenue lost to the Olivera-Tanzi effect and dead-weight inflation costs.

To bring capital controls directly into view, add a Cagan semi-log money demand equation where nominal interest rates are dominated by expected inflation. For a given steady-state level of output, demand for real money balances then depends mainly on expected inflation, π^e. When the money market is in equilibrium seigniorage revenue amounts to,

(2) $*S = \mu m^d = \mu m_0 \exp(-\alpha(\tau_1) (\pi^e - \pi^*))$

where the elasticity of demand for money, $\alpha(\tau_1)$, depends on the degree of capital account openness with τ_1 varying from zero to one as restrictions on foreign currency transactions are lifted. Easing exchange controls makes it easier for residents to avoid the inflation tax by switching to foreign currency. As capital account restrictions are lifted, the inflation elasticity of demand for domestic currency rises, that is $\partial\alpha/\partial\tau_1 > 0$. In the steady state, seigniorage equals the inflation tax, that is $S = \mu m_d$ where μ is the money supply growth rate set by monetary authorities. In equilibrium $\mu = \pi$ and the revenue maximizing money growth rate is $1/\alpha(\tau_1)$. Whether operating in a fixed or floating exchange rate regime, capital controls raise the optimal inflation rate as they lower the interest rate elasticity of money demand.

However, inflation is not costless and reserves are needed to support a fixed exchange rate regime. Hence another potential cost of higher seigniorage involves loss of reserves through trade account when home prices rise faster than foreign prices, $\pi > \pi^*$. Again controls on capital and current account transactions reduce the sensitivity of the trade surplus to variations in domestic

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Reinhart's "Fear of Floating" discussion reaches a similar conclusion suggesting this reserves specification applies to

inflation. Central Bank reserves depend on the trade balance TB and net private capital inflows as reflected in the change in foreign assets, ΔF,

$$(3) \qquad \Delta R_t = TB(\pi - \pi^*, \tau_2) + \Delta F(\pi^e - \pi^*, \tau_1, \tau_2).$$

The trade balance TB in turn depends on the appreciation of the real exchange rate, $\pi - \pi^*$. Net private capital inflows, ΔF, depend on expected inflation, π^e. Higher expected inflation raises investor fears of future devaluations so they hedge by exchanging local currency for dollar assets. Restrictions on current account transactions, represented here by τ_2, can also affect capital account convertibility. As Dornbusch (1990) emphasizes, residents often evade capital controls by using current account transactions to accumulate foreign assets by over-invoicing imports or under-invoicing exports. Controls on current account transactions also make the trade balance less sensitive to changes in domestic inflation. Both types of controls thus reduce the "reserve loss" penalty associated with higher inflation.

Capital and current account controls give the central bank some discretion over monetary policy, despite a fixed exchange rate. To solve for the inflation under a discretionary regime, we assume $\pi^* = 0$ and $m_0 = 1$. The central bank retains the option to change future money growth taking the private sector's expected inflation rate set by the private sector as given and maximize (1) subject to (2) and (3). To get an illustrative solution for a discretionary money regime, take a central bank utility function similar to that of Agénor and Montiel (1999) and Barro (1993),

$$(4) \qquad U_{CB} = \theta\mu m_0 \exp(-\alpha(\tau_1)\pi^e) - \exp(\gamma_1\tau_1\pi^e + \gamma_2\tau_2\pi).$$

The first term reflects seigniorage revenue, a positive for the CB, while the second term in parenthesis summarizes the negative effects of higher inflation on the trade and capital account. The policy weights are combined as $\theta = \theta_1/\theta_2$. Now $\gamma_1\tau_1$ captures the response of reserves to expected inflation π^e as attenuated by capital controls, τ_1, while $\gamma_2\tau_2$ captures the impact of actual inflation on reserves via current account restrictions, τ_2. The monetary authorities maximize subject to money demand equation (2) and potential reserve losses, taking private sector inflation expectations as

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these "flexible" or semi-floating regimes as well.

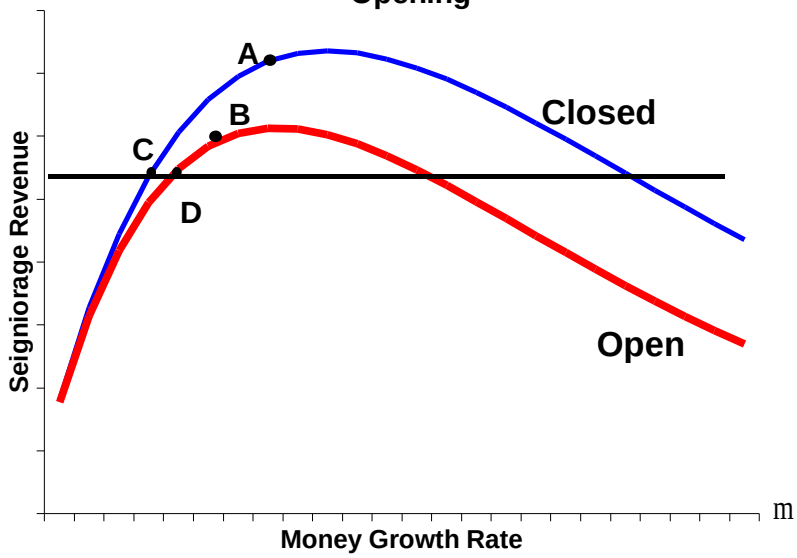
given. Recalling that in the steady state $\mu = \pi$ and output is given, taking the log of both sides of (1) and solving for inflation under discretionary monetary policy π_d,

$$(5)\quad \pi_d = \ln[\theta/(\gamma_1\tau_1)]\,[(\tau_1\{\alpha(\tau_1) + \gamma_2\} + \gamma_2\tau_2]^{-1}$$

where $\theta = \theta_1/\theta_2$ or the relative weight of seigniorage to reserve targets in the CB utility function. Note that increasing capital account or current account openness, that is raising τ_1 or τ_2, lowers the equilibrium inflation rate both by lowering the optimal inflation rate and by making the balance of payments more sensitive to domestic inflation. The solution for rules-based monetary policy where the monetary authorities can effectively pre-commit to the optimal inflation rate is similar. Inflation starts lower under the rules regime but also falls with capital account liberalization as capital controls change the penalties for higher inflation, whether its expected or unexpected.

In this model, the central bank maximizes seigniorage, balancing the benefits of higher inflation against potential reserves losses. Loosening capital controls raises the elasticity of money demand, reducing the optimal seigniorage-maximizing rate of inflation. But what if the central bank is not free to reduce its fiscal revenue contribution? This seems to be the situation McKinnon and Mathieson (1981) focused on in their wonderfully titled monograph "How to Manage a Repressed Economy." These two contrasting scenarios are summarized in Figure 2. In the model outlined here, opening the capital account raises the elasticity of demand for money, shifting the inflation Laffer curve down and to the left. The central bank reduces money growth from A to B as potential reserve and dead-weight losses keep money growth a bit to the left of each Laffer curve's peak. But note that moving from A to B seigniorage revenue also declines. Holding seigniorage revenue constant— the no fiscal adjustment case of McKinnon and Mathieson-- inflation rises from C to D when the capital account opens. Clearly if the money growth is on the far side of the Laffer curve, capital account opening reduces inflation with or without fiscal adjustment.

Figure 2: Inflation and Capital Account Opening



Yet another line of reasoning that suggests capital account liberalization may increase inflation derives from the observation that large external shocks may undermine central bank credibility as in Dornbusch (1990). To the extent that capital controls help insulate monetary policy from disruptive external shocks or big swings in capital inflows, they make it easier to manage the money supply. This is the main argument of Rodrik (1998) and in part appears to be what led Krugman (1998) to advocate capital controls for Malaysia and other emerging market countries.

II. Capital Controls and Disinflation: Empirical Evidence

In the model of the previous section, capital account opening reduces inflation by lowering the optimal rate of money growth. But there are other scenarios under which capital account liberalization can increase inflation—such as the no fiscal adjustment scenario of McKinnon and Mathieson (1981). As it happens, the 1990s provide a natural opportunity for assessing the impact of capital account liberalization on inflation. While not universally embraced, capital account liberalization did become more fashionable in the 1990s. Of the 112 countries in our sample, the IMF Survey of Exchange Rate Arrangements shows 69 eased restrictions on foreign currency transactions, 17 tightened controls and 26 countries made no change in policy. As shown in Figure 1, the overall trend was toward capital account opening as an index of average global openness for 112 countries rose from 1.6 in the 1980s to 2.1 in the 1990s. During the 1980s only 13 countries

had no convertibility restrictions of any kind for the entire decade—a perfect score of 4.[8] During the 1990s this "totally open" group expanded to 21 countries.

A number of studies use IMF Survey data to explore the relationship between openness and inflation.[9] To investigate how capital account liberalization affects inflation, we construct a liberalization index aggregating four convertibility restrictions monitored by the IMF. As discussed previously, governments use a wide variety of methods to restrict currency convertibility including current account restrictions that may reduce access to dollar assets as well. The liberalization index used here was tested econometrically, as discussed in appendix A. We used a four-component index to run a series of regressions similar to those reported in Tables 1 and 2. The second step was to test each component of this index. Any component of the index that failed either conventional significance tests or tests for equality of coefficients was dropped from the index. The result was three-component index described in detail in Appendix A.

Table 1 summarizes the main results using the three-component index of capital account liberalization tested in Appendix A (the four component index includes multiple exchange rate regimes, the three component index does not). Our basic 112-country sample includes the same 20 OECD and 82 developing countries used in Romer (1993). Table 2 provides a similar set of regressions for a subgroup of 80 developing countries. For both groups of countries, capital account liberalization had a significant impact on the rate of disinflation—measured here as the fall in average inflation between 1981-1990 and 1991-1996. Countries that opened their capital accounts experienced greater disinflation in the 1990s than those that did not. Capital account liberalization was more important for developing countries and for countries with a history of Central Bank turnover—results consistent with the Barro-Gordon credibility models discussed in section 2.

As in Romer (1993) all equations include per capita income and openness—imports over GDP. Per capita income was always significant, but trade openness rarely has an impact. We also tried using the change in openness with the same lack of success. Apparently trade shares change

[8] For example, if a country employed capital account restrictions in five of ten years, it receives a .5 for that d decade. A country that did not employ a given restriction in any year receives a "1" for that decade, and so on. The 1980s are defined as 1981-90 and the 1990s are 1991-96—in 1997 the IMF changed the format of its survey and the data are not comparable with the previous survey.

[9] Romer (1993), Lane (1997) and Campillo and Miron (1996) explore the empirical link between trade openness and inflation. Though they differ on causal mechanisms and ancillary variables, each of these papers find a strong link between inflation and openness to trade, as measured by the share of imports in total GDP. Similar results for capital account openness and inflation are found Grilli and Milesi-Ferretti (1995). Using a panel data set over the period 1973-89, they find that greater restrictions on capital account transactions and convertibility are associated with higher inflation. Grill and Milesi-Ferretti, do not however, explore the potential link between capital account liberalization and inflation. The period 1973 to 1989 was one of constant to increasing capital controls. In 1990s however capital account liberalization again came into fashion.

slowly acting as "state variables" or proxies for institutional conditions associated with openness to trade. We also found the latitude or proximity to the equator made disinflation more difficult as did being in Latin America.

To reduce the impact of outliers and heteroskedasticity, the basic regression equation 1.1 was also run excluding the five countries where inflation averaged over 100% annually in the 1980s. These results are reported as equations 1.2 and 2.2—with essentially unchanged results. To avoid the statistical errors and confusion caused by heteroskedasticity problems, the standard errors we report are calculated by White's heteroskedasticity-consistent method. The third line from the bottom in Tables 1 and 2 also reports the confidence level at which heteroskedasticity can be rejected based on the standard White test. Heteroskedasticity is not a problem in equation 1.3 when the same political stability variable used by Romer (1993) is added to the basic model. However, when we move to the smaller 52-country sample for which the Central Bank Independence indices are available, the White test does suggest a problem of heteroskedasticity. To reduce this problem, equation 1.4 is estimated again using the Central Bank turnover rate as the weighting variable. This reduces heteroskedasticity and increases the impact of capital account liberalization. That is, in countries with a history of problems with central bank turnover, capital account opening has a bigger impact on the rate of disinflation. This is consistent with the disciplining or signaling interpretation of capital account opening underlying the model of the previous section.

In addition to the institutional and structural variables discussed above, it is also important to control for other "fundamentals." Campillo and Martin (1996) claim to find less support for institutional variables as determinants of inflation and more for fundamentals such as public debt to GDP ratios in determining the rate of inflation across countries (they do not look at changes in inflation). We also tried various debt burden measures, levels and changes, but found no consistent effects on disinflation. Another obvious fundamental is the budget deficit. Equations 1.4 and 2.4 include the change in the average budget surplus, 1980s to 1990s as reported by the World Bank. This variable is sometimes significant—especially in the weighted least squares estimates.

Another econometric problem involves the potential endogeneity of capital controls. Countries that disinflate may then be in a better position to open their capital accounts. To cope with this problem, we turn to instrumental variables. The last three columns of Tables 1 and 2 report instrumental variable estimates of equations 1.1, 1.3 and 1.4. The instruments used to predict changes in capital controls and budget surpluses are largely country size variables: total GDP in

1980 dollars, the total square miles of land and oil exporters. Large countries, economically and geographically, tended to liberalize less. Oil exporting countries were less likely to liberalize.

The two-stage estimates tend to show a stronger impact of capital account liberalization on inflation—and in every case capital account opening remains a significant predictor of disinflation. Two specification tests were used to evaluate these instrumental variable estimates. The first uses a Hausman-type specification test to compare the OLS and TSLS estimates, assuming the later are consistent. Assuming that the endogeneity of capital controls is what makes the OLS estimates inconsistent, this test can be interpreted as a test of the extent to which these variables are endogenous and/or that simultaneous equation bias is a problem.[10] The penultimate rows of Tables 1 and 2 provide mild evidence that capital controls and/or the fiscal deficit have an endogenous component and warrant two-stage estimation.

The second specification test provided in each Table is the Sargan instrument validity test. The last row of Tables 1 and 2 provides the confidence level for rejecting the null hypothesis that the instruments are correlated with the error term. The results of this test strongly confirm what should be obvious from the type of instruments selected—the instruments chosen here are not correlated with the dependent variable-- the rate of disinflation.

Taken together these specification tests suggest that the instrumental variable estimates presented in the last three columns of Table 1 and 2 provide a better indication of how capital account liberalization affects inflation. In almost every case the coefficient on capital controls is higher in the TSLS—hence we conclude if anything the OLS understate the importance of capital account opening

IV. Conclusions

Recent financial crises in Latin America and Asia have led many to question the benefits of capital account liberalization. Rodrik (1998) bluntly sums up the skeptics' view: "Enshrining capital account convertibility in the IMF's articles of agreement is an idea whose time has not yet come. We have no evidence it will solve any of our problems, and some reason to think it will make them worse."[11] The lessons of an earlier wave of Latin American balance of payments crises,

[10] Davidson and MacKinnon (1993) term this "endogeneity" test the Durbin-Hausman-Wu (DWH) test and provide the artificial regression approach used to conduct this test for Tables 1 and 2.

[11] Rodrik also takes a stand on the empirical evidence, "The bottom line is easily summarized. There is no evidence that countries without capital controls have grown faster, invested more or experienced lower inflation. Capital controls are essentially uncorrelated with long-term performance once other determinants are controlled for." Rodrik (1998, p. 9).

particularly the Southern Cone programs of the late 1970s, also provided cautionary tales regarding the proper "sequencing" of current and capital account liberalization.

Despite these misgivings and warnings, the 1990s saw a concerted and continuing move toward capital account liberalization. This paper identifies one potentially important benefit of this liberalization, quite apart from greater access to external financing or "signaling" policy regime changes. Capital account openness appears to discipline monetary authorities, or to help them convince the private sector that they will be more disciplined in the future. Our results suggest that sustained removal of even one capital or current account restriction—as reported in IMF Survey of Exchange rate restrictions-- can reduce average annual inflation by as much as 3%. And since the link between high inflation and economic growth and poverty is now fairly well established (see footnote 6), disinflation may be an important indirect benefit of increased global integration.

His indictment of liberalization follows "It is not that capital controls are necessarily the solution to any of these problems, they are not. But capital account liberalization fits the bill even less." Rodrik (1998,p. 3).

Appendix A: Text of Restrictions implied by an Aggregate Index of Currency Convertibility

From 1968 to 1996 the IMF Survey of Exchange Rate Arrangements tracks the use of four different restrictions on currency convertibility.[12] To help overcome some limitations of the IMF survey indices, which are basically check marks without much specific detail,[13] we average each restriction across decades—not relying on a particular year of liberalization—and we focus on a composite index constructed from four different types of capital or current account convertibility restrictions (see Figure 1). Each index tracks a country that employs a restriction in a given year with a 1 the year that restriction is noted in the Survey.[14] In section 2 we argue both current and capital account restrictions can restrict capital account transactions.[15] In practice it is difficult to restrict access to foreign exchange without resorting to both types of restrictions. A country that begins with capital account restrictons may add current account restrictions and vice versa.

In these situations an aggregate index may provide more information than each component taken separately. But should that aggregate index include all four types of restrictions tracked by the IMF, or some subset of these? Do current account restrictions actually affect macroeconomic variables similarly to capital account restrictions? This section provides some insight into both of these questions by testing restrictions implied by an aggregate index.

The first, referred to as the A Index includes all four of the restrictions monitored by the IMF in its Annual Survey of Exchange rate arrangements. These four categories are shown in Figure 1. The overall index averages restrictions for 112 countries, taking a value between 0 and 4 depending upon the proportion of years a given restriction was employed in each decade. We then used this four-component A-index to estimate a series of cross sections regressions with the change in the log of the average inflation rate between the two decades as the dependent variable. These regressions, very similar to those in Table 1 below, are reported in an earlier paper Gruben and McLeod (2000). The next step was to test the structure of this index component by component. These regressions are reported in Table 3 and section 3 below. These tests suggest that lifting on category of exchange rate restrictions, the use of multiple exchange rates, was not associated strongly association with disinflation. All three of the remaining restrictions including current and capital account restrictions, and "surrender of export proceeds" tend to have significant coefficients

[12] In their comprehensive survey, Grilli and Miles-Ferretti (1995) use these indices to study the effect of capital controls on GDP growth and inflation. Their results show level of capital controls do contribute to inflation. Klein and Olivei (1998) use a similar capital controls index to study financial market deepening.

[13] There are a number of limitations of indices constructed from the IMF survey. See for example Quinn and Toyoda (1996). Cooper (1999) provides the improved Quinn-Toyoda openness index for 1989. Unfortunately their reworked IMF index for the 1990s will not be available until 2002. Our tests using their controls index produced results very similar to those reported in Tables 1 and 2, albeit for the average rate of inflation and the level of capital controls—not the first difference of both variables that is the main subject of this paper.

[14] This index is then averaged across a decade and then subtracted from one. If the country did not employ that restriction at all during the decade, it receives a "1" designating full openness with regard to that restriction,

$$t_{80s} = 1 - (1/n)\sum_{i=1}^{n} t_i$$

If restrictions were employed for 5 of 10 years, the index would take a value of .5. If a country employ a given restriction for the entire decade the index would be zero indicating no openness.

[15] In countries that employ capital controls, for example, a popular method of accumulating dollar assets abroad is to over invoice imports or under invoice exports, see Dornbusch (1990). In this case current account restrictions or even "surrendering export proceeds" may also inhibit capital account transactions.

of similar magnitude and sign in many of test regressions. These three restrictions also passed a Wald test with the null hypothesis that all had equal magnitude and sign—the implication of aggregate index (see Table 3 footnote 4).

Table 3 reports the same regressions reported in Tables 1 and 2 with the index split into its four components. To conserve space, Table 3 only reports the coefficients on the four convertibility restrictions. Again the index is computed by summing years in which restrictions were in place, dividing by the total years in the "decade" and then subtracting that average from one.[16] The results reported in Table 3 suggest that the various types capital and current account restrictions have significant impacts on the rate of disinflation, with multiple exchange rates being a possible exception. Moreover, the coefficients associated with these components are similar in magnitude to those reported for the aggregate index in Tables 1 and 2. There is, however, a correlation between the capital account and "surrender" variable—hence equation 2.1 is also reported without the "surrender" variable. Note that compared to other restrictions, the multiple exchange rate variable is less significant and not reliably negative. Table 3 provides tests of two restrictions—one that all four variables have the same value and one that all variables except the multiple rate variable are equal. It is much harder to reject the null of equal coefficients for the three components other than multiple exchange rates.

The evidence on the multiple exchange rates suggests these restrictions are not as damaging as other forms of capital account restrictions—a result consistent with the 1980s literature on dual exchange rates for capital and current account transactions. Given this evidence, and the acceptable Wald tests for the other three components, we recomputed our index leaving out the multiple exchange-rate component. This three-component index is the one used for the estimates reported in Tables 1 and 2 of the previous section. An earlier version of this paper reports estimates for a similar set of equations using the four-component index—see Gruben and McLeod (2000). Overall these disaggregated estimates confirm the arguments of section two regarding the importance of both current and capital account restrictions on convertibility and justify construction of an aggregate liberalization index. Of course more research is needed to determine the various channels through which capital account liberalization reduces inflation. Alternative capital account liberalization indices also need to be developed and tested, as in Quinn and Toyoda (1997).

[16] A country that used that restriction every year would score 0, while a country that had no restriction in any year during the decade would receive a "1"—full openness for that restriction.

References

Agénor, Pierre-Richard and Peter Montiel (1999) *Development Macroeconomics*, Princeton University Press, Princeton New Jersey.

Barro, Robert (1997) *Determinants of Economic Growth*, MIT Press, Boston.

Barro, Robert J. and David B. Gordon (1983) "A Positive Theory of Monetary Policy in a Natural Rate Model," *Journal of Political Economy*, 91, 1983, 589-610.

Barro, Robert J. (1983) "Inflationary Finance Under Discretion and Rules" *Canadian Journal of Economics*, 16, February, 1-16.

Campillo, Marta and Jeffery Miron (1996) "Why Does Inflation Differ across Countries?" National Bureau of Economic Research Working Paper #5540, NBER, Cambridge, MA.

Cardoso, Eliana. (1992) "Inflation and Poverty," NBER Working Paper # 4006.

Cardoso, Eliana and Ilan Goldfajn (1998), "Capital Flows to Brazil: The Endogeneity of Capital Controls," *IMF Staff Papers*, 45:1,161-202.

Cooper, Richard (1999) "Should Capital Controls Be Banished?" *Brookings Papers on Economic Activity*, 1, 89-125.

Cukierman, Alex, Sebastian Edwards, and Guido Tabellini, "Seigniorage and Political Instability," *American Economic Review*, LXXX11 (June 199l), 537-55.

Cukierman. Alex. Steven B. Webb. and B. Neyapti (1992), "Measuring the Independence of Central Banks and Its Policy Outcomes." *World Bank Economic Review*, (3), 353-98.

Davidson, Paul (2000), "Liquidity vs. Efficiency in Liberalized International Financial Markets: A Warning to Developing Economies," *Brazilian Journal of Political Economy*, 20, 3-21.

Davidson, Russell and James MacKinnon (1993) *Estimation and Inference in Econometrics*, Oxford University Press, New York.

De Gregorio, Jose (1998), "Financial Integration, Financial Development, and Economic Growth," (July), Center for Applied Economics, Department of Industrial Engineering, Universidad de Chile.

Dooley, Michael (1995), "A Survey of Academic Literature on Controls Over International Capital Controls," University of California, Santa Cruz, Working Paper #318 (June).

Dornbusch, Rudiger (1990) "Capital Flight: Theory, Measurement and Policy Issues" Occasional Paper 2, IDB, Washington D.C.

Grilli, Vittorio, Donato Masciandaro, and Guido Tabellini (1991), "Political and Monetary Institutions and Public Financed Policies" *Economic Policy*, 13:341-92.

Grilli, Vittorio, and Gian Maria Miles-Ferretti (1995), "Economic Effects and Structural Determinants of Capital Controls," *IMF Staff Papers*, 42(3), September, 517-551.

Gruben, W.C. and Darryl McLeod (2000) Openness and Inflation II: The Capital Account, Working Paper in Financial Economics, Fordham University, New York.

Klein, Michael and Giovanni Olivei (1999), "Capital Account Liberalzation, Financial Depth and Econmomic Growth" NBER Working Paper #7384 .

Kydland, Finn E., and Edward C. Prescott (1977), "Rules Rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy* 85, 473-91.

Lane, Philip (1997) "Inflation in Open Economies," *J. of International Economics,*42, 327-47.

Mankiw, N. Gregory, "The Optimal Collection of Seigniorage: Theory and Evidence," *Journal Of Monetary Economics,19.*

McKinnon, Ronald I. and Donald J. Mathieson (1981) How to Manage a Repressed Economy, *Essays in International Finance #145*, December, Economics Dept., Princeton University, NJ.

McLeod, Darryl and J. Welch (1993) "Costs and Benefits of Fixed Exchange Rates in Latin America, *Economic Review*, 1st Quarter, Federal Reserve Bank of Dallas, 31-43.

Quinn, Dennis and Maria Toyoda (1996), "Measuring International Financial Openness and Closure," Business School and Dept. of Political Science, Georgetown University, Washington, D.C.

Quinn, Dennis (1997), "The Correlates of Change in International Financial Regulation, *American Political Science Review* 91(3):531-551.

Quinn, Dennis and Robert. Jacobson (1989)"Industrial Policy Through Restriction of Capital Flows" *American Journal of Political Science*, 33:3, 700-36.

Rodrik, Dani (1998) "Who Needs Capital Account Convertibility?", February, Harvard University.

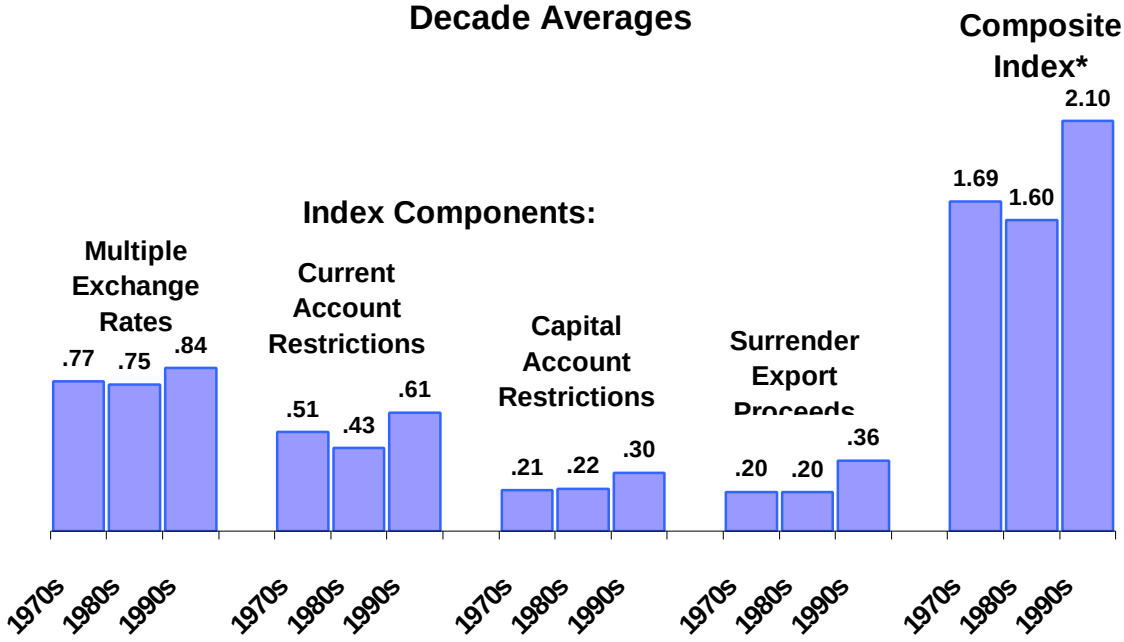
Rodrik, Dani and Andres Velasco (1999), "Short Term Capital Flows," (May), Harvard University, New York University, and National Bureau of Economic Research.

Romer, David, "Openness and Inflation: Theory and Evidence," *Quarterly Journal of Economics,* CVII(4), November 1993, 869-904.

Romer, David and Christina Romer (1998) "Monetary Policy and the Well-Being of the Poor," NBER Working Paper #6793, November, Cambridge, MA.

Wade, Robert and Frank Veneroso (1998), "The Gathering Support for Capital Controls," *Challenge*, 41, (November-December), 14-26.

Figure 1: Capital Account Openness for 112 Countries, Decade Averages



*Full open for the whole decade is 1 for each component and 4 for the composite index.
Source: IMF Survey of Exchange Rate Arrangements, Various Issues

Figure 2: Inflation and Capital Account Opening

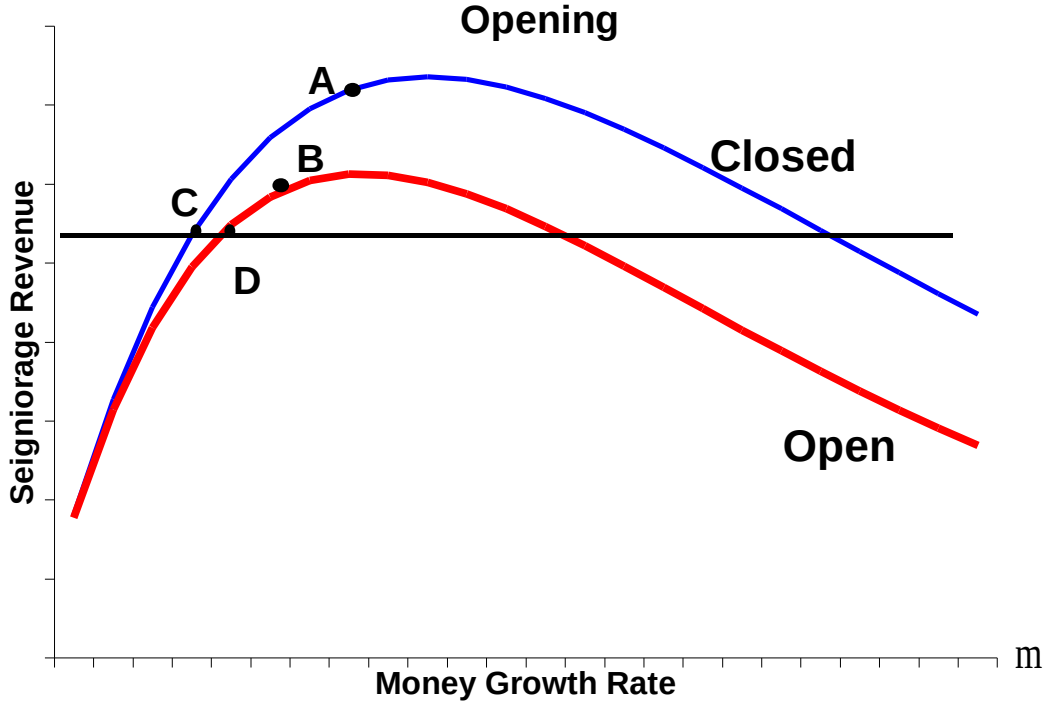


Table 1–Disinflation and Capital Account Liberalization: 1980s to 1990s for 112 Countries

Dependent Variable: Change in Log Average CPI Inflation 1980s vs. 1990s
(White Heteroskedasticity-Consistent t-statistic)

Subsample:	OLS—Full sample				WLS	TSLS 3/		
	All ctys	π < 100%	**Pol stab**	**CBI 1/**	**CBI 1/**	All	Pol stab	CBI 1/
	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.1a)	(1.3a)	(1.4a)
Constant	2.69 ***(4.91)***	2.64 ***(5.0)***	3.73 ***(4.66)***	3.34 ***(4.04)***	1.54 ***(1.4)***	2.67 ***(4.1)***	3.78 ***(4.34)***	2.29 ***(2.12)***
1980 Per Capita PPP GDP	-0.38 ***(-5.14)***	-0.37 ***(-5.34)***	-0.48 ***(-5.31)***	-.45 ***(-4.55)***	-.21 ***(-.12)***	-.34 ***(-3.49)***	-0.43 ***(-3.69)***	-0.28 ***(-1.99)***
Trade Openness [4/]	.002 ***(.93)***	.001 ***(0.57)***	0.00 ***(.08)***	.005 ***(1.87)***	.001 ***(.56)***	.001 ***(.16)***	-.002 ***(-.52)***	.001 ***(.13)***
Capital Account Openness Index B: Δ1980s to 1990s	-0.77 ***(-5.14)***	-0.55 ***(-4.61)***	-0.77 ***(-5.37)***	-.71 ***(-4.76)***	-1.06 ***(-7.9)***	-1.50 ***(-3.77)***	-1.63 ***(-3.23)***	-1.47 ***(-5.34)***
Latin America Dummy	0.27 ***(.97)***	0.52 ***(2.38)***	0.43 ***(1.86)***	0.08 ***(.31)***	.01 ***(.98)***	.43 ***(1.37)***	0.62 ***(2.07)***	-.05 ***(-.13)***
Latitude	.008 ***(2.41)***	.004 ***(1.52)***	.009 ***(2.9)***	.004 ***(1.45)***	.015 ***(3.24)***	.012 ***(2.95)***	.014 ***(2.59)***	.01 ***(2.53)***
Political Stability [4/]			-1.22 ***(-1.58)***		-.85 ***(-2.63)***		-1.29 ***(-2.7)***	
Central Bank Independence[1/]				-.39 ***(-1.42)***	.41 ***(.59)***			-64 ***(.63)***
Change in Gov. Surplus				-.04 ***(-2.07)***				-.04 ***(-.88)***
Number of Observations	103	98	102	52	60	97	96	52
Adjusted R^2	.32	.38	.38	.56	.13	.09	.07	.30
White Heteroskedasticity Test – Prob Value.	.20	.27	.00	.97	.08	.22	.00	.43
DWH Endogeniety Test—F-Stat Prob Value[5/]						.10	.01	.09
Sargan Instruments Test Chi Sq Prob value:[6/]						.91	.64	.56

1/ Central Bank Turnover is one index of Central Bank Independence prepared for 61 countries by Cukierman, Webb.and Neyapti (1992) as reported in Table 11 page 380.
2/ The weighting variable for the WLS estimates reported as equation 1.5 is also the Central Bank turnover ratio discussed in footnote 1 above. The R^2 reported is that for the unweighted regression. .
3/ Instruments are all variables listed except the capital controls index and the budget surplus plus total GDP in PPP$1980, log area in square miles and a country dummy for fuel exporters. The last three instruments were obtained from the GDN data based "Fixed Factors" spreadsheet—also the source for the Latitude variable (see the World Bank Growth Web page: www.worldbank.org/research/growth/GDNdata.htm#4).
4/ Openness to trade is the average share of imports in GDP 1973-89. This openness measure, the political stability index and 1980 per capital GDP are from Romer(1993) Appendix 2.
5/ See Table 2 note #5.
6/ See Table 2 note #6.

Table 2–Disinflation and Capital Account Liberalization: 1980s to 1990s LDCs

Dependent Variable: Change in Log Average CPI Inflation 1990s vs 1980s
(White Heteroskedasticity-Consistent t-statistics)

Subsample:	OLS—Developing Countries				WLS	TSLS-LDCs		
	All ldcs	π < 100%	**Pol. Stab**	**CBI 1/**	**All ldcs**	All ldcs	Pstab	CBI 1/
	(2.1)	**(2.2)**	**(2.3)**	**(2.4)**	**(2.4w)**	**(2.1a)**	**(2.3a)**	**(2.4a)**
Constant	2.11 *(3.02)*	2.13 *(3.27)*	3.08 *(4.10)*	1.52 *(1.61)*	2.54 *(4.27)*	2.17 *(2.42)*	3.22 *(3.49)*	1.20 *(1.18)*
1980 Per Capita PPP GDP	-0.29 *(-2.87)*	-0.29 *(-3.19)*	-0.37 *(-3.96)*	-.17 *(-1.22)*	-.34 *(-4.2)*	-.26 *(-1.97)*	-0.34 *(-2.74)*	-.11 *(-.75)*
Trade Share 1980 GDP	.002 *(.60)*	.001 *(0.43)*	-.002 *(-.48)*	.002 *(.76)*	-.003 *(-.73)*	-.001 *(-.15)*	-.004 *(-1.1)*	001 *(.19)*
Capital Account Openness Index: Δ1980s to 1990s 7/	**-.81** *(-4.37)*	**-0.52** *(-3.36)*	**-.81** *(-4.66)*	**-.93** *(-8.3)*	**-1.20** *(-3.58)*	**-1.40** *(-2.92)*	**-1.47** *(-3.28)*	**-1.28** *(-6.49)*
Latin America Dummy	.18 *(.56)*	0.44 *(1.76)*	0.33 *(1.26)*	-.08 *(-.35)*	-.40 *(-1.15)*	.29 *(.80)*	0.47 *(1.41)*	-.07 *(.22)*
Latitude	.012 *(2.75)*	.007 *(1.97)*	.014 *(3.39)*	.011 *(2.54)*	.014 *(2.46)*	.014 *(2.74)*	.016 *(3.05)*	.013 *(3.58)*
Political Stability			-1.42 *(-1.85)*				-1.54 *(-2.22)*	
Central Bank Independence				-.50 *(-.75)*				-.26 *(-.42)*
Change in Gov. Surplus				-.06 *(-3.14)*				-.07 *(-2.04)*
Number of Observations	80	75	79	31	80	75	74	31
Adjusted R^2	.26	.19	.36	.75	.26	.10	.20	.72
White Heteroskedasticity Test – Prob Value.	.40	.03	.00	.98	.15	.33	.00	.97
DWH OLS Consistency Test—F-Stat Prob Value[5/]						.21	.10	.10
Sargan Instruments Test Chi Sq Prob value:[6/]						.98	.98	.69

For notes 1-4, see Table 1 notes 1-4.

5/ The Durbin-Wu-Hausman test compares the TSLS and OLS estimates assuming the former are consistent. We report the confidence level at which consistency of OLS estimates can be rejected. This test can be interpreted as an exogeneity test, provided any lack consistency is attributed to simultaneous equation bias—that is, endogeneity of capital controls and the fiscal surplus variables.

6/ The Sargan test null is that the chosen instruments are uncorrelated with error term, a condition appropriate instruments should fulfill.

Table 3 – Capital Account Liberalization by type of Restriction: 1980s to 1990s

Dependent Variable: Change in Log Average CPI Inflation ***(White Heteroskedasticity-Consistent t-statistic)***

	OLS—Full sample 1/				OLS—LDCs Only 1/			
Plus all Variables Reported in this Equation see Tables 1&2:	All ctys **(1.1)**	**Pstab (1.3)**	**CBI 2/ (1.4)**	WLS **(1.4) 3/**	LDCs **(2.1)**	LDCs **(2.1)**	Pstab **(2.3)**	CBI 2/ **(2.4)**
Capital Account Restrictions	-.88 *(-2.21)*	-.80 *(-2.44)*	-.67 *(-1.96)*	-1.64 *(7.67)*	-1.23 *(-1.86)*	-1.46 *(-2.55)*	-.93 *(-2.07)*	-1.36 *(-3.94)*
Current Account Restrictions	-.66 *(-2.13)*	-.60 *(-1.96)*	-.83 *(-1.8)*	-.51 *(-4.6)*	-.46 *(-1.45)*	-.46 *(-1.43)*	-.47 *(-1.49)*	-.57 *(-1.28)*
Multiple Exchange Rates	-.21 *(-.73)*	-.30 *(-1.27)*	.11 *-(.40)*	0.01 *(3.9)*	-.37 *(-1.07)*	-.40 *(-1.11)*	-.49 *(-1.79)*	-.32 *(-.83)*
Surrender Export Proceeds	-.72 *(-2.36)*	-.83 *(-3.12)*	-.73 *(-2.7)*	-.70 *(-6.1)*	-.77 *(-1.61)*		-1.02 *(-2.75)*	-.72 *(-3.76)*
Number of Observations	103	102	52	52	80	80	79	31
Adjusted R^2	.31	.37	.53	.22	.25	.22	.36	.74
Wald Test for Equal Coeffs on all Restrictions[4/]	.43	.33	.10	.00	.31	.23	.22	.20
Wald Test for Equal Coeffs excluding multiple fx rates[5/]	.89	.81	.97	.02	.31		.34	.26

1/ These equations are estimated with all the variables reported in Tables 1 and 2 under the same equation number. However, only the disaggregated capital restriction coefficients are reported here to conserve space. All regression are OLS except 1.4 which uses weighted least squares—see footnote 3 below.
2/ The central bank independence index is available for 61 countries as prepared by and reported in Cukierman, Webb.and Neyapti (1992). Here the variable is Central Bank Turnover, 1951-89 as reported in Table 11.
3 / The weighting variable is Central Bank Turnover, as discussed in footnote 1 above. This same weighted least squares equation is reported in Table 1 as eq. 1.4. However, only the coefficients for capital controls variables are reported here.
4/ This is the p-value or marginal significance level for a Wald test of the null hypothesis that all of the capital control coefficients are equal. In equation 1.1, for example, the null of equal coefficients can only be rejected at the 43% significance level, far below the standard 10% or 5% marginal significance levels normally required. Hence we cannot reject the null of equal coefficients.. The regressions reported in Tables 1 and 2 implicitly impose this restriction of equal coefficients by using the aggregate capital control index. This restriction is rarely rejected by the unrestricted regressions run in this table, with the exception of equation 1.4 when estimated by WLS.
5/ Note that the coefficient for multiple exchange rate arrangements is often quite different, but generally low statistical significance. This row tests the hypothesis that all the coefficients other than multiple exchange rates are equal.