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The Effectiveness of Capital Controls and their Implications for Monetary Autonomy in the Presence of Incomplete Market Separation

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Abstract

This paper demonstrates the long-run ineffectiveness of quantitative capital controls using a model in which economic agents can evade controls by incurring costs at the time that capital is transferred. Differentials between domestic and off-shore interest rates, together with expectations about future yield differentials, provide incentives for capital flows, which in turn feed back to eliminate the differentials in the long run. Consequently, under fixed exchange rates, the proportion of a change in domestic credit that is "offset" by capital flows is a function of time; quantitative capital controls can provide only some temporary autonomy for national monetary policy.

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Summary

This paper proposes a new way to look at the effects of capital controls. The usual analysis of capital controls assumes either that the controls introduce a constant yield differential between domestic and international interest rates or that the controls stop all capital flows. The central idea of this paper, however, is that since in reality capital controls are not perfect, private agents will circumvent them if the incentive is attractive enough. This idea is formalized in an adjustment cost function that posits that agents can export capital if they are willing to incur some costs. If marginal adjustment costs are increasing, it is shown that in the long run the interest differential between domestic and international capital markets has to be eliminated. This result implies that while capital controls might be useful to provide some insulation against short-run shocks, they should not be used to attempt to keep domestic interest rates below international interest rates in the long run.

The analysis in this paper also disputes the common argument that when controls apply only to capital outflows and not to capital inflows, the potential for massive capital inflows could prevent domestic interest rates from ever exceeding corresponding off-shore rates. The flaw in this argument is that private operators who take the future into account might not transfer funds to the domestic market if they perceive that domestic interest rates are only temporarily above off-shore rates. If future off-shore rates are expected to be very high relative to domestic rates, it is even possible that capital outflows could take place during periods in which off-shore rates are below domestic rates. Accordingly, even with a given enforcement mechanism designed to impede capital outflows, the observed interest differential might be positive or negative and vary considerably over time. Actual interest rate differentials are thus not an accurate measure of the effects of quantitative capital controls.

This paper also analyzes the implications of incomplete market separation for the degree of autonomy of monetary policy and shows that the so-called "offset coefficient" (measuring how much a change in domestic credit is neutralized by capital flows) is a function of both time and the speed of adjustment of the interest differential. The short-run offset coefficient might be quite low, but the long-run offset coefficient is always equal to (minus) one. It is also argued that the magnitude of the arbitrage flows caused by a monetary policy that is aimed at keeping domestic interest rates low depends on the degree of persistence of such a policy.

I. Introduction

Many opponents of quantitative controls on the flow of international capital have argued that such controls may work in the short run, but that in the long run economic agents in an otherwise open economy will find ways to evade them. This note formalizes the notion of the long-run ineffectiveness of quantitative capital controls by using a framework in which economic agents can evade the controls if they are willing to incur some costs.

This framework contrasts with most other economic models of capital controls, which assume that the controls either introduce a constant (relative or absolute) differential between the yields in domestic and foreign capital markets or effectively stop all capital movements. 1/ By maintaining a yield differential or stopping all capital flows, capital controls are effective in these models, even in the long run. In contrast, the central theme of this paper is that capital controls are not perfect in reality and are likely to be circumvented if the incentive is large enough. Even if circumventing or evading capital controls is a costly activity, some capital flows are likely to occur in reponse to a yield differential. To the extent that those flows that do occur in spite of the controls have some feedback effect on the yield differential, moreover, they would tend to reduce or even eliminate the yield differential in the long run, other things equal. One might then observe a declining yield differential over time, even when the regulations used to control the movements of capital are not changed. Modeling explicitly the way in which capital controls can be circumvented is thus of central importance for describing either the effects of imposing capital controls or the dynamic adjustment of financial market conditions following various disturbances in the presence of capital controls.

In developing an analysis of capital controls, it is important to distinguish between quantitative controls on capital flows and controls that are based on differential tax treatment. Controls of the latter type usually involve the use of required reserve ratios or withholding taxes and generally apply not to flows of capital, but rather to the entire stocks of particular types of assets outstanding. Such controls might therefore be able to sustain a constant yield differential between domestic and foreign capital markets, as long as stocks of both types of assets (those under control and those free from controls) remain outstanding. 2/

1/ See, for example, Adams and Greenwood (1985), Aizenman (1986), Basevi (1985), Dornbusch (1985), Flood and Marion (1982), Stockman and Hernandez (1985). The only exception seems to be Bhandari and Decaluwe (1984).

2/ The yield differentials sustained by this type of controls, however, are usually small relative to the yield differentials that are sometimes caused by quantitative controls. For example, the yield differential

It should be emphasized at the outset that this paper will not be concerned with controls based on differential tax treatment of different securities, but is rather concerned mainly with the types of quantitative controls that have been employed in the European Monetary System (EMS). The two EMS members that still have such capital controls in place are Italy and France. The Italian capital controls have been designed to eliminate or reduce the profitability of portfolio investments abroad for residents. 1/ Since exporters and importers of goods and services, however, could circumvent regulations on portfolio investments by changing the terms of payment on their respective contracts, strict regulations have also been imposed on the terms that exporters can give their foreign clients and the time intervals within which export receipts must be converted into lire. Similar restrictions apply on the import side. Nevertheless, in an otherwise open economy, where imports of goods and services account for 30 percent of GNP and where each year millions of tourists cross national frontiers, it is very difficult to control all of the various channels through which capital can be exported. It has therefore been argued that capital controls in a country like Italy (or France) cannot maintain a constant interest rate differential over the long run.

This argument is borne out by the behavior of the differentials between the regulated domestic interest rates and the unregulated offshore or Euro-interest rates on deposits denominated in lire. As indicated by Chart 1, the experience since 1980 shows in this respect that during periods of "calm" in the EMS, that is when no realignment was expected, the Euro-lire rates have been very close to corresponding domestic Italian interest rates, despite the presence of capital controls. 2/ However, when realignments were expected, the Euro rates stayed for several months considerably above the domestic Italian rates. (Immediately before realignments, the difference between the two interest rates often exceeded 10 percentage points.) Similarly, Chart 2 shows

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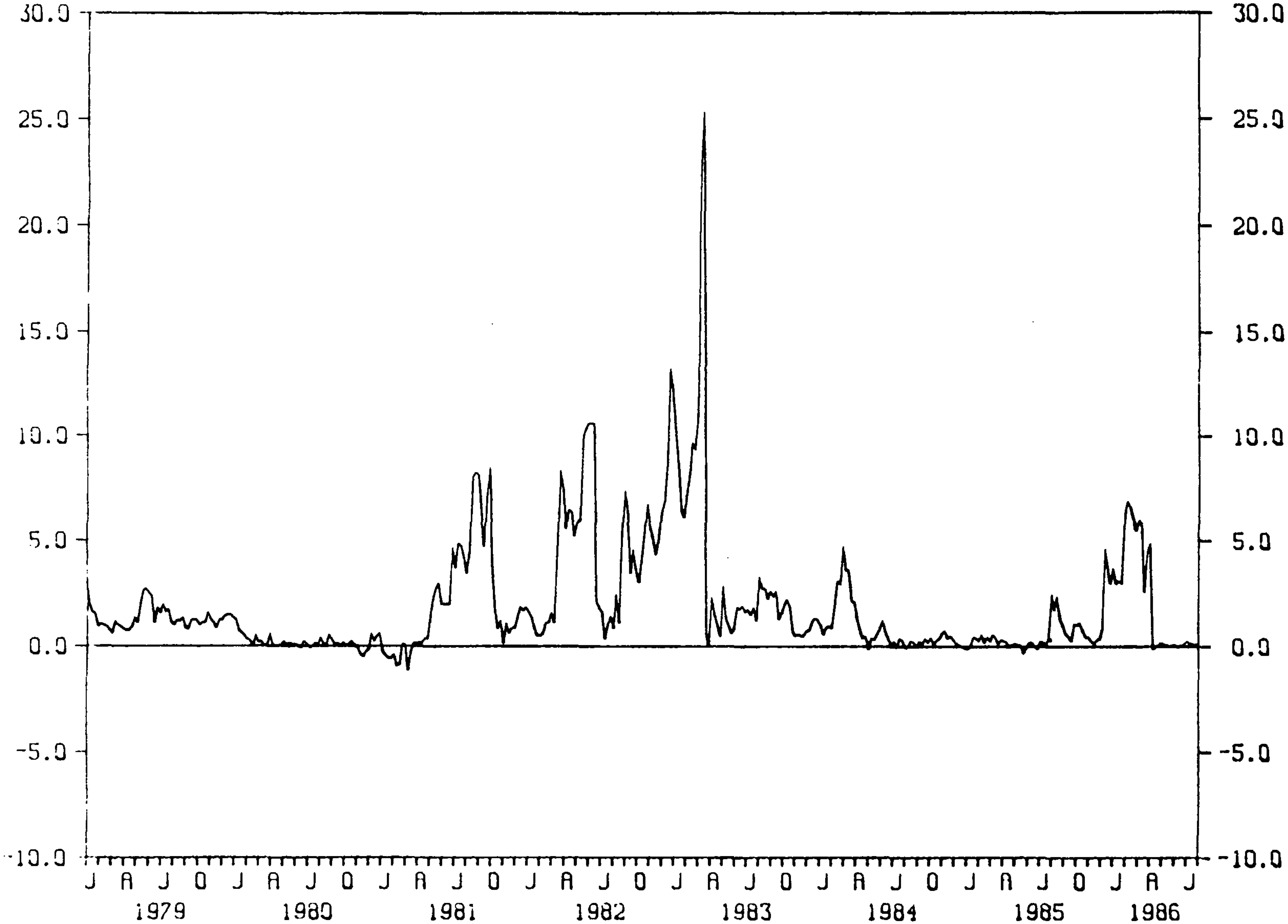
2/ (Cont'd from p. 1) between domestic and Euro-rates on assets denominated in deutsche marks is usually below one half of 1 percentage point; in particular, Euro-deutsche mark rates are always inside a corridor around German domestic rates, with the width of the corridor determined by the German reserve requirements (see Issing, forthcoming). By contrast, the corresponding yield differential on assets denominated in lira has sometimes exceeded 10 percentage points.

1/ Until recently, it was required that for each dollar invested abroad, 50 cents had to be held in a zero interest lira deposit. Portfolio investment abroad would thus have been profitable only if the foreign interest rate was more than double the Italian interest rate. This regulation has recently been changed by lowering the zero interest deposit to only 15 percent of the portfolio investment abroad.

2/ See Appendix I for descriptions of the data in Charts 1 and 2. Similar data are presented in Giavazzi and Pagano (1985); see also Claasen and Wyplosz (1982).

Chart 1. The Effects of Capital Controls: Italy

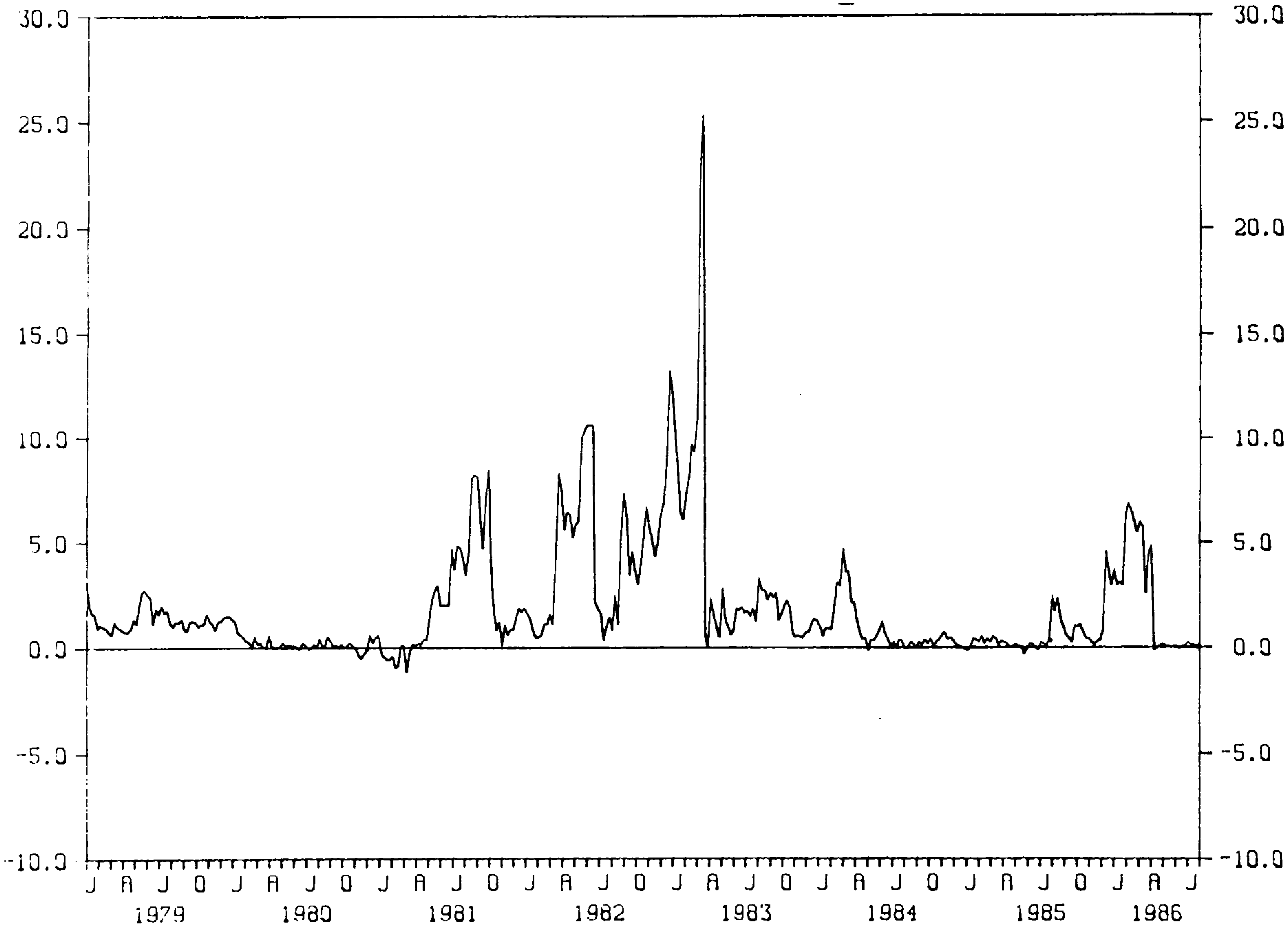
The Difference Between Covered (in Italian Lira)
Euro Deposits and Domestic Interest Rates in Milan 1/



1/ This is the variable IT.SERW explained in Appendix I.

Chart 2. The Effects of Capital Controls: France

The Difference Between Euro-French Franc Interest Rates
and Domestic Interest Rates in Paris 1/



1/ This is the variable DIF.132W explained in Appendix I.

that the Euro rates on French franc deposits have deviated considerably from corresponding domestic French interest rates only during the periods preceding EMS realignments. The actual interest rate differential that has been often used as an indicator of the severity of capital controls 1/ should therefore be regarded as a function not only of the severity of the controls, but also of the nature of the "disturbances" that are affecting the economy and the time the economy has had to adjust to those disturbances.

The analysis of this paper also disputes the common argument that when controls apply only to capital outflows and not to capital inflows, the potential for massive capital inflows could prevent domestic interest rates from ever exceeding corresponding off-shore rates. The flaw in this argument is that private operators who take the future into account might not transfer funds to the domestic market if they perceive that domestic interest rates were only temporarily above off-shore rates. In particular, if they expected future domestic interest rates to be below off-shore rates, and if controls imply that future capital outflows would be costly, it might not be optimal for them to transfer funds to the domestic market and later incur the costs of transferring them back to the off-shore market. If future off-shore rates were expected to be very high relative to domestic rates, it is even possible that capital outflows could take place during periods in which off-shore rates were below domestic rates. The results of this paper therefore suggest that even with a given enforcement mechanism designed to impede capital outflows, the observed interest differential might be positive or negative and vary considerably over time. Actual interest rate differentials are thus not an accurate measure of the effects of quantitative capital controls.

To begin to formalize these arguments, the next section of the paper presents a model of how operators use resources in their efforts to obtain arbitrage profits. It is shown how this activity might eliminate the interest rate differential over time and how the interest rate differential and capital flows are linked in the short run. Section III then presents a simple macroeconomic model that incorporates the relationship between capital flows and interest rate differentials and provides a feedback mechanism from the capital flows to the interest rate differential, which leads to a stable equilibrium. In the context of this model, the main effect of capital flows are confined to the money market. The speed of adjustment of the interest differential is shown to depend on a parameter that characterizes the costs imposed on agents by the capital controls and a parameter that characterizes the demand for money.

Section IV then analyzes the implications of incomplete market separation for the degree of autonomy of monetary policy. It shows that in this framework the so-called "offset coefficient" is a function of

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1/ See Ito (1983) and Otani and Tiwari (1981).

both time and the speed of adjustment calculated in the previous section. The impact offset coefficient might be quite low, but the long-run offset coefficient is always equal to (minus) one. This section also argues that the magnitude of the arbitrage flows that are caused by a monetary policy that is aimed at keeping domestic interest rates low depends on the degree of persistence of such a policy. A policy that sustains and is expected to sustain a permanent interest differential might lead to arbitrage flows that are ten to twenty times larger than the flows induced by a transitory policy. Section V contains some concluding remarks.

II. A Model of Capital Controls and Evasion Activity

Assume that the domestic interest rate on riskless, domestic currency loans is equal to r_t and the rate on Euro-deposits (also in domestic currency, riskless, and for the same maturity) is equal to i_t. Any operator that could obtain a loan in the domestic capital market and then invest the proceeds in the Euro-market would make a riskless arbitrage profit equal to $y_t(i_t-r_t)$, where y_t indicates the amount of the loan and thus the scale of arbitrage activity. 1/

The scale of arbitrage activity is interpreted as a cumulative stock of funds that has been allocated toward earning arbitrage profits. It is assumed that a private operator may incur costs in transferring capital abroad, and that once he has succeeded in transferring his capital he does not incur any costs in simply rolling over his previous position to continue to make the arbitrage profit $y_{t-1}(i_t - r_t)$, but only incurs additional costs if he tries to transfer more capital abroad. Thus, it is assumed to be costly for agents to increase the amount of arbitrage activity they are undertaking, but not to reduce their arbitrage activity. This is captured by an adjustment cost function $g(\Delta y_t)$, where $\Delta y_t = y_t - y_{t-1}$, such that $g(\Delta y_t) = 0$ for $\Delta y_t < 0$ and both $g' > 0$ and $g'' > 0$ for $\Delta y_t > 0$. The latter conditions assume that the marginal cost of increasing the arbitrage activity is increasing. The assumption that adjustment costs take such a form can be justified by the observation that usually capital controls are imposed against capital flows in one direction only. Thus, in Italy and France, the controls are designed to prevent capital outflows, whereas in Germany during the 1970s the controls were designed to prevent capital inflows.

1/ The distinction between deposit and loan rates is not emphasized in the remainder of the paper, but it considers only situations in which r_t is smaller or equal to i_t. However, the difference between asked and bid rates is taken into account in the data shown in Charts 1 and 2 on differentials between the Euro-deposit rates and domestic Italian and French loan rates. These charts show that since 1979 domestic French rates have always been below the corresponding Euro-rates. The same is true for the period 1979-83 for Italy.

Given these adjustment costs and arbitrage opportunities, a profit maximizing operator in the capital market will maximize the expected discounted sum of future profits, which are given by: 1/

$$(1) \quad \max_{[y_t]} W = \Sigma \, [y_t(i_t - r_t) - g(\Delta y_t)] \, A^t$$

where $A \equiv 1/(1+\rho)$ is the discount factor (ρ is the discount rate) for future profits. 2/ Since this paper is not concerned with the effects of surprises or risk, it is assumed that agents have perfect foresight; therefore, the expectations operator has been suppressed. The Euler equation for this problem is:

$$(2) \quad (i_t - r_t) = g'(\Delta y_t) - g'(\Delta y_{t+1})A$$

This equation implies that the capital flows, Δy_t, are not only a function of the present interest rate differential ($i_t - r_t$), but also of expected future interest differentials. An important consequence of this is that equation (2) might hold even if the present interest rate differential is negative; that is, if the domestic interest rate is above the off-shore interest rate. If future interest rate differentials are expected to be large, relative to present interest rate differentials, Δy_{t+1} would be large, relative to Δy_t and the right hand side of equation (2) might be negative. In this case, capital outflows might take place today, even if the domestic interest rate exceeds the off-shore interest rate. This might be optimal for private operators to do because the instantaneous loss they make today might be more than outweighed by the future gains due to the future positive interest rate differentials and the savings in adjustment costs they can obtain by distributing their activity more evenly over time. 3/

1/ It is impicitly assumed that arbitrageurs can repatriate the profits without further costs. For example, they could use their profits to pay foreign suppliers or just take a vacation abroad.

2/ It is also assumed that optimal path implies that Δy_t is always positive. The maximization problem (1) does not contain any net asset constraint since the arbitrage activity variable, y_t, does not represent any net position. Frenkel and Razin (1986) emphasize the constraints implicit in the intertemporal budget constraint for the viability of dual exchange rates and thus capital controls.

3/ It is implicitly assumed here that borrowing on the off-shore markets is not allowed, or equivalently, that domestic deposit rates are always below Euro-loan rates.

The view of the effects of quantitative capital controls proposed here, therefore, implies that even if a country only has controls that restrict capital outflows and no restrictions on capital inflows, one might sometimes observe that domestic interest rates were above corresponding off-shore interest rates. Even if capital controls operate only against outflows, private operators value capital they have already brought abroad not at the present interest rate, but they take into account also future interest rates because they know that it would be costly for them to rapidly transfer capital abroad if interest rate differentials change in favor of the off-shore markets.

Any individual private operator has to take i_t and r_t as given, but a stable general equilibrium can exist only if there is some feedback from y_t to (i_t-r_t) because (2) implies that capital outflows will stop if:

$$(3)\quad (i_{ss}-r_{ss})/[\rho/(1+\rho)] = g'(0)$$

where the subscript ss refers to a steady state value. This implies that if there is a permanent increase in the international interest rate, that is, if i_{ss} rises, the domestic interest rate has to increase by the same amount if the economy is to reach a new stationary equilibrium. In this sense, capital controls would be ineffective against permanent shocks.

The complete macroeconomic model that describes how the stationary equilibrium is attained is described in the next section. But whatever the details of this model, equation (3) has to hold at the stationary equilibrium. Equation (3) says that at the steady state, the marginal cost of transferring an infinitesimal additional amount of capital abroad, $g'(0)$, has to be equal to the marginal benefit, which is equal to the interest differential $(i_{ss}-r_{ss})$ multiplied by $1 + \rho/\rho$, since the flow of additional benefits can be reaped for the entire future. This implies that if the marginal cost of increasing the arbitrage activity by a small amount is equal to zero around the stationary equilibrium, i.e., if $g'(0) = 0$, the steady state interest rate differential has to be equal to zero. The data on the differential between Euro- and domestic interest rates for French franc and lira deposits, as presented in Charts 1 and 2, suggest that this is indeed the case for these two currencies; over the long run, the interest rate differential seems to disappear. A particular functional form of the adjustment cost function that would yield this result is given by:

$$(4)\quad g(\Delta y_t) = (\phi/2)(\Delta y_t)^2 \qquad \phi > 0$$

where ϕ indicates the severity of the capital controls. This specific functional form will be used in the remainder of the paper because it yields a linear solution. 1/ With quadratic adjustment costs, the solution for y_t becomes:

$$(5) \quad \phi(\Delta y_t) - \phi(\Delta y_{t+1})A = i_t - r_t$$

Equation (5) again illustrates the point that capital outflows (positive values of y_t) might occur even if the domestic interest rate is higher than the off-shore interest rate. With quadratic adjustment costs, $i_t < r_t$ could occur if $\Delta y_{t+1}/\Delta y_t$ (i.e., the proportional rate of change in capital flows) exceeds A.

Most macroeconomic models that incorporate the concept of limited capital mobility have assumed that capital flows are a function of only the current interest differential. In contrast, the present formulation

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1/ Capital flows from one market to another can be compared to flows of a liquid between two containers. If capital markets are open, the flow between the two containers can be said to be unrestricted; this implies that the liquid must always attain the same level in the two containers, i.e., the same rate of return must always prevail in both markets. Capital controls can then be viewed as restricting the flow between the two containers, for example, by connecting them only with a small pipe. The friction inside the pipe slows down the flow between the two containers, and the liquid may therefore stay at different levels for some period of time. Eventually, however, the flow through the pipe will equalize the level of the liquid in the two containers, i.e., the rates of returns will eventually be equalized across markets. In physics, the force opposing the flow of a viscous liquid through a pipe is a function of the viscosity of the liquid, the length of the pipe, and the speed at which the liquid flows (see Van Heuvelen (1982) p. 281):

$$F = 4\pi\eta Lv$$

where η represents the coefficient of viscosity, L the length of the pipe, and v the speed at which the liquid flows through the pipe. This relationship implies that the power, P (the energy per unit of time) needed to force a liquid through a pipe of length L is given by:

$$P = 4\pi\eta Lv^2.$$

The adjustment cost equation proposed in the text is: adjustment costs = constant times Δy^2. If that constant is equal to $4\pi\eta L$ and the capital flows, Δy, represent the velocity at which capital flows, this model of adjustment costs is exactly analogous to the mathematical description of the flow of liquids in physics.

emphasizes that capital flows should be a function of present and future (expected) interest differentials. This can be seen by solving the difference equation (5) forward:

$$(6)\quad \Delta y_t = \frac{1}{\phi} \sum_{j=0}^{\infty} (i_{t+j} - r_{t+j})\, A^j$$

This equation implies that capital flows today depend on the present value of present and future discounted interest differentials.

The quadratic formulation of the adjustment costs also implies that at the steady state, the interest rate differential has to disappear, so that:

$$(7)\quad r_{ss} = \bar{i}$$

if the Euro-interest rate is constant at $\bar{i}$. This result implies that if capital controls were reinforced in such a manner that ϕ increases, this would have no effect on the steady state and interest rates would still be equalized across markets. In this framework, the domestic interest rate is therefore determined in the long run exclusively by the foreign interest rate.

III. The General Equilibrium

This section describes the general equilibrium model that captures the feedback from the capital flows to the interest rate differential. This feedback is assumed to occur through the impact of capital flows on the domestic money market, which determines the domestic interest rate, r_t; the Euro-interest rate, i_t, is assumed to be exogenous.

The assumption that the Euro-interest rate is exogenous may appear unusual because Euro-interest rates are usually thought of as being determined by the market. However, it is exactly this fact that is being used here. In the Euro-markets, covered interest parity seems to hold precisely. This implies that given the deutsche mark interest rate, the interest rate on Euro-deposits in domestic currency has to be equal to the sum of the deutsche mark interest rate and the forward discount on the domestic currency. The forward discount in turn is related to the expected rate of depreciation of the domestic currency. However, if the home country, for example Italy, is in the EMS, the expected rate of devaluation, and thus the forward discount is determined by the probability of a realignment if the domestic currency is at or near its lower intervention limit. For the purpose of this paper, the EMS is therefore treated as a system of fixed exchange rates, which can be adjusted from time to time by the participating governments. Hence, the forward discount on the domestic currency is exogenous in the sense that it is determined by the expectations of the public about the likely actions of the authorities. 1/

Formally, covered interest parity implies that $(1+i_t)=(1+i_{t,DM})(F_t/S_t)$ where $i_{t,DM}$ is the Euro-interest rate on deutsche mark deposits, F_t is the forward exchange rate, and S_t is the spot exchange rate, both expressed in terms of domestic currency per deutsche mark. The Euro-interest rate on deposits in domestic currency, i_t, is thus exogenous because the interest rate on deutsche mark deposits is determined in the German market and the forward discount (F_t/S_t) is determined by the authorities.

The domestic interest rate, r_t, however, is assumed to respond to the conditions in the domestic money market. The equilibrium in the domestic money market is determined by money demand and supply. Money demand is given by a simple function:

$$(8) \quad r_t = -\lambda(m_t - p_t) \qquad \lambda > 0$$

where λ represents one over the semi-interest rate elasticity of money demand, m_t is the natural logarithm of the nominal money supply ($m_t=\ln(M_t)$) and p_t is the natural logarithm of the general price level. Income does not appear as a separate determinant of money demand in equation (8) because it is assumed to be exogenous. It will be shown later that the results would not be affected if this assumption were dropped.

Capital flows influence the domestic interest rate because they influence the monetary base. Assuming for simplicity that the multiplier is equal to one, the money supply is equal to the monetary base, which in turn is given by the sum of domestic credit and net foreign assets of the central bank:

$$(9) \quad m_t = \ln(C + F_{cb,t}) = \ln(C + F_t - F_{p,t})$$

where C represents domestic credit, which is exogenously determined by the central bank. $F_{cb,t}$ represents the net foreign assets of the central bank, which is equal to the difference between the economy's

1/ If the forward discount is equal to the expected rate of depreciation, it should be equal to the product of the probability of a realignment times the size of the expected devaluation if a realignment occurs.

overall net foreign assets, F_t, and the net foreign assets of the private sector, $F_{p,t}$.

The model of capital controls and evasion activity developed in the previous section can now be used to determine the path of the net foreign asset position of the private sector, $F_{p,t}$. Since outflows of private capital correspond to an increase in the net foreign asset position of the private sector, this implies that the variable y_t used to describe the capital flows or arbitrage activity in the previous section corresponds to the net foreign asset position of the private sector, $F_{p,t}$, in this section. 1/ The evolution of the net foreign assets of the private sector are thus given by (see equation (5)): 2/

$$(10) \quad i_t - r_t = \phi(1+A)F_{p,t} - \phi F_{p,t-1} - A\phi F_{p,t+1}$$

The evolution of the net foreign asset position of the economy, F_t, reflects the time path of the current account, which is assumed to be a function of the terms of trade and the difference between the actual and the desired net foreign asset position of the economy, F_t:

$$(11) \quad \Delta F_t = \beta_1(s-p_t) - \beta_2(F_t-\overline{F})$$

where s represents the natural logarithm of the nominal exchange rate. Normalizing the foreign price level to one $(s-p_t)$ thus represents the terms of trade or real exchange rate. As mentioned above, the EMS is treated here as a system of fixed exchange rates and s is therefore assumed to be constant. The results of the analysis would not be affected, however, if the authorities fixed a path for the nominal exchange rate that was not constant. For the purpose of this anaysis, it is sufficient to assume that the exchange rate is determined outside the model. In equation (11), $\overline{F}$ represents the target or desired level of foreign wealth of the economy and the βs are positive constants.

1/ In the context of this model, there should be no two-way flows of private capital. As long as r_t is below i_t, imports of capital would never be profitable for private agents.

It is also important to note that the variable y_t in Section II referred to the capital flows effected by an individual, competitive operator, the variable $F_{p,t}$ represents the market aggregate.

2/ Since the capital controls are assumed to be used only to discourage capital outflows, it is assumed that the present value of future interest rate differentials is positive so that private agents would like to export capital.

The model can be closed by using a conventional sticky price adjustment formula that assumes that inflation is related to excess demand, which in turn is related to the terms of trade or real exchange rate:

$$(12) \quad \Delta p_t = \alpha\,(s - p_t) \qquad \alpha > 0$$

The system of equations (8) through (12) describes the path of the slowly adjusting variables p_t, F_t, $F_{p,t}$, and the domestic interest rate, r_t, as a function of the exogenous forcing variables i, $\overline{F}$, s, and C. The solution to the system is recursive in that equation (12) determines the path of the price level, p_t. Given this path of the price level, equation (11) determines the path of the net foreign asset position of the economy, F_t. The variables p_t and F_t are thus exogenous to the money market equilibrium as determined by the equations (8) through (10), which can be written in one equation as: 1/

$$(13) \quad 0 = i_t + \lambda[\ln(C+F_t-F_{p,t}) - p_t] - \phi(1+A)F_{p,} + \phi F_{p,t-1} + A\phi F_{p,t+1}$$

Equation (13) can be treated as a single second order difference equation in $F_{p,t}$ with roots:

$$(14) \quad \Lambda_{1,2} = (\tfrac{1}{2})(\tfrac{\lambda}{M\phi} + 2 + \rho) \pm [(\tfrac{1}{4})(\tfrac{\lambda}{M\phi} + 2 + \rho)^2 - (1 + \rho)]^{1/2}$$

where M represents the nominal money supply. It is apparent from equation (14) that this equation has one unstable and one stable root. Since operators in the financial markets would not expand the arbitrage activity ad infinitum if the forcing variables in equation (14) were constant, it can be asumed that the domestic interest rate maintains the economy on the stable path and the unstable root can be eliminated from the solution.

Since the (stable) root, Λ_2, determines the speed at which the system would converge to the steady state, equation (14) shows that the speed of adjustment is a function only of the parameters that describe the financial markets, ρ and λ/ϕ. It can also be shown from

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1/ This result would not be affected if money demand were a function of income and income in turn were determined by the real exchange rate and the net foreign assets of the economy. The additional term that would appear in equation (12) in this case would still act like an exogenous forcing variable.

equation (14) that the stable root is a decreasing function of λ/ϕ. Since λ is equal to one over the semi-interest elasticity of money demand, this implies that the speed at which the equilibrium is reached is inversely related to the semi-interest elasticity of money demand. Intuitively, this means that the equilibrium, which implies $i_t = r_t$, is reached faster if even small capital inflows have a large effect on the domestic interest rate. The same result also implies that an increase in the restrictiveness of the capital controls, i.e., an increase in ϕ, leads to a slower adjustment.

IV. The Implications for the Degree of Autonomy of Monetary Policy

The degree of autonomy of national monetary policy in a regime of fixed exchange rates has often been discussed in terms of the so-called "offset coefficient." This coefficient measures by how much any given change in domestic credit is offset or neutralized by capital flows. Without capital controls (and if domestic and foreign assets are perfect substitutes) this offset coefficient should be equal to one, since in this case 1/ the domestic interest rate and thus money demand are fixed by the foreign interest rate, so that the central bank cannot control the money supply. Capital controls have been used by a number of countries precisely for the reason that they would allow the central bank to influence the domestic interest rate even if the exchange rate was fixed.

This section shows that in the framework proposed here, the offset coefficient is a function of time and goes to one in the long run. The result that the offset coefficient is larger in the long run than in the short run has been rationalized in literature by assuming a partial adjustment in money demand (and sometimes money supply). 2/ In this framework, a similar result is obtained because capital controls slow down the capital inflows attracted by the interest rate differential. 3/

The offset coefficient can be calculated by computing the change in $F_{p,t}$, that is the capital outflows, induced by an unanticipated increase

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1/ That is, in the case with fixed or predetermined exchange rates, no capital controls, and perfect substitutability between assets.

2/ See for example E.M. Claasen and C. Wyplosz (1982) and the references cited therein.

3/ In literature, a long-run offset coefficient different from one is usually allowed for by assuming that foreign and domestic assets are not perfect substitutes. This effect is not considered in this paper.

in domestic credit by ΔC from C to C'. The difference equation that determines the time path of $F_{p,t}$ can be written as: 1/

(15) $$F_{p,t} = - \Delta C \Lambda^{t} + F_{p,ss}$$

where Λ is the stable root in equation (14) and $F_{p,ss}$ is the steady state stock of private assets abroad, which is determined by the steady state equilibrium condition on the money market:

(16) $$F_{p,ss} = C' + \overline{F} - \exp(-\lambda i_{ss} + s)$$

This implies that if there is an unanticipated increase in domestic credit of ΔC at time zero and if the system was initially at its steady state, the capital outflows, denoted by $\Delta F_{p,t}$, caused by the increase in domestic credit, are given by:

(17) $$\Delta F_{p,t} = - (1 - \Lambda^{t}) \Delta C$$

which implies that the offset coefficient, given by $(1 - \Lambda^{t})$, is an increasing function of time and goes to one in the long run. The impact offset coefficient is given by $1-\Lambda$. The size of the offset coefficients thus depends on the parameters that determine the speed of adjustment of the difference equation in $F_{p,t}$. As discussed in the previous section, this speed of adjustment, that is Λ, depends only on ρ and (λ/ϕ). An increase in the severity of capital controls, that is an increase in ϕ, would lead to a lower offset coefficient; capital controls would therefore increase the degree of autonomy of domestic monetary policy in the short run. But, whatever the degree of short-run autonomy for monetary policy, this framework also implies that in the long run the offset coefficient goes to one.

Another way to measure the degree of autonomy of monetary policy would be to calculate the amount of capital outflows the central bank would have to sterilize if it wished to keep domestic interest rates below international interest rates. Such a policy has been suggested

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1/ This assumes prices are at the steady state level p = s and that the system was initially at a steady state. The general solution for $F_{p,t}$ would be: $F_{p,t} - F_{p,ss} = K\Lambda^{t}$, where K is an arbitrary constant. Evaluated at time zero, this yields: $F_{p,o} - F_{p,ss} = K$. However, since $F_{p,t}$ is a slowly adjusting variable, $F_{p,o}$ has to be equal to the previous steady state value, which would be given by equation (16) evaluated with C instead of C'. This implies therefore $-\Delta C = K$.

for countries with a large public sector debt burden. The argument for capital controls in this case is that they would lead to lower interest payments on the (domestic) public sector debt and thus help to limit the fiscal deficit. The framework presented here suggests that such a policy would lead to large capital outflows. The magnitude of the capital outflows would depend not only on the size of the interest differential the authorities wish to maintain, but also on the time span for which the authorities wish to maintain the interest differential.

The difference in the magnitude of the capital outflows in response to temporary and permanent interest rate policies can be calculated directly from equation (5). If the authorities maintain an interest rate differential of $i_t - r_t = D$ for only one (the current) period (a transitory policy), capital outflows are given by $(i_t - r_t)/\phi = D/\phi$. However, if the authorities maintain the same interest differential for the indefinite future (a permanent policy), capital outflows are given by $[D/\phi][(1+\varepsilon)/\varepsilon]$. The difference in the effects of transitory and permanent policies is thus given by the factor $(1+\varepsilon)/\varepsilon$. If ε, that is the rate used by arbitrageurs to discount future profits, is equal to 10 percent, this factor is equal to 11. This implies that a permanent policy of maintaining domestic interest rates below international interest rates would lead to capital outflows that are eleven times as big as the capital outflows induced by a transitory policy. With $\varepsilon = 5$ percent, the magnification factor for a permanent interest rate policy would be equal to 21.

V. Concluding Remarks

This paper has developed a simple model of capital controls in the presence of incomplete market separation and has demonstrated that quantitative controls are not effective in the long run. While this argument has often been made informally, it apparently has never been formally incorporated into the macroeconomic models that are often used to discuss short- and medium-run policy problems.

The main conclusion from the framework presented here is that quantitative capital controls could be effective in controlling short-run fluctuations in domestic interest rates, but that they should not be used in attempts to offset permanent shocks and to keep domestic interest rates below international interest rates in the long run. Thus, quantitative controls should be used only to provide some insulation against temporary short-run fluctuations in the economic environment.

The available data on on-shore and off-shore interest rates for France and Italy seem to confirm this conclusion insofar as significant differentials between on-shore and off-shore interest rates have appeared only during periods of turbulence in the EMS. During periods of calm in the EMS, that is when no realignment has been expected, the interest rate differentials have disappeared.

The framework developed in this paper also implies that the evasion or arbitrage activity that is induced by the interest rate differential between domestic and off-shore markets leads to capital flows that are a function not only of the present interest rate differential, but of future interest differentials as well. Thus, capital outflows might occur even if the present interest rate differential is close to zero, because investors take future interest rate differentials into account when they decide where to invest.

The long-run ineffectiveness of capital controls in isolating domestic financial markets also shows up in the so-called offset coefficient. In this framework, the offset coefficient is a function of time: in the short run, it might be close to zero; but in the long run, it always equals (minus) one. This implies that under a fixed exchange rate and with capital controls, a given change in domestic credit would only partially be offset through the balance of payments in the short run; but in the long run, the offset would be complete. Capital controls can, therefore, provide only some temporary autonomy for a national monetary policy.

Sources of data for Charts 1 and 2 (Assembled by Kellett Hannah)
(All interest rates are in units of percent per annum)

USD03A: three-month Euro-rate (LIBOR) on U.S. dollar [asked]
daily from DRI FACS, June 1, 1973
Bank of America, San Francisco, CA., 10:00 a.m. (PST)

IT.SERW: weekly, Wednesday observation
= R1 when R1 > 0
= R2 when R1 < = 0 and R2 < 0
= 0 when R1 < = 0 and R2 > = 0

R1: 400*((1+USD03B/400)*(ITC00A/ITC03B)-(1+ITM03A/400))
R2: 400*((1+USD03A/400)*(ITC00B/ITC03A)-(1+ITM03B/400))

USD03B: three-month Euro-rate(LIBOR) on U.S. dollar [bid]
daily from DRI FACS, June 1, 1973
Bank of America, San Francisco, CA., 10:00 a.m. (PST)

ITC00A: spot Italian lire [asked] (US$/lire)
daily from DRI FACS, June 1, 1973
Bank of America, San Francisco, CA., 9:00 a.m. (PST)

ITC00B: spot Italian lire [bid] (US$/lire)
daily from DRI FACS, June 1, 1973
Bank of America, San Francisco, CA., 9:00 a.m. (PST)

ITC03B: three-month forward Italian lire [bid] (US$/lire)
daily from DRI FACS, June 1, 1973
Bank of America, San Francisco, CA., 9:00 a.m. (PST)

ITC03A: three-month forward Italian lire [asked] (US$/lire)
daily from DRI FACS, June 1, 1973
Bank of America, San Francisco, CA., 9:00 a.m. (PST)

ITM03A: three-month Italian interbank rate [asked]
daily from DRI FACS, Nov. 12, 1980
Bank of America, San Francisco, CA., 9:30 a.m. (PST)
(uses TD13660C before Nov. 12, 1980)

ITM03B: three-month Italian interbank rate [bid]
daily from DRI FACS, Nov. 12, 1980
Bank of America, San Francisco, CA., 9:30 a.m. (PST)
(uses TD13660C before Nov. 12, 1980)

TD13660C: three-month Milan money
daily from Treasurer's Department, Jan. 3, 1978

DIF.132W: TD13260EB - TD13260C
weekly, Wednesday observation

TD13260EB: three-month Euro-rate [bid] on French franc
daily from Treasurer's Department, Jan. 3, 1978
mid-morning London

TD13260C: three-month French interbank rate
daily from Treasurer's Department, Jan. 3, 1978

Derivation

This Appendix calculates the jump of the exchange rate in response to an unanticipated jump in the money supply.

It is convenient to start by assuming that the economy was initially at the steady state with $r_{ss}=\bar{i}$ and thus $p_{ss}=(\bar{i}/\lambda)+\bar{m}$. If the money supply increases by Δm, from $\bar{m}$ to $\bar{m}'$, this implies that the new steady state price level, p_{ss}', is equal to $p_{ss} + \Delta m$. The equation that determines the behavior of the price level, which is a slowly adjusting variable, is given by:

(1) $p_t = \Delta m \exp(\mu t) + p_{ss}'$

The exchange rate, however, can jump when the money supply increases. Denoting the new steady state value of the exchange rate by s_{ss}', this implies that the behavior of the exchange rate is governed by:

(2) $s_t = K' \exp(\mu t) + s_{ss}'$

The relationship between K' and Δm will then determine whether the exchange rate over or undershoots. The equations that determine the time path of the price level and the exchange rate can then be used in equation (1), evaluated at time zero (after the increase in the money supply). This yields (recall that at the steady state F = 0):

(3) $$\bar{i} + \mu K' + \lambda\ (\bar{m}' - (\bar{i}/\lambda) - \bar{m}) - \rho\phi\beta\ (K' + \bar{s}' - \bar{p}) + \phi\beta\ (\mu K')$$

$$- \phi\beta\alpha\ (K' + \bar{s}' - \bar{p}) = 0$$

After some transformations, this can be solved for K':

(4) $K' = \varepsilon\ \Delta\bar{m}$

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