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ABSTRACT

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This paper analyzes the effects of changes in 'the real rate of interest' in the international capital market in an economy that is fully integrated into the international capital market. The implications of alternative models are examined carefully and in the process a number of problems concerning the modelling of the open economy are discussed. The paper also analyzes restrictions on capital movements and argues that the economic case for free capital movements is basically the same as the case for free trade in goods and services. Accordingly, an efficient response to changes in the world interest rate requires a reallocation of domestic resources and consumption between goods and sectors, and over time, in the same way that an efficient response to terms of trade changes call for reallocation of resources. It is argued that policy can best support the adjustment process by maintaining steady growth of nominal GNP while letting the exchange and domestic interest rates adjust freely.

Macroeconomic Adjustment to Interest Rate Disturbances: Real and Monetary Aspects

Pentti J.K. Kouri*

Introduction

With the rapid growth of international money and capital markets, and increasing financial openness of national economies, adjustment to changes in international interest rates has become an important policy concern. Flexibility of exchange rates does not insulate national economies from changes in the real interest rate in the international capital market, but leaves policymakers with difficult adjustment alternatives. Should the domestic interest rate increase, or decrease, pari passu with the world interest rate? Or should the domestic currency instead be allowed to depreciate (appreciate) to a point at which an expectation of future appreciation (depreciation) would just match the difference between domestic and foreign interest rates? Or, should the central bank simply follow monetarist advice and keep the money supply unchanged, leaving the exchange rate and the interest rate to market forces? Or, as yet another policy option, is there an economic case for interfering with free international movement of capital?

These questions have not been systematically discussed and analyzed in the literature, despite their obvious importance for macroeconomic policy. The purpose of this paper is to present such analysis, and in the process to discuss some theoretical issues concerning the modelling of capital movements and capital market integration.

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Rather than developing one model, I start the paper by discussing the implications of interest rate disturbances in familiar models of the open economy.

Discussion of the Mundell-Fleming model brings out the result that under flexible exchange rates and with nominal wage rigidity, an increase (decrease) in the 'world interest rate' is expansionary (contractionary), provided that the Marshall-Lerner condition holds. Expansion in output and unemployment occurs because improvement in the trade balance, caused by real depreciation, more than outweighs the deflationary effect of the interest rate increase on investment and consumption. If the Marshall-Lerner condition does not hold, there is a problem of stability in the Mundell-Fleming model. One way out of this problem is to assume regressive exchange rate expectations, but in that case, an increase in the foreign interest rate must be accompanied by a decline in the domestic interest rate.

The results of the Mundell-Fleming model carry over to full employment equilibrium with price flexibility: an increase in the world interest rate leads to a deterioration in the domestic terms of trade, and an increase in the domestic price level. The Dornbusch model, discussed in the second section of the paper, bridges the gap between full employment equilibrium and the short run unemployment equilibrium a la Mundell-Fleming.

The Mundell-Fleming-Dornbusch model completely ignores the intertemporal balance of payments constraint, and, as is shown in the third section, leads to incorrect conclusions. In particular, the deterioration in the terms of trade that occurs in the short run, has to be reversed over time because of the increase in net foreign asset holdings and net interest income. In long run stationary (or steady state) equilibrium, an increase in the foreign

interest rate leads to a improvement in the domestic terms of trade, or 'real appreciation' of the domestic currency. The domestic price level will, however, be higher because of higher velocity while the nominal exchange rate may either depreciate or appreciate depending on the relative strengths of the price level effect on the one hand, and terms of trade improvement on the other.

A further implication of portfolio balance models noted in the discussion is that with rational expectations the domestic real rate of interest measured in terms of domestic output does not increase by the full amount of the increase in the foreign interest rate except in long run stationary (or steady state) equilibrium. The less open the economy in goods markets, the less is the short run effect of an increase in the foreign interest rate on the domestic interest rate, and the greater is the effect on the terms of trade.

The Mundell-Fleming model does not justify the concern recently expressed by many European governments that the increase in U.S. real interest rates prolongs stagnation in their economies. It is argued in this paper that the explanation is the assumption of nominal wage rigidity, and the neglect of imported raw materials in the Mundell-Fleming model. With wages responding to prices, and currency depreciation having a direct effect on production costs, capital outflow caused by an increase in the world interest rate adds to domestic inflation at each level of unemployment. If policymakers attempt to fight 'imported inflation' by tight monetary policy, there will indeed be an increase in unemployment following an increase in the world interest rate. It is argued further that with complete real wage rigidity capital outflow reduces domestic output and increases 'classical' unemployment

without monetary policy being able to do anything about it except in the very short run.

The paper also discusses the implications of models that are derived from individual optimizing behaviour: Ramsey-Sidrauski type models with infinitely lived families that maximize an additively separable utility function; Uzawa-type models in which the rate of time preference is an increasing function of the level of consumption; and life-cycle-overlapping generations models in which distribution effects across cohorts of different age play a key role. This discussion has less immediate relevance for policy but it brings up a number of important issues in the rigourous modelling of the open economy with capital movements.

The effects of interest rate changes on the cost of fixed capital, as well as working capital is then discussed and compared to the cost effects of oil price increases. It is argued that although capital costs are typically ignored in macroeconomic models, they are important and pervasive. In the small open economy changes in relative capital costs are a potentially important source of external disturbances.

The paper concludes with a discussion of restrictions of capital movements and argues that the economic case for free capital movements is basically the same as the case for free trade in goods and services. In the same way that terms of trade disturbances do not justify interference with the structure of free trade, 'interest rate disturbances' do not justify interference with free movement of capital. In particular, a small open economy cannot insulate itself from the effects of an 'adverse' change in the world interest rate by imposing capital controls ex post. On the contrary, such controls add to the cost imposed by the external disturbance. With price rigidities, capital controls can, however, increase domestic output and welfare. However, if that justification is accepted the same logic also

applies to using tariffs in place of devaluation to maintain full employment following a disturbance in the trade balance.

The paper concludes with some remarks on how individuals and firms can hedge against terms of trade and interest rate disturbances through futures markets and the use of other available methods of hedging. It is argued that policy can best support adjustment to interest rate changes by adhering to a steady course as far as the expansion of nominal income is concerned, without intefering with the adjustment of the exchange rate and domestic interest rates. Such policy does not imply constant money supply but requires that the money supply be reduced (increased) so as to offset the increase (decrease) in the velocity of circulation.

The Mundell-Fleming Model

The standard Mundell-Fleming model[1] deals only with the short term aggregate demand effects of international capital movements. The basic result of the model is that an increase in 'the world interest rate' is expansionary, and a decrease contractionary under flexible exchange rates.[2] The reason for this is that an increase (decrease) in the world interest rate causes a shift away from domestic to foreign assets and thus leads to currency depreciation (appreciation), and an improvement in the trade balance provided that the Marshall-Lerner condition holds. If the Marshall-Lerner condition does not hold, an increase in the foreign interest rate is, however, deflationary because of the deflationary impact of the trade balance deterioration.

With perfect capital mobility, and static exchange rate expectations, as is assumed in the standard Mundell-Fleming model, the domestic nominal interest rate must increase (or decrease) by the same amount as the foreign interest rate. Since prices are stable, and expected to remain stable, in the Mundell-Fleming model, the interest rate increase represents an increase in the real interest rate. Therefore, there will be a decline in domestic consumption and investment. Yet, the model implies that total domestic output must increase if the central bank holds the supply of money unchanged. The formal explanation of this surprising implication is that the increase in the domestic interest rate increases the velocity of circulation of money: since prices are assumed to remain stable, domestic output must increase to restore equilibrium between the demand for and the supply of money. The economic mechanism that leads to the increase in output is the depreciation of the domestic currency, induced by initial excess demand in the foreign exchange market. The stimulative effect of the devaluation is more than sufficient to offset the contractionary effect of the higher interest rate on consumption and investment. Obviously, the Marshall-Lerner condition must hold for this analysis to be correct.

An increase in the foreign interest rate is expansionary in the Mundell-Fleming model even with regressive exchange rate expectations as long as there is some increase in the domestic interest rate.[3] The result does not depend on the assumption of perfect capital mobility either. With zero capital mobility there is obviously no effect on the domestic economy; with some responsiveness of capital movements to interest rate differentials, the expansionary effect goes through. Inclusion of wealth in the demand for money function as in most portfolio balance models, is unlikely to change the conclusion and may well strengthen it. The latter is true if the net

wealth effect of interest rate and exchange rate changes is negative: in that case domestic output has to increase by even more to make up for the 'slack' in money demand.

If the Marshall-Lerner condition does not hold, as is reasonable to assume in short run analysis, the issue becomes more problematic.

Currency depreciation will then depress domestic output. But how can output fall if the supply of money is fixed, and most importantly, prices remain stable? Only if the domestic interest rate declines in response to the increase in the foreign interest rate! This would enable excess money supply to be absorbed by a decline in the velocity of circulation. For this paradoxical situation to be consistent with equilibrium in the foreign exchange market, domestic currency would have to depreciate so much that from its low point the market would then expect it to appreciate at a rate equal to the nominal interest rate differential. It would not be difficult to construct a dynamical model which would allow for this sort of perverse short term response, with the perhaps equally paradoxical expansionary Mundell-Fleming effect taking over as the J-curve unwinds. But the implication that the domestic interest rate would have to decline when the foreign interest rate increases does not square well with economic intuition, nor does there appear to be any empirical evidence of such response.

As far as policy is concerned, the Mundell-Fleming model has different implications depending on whether one assumes that the Marshall-Lerner condition holds, or that it does not. If it is assumed to hold, then the supply of money should be <u>reduced</u> in response to an interest rate increase in order to offset the net expansionary effect of depreciation. Some currency depreciation would, however, be necessary to offset the contractionary effect

of the higher interest rate level. If policy attempted to maintain both the exchange rate and the level of output unchanged, it would be necessary to introduce a fiscal stimulus and at the same time to reduce the supply of money.

When the Marshall-Lerner condition does not hold the only policy option to offset an interest rate disturbance is a mix of expansionary fiscal policy and restrictive monetary policy.

Yet another policy option that suggests itself in the Mundell-Fleming model is a tax on foreign investment. It would appear to be possible in the Mundell-Fleming model to offset interest rate disturbances completely by means of an 'interest equalization tax', but as we shall see this result does not hold true in a correctly specified model.

The Dornbusch Model

Dornbusch's celebrated 1976 paper on exchange rate dynamics bridges the gap between long run full employment equilibrium and short run Keynesian unemployment equilibrium by assuming a Phillips curve relationship between domestic inflation and the rate of unemployment.[4] A key result of the model is the demonstration of the possibility of overshooting the exchange rate to monetary disturbances with rational exchange rate expectations.

The Dornbusch model implies that an increase in the world real interest rate causes a permanent deterioration in the domestic terms of trade in full employment equilibrium: this is necessary to offset the contractionary effect of the higher real interest rate on aggregate demand. Furthermore, there is a permanent increase in the domestic price level, with a constant money supply, because of the increase in velocity caused by the rise in the

interest rate. For both of these reasons, there is a permanent depreciation of the domestic currency in full employment equilibrium.

In the short run the Dornbusch model behaves like the Mundell-Fleming model with regressive exchange rate expectations around the long run equilibrium value of the exchange rate. Depending on the values of the parameters, the domestic interest rate may increase by less than the foreign interest rate in the short run. In that case, the exchange rate would have to overshoot its long run equilibrium value.

Qualitatively, the response of the domestic economy to an interest rate disturbance is the same in the Dornbusch model as in the Mundell-Fleming model: domestic currency depreciates, interest rate increases and output expands. Over time domestic prices and wages increase to a new and higher equilibrium level. To offset the inflationary impact, the central bank should reduce the supply of money in response to an increase in the world interest rate. The only way to keep both the exchange rate and domestic output and price level unchanged, would again be a mix of tight monetary and expansionary fiscal policy. An 'interest equalization tax' would appear to be another policy option to completely offset the domestic effects of a change in the world interest rate. We shall see later on, however, that such policy will not provide insulation in a properly specified model.

Effects of Changes in the World Interest Rate in Portfolio Balance Models

The Mundell-Fleming model, and Dornbusch's extension of it, are both ad hoc models designed to capture some macroeconomic relationships that are perceived as particularly relevant and important. The simplifications that are made in these models do not matter in the analysis of some problems but they do matter in the analysis of capital movements.

Consider Dornbusch's full employment version of the Mundell-Fleming model. The model implies that in response to an increase in the world interest rate the current account will be permanently in surplus. Clearly, this cannot be a sustainable equilibrium, but rather reflects a misspecification of the model. The misspecification that is responsible for this conclusion is the neglect of the intertemporal budget constraint, or, what comes to the same, of the effects of interest earnings (payments) on domestic absorption.

In portfolio balance models the intertemporal budget constraint is recognized by the inclusion of interest earnings on foreign assets as part of disposable income, and by the direct effect of foreign asset holdings, as part of total private wealth, on consumption. With this change of specification, an automatic mechanism of current account adjustment is introduced.[5] As long as the current account is in surplus (deficit) domestic wealth increases (decreases) and thus domestic consumption also increases (decreases). Provided that the marginal propensity to spend out of interest income exceeds one, and that the Marshall-Lerner condition holds, the stock of foreign assets will eventually reach a stationary equilibrium value (assuming no secular growth). In the stationary equilibrium the current account is equal to zero, and the trade account surplus (deficit) is equal to net foreign interest income.

Consider now the effect of an increase in the foreign interest rate once the requirement of long run portfolio balance is recognized. Assume initially that full employment prevails both in the short run and in the long run. In the short run an increase in the foreign interest rate causes an outflow of capital, a deterioration of the terms of trade and an increase of the domestic price level. Over time, the stock of foreign assets increases and causes an improvement in the terms of trade. In the new long run equilibrium, the stock of foreign assets is higher, and the interest account surplus is greater than in the initial equilibrium. Therefore, the long run effect of an increase in the foreign interest rate on the domestic terms of trade is favourable. The effect on the exchange rate is ambiguous: real appreciation may, or may not be, offset by an increase in the domestic price level caused by an increase in the velocity of circulation. Furthermore, there may not be any decrease in the demand for money in the long run, if the demand for money depends on total disposable income, or total expenditure, rather than on domestic income only, or if there is a wealth effect on money demand.

The implications of the Mundell-Fleming model with the inclusion of the requirement of long run portfolio balance are very sensitive to the specification of the demand for money function. Obviously, if one assumes that the demand for money depends only on the level of domestic output, the price of domestic output, and the nominal interest rate, and that the domestic price level is fixed, an increase in the foreign interest rate is expansionary both in the short run and in the long run. The long run effect on the exchange rate is, however, ambiguous: on the one hand, there is an improvement in the interest service account but on the other hand, there is an increase in import demand because of higher levels of domestic income, foreign interest earnings and wealth.

If the demand for money is assumed to depend on total income, or total expenditure, and wealth, the long run effect of an increase in the foreign interest rate on domestic output is ambiguous.

If one does not assume perfect substitutability between domestic assets, and claims issued by domestic residents, on the one hand, and foreign assets on the other, there is another adjustment mechanism at work restoring equilibrium in the current account. A surplus (deficit) in the current account increases (decreases) the supply of foreign assets relative to domestic assets and thus causes the domestic interest rate to decline and the price of foreign currency to decrease so as to maintain equilibrium in financial markets. Both of these effects are independent of the wealth effect on expenditure, and on their own tend to restore equilibrium in the current account.

In the portfolio balance models with imperfect substitutability, an increase in the foreign interest rate has two conflicting effects on the domestic interest rate in the long run. On the one hand, there is a substitution effect, a shift away from domestic to foreign assets at a given level of wealth, and on the other, there is a wealth effect, which causes the stock of wealth and therefore, the demand for domestic assets to increase. It is possible that the wealth effect dominates in the long run, in which case an increase in the foreign interest rate would paradoxically lead to a decline in the domestic interest rate.[6]

Descriptive portfolio balance models suffer from all the shortcomings of ad hoc models in that they do not really enable one to narrow down the range of outcomes, nor to condition the outcomes on parameters or considerations that have a clear interpretation in terms of the behaviour of individuals, or in terms of distribution effects across individuals. Below, we shall therefore discuss the implications of models that are explicitly derived from optimizing behaviour by individuals.

Summary: Short Run Depreciation, Long Run (Real) Appreciation

In summary of the brief review of the literature, we note that once the requirement of long term portfolio balance is taken into consideration, an increase in the foreign interest rate (in real terms) leads to an immediate depreciation of the domestic currency followed by a period of appreciation. Therefore, with rational expectations the domestic interest rate does not increase by the full amount of the increase in the foreign interest rate.

In the long run there will be real appreciation of the domestic currency because of the increase (decrease) in foreign interest earnings (payments). The long run effect on the nominal exchange rate, as well as on the domestic price level is, however, ambiguous.

The reversal of the initial effect does not occur in the Mundell-Fleming model, or in Dornbusch's extension of it, because there is no requirement of long run current account equilibrium in these models.

Finally, we note that except for the problems caused by the 'J-curve', an increase in the foreign interest rate is expansionary in the short run in the standard macroeconomic models.

Real Wage Rigidity, Raw Material Imports and the Inflation-Unemployment Trade-Off

The nature of the short effects of disturbances under flexible exchange rates depends critically on whether one assumes that wages are rigid in nominal or real terms. This is also true as far as the effects of interest rate disturbances are concerned.

If wages are indexed de facto or de jure in such a way that the real wage rate in terms of domestic and imported goods is rigid, an increase in the world interest rate leads to an increase in unemployment, a decrease

in domestic output and an increase in the domestic price level.[7] The domestic price level increases for two reasons: because of the increase in velocity and because of the reduction in domestic output.

Even with real wage rigidity, however, the current account moves into a surplus if the Marshall-Lerner condition holds. Therefore, the initial deterioration of the terms of trade will be offset by subsequent real appreciation. In the long run, the improvement in the terms of trade permits an increase in the real wage rate and/or in the level of employment.

If the wage rate is 100 percent indexed and adjusts with virtually no time delay to price changes, monetary policy has no real effects and, in particular, has no effect on employment. In that case monetary policy might as well aim directly at price stability. To the extent that fiscal policy could be used to shift demand from foreign to domestic products, and thus to improve the terms of trade, it could be assigned to domestic employment and output targets.

With some delay in wage adjustment there would still be some room at least in the short run to buy more output and employment by tolerating more inflation.[8]

In this case, an increase in the foreign interest rate could be interpreted as causing an adverse shift in the short run Phillips curve: the outcome would be stagflationary or inflationary depending on the policy choice.

The stagflationary effect of depreciation is reinforced once we incorporate imports of intermediate inputs, such as oil into our model.[9] Even without any wage response, there will be an increase in the domestic price level. Without monetary accommodation, domestic output will decrease

or increase depending on the relative magnitudes of the price level increase on the one hand, and the increase in velocity, on the other.

From another perspective, an increase in the price of raw materials causes an adverse shift in the short run Phillips curve, and is stagflationary if the central bank chooses to fight 'imported inflation' by means of a more restrictive monetary policy.

FIGURE I

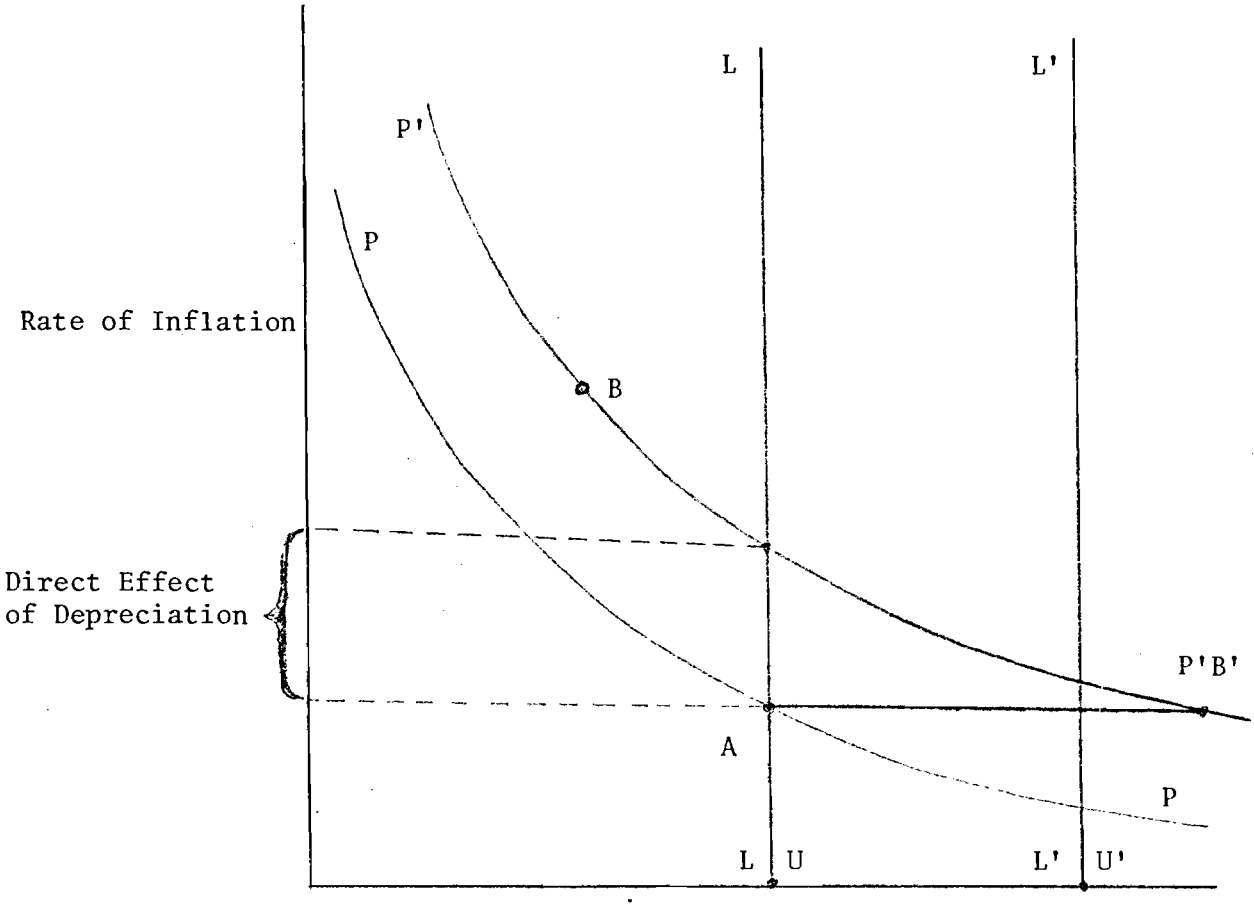


Figure I illustrates the effect of an increase in the foreign interest rate on the domestic inflation-unemployment trade-off. Because of the increase in import prices caused by the depreciation of the domestic currency, and the response of wages to higher prices, the short run Phillips curve shifts from PP to P'P'. With no change in the supply of money, the economy may end up at a point such as B with more inflation and less unemployment because of the expansionary effects discussed above. If, on the other hand, policy attempts to keep the rate of inflation unchanged, then there has to be an increase in unemployment to a point such as B' in figure I.

If the real wage rate is completely rigid there is an increase in the 'noninflationary rate of unemployment', from U to U' in figure I, because of the deterioration in the terms of trade. Over time, however, the accumulation of foreign assets leads to an improvement in the terms of trade, and thus, to a decrease in the noninflationary rate of unemployment below the initial unemployment rate.

Implications of Models Derived from Optimizing Behaviour

Optimizing models of the open economy are still at their infancy. There are three different classes of models, each with quite different implications: a Ramsey-Sidrauski type model with an intertemporally additive utility function, an Uzawa-type model with endogenous time preference; and life-cycle models.[10]

A Ramsey-Sidrauski type model has the unfortunate implication for the open economy that unless the foreign interest rate happens to equal the rate at which domestic residents discount future utility, there is no stationary equilibrium. An increase in the foreign interest rate, for example, would lead to a permanent surplus in the current account, and a steady increase in the stock of foreign assets and consumption, with the rate of decrease of the marginal utility of consumption equal to the difference between the world interest rate and the domestic rate of time preference. With inelastic foreign demand for domestic exports, or with nontraded goods, an increase in the foreign interest rate would lead to continuous real appreciation after an initial real depreciation.

A further implication of the Ramsay model is an indeterminacy of equilibrium in the sense that there is no tendency for the economy to converge to a long run equilibrium which is independent of initial conditions. If, for example, the foreign rate of interest was equal to the domestic rate of time preference, a windfall increase in domestic wealth would increase domestic wealth permanently, and thus it would have a permanent effect on equilibrium prices.

In a model with two or more countries, the Ramsey model has the disturbing implication that if the rates of time preference happen to be unequal between the residents of the two countries, the country with the lower rate of time

preference will end up consuming total world output, and earning total world income, with the income and consumption of the 'impatient' country converging asymptotically to zero.

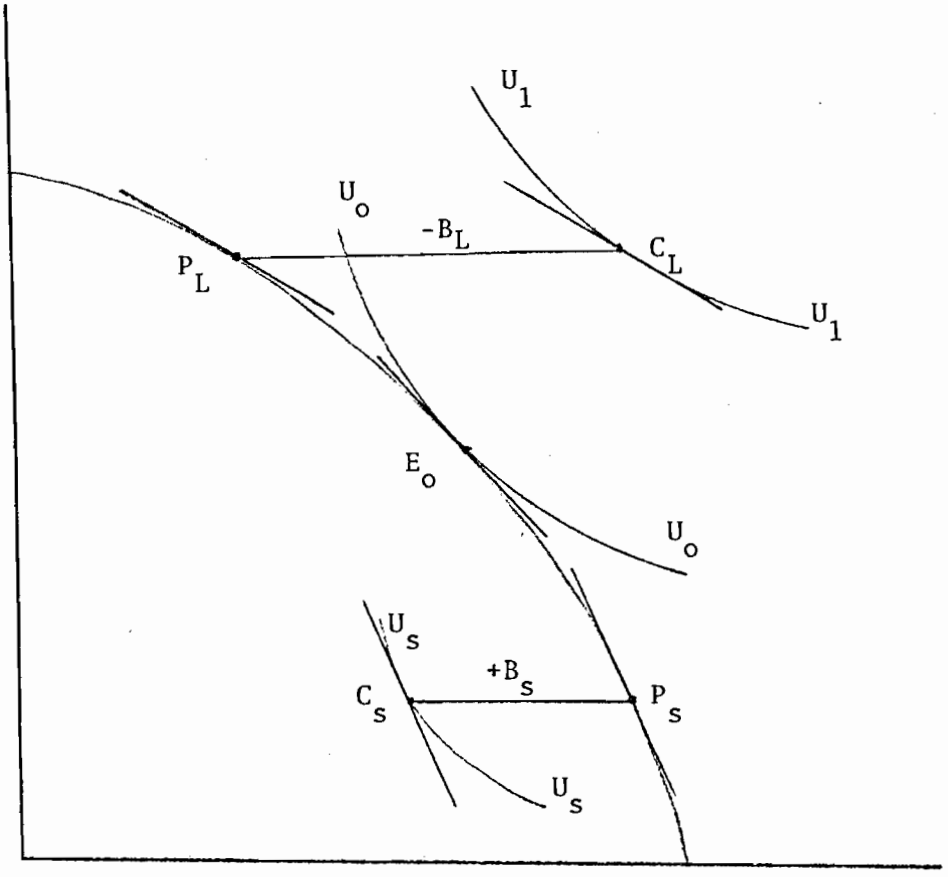
If, on the other hand, one assumes that for some reason the rates of time preference happen to be equal between the two countries, the distribution of wealth, and therefore, the entire relative price structure have no equilibrium values which are independent of initial conditions.

The Uzawa model assumes that the rate of time preference is an increasing function of the rate of consumption, and thus implies a long run target level of consumption which is an increasing function of the rate of interest. In this model savings behaviour can be interpreted in the Metzlerian way as an adjustment of the stock of wealth to its long run desired level.

In an Uzawa-type model an increase of the foreign interest rate increases consumption in the long run, and therefore increases the demand for domestic output in the long run. In a model in which the domestic economy produces one good which is consumed at home and exported, and faces inelastic demand, the long run effect of an interest rate increase is an improvement in the terms of trade, or real appreciation. In a model with nontraded goods, the relative price of nontraded goods must increase in the long run. Figure II illustrates this result.

The economy is initially in equilibrium at E_o with utility U_oU_o. An increase in the world interest rate increases the long run target rate of consumption -- measured in terms of utility -- to U_1U_1. This consumption target is outside the initial production and consumption possibilities frontier of the economy, so that it can be achieved only through saving. Since we are ruling out domestic capital accumulation (and, in any case, domestic capital

FIGURE II


U1
Uo
-BL
PL
CL
U1
NONTRADABLE
GOOD
Eo
Uo
Us
+Bs
Cs
Ps
Us
TRADABLE GOOD

stock would decrease in response to a higher foreign interest rate), the only way that wealth can increase is through accumulation of assets. Eventually, long run equilibrium is obtained with consumption at C_L and production at P_L, and the real exchange rate equal to the slope of the production possibilities frontier at $P_L$and the indifference curve at C_L. In comparison with initial equilibrium at E_o, the relative price of home goods at (P_L, C_L) is higher reflecting the increase in the relative scarcity of home goods whose supply is constrained to be on the production possibilities frontier, while the supply of traded goods can be increased through saving. In the long run equilibrium, the trade account is in deficit by B_L.

In order for the increase in the stock of foreign assets to be possible, the current account must be in surplus in the process of adjustment. In figure II consumption (measured in terms of utility) initially declines to U_sU_s. Short run equilibrium obtains with production at P_s, consumption at C_s and the trade account in surplus by B_s. At (C_s, P_s) the price of traded goods is higher than in the equilibrium at E_o, implying 'real depreciation' of the domestic currency. In the process of adjustment from (C_s, P_s) to (C_L, P_L) the domestic currency continuously appreciates in real terms as long as the current account is in surplus. Therefore, the domestic interest rate must be below the foreign interest rate until long run equilibrium is reached at (P_L, C_L).

The behaviour of the nominal exchange rate cannot be inferred without specifying the demand for and the supply of money. In the short term there has to be depreciation also in nominal terms, but whether there is nominal depreciation in the long run is ambiguous. On the one hand, there is an increase in the velocity of circulation because of the higher interest rate, but on the other, there is also an increase in the demand for money because

of the increase in consumption and wealth. Therefore, the direction of change of the price level is ambiguous in the long run. And even if the price level increases, the increase may be offset by real appreciation, implying the possibility that the domestic currency appreciates also in nominal terms in the long run.

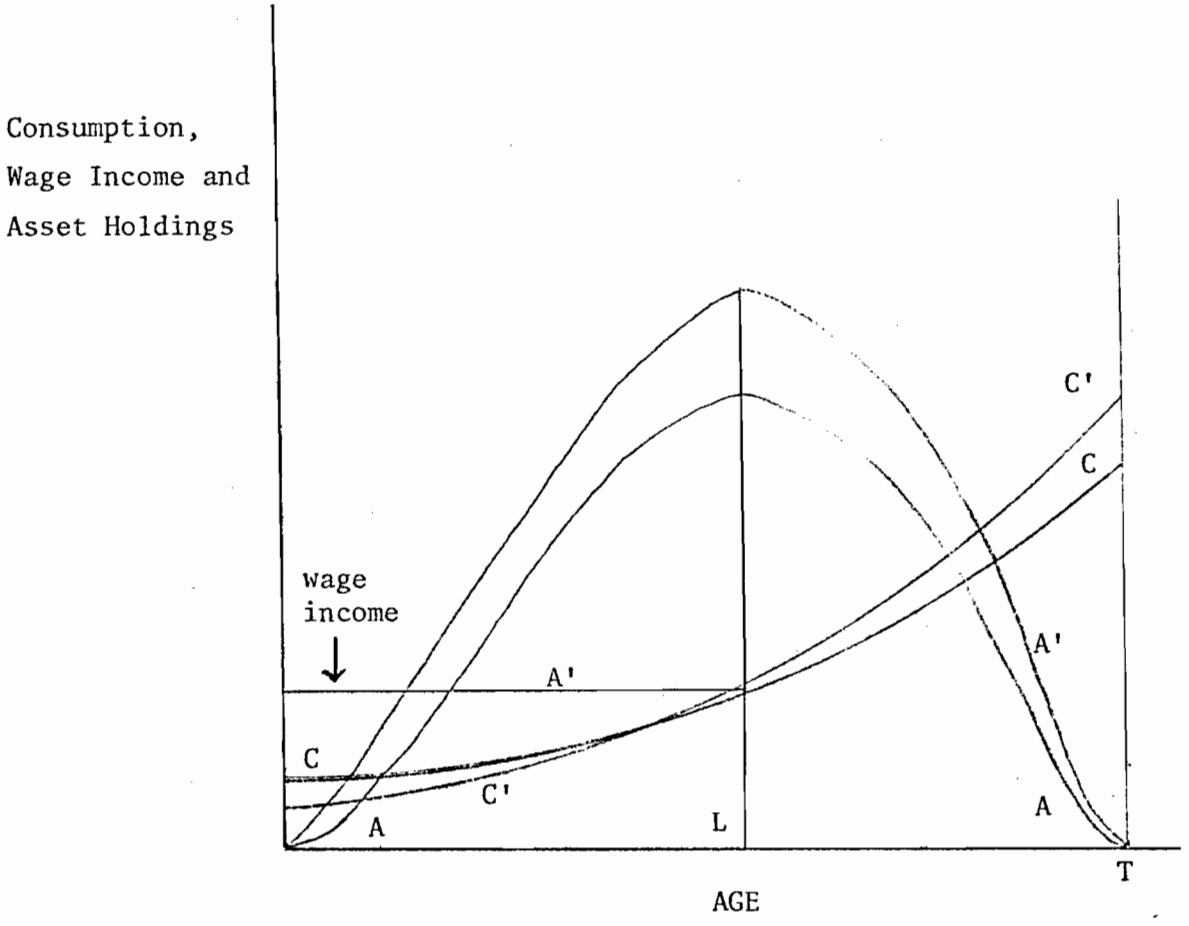
A third framework of analysis which starts from a specification of individual optimizing behaviour is a model with finitely lived overlapping generations. As is well known such model gives rise to a long run 'wealth demand function' which resembles the type of function typically assumed in portfolio balance models. The behaviour of an economy with selfish overlapping generations also resembles the behaviour of an Uzawa-type economy of infinitely lived families. There is, however, one important difference. In the life-cyle-overlapping generations model, capital and human wealth are complementary, whereas in the Uzawa model they are substitutable. Thus, in the overlapping generations model an exogenous increase in wage income would lead to an increase in the supply of capital, whereas in the Uzawa model there would be a decrease in the supply of capital. The intuitive reason for the complementarity between wage income and capital income in the overlapping generations model is that to enjoy part of their increased wage income in retirement years, individuals need to accumulate a larger stock of assets for consumption in those years. In the Ramsey model the supply for capital is infinitely elastic in the long run, so that the question of complementarity versus substitutability is not even well defined.

Figure III illustrates the effects of an interest rate increase in a life-cycle model. It portrays the lifetime consumption-savings plan of an individual at the beginning of his active life. For simplicity it is assumed that the individual earns a constant wage income in his active years (assumed to be of duration L), and earns no wage income in his retirement years. Assuming that the individual chooses his consumption-cum-savings plan so as to maximize an additively separable utility function, and plans to leave no bequests, his consumption profile might look like the CC schedule in figure III. It is assumed that the rate of interest is greater than the individual's rate of time preference, so that the marginal utility of consumption decreases -- and therefore consumption increases -- along the planned consumption path. The AA schedule illustrates the planned time path of asset holdings.

An increase in the rate of interest tilts the consumption path up and reduces consumption in the early years. Thus, for young people saving is unambiguously an increasing function of the rate of interest. This is because the substitution effect and the income effect go in the same direction: an increase in the rate of interest reduces the present value of wage income. For older people with substantial non-human wealth (or young people with inherited wealth) the wealth effect of an interest rate increase is positive and thus consumption may be an increasing rather than a decreasing function of the rate of interest.

The effect of an interest rate increase on total saving is the net outcome of substitution and income effects at the individual level, and distribution effects across individuals in different age groups. The distribution effects work against the substitution effects because an increase in the rate of interest reduces the human wealth of young people with relatively high savings propensity.

FIGURE III


Consumption,
Wage Income and
Asset Holdings
wage
income
A'
C
C'
A
L
C'
C
A'
A
T
AGE

The long run effects of an interest rate increase on the demand for wealth -- or the supply of capital -- can be inferred from the life-cycle plan of the individual if we assume a stationary population with a rectangular demographic profile. In figure III the effect of an interest rate increase on the supply of capital is measured by the difference between the area under the A'A' curve on the one hand, and the AA curve on the other. As the curves are drawn the supply of capital unambiguously increases, but that need not be the case.

Total long run consumption can also be inferred from figure III: it is the area under the CC (C'C') schedule. Whether total long run consumption is an increasing or decreasing function of the rate of interest is also ambiguous, but in general the presumption is that it is an increasing function. Obviously, the requirement that long run consumption be an increasing function of the rate of interest is less stringent than the requirement that the supply of capital be an increasing function of the rate of interest.

Although the life-cycle model implies a long run consumption function, there is an important difference with the Uzawa model. Unlike in the Uzawa model, long run consumption is not independent of wage income in the life-cycle model but is instead an increasing function of wage income. In the Uzawa model wage income (or other non-capital income, such as transfers) and capital income are perfect substitutes; in the life-cycle model they are complements. This difference has an important bearing on a number of issues, such as the long run effects of transfer payments, or of a terms of trade deterioration on the balance of payments. For example, the Uzawa model implies that following a permanent deterioration in the terms of trade with no change in the real rate of interest the current account moves into a <u>surplus</u>, and remains in surplus until the economy is able to support the same level of

consumption as before from a higher level of interest earnings abroad. In contrast, the life-cycle model implies the intuitively more plausible response, that a deterioration in the terms of trade will be followed by a period of current account deficits, and will lead to a permanent reduction in non-human wealth and long run consumption.

In the Uzawa model the real rate of return on capital investments, or saving, is the sole determinant of long run consumption and it is therefore the most crucial relative price that a small open economy faces in the world market. In the life cycle model the real wage rate is an equally important determinant of long run consumption and welfare.

Population growth, demographic profile, productivity increase, social provision of retirement benefits, and so forth are all important considerations in the life cycle framework in analyzing the savings behaviour of different economies, and the flow of capital between them.

In international economics, the full implications of the life-cycle model are yet to be worked out. With a great diversity of demographic profiles, productivity growth rates and social security systems between countries, one can expect rich rewards from that line of research.

Effects on the Cost of Capital, the Demand for Capital and Investment

So far we have abstracted from the effects of interest rate changes on the supply side of the economy. For permanent interest rate changes such effects are profound; while short term changes mainly affect consumption and the timing of investment projects.

From the long run point of view capital cost in the open economy is exactly like the cost of imported raw materials or other intermediate inputs. Therefore, long run adjustment to an increase in the real rate of interest presents the same adjustment problems as the much analyzed increase in the relative price of energy. In particular, other factors being given, and abstracting from ambiguities that might arise because of reswitching, an increase in the cost of capital requires a reduction in the real wage rate. Indeed, in the standard neoclassical model with labour and capital as the only inputs in a production process that exhibits constant returns to scale, the real wage rate is uniquely determined by the cost of capital. At the real wage rate so determined, the long run demand for labour is infinitely elastic! Allowing for non-reproducible specific factors of production, such as land and human talent, the long run demand for labour function becomes downward sloping, but still an increase in the cost of capital reduces the marginal product of labour, and therefore its demand.

In the long run, the distinction between traded and nontraded goods is further blurred by the fact that the nontradable sector uses capital services, which are tradable inputs. An increase in the rate of interest increases the cost of housing, or of hospital services, much in the same way that an increase in the cost of oil does in the short run.

An increase in the cost of capital changes the structure of relative prices in the long run with the relative price of capital intensive products likely to increase. There is no reason to expect that the relative price of 'nontraded goods' should change in any particular way. Although some sheltered sectors, such as restaurants and government bureaucracies, are very labour intensive, others, such as housing services, electric utilities, public roads and other transportation infrastructures are very capital intensive.

Finally, we should note that the cost of capital measured in terms of domestic output, depends not only on the rate of interest but also on the relative price of capital goods in terms of domestic output. If capital goods are mostly imported, an improvement in the terms of trade can have a substantial effect on the cost of capital. This introduces a potential link between domestic saving and the domestic cost of capital. An increase in saving leads, in the short run, to a deterioration in the terms of trade because of capital outflow, and therefore to an increase in the relative price of capital goods. Over the long run, however, there will be an improvement in the terms of trade because of the higher level of interest earnings, and therefore a reduction in the cost of capital. Whether the cost of capital, as opposed to the relative price of capital goods, increases or decreases in the short run depends on whether the anticipated improvement in the domestic terms of trade offsets the effect of the temporarily higher price of capital goods.

Increase in the cost of capital reduces the demand for capital in the long run both because of substitution from capital to labour intensive methods of production, and also because of the shift of demand from capital to labour intensive products. Therefore, there is a decline in gross investment, in the short run and a permanent decline in replacement investment in the long run. Accordingly, there will be a reallocation of resources from industries

producing capital goods to sectors that produce consumer goods and services.

Effects on the Cost of Working Capital, Inventories, and Money Balances

For reasons that are not altogether clear, the cost of working capital, inventories and money balances is typically totally ignored in macroeconomic models although such costs are far from being trivial. Furthermore, such costs provide an immediate link between the cost of output and the rate of interest, unlike in the case of fixed capital that earns quasi-rent in the short run.

The cost of inventories of finished products and raw materials is the sum of storage costs and the opportunity cost of the capital that is tied up in inventories. These costs are considerable and they must be covered by the price of the product even in the short run. Therefore, an increase in the rate of interest increases the supply price of output. With inventories equal to 30-40 percent of annual output, the capital cost of inventories cannot be ignored.

Because investment projects take time to be completed, the interest cost of resources that are tied up during the construction phase must be included in the cost of capital goods. Thus, if it takes two years to build a steel plant the price of the plant in two years is not equal to the sum of wages, raw materials, machines and so forth that were paid during the two years, but rather the relevant price is the augmented cost, with each month's expenditure multiplied by an interest rate factor.

Yet another cost that is almost always ignored in macroeconomic models, is the capital cost of time that elapses in the shipment of goods from producers to users. In the input-output model, for example, each entry in the cost matrix contains a capital cost element of this nature.

The opportunity cost of holding money balances that yield nominal interest below the market rate of interest is recognized in monetary theory but again, macroeconomic models never include the cost of money balances as part of the total cost of output. In a correctly specified model such costs should obviously be included as a part of total variable costs. This addition to the standard macroeconomic model would introduce the nominal rate of interest (minus the nominal rate of return on money balances) as one of the determinants of the supply price of output.

Finally, we should also note here that in most countries the cost of housing is incorrectly measured in the consumer price index. In a well-functioning market for housing services, the short term rental cost of housing does not depend on the rate of interest, given the fixed supply of space for housing services. In practice, however, given rent controls, rents are often adjusted on the basis of the cost of interest service; and in any case, the imputed cost of owner-occupied housing is measured on the basis of the cost of interest service.

This bias in the construction of the CPI index exaggerates the extent of inflation, or of the decline of real wages when the nominal interest rate increases because of higher inflation.

Effects on the Cost of Public Debt Service and Seignorage

A potentially important effect of interest rate changes is the effect on the interest burden of public debt. The governments of many small countries have borrowed extensively in the international capital market, and typically with variable interest rates, so that they are immediately affected even if the domestic capital market was not integrated to the international capital market. With capital market integration, the cost of domestic debt service increases pari passu with the cost of external debt service. Because the

government, too, faces an intertemporal budget constraint, an increase in the rate of interest must either lead to a reduction in government expenditure or to an increase in taxes, or some combination of the two. Both alternatives are politically unattractive, and the second, in addition, magnifies the costs of distortions caused by taxes.

The central bank will benefit from higher interest rates: its interest earnings on domestic and foreign assets increase; or from the other side of the balance sheet the seignorage on reserve money increases. This will partly offset the higher cost of public debt service.

Private banks too may benefit, if their deposit rates do not adjust while loan rates go up with other interest rates.

International Capital Movements and Domestic Welfare

The analysis of the effects of interest rate changes has established that they are pervasive both in the short run and in the long run, and often pose difficult macroeconomic adjustment problems. In part for this reason, freedom of capital movements has never been advocated with the same conviction as freedom of trade in goods and services. The current international trade and payments system requires neither convertibility nor absence of restrictions on capital account transactions.

Yet, the economic case for freedom of capital movements is as clearcut as the case for free trade. And free trade, too, contributes to macroeconomic adjustment problems, as recent years clearly demonstrate. It is taken for granted, however, that 'macroeconomic reasons' do not justify interference with the basic long term structure of free trade.

With capital movements countries do, however, have such freedom. Should an individual country then use it when faced, for example, by an increase in 'the world interest rate'.

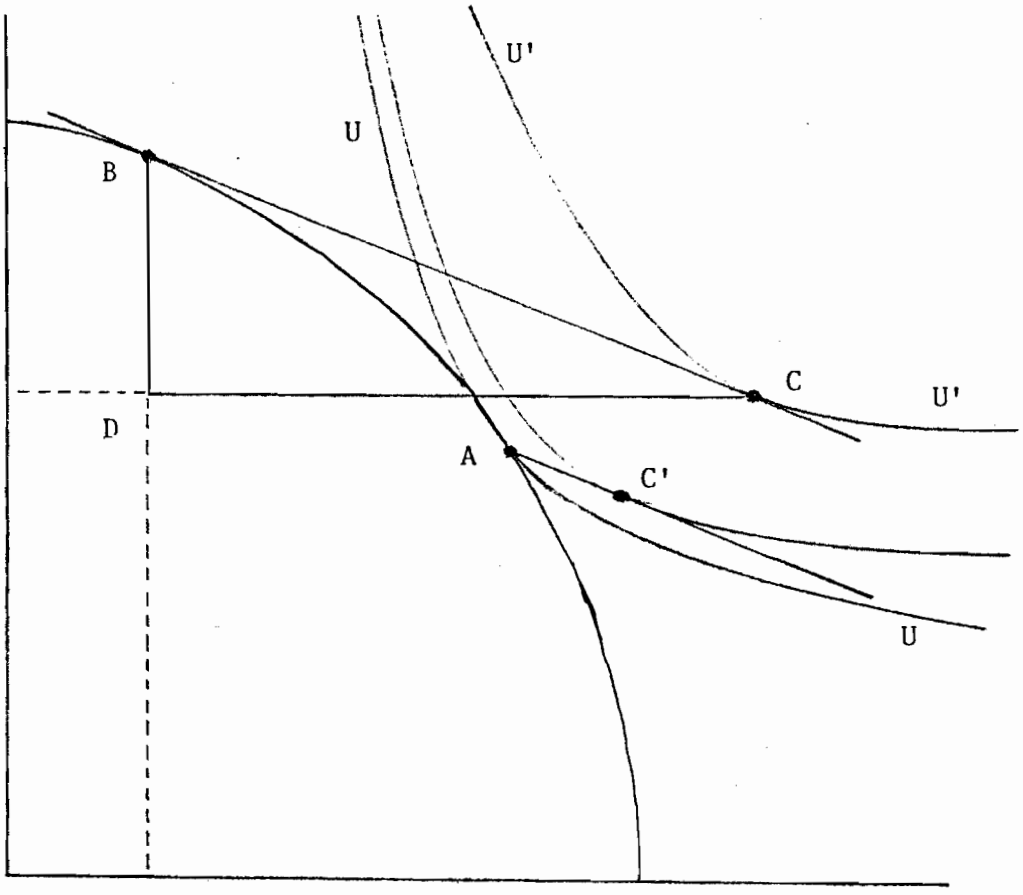
To discuss this question let us consider a prototype Fisherian two-period model of a small open economy which produces a single internationally traded good. Let us assume further that this good can be either consumed or invested to augment future consumption.

The PP schedule in figure IV illustrates the consumption possibilities of such economy under autarchy. Indifference curves, such as UU and U'U', represent consumers' preferences between current and future consumption. In the absence of international capital movements equilibrium obtains at the point of tangency of indifference curve UU and the consumption possibilities frontier at A. The common slope of the UU and PP schedules at A is equal to the relative price between next period's and current period's consumption, or 1+r where r is the rate of interest.

If the world interest rate is different from the domestic interest rate that obtains under autarchy, 'capital market integration' increases domestic welfare. Figure IV illustrates a case when the world interest rate is less than the domestic interest rate. New consumption equilibrium obtains now at point C and new production equilibrium at B. Social welfare increases from UU to U'U'. This increase can be divided in the usual way into a consumption gain -- move from A to C' in the figure -- and a production gain -- move from C' to C.

Trade balance surpluses and deficits measure the extent of intertemporal trade, in the same way that the levels of imports and exports measure the extent of contemporaneous trade. In figure IV the trade balance is in surplus in the second period by BD and in deficit in the first period by DC. It follows from the budget constraint that the present value of trade surpluses or deficits, or $DC+\frac{1}{1+R^X}$ BD in the figure, is equal to zero.

FIGURE IV

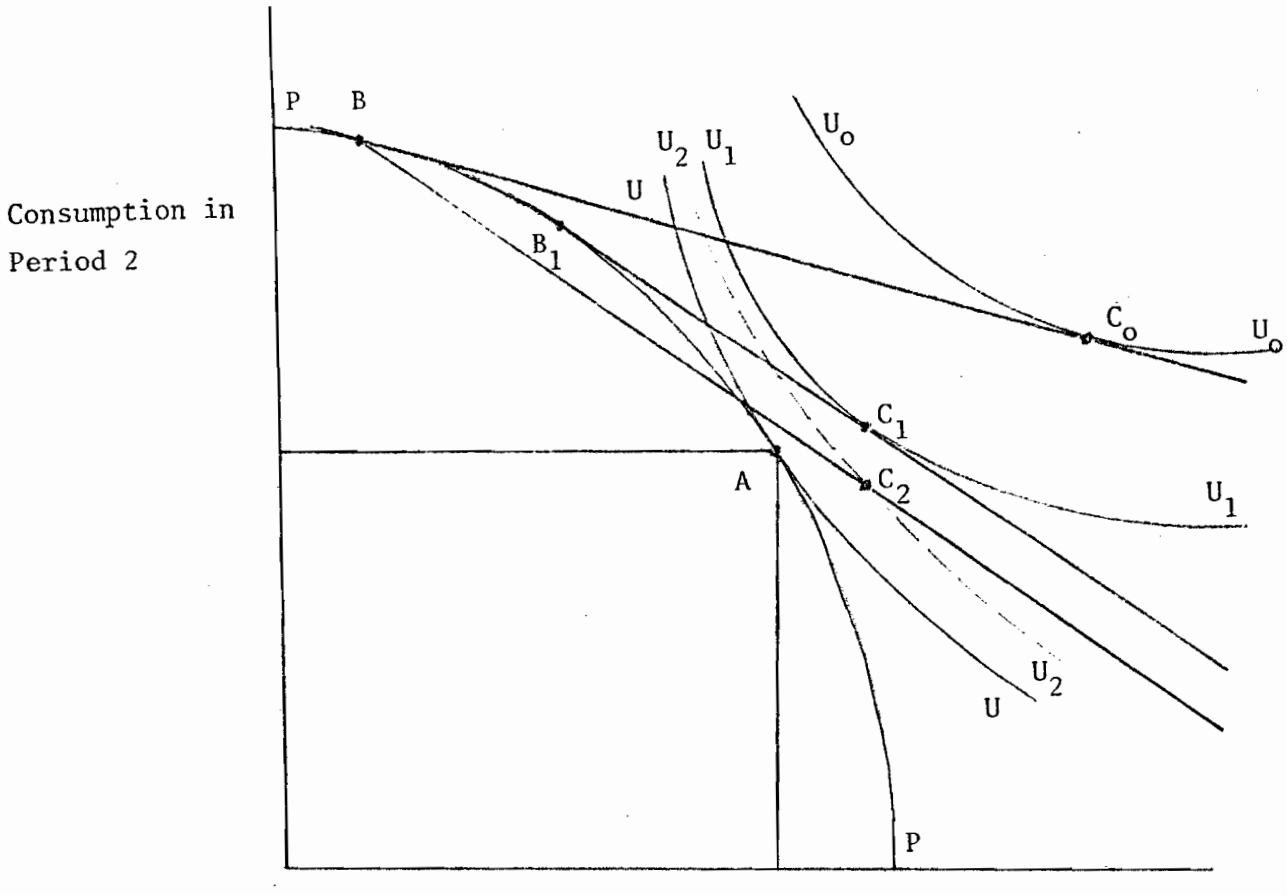


Although the trade account is in deficit in period 1 in our example, the deficit does not represent a policy problem, nor does it imply that the society is sacrificing future consumption to maintain current consumption. A large enough tariff on foreign borrowing could eliminate the deficit and restore autarchic equilibrium at A in figure IV but only at the cost of a decline in social welfare from U'U' to UU. In the example illustrated in figure IV, elimination of the trade deficit means less consumption in the future as well as in the present.

After these preliminaries consider the effects of interest rate changes. Let us assume an 'overlapping generations' model, with each generation living for two periods. Let us also assume for simplicity that both the consumption possibilities frontier and the indifference map are the same for each generation. Suppose, with reference to figure V, the the old generation faced interest rate R_o^x and was in equilibrium at points B_o and C_o with utility level U_oU_o. In the current period, the world interest rate is R_1^x, which is assumed to be higher than the previous period's interest rate. The old generation is unaffected by this 'disturbance' but the young generation's real income is now lower than what it would be had the world interest rate stayed at R_o^x. In the absence of policy intervention new equilibrium obtains at points B_1 and C_1. The young generation's consumption plan is on indifference curve U_1U_1; at the old interest rate it would be on indifference curve U_oU_o. There is, however, nothing that the government can do to reduce this welfare loss.

The government might decide to keep the domestic interest rate unchanged despite the increase in the world interest rate. It could do so by means of a tax on foreign investment equal to the change in the world interest rate.

FIGURE V


Consumption in Period 2
P
B
B_1
U_2
U_1
U_o
U
C_o
U_o
C_1
A
C_2
U_1
U_2
U
P
Consumption in Period 1

Producers' equilibrium would remain at B_o, but as consumers domestic residents would be made worse off with consumption plan C_2 on indifference curve U_2U_2.

It is shown in the appendix that marginal change in real income measured in terms of current consumption is given by:

1. $du = -\frac{r-r^x}{1+r}\, dB - (X_2-C_2)\frac{dr^x}{1+r^x}$, where r = domestic interest rate

r^x = world interest rate

B = trade surplus.

The second term measures the unavoidable primary loss (gain) from an exogenous change in the world interst rate. If r is initially equal to r^x, there is no secondary loss on the margin. But once the domestic interest rate is below the world interest rate, an improvement in the trade balance entails a reduction in utility.

Change in real income (utility) can be further expressed in terms of interest rate change as follows (see appendix I):

2. $du = -\frac{(r-r^x)\ \mu_c C_1 + \mu_I I}{1+r-\pi_1(r-r^x)}\left(\frac{dr}{1+r}\right) - \frac{(1+r)(X_2-C_2)}{1+r-\pi_1(r-r^x)}\left(\frac{dr^x}{1+r^x}\right)$, where

μ_c = absolute value of the interest elasticity of current consumption

μ_I = absolute value of the interest elasticity of investment.

π_1 = marginal propensity to consume

We note that if the domestic interest rate is below the world interest rate, a further reduction of it reduces domestic welfare, the more so the greater are the interest elasticities of consumption and investment. Once autarchy is reached, $X_2=C_2$, and domestic welfare is no longer affected by changes in the world interest rate. This insulation is achieved, however, at the cost of a permanently lower real income.

The relationship between interest rate changes and the trade balance is also of some interest. It is given by (see appendix I):

$$3.\quad dB = \frac{\mu_c C_1 + \mu_I I}{1+r-\pi_1(r-r^x)}\,dr - \frac{(1+r)^2\pi_1(X_2-C_2)}{(1+r^x)(1+r-\pi_1(r-r^x))}\,dr^x \ .$$

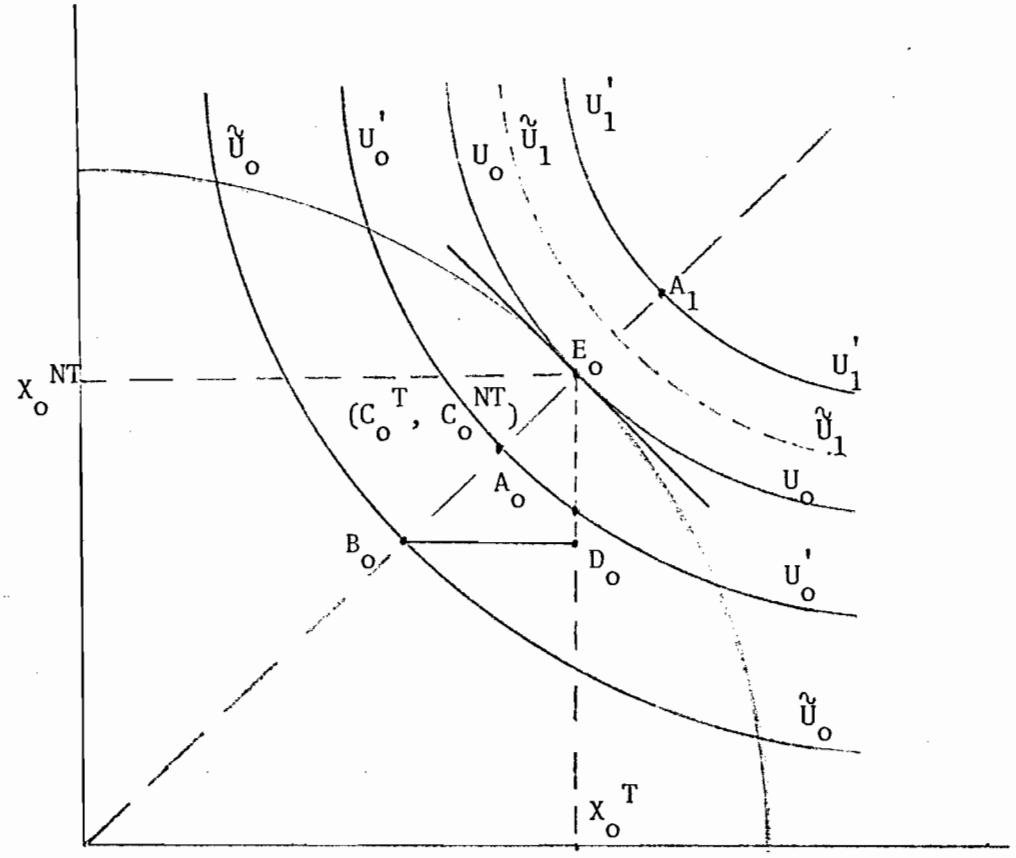
An increase in the domestic interest rate unambiguously improves the trade balance (for all 'reasonable' values of r), and thus causes an outflow of capital. The effect of a change in the foreign interest rate depends on whether the domestic economy is a net debtor or a net creditor. In the first case the effect is negative (trade balance deteriorates) whilst in the second case the effect is positive (trade balance improves).

In summary, taxes on international capital movements work like tariffs on trade in goods and services. They distort intertemporal production and consumption plans in a way that entails a deadweight welfare and efficiency loss.

There are two economic arguments for restricting capital movements despite the prima facie case for free trade. One is the familiar argument that the rate of interest that domestic residents earn on their foreign investments, or the rate of interest that they have to pay on foreign loans, depends on total domestic foreign investment or borrowing. In that case the usual optimal tariff argument applies. Also, if the domestic economy has some monopoly power in commodity trade but cannot impose tariffs on trade, some restriction, or subsidization, of capital movements may be optimal from the viewpoint of national interest.[11]

The second argument for controls on capital movements is the macroeconomic argument. Figure VI illustrates the argument by means of an example. The domestic economy is initially in equilibrium at E_o with output of traded

FIGURE VI


Nontradable Good
$\tilde{U}_o$
U_o'
U_o
$\tilde{U}_1$
U_1'
A_1
E_o
U_1'
X_o^{NT}
(C_o^T, C_o^{NT})
$\tilde{U}_1$
A_o
U_o
B_o
D_o
U_o'
$\tilde{U}_o$
X_o^T
Tradable Good

goods equal to X_o^T and output of nontraded goods X_o^{NT}. The consumption vector is (C_o^T, C_o^{NT}) and it puts domestic residents on indifference curve U_oU_o. For simplicity, it is assumed that trade is initially in balance. It is assumed further that in the second period the production possibilities frontier is the same and equilibrium obtains at the same point E_o.

Suppose now that there is an increase in the world interest rate. At the given relative price between traded and nontraded goods, and with production still at E_o in both periods, the consumption plan would be (A_o, A_1). This plan is clearly not consistent with equilibrium in either period. To effect the intertemporal adjustment, there has to be real depreciation in the first period and real appreciation in the second. If domestic prices are rigid, price adjustment is not possible and therefore, there will be adjustment in quantities.

There will clearly be excess supply of nontraded goods in the first period and a surplus in the trade account. Therefore, the output of nontraded goods has to decline: thus, there will be Keynesian unemployment in the first period. Consumption equilibrium might obtain at a point like B_o and production equilibrium at D_o, implying a trade surplus of B_oD_o. In the second period domestic production of traded goods remains unchanged because relative prices remained unchanged. The supply of traded goods is, however, then greater because of the accumulation of foreign assets, and interest earnings on them, in the first period. Therefore, there will be excess demand for nontraded goods in the second period.

Thus, an increase in the world interest rate causes a problem of Keynesian unemployment in the first period and one of excess demand, or 'repressed inflation' in the second. If prices are completely rigid in <u>real terms</u>, it is possible that an increase in the world interest rate leads to a quantity equilibrium that is worse than equilibrium that would prevail

under autarchy. In that case capital controls might be justifiable as a second best device to support domestic output and employment.

However, this same justification applies also to tariffs on trade in goods and services and it is not accepted as a valid justification. A better alternative from the long run point of view is to improve the workings of the domestic labour market in such a way that required relative price adjustments can be achieved by means of devaluations and revaluations of the domestic currency.

Appropriate Policy

Capital market integration improves efficiency of intertemporal resource allocation and increases domestic welfare, but it also exposes the domestic economy to fluctuations of equilibrium interest rates in the international capital market. There is, however, no reason to think that the level of interest rates would necessarily be less stable if the domestic economy is integrated into the international capital market, than if it is not.

Nevertheless, with capital market integration the domestic economy has to adjust to changes in international interest rates in the same way that it has to adjust to changes in the terms of trade or in the relative prices of raw materials. Various aspects of such adjustments have been examined in this paper.

An increase in international interest rates requires some increase in the level of domestic interest rates and some deterioration in the terms of trade, and some increase in the relative price of traded versus nontraded goods, in order that domestic resources be efficiently reallocated. A reduction in international interest rates requires adjustments in the opposite direction.

Under flexible exchange rates, domestic interest rates and the exchange rate move automatically in the right direction to effect the required adjustment. However, a policy of constant money supply (or steadily growing money supply) is not appropriate in an economy that is integrated into the international capital market, because the velocity of circulation of money then changes with the level of international interest rates. Instead, monetary policy should aim to stabilize the level of nominal GNP.[12]

Such policy would not completely stabilize the domestic price level: a terms of trade deterioration, or an increase in the relative price of imported raw materials would still increase the domestic price of final output. Achievement of complete price stability would, however, require more flexibility of nominal wages than one is likely tohave in any country in order for employment to be maintained in the face of changes in the terms of trade, or in the relative price of raw materials.

From a different point of view, absolute price level stability is not desirable in any case when the economy is subject to unavoidable real disturbances, such as terms of trade or real interest rate changes.[13] In most economies individuals cannot completely hedge against real disturbances of that nature by means of contingent contracts or equity claims. That being the case it is desirable to have the price level affected by real disturbances: nominal bonds, and other nominal contracts become then vehicles of risk sharing between borrowers and lenders. To improve the efficiency of such risk sharing, macroeconomic policy should aim to eliminate the 'noise' of purely nominal disturbances.

This point applies to exchange rate fluctuations also. It is desirable to eliminate nominal exchange rate fluctuations, and have the exchange rate correlate closely with 'the real exchange rate'. In that case, forward and futures currency markets enable individuals and firms

to hedge against unpredictable changes in the terms of trade.

The same point holds true for hedging in the bond markets as well. If the price level is negatively correlated with real income in each period, borrowers can hedge their real income risk by matching the term structure of their nominal bond holdings by the term structure of their expected income stream. If real income in some future period turns out to be lower than expected, the real burden of a nominal discount loan of the same maturity will then also be less.

FOOTNOTES

1. Mundell (1968) and Fleming (1962).

2. For most part we shall be discussing adjustment to an increase in the rate of interest. The effects of a decline in the rate of interest can be readily inferred. Mathematical derivations are left out because they are staightforward, or readily available in the literature.

3. Argy and Porter (1972) were the first to develop the implications of the Mundell-Fleming model with regressive exchange rate expectations.

4. Dornbusch (1976).

5. The automatic current account adjustment mechanism is formalized in Dornbusch and Fischer (1980), Kouri (1975, 1976, 1980) and Kouri and de Macedo (1978), and C.A. Rodriguez (1977).

6. See Kouri (1980).

7. The importance of 'real wage rigidity' has been emphasized by Bruno and Sachs (1981), Branson and Rotemberg (1980), Modigliani and Padoi-Schioppa (1978), and Sachs (1979), who have also developed the Mundell-Fleming model from the assumption of real rather than nominal wage rigidity.

8. Delay in the adjustment of nominal wages to past price increases gives rise to a downward sloping Phillips curve in Modigliani and Padoi-Schioppa (1978).

9. Raw material imports were introduced into the Mundell-Fleming model by Findlay and Rodriguez (1977). Schmid (1976) is another early reference.

10. Sidrauski (1967) is the basic reference on the 'Ramsey-Sidrauski approach'; Uzawa (1968) on the variable time preference model; and, in the trade context, Gale (1971) on the life-cycle-overlapping generations model. Frenkel (1971) develops an illuminating diagrammatic analysis of growth and the balance of payments. Onitsuka (1974) is another basic reference. Obstfeld (1981) develops a Sidrauski-Uzawa model to study exchange rate dynamics.

11. The economic case for restricting capital movements was first developed by MacDougall (1960). Kemp (1966) provides a modern treatment in a Hechscher-Ohlin-Samuelson framework. Karekan and Wallace (1977) argue the case for free capital movements.

12. This argument is developed in Kouri 1981a.

13. This point is developed in Kouri 1981b.

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