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1. Introduction

This paper presents a comparative statics, monetary analysis of the classical transfer problem under three different exchange rate regimes--fixed, floating and indexed. Specifically it compares, under the three different exchange arrangements, (1) the degree to which an unrequited transfer is completed in a small, open economy, (2) the domestic price level and resource allocation effects of the transfer, and (3) the form taken by the under effected portion of the transfer. The first two regimes serve as standards with which to compare the increasingly popular indexing scheme.

The economy receiving the transfer is assumed to "small" in international commodity markets--the prices of its exports and imports are quoted in foreign currency and unaffected by local activities. This means that the transfer cannot be effected through the mechanism of changes in the international terms of trade.[1] However, the economy includes a nontraded goods sector and changes in its relative price do form part of the transfer mechanism in what is now well-known fashion.[2]

The transfer is assumed to be a fixed (net) amount of foreign currency. Our interest centers on the portion which is spent on local goods; we ignore that portion immediately spent on imports as already transferred and any saving

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*This paper was completed while the author was a Visiting Scholar in the International Finance Division of the Board of Governors of the Federal Reserve System. The paper represents the views of the author and should not be interpreted as reflecting the views of the Federal Reserve System or its staff.

[1] See Keynes for a statement of this transfer mechanism.

[2] See Viner and Samuelson.

out of the transfer. For example, we would be concerned with immigrant remittances or the portion of program aid spent on locally produced goods and its effects on the local economy, as opposed to shipments of goods by emigrants or the import component of project aid. Since the first type of transfer is of great importance, it seems wise to investigate how it "works" under the different exchange rate arrangements which currently exist.

In comparing the local effects of the transfer under the three "pure" exchange regimes we are cognizant of the fact that most economies use some intermediate system for regulating international payments. Dirty floats have been well known since 1971 and countries such as Argentina, Brazil, Chile, Colombia, and Peru which claim to pursue indexing schemes, in fact, deviate substantially from what we define as indexing in this paper--an exchange rate which moves proportionately to the difference in the inflation rates of foreign and local goods.[3] Nonetheless, there seems to be some value in exploring the limiting cases, since one might represent intermediate cases by some average of the three, or some modification of the "pure" indexing scheme described here.

The basic conclusion of the paper is that under indexed rates transfers cause the most disturbance to home goods prices and to the price level; under flexible rates, the least. Fixed rates generate an intermediate rise in home goods prices and the price level. To see these results first note that under free rates prices of tradeables fall, while home goods prices rise. By comparison under fixed rates local prices of tradeables remain constant. The larger price rise under fixed rates generates a wealth effect

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[3]See Donges, Hanson, Langoni and Kogut and Suplicy.

and a correspondingly larger nominal demand for money. This demand is assumed to be satisfied by the monetary authorities' increased issuance of local money in exchange for foreign exchange reserves. Indeed the results of our flexible exchange case are based on the assumption that the transfer causes no additional, private, local demand for foreign exchange and requires no central bank intervention. Thus in the flexible exchange rate case the transfer is fully effected by increased purchases of imports (motivated by the pure substitution effect of an appreciated exchange rate on import prices combined with a rise in home goods' prices) and a decline in exports (also motivated by the appreciated exchange rate and the rising home goods' price). In the fixed rate case the transfer is not fully effected since there is some general price rise which requires some new money and acquisition of foreign exchange by the central bank.

Next, an indexed rate cause is shown to cause a larger rise in home goods prices and the price level than fixed rates. The reason is that indexing eliminates the substitution effect (the indexing rule being assumed to keep the exchange rate proportional to local prices). Therefore, the demand for home goods which arises from the transfer can be satisfied only as all prices rise, reducing private demand for home and foreign goods, and increasing nominal money demand. Households add to their nominal money balances to a greater degree than in either of the other two cases, because prices of tradeables as well as home goods, rise.

In fact, we show the theoretical increase in money and reserves exceeds the original transfer. Since there is no substitution effect, domestic goods' prices increase sufficiently to make room for the transfer motivated demand via an equivalent increase in household money holdings and internation reserves. However, indexing also means traded goods prices rise proportionately, creating additional, nominal demand for money and therefore a total reserve accumulation which exceeds the original transfer. This result may explain Colombian accumulation of reserves in the

early 70's[4] and the recent Brazilian accumulation, despite

[4]See Barro and Hanson.

"large" current account deficits, which, however, were less than capital inflows.

This accumulation of foreign exchange represents a net loss to society, as shown below. Thus indexed exchange rates are not good arrangements for countries which receive large and fairly constant transfers, though, as argued in the conclusion, they may be useful in situations where transfers are highly variable, particularly in inflationary economies.

2. The Comparative Statics Model

Consider a simplified model of an economy in which three equations can be used to represent demand-supply equilibrium in the markets for home goods, money, and foreign exchange. Since only two equations need be considered explicitly because budget constraints make all three interdependent, we will focus on the first two for ease of analysis. To simplify the analysis we do not include a nonmonetary asset market and neglect the labor market as discussed below.

Demand for home goods is the sum of (the price deflated value of) the transfer and of household demand, which is assumed to be a function of relative price of imports vis-à-vis home goods, real income, and real wealth, as shown in equation (1).[5] Imports demand is a function of the same arguments

[5]This function may be derived from a demand function homogeneous of degree one in nominal income, nominal wealth, and prices which in turn may be derived from intertemporal maximization of utility, subject to a budget constraint. Aggregate demand is assumed to be independent of the functional distribution of income, which is suppressed in the model. See Lucas and Grossman, Hanson, and Lucas.

as household demand for home goods. For simplicity we neglect any effects of the transfer on money demand or on imports.

$$(1)\quad (eT/P_c) + C^d\left(e\frac{\bar{P}_x}{P_c}x^s(e\bar{P}_x/P_c) + C^s,\ e\bar{P}_y/P_c,\ M^o/P_c\right) - C^s(e\bar{P}_x/P_c) = 0$$

(+ under C^d's first argument; + under $e\bar{P}_y/P_c$; + under M^o/P_c; − under $C^s(e\bar{P}_x/P_c)$)

where C^d = household demand function for home goods

e = exchange rate, local currency per unit "world" currency

$\bar{P}_x$ = price of exports, fixed in "world" currency

P_c = price of home goods

$\bar{P}_y$ = price of imports, fixed in "world" currency

M^o = initial money holdings

T = transfer, fixed in "world" currency

C^s = supply function of home goods

x^s = export supply function

and signs beneath variables indicate (assumed) signs of the partial derivative of the function with respect to that variable.

The arguments of this paper hold exactly in a tradeable-nontradeable goods model. However, exports and imports are distinguished in a simplified way to permit comparisons with the usual models in which the terms of trade are important. Only imports' relative price enters household demand directly because of the simplifying assumption that exports are not purchased locally. Note that the partial derivative with respect to relative prices includes wealth as well as substitution effects (but see below). Note also that the price of tradeables could be substituted for import prices throughout the analysis of this paper, since international prices are held fixed and local prices are determined by multiplying international prices by the exchange rate. The same rationale would permit the use of tradeables' production instead of only exports in the definition of real income; here we simplify and assume no imports are produced locally.

The choice between supplying home and export goods is assumed to be a function of relative price, as described by a production possibility curve. Except for a brief discussion of transfer problems under flexible rates in note 9 we assume factor prices are sufficiently flexible to guarantee full employment of the fixed supplies of factors of production.

Local money is assumed to be the only form of wealth and to be held only by households. Its use may be justified by reference to intertemporal utility maximization or to facilitate transactions. Households are assumed to obtain their desired levels of money balances within the period of analysis. To simplify the analysis we assume the demand for money depends only on nominal income[6] and wealth

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[6]Purchases could be included in addition to or instead of income without much change in the results. For simplicity we have assumed relative price changes are considered permanent by myopic consumers and do not affect money demand. See Kemp, Borts and Hanson, and Rodriguez.

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and ignore any changes in transactions velocity or switches between local and foreign money, though the qualitative nature of the conclusion described below would be unchanged under the usual assumptions about the directions of these processes. By assumption any changes in nominal balances can be made only through transactions in foreign exchange with the central bank. This assumption is made to focus the analysis on effects generated by the foreign sector, without the complication of domestically based monetary creation. Thus we may represent equilibrium in the money market as

$$(2)\quad M^d\left(\frac{e\bar{P}_x}{P_c}x^s + C^s,\ M^o/P_c\right) - dM = 0$$

$$\qquad\qquad +\qquad\quad -$$

where M^d = addition to money balances desired over the period

dM = addition to money balances = e multiplied by additional central bank holdings of foreign exchange (dR).

Equilibrium in the market for foreign exchange is simply written as:

$$(3)\quad \bar{P}_x x^s - \bar{P}_v v^d + T - dR = 0$$

where v^d = import demand function

but this is implied by (1), (2) and the household budget constraint:

$$(4)\quad M^d + P_c C^d + e\bar{P}_v v^d = e\bar{P}_x x^s + P_c C^s.$$

3. The Comparative Statics of a Transfer Under Alternative Exchange Regimes

To determine the effects of a transfer under the various exchange regimes we first differentiate the system totally, which yields the following matrix system:

$$\begin{bmatrix} -a_1\frac{e}{P_c} - C^d_3\frac{M^o}{P_c^2} & a_1 & 0 \\ -M^d_1\frac{e\bar{P}_x x^s}{P_c^2} - M^d_2\frac{M^o}{P_c^2} & M^d_1\frac{\bar{P}_x x^s}{P_c} & -1 \end{bmatrix} \begin{bmatrix} dP_c \\ de \\ dM \end{bmatrix} = \begin{bmatrix} -\frac{e}{P_c}\,dT \\ \\ 0 \end{bmatrix}$$

where subscripts indicate partial derivatives of a function,

where $a_1 = C_1^d \frac{\bar{P}_x}{P_c} x^s + C_2^d \frac{P_y}{P_c} + \frac{T}{P_c} - C_1^s \frac{P_x}{P_c} > 0$

and we use the production condition,

$$\frac{dx^s/dP_c}{dC^s/dP_c} = - \frac{P_c}{e\bar{P}_x},$$

to eliminate derivatives of production with respect to a price.

The effects of a transfer under fixed, flexible, and indexed rates may now be compared by using side conditions to eliminate various rows of the matrix.

Flexible Rates: It is assumed there is no change in the holding of foreign currency. Therefore,

$\Delta M = -e\Delta R = 0$. Thus we eliminate the third column and require prices to adjust to both clear the commodity market and leave households satisfied with existing money balances. In this case the system determines two prices and is quite stable.

The general equilibrium effects of a transfer are then

5.a $dP_c/dT = (e/P_c)/((C_3^d M^o/P_c^2) - ((M_2^d a_1 M^o/P_c^2)/((M_1^d \bar{P}_x x^s/P_c))) > 0$

$dP_c/dT \leq (e/P_c)/((C_3^d M^o/P_c^2) + (a_1 e/P_c))$

since

$$- M_1^d \frac{e\bar{P}_x x^s}{P_c} - M_2^d \frac{M^o}{P_c^2} \geq 0.$$[7]

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[7]This can be seen by noting that the M^D function, (2), is derived from a general money function which includes nominal income, nominal wealth, home goods prices and

[7]Footnote continued

import prices. Presumably the partial derivative of this function with respect to home goods prices is positive which implies the above condition. Essentially we are saying that when home goods prices rise, household try to spread their increased nominal income over more than one period (and/or refrain from consuming "expensive" home goods now) by holding more money.

$$5.b \quad de/dT = \frac{(e/P_c)\left[-M_1^d \frac{e\bar{P}_x x^s}{P_c^2} - M_2^d \frac{M^o}{P_c^2}\right]}{-C_3^d \frac{dM^o}{P_c^2} M_1^d \frac{\bar{P}_x x^s}{P_c} + M_2^d \frac{M^o}{P_c^2} a_1} < 0$$

$$5.c \quad dM/dT = 0.$$

Fixed Rates. The exchange rate is held fixed by the central bank's activity as a buyer or seller of last resort, exchanging local money for foreign exchange; thus $de = 0$ and the second column now becomes irrelevant. The system determines P_c and dM.

$$6.a \quad dP_c/dT = \frac{e/P_c}{a_1 \frac{e}{P_c} + C_3^d \frac{M^o}{P^2}} > 0$$

$$6.b \quad de/dT = 0$$

$$6.c \quad dM/dT = \frac{-e/P_c\left((M_1^d \bar{P}_x x^s/P_c) + (M_2^d M^o/P_c^2)\right)}{a_1 \frac{e}{P_c} + C_3^d \frac{M^o}{P_c^2}} > 0$$

Indexed Rates: It is assumed that the exchange rate is adjusted so as to maintain equal rates of inflation between home goods prices and import-export prices. Assuming no inflation in the rest of the world

$$de = \frac{e}{P_c} \, dP_c .$$

Such price setting of foreign exchange, as in the case of fixed rates, requires a buyer or seller of last resort: the central bank. Thus, once again, the money supply is affected by international conditions and the third column becomes relevant. The second column, describing the effects of exchange rate changes is added to the first column, describing the effects of changes in home goods' prices.

7.a $\quad dP_c/dT = (e/P_c)/C_3^d \; M^o/P_c^2$

7.b $\quad de/dT = \frac{e}{P_c} \; \frac{dP_c}{dT}$

7.c $\quad dM/dT = (-e/P_c)(M_2^d)/(C_3^d)$

which implies

$$dM = edT \; (1 + e\bar{P}_v v_3^d/C_3^d \; P_c) > edT$$

since $\quad M_2^d + e\bar{P}_v v_3^d + P_c C_{\cdot 3}^d = 0$

by the household budget constraint.

A comparison of 5.a, 6.a and 7.a shows that flexible exchange rates raise home goods prices the least of the three regimes and actually lower local import (and export)

prices. Fixed exchange rates have an intermediate effect and indexed rates raise home goods prices most. The reason for this result is that under indexed rates the excess demand for home goods, generated by the transfer, is met solely through a reduction in household demand for all goods, generated by a pure wealth effect. The proportionate movement of the exchange rate and home goods prices means that the real value of transfer, in terms of home goods, is unaffected by the rise in their price, and that consumers do not switch to imports and producers do not expand home good production. In contrast, fixed rates permit some substitution in production and consumption as well as a decline in the "real" value of the transfer, though overall prices still rise and there is some wealth effect.[8]

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[8]Notice this result depends crucially on the assumption that households increase their money holdings when domestic goods' prices rise.

Flexible rates provide the most substitution--export and import prices actually fall. There is no wealth effect and all adjustment takes place through substitution in production and consumption and through changes in the real value of the transfer.

Comparing the effects of the transfer on the pattern of production, we see that, correspondingly, flexible rates cause the greatest change of production patterns, with fixed rates generating a lesser shift toward home goods production and indexed rates none whatsoever, as there is no change in relative prices. This is the usual result and, of course, provides a commom argument

against flexible rates--that they generate substantial shifts in production, with correspondingly higher total adjustment costs.[9]

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[9]It is interesting to note that another common argument against free rates--that they reduce labor demand because of currency appreciation in the face of capital inflows--becomes much less potent once we allow for the spending induced by the capital inflows. Demand for home goods and employment in their production rises, tending to offset any loss of employment in tradeable goods production. Under our assumption that relative price changes do not affect saving propensities, nominal aggregate income, demand for money and, therefore, household spending would be constant, with the switch in household demand from home goods to imports exactly matched by the rise in government demand for home goods, financed by the transfer. If, as a first approximation, we assume that marginal value products of labor in each industry are equal, then the unemployment generated by the reduction in the nominal value of export production will be just matched by increased employment in home goods production. For nonmarginal changes or fixed factor prices one also would have to consider the elasticity of the marginal productivity schedule in the two industries. If home goods were say, more labor intensive, then employment initially would rise.

If production of home goods were constrained by lack of aggregate demand, as described in Grossman, Hanson and Lucas, then the value of the marginal product of labor would exceed its wage and, therefore, the value of the marginal product in export production, where there is

no shortage of buyers. In this case the capital inflow again leaves nominal income constant but the switch in the pattern of production would permit less use of labor, because of the higher value of the marginal product in the home goods industry. This argument implies that the degree to which the transfer increases unemployment depends on the ratio of marginal products in the two industries and suggests the problem may have been overstated.

Against the higher adjustment costs imposed by the necessarily greater shifting of resources under free and fixed exchange rates, we must consider the loss in purchasing power and utility which government use of the transfer imposes on households. This loss, valued at original prices, can be approximated by the degree to which the transfer remains uneffected in the classical sense, for that measures the degree to which households refrain from normal spending in order to rebuild inflationary losses on real money balances.

By assumption there is no change in reserve holdings under flexible rates so the transfer must be fully effected. Thus households are able to substitute imports for the reduction in their consumption of home goods. Comparing fixed and indexed rates (6.c and 7.c) we see that reserve holdings increase by a greater amount under indexed rates. In fact, under indexed rates the transfer is not only incomplete, its local effects actually stimulate an additional increase in reserve holdings, over and above the original transfer (see 7.c).

Under indexed rates the process through which the transfer provides the government with increased real command over goods is exactly the same as monetary expansion--households reduce demands for all goods in order to reconstruct

the real value of money balances. Indeed in the Colombian experience with indexed rates, as described by Barro and by Hanson, the fiscal sector of the government used foreign transfers to create additional money at the central bank, rather than simply borrowing directly. The nominal value of the loss to households created by the transfer is not solely their reduction in consumption of home goods, matched by increased government purchases, but also their reduction in consumption of imports.[10] This second reduction is equal to the gain

[10]This reduction in desired import consumption helps to explain why real Colombian imports grew slowly in 1972 and 1973 and in 1975, despite attempts at import liberalization. See Hanson.

in reserves, over and above the transfer and represents a net loss (at base prices) to the economy under indexed rates.[11] This loss would not occur if the increased

[11]We have not attempted to derive explicitly Bailey's inflation tax burden because we abstract from inflation, the resulting variations in the velocity of money and correspondingly the resources necessary to economize on the use of money, which is presumably reflected in the downward sloping demand curve for money.

government purchases of home goods were financed by domestic monetary creation and exchange rates were free. Under those circumstances it can be shown that relative prices of home goods rise, rather than remain constant[12]

[12]This can be seen by using the matrix equation system for flexible rates, after substituting dM for Te/P_c in equation (1) and solving for dP_c/dM and de/dM.

and therefore, households do not have to reduce their total consumption to finance the rise in the local value of export as well as home goods production, as is the case under indexed rates.

A similar type of analysis can be used to determine the social loss imposed by fixed regimes. Comparison of 6.c and 7.c shows that a greater percentage of the transfer is completed under a fixed rate regime than under an indexed rate regime. However, 6.c also shows that the transfer is not fully effected, as reserves increase. It also is possible that reserves may increase by more than the transfer.[13]

[13]This may be seen by using the total derivative of the household budget constraint, (4), to observe that the difference between the numerator and denominator of vi.c (ignoring T) is equal to the unsigned expression

$$\frac{e\bar{P}_v v^d}{P_c}\left[\varepsilon v^d{:}y\ \frac{e\bar{P}_x x^s}{y} + \varepsilon v^d{:}\ e\bar{P}_v/P_c + \varepsilon v^d{:}M^o/P_c\right]$$

where $\varepsilon_{x:y}$ = elasticity of x w.r.t y. If demand for imports is very price elastic, the transfer will be partially completed.

4. Conclusion and An Extension

This paper has demonstrated the comparative static proposition that flexible exchange rates permit a transfer to be fully effected, through an adjustment of relative prices of home and traded goods which leaves the price level unchanged, but which generates a substantial reallocation of factors of production toward the home goods industry. In contrast, fixed exchange rates and fully indexed rates raise the price level, forcing part of the transfer to be absorbed by the foreign currency desk of the central bank in exchange for increases in domestic money, rather than to be used to increase imports and decrease exports. These increased nominal holdings of domestic money come at the expense of household consumption. The reduction in home goods consumption makes room for transfer motivated goods demand and thus both fixed and indexed rates require a smaller reallocation of factors of production than flexible rates to satisfy that new demand; indeed, indexed rates require no reallocation at all for there is no change in relative prices. However, the reduction in consumption of imports represents a real loss to society, since it is unmatched by a corresponding rise in government consumption, as is the case with reduced consumer spending on home goods. Such a loss may occur under a fixed rate regime if the substitution effect of relative price changes is small, and will certainly occur under an indexed regime where there is no change in relative prices. The loss shows up as an increase in reserves over and above the transfer. To prevent such a loss flexible exchange rates are in order.

The above analysis is one of the comparative statics of the price level. It might, therefore, be asked whether the conclusions are robust if the transfer were (a) a

one shot affair, or (b) continued.

If the transfer were a one shot affair, then once it is stopped the analysis of Section 3 would simply run in reverse, and the above recommendation for the use of flexible rates is much less correct. Under flexible rates, the end of the transfer would return relative prices to their former values, and factors of production to their former uses, with associated adjustment costs. In contrast, under other regimes the fall in demand for home goods would lower their prices and the price level and household, finding themselves with excess money balances, would proceed to buy goods, eventually running down foreign exchange reserves to their pretransfer level, thereby completing the transfer. Here money could serve as a buffer,[14] spreading purchasing power

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[14]See Darby and Borts and Hanson.

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intertemporally and reducing adjustment costs, and it seems more appropriate to use fixed or even indexed rates.

In contrast, flexible rates seem most appropriate if the same transfer is to be continued for some time periods. In this case the adjustment costs can be spread over many periods and there need be no reduction of household consumption; it is almost as if income has risen. Fixed rates create a one time loss to households while they accumulate money balances in accordance with the necessities of the higher price level that must be achieved to adjust relative prices. Once that new set of relative prices and higher nominal money balances

is obtained, then the transfer would be completed in all subsequent periods.[15] Indexed rates are most undesirable

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[15]Observe from (3) that the derivative of $\bar{P}_x x^s - \bar{P}_v v^d$, holding M/P_c constant, is strictly negative.

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since they involve no relative price changes and thus the extra flow demand for home goods can only be accommodated through a continuous rise in prices, which forces household saving, additions to reserves and a corresponding loss of welfare in each period. No benefit is gained from the transfer under indexed rates, the same government command over purchasing power could be obtained at a lower cost to society through domestic credit creation and free rates. Thus our conclusion that free rates are the most desirable exchange regime for effecting transfers which occur over a number of time periods.

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