

On the Concept of the Foreign Exchange Multiplier

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Although in recent years there has been increasing recognition of the importance of intermediary imports, the conventional Keynesian treatment of aggregate supply has generally been adopted. By assuming supply elasticity and conditions of over-production, such imports are treated as a leakage and therefore deflationary. This paper investigates another special case which may be a more realistic model for many industrialising economies like Pakistan. Namely, by assuming supply bottlenecks and the technical dependence of domestic production on imported inputs, an increase in imports may be inflationary and have an import or foreign exchange multiplier effect.

A Two Sector Model

In developing countries which have pursued a policy of self-sufficiency by import substitution, foreign exchange bottlenecks have in the past appeared particularly troublesome. Typically not only do these countries have to rely on the earnings of a narrow range of staple exports facing stagnating external demand, but at the same time their assembly industries are heavily dependent on imported raw materials. Superficially, the policy problem they face is the same as under Keynesian assumptions: namely, the maintenance of full utilization of available productive capacity. However, the cause of this economic slack is completely different arising from a shortage of complementary factors of production rather than a deficiency in effective demand.

It is possible to characterize this slack problem diagrammatically for a dual economy, where the maintenance of industrial output depends on the foreign exchange earnings of the rest of the economy. In quadrant I of Diagram A, these foreign exchange earnings are translated into imports for the industrial sector by a simple linear function OT. If the foreign exchange is earned by agricultural exports then the slope of the line OT would be less than 45° due to foreign exchange leakages caused by the trade multiplier. On the other hand, if the foreign exchange is received as a gift without generating any domestic income effects the line OT would be 45° , indicating a one-to-one relationship between foreign exchange available and imported inputs. Obviously the effects of improvement in the country's terms of trade would be to steepen the slope of OT and allow a greater import capacity per unit of foreign exchange received. With fixed factor proportions the increase of output caused by the increase in imported inputs is shown by the expansion path OS in the isoquant map of quadrant II.

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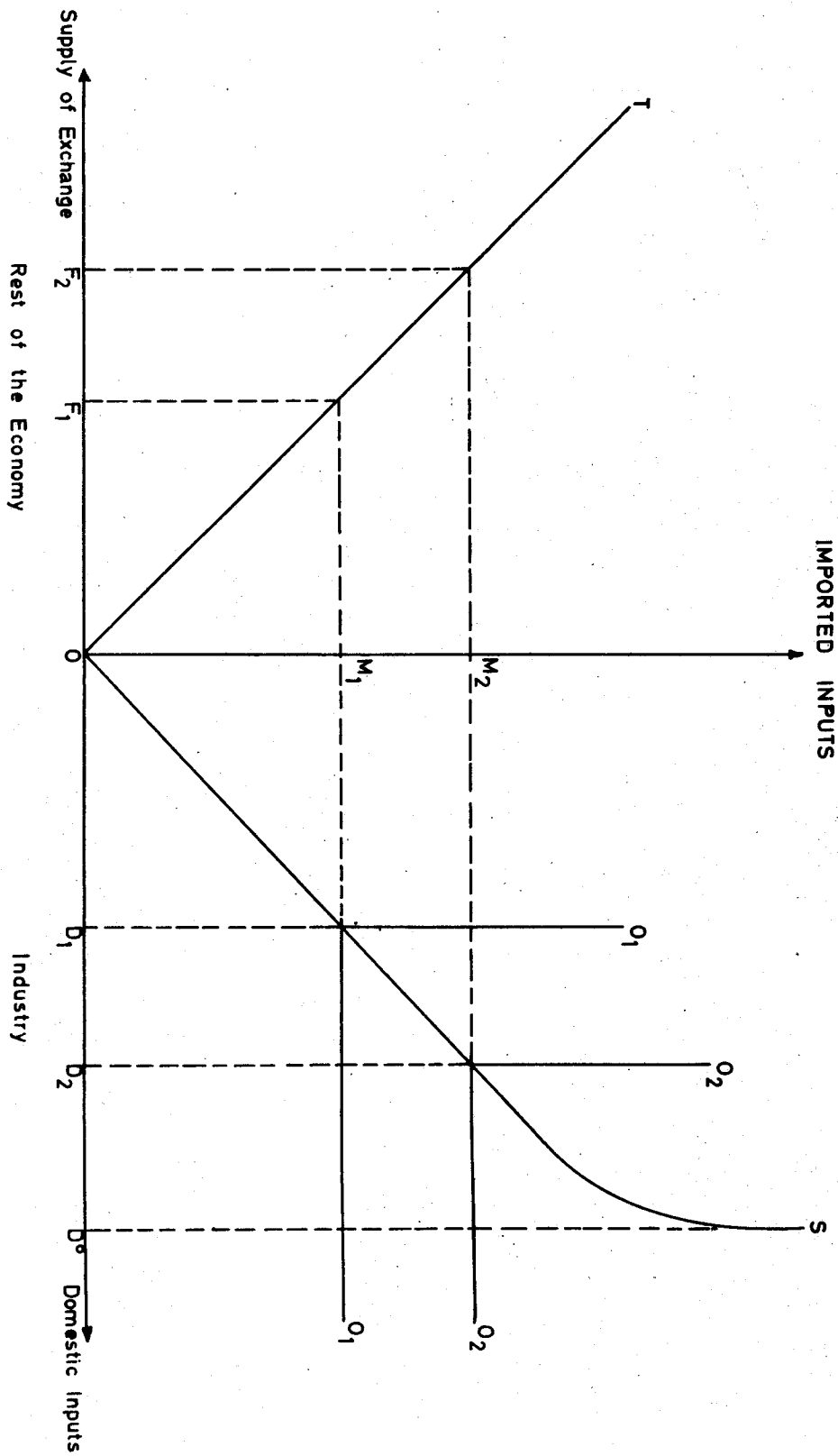


Diagram A

From this diagram it can be seen that an increase in the supply of foreign exchange, say from an increase in foreign borrowing, F_1 to F_2 increases industrial output from O_1 to O_2 and brings into use idle domestic resources, D_1 to D_2 . This represents a movement towards the full employment capacity level of the industrial sector, D^* , (i.e. that level set by the availability of domestic resources). It is the relationship between the supply of foreign exchange and the increase in domestic output given by the slope of the line OS, which may be termed the foreign exchange multiplier. That is, $(O_2 - O_1) / \lambda(M_2 - M_1)$, where λ denotes the import multiplier.

The technological character of this multiplier and the type of economic slack which gives rise to it should be immediately apparent. The underlying assumptions are those of complete complementarity of factors¹ coupled with the existence of imported inputs as a separable factor and the dominant constraint². This is probably realistic for many less advanced countries, especially in the short-run. It should be remembered that developing countries use a technology derived from the more advanced countries geared to mass production and standardization, which implies that factor variations must at any rate be discontinuous if at all possible. Moreover, factor substitutability implies managerial and entrepreneurial ability to provide the productive system with such flexibility, but such skills have long been recognized as being in short supply in these countries.

The Multi-Sector Specification

Insofar as the above model presents an over-simplified view of the industrial sector in most developing countries, it can only provide a partial indication of the full multiplier effects associated with the provision of foreign exchange. A simple example can be used to illustrate this. Suppose that there are technological linkages between different industrial activities, and that there is inadequate foreign exchange to purchase a necessary raw material, say steel. If steel were imported, as a gift, this would result in an increased level of output in the steel-using industries, which in turn would have secondary repercussions on other industries technologically dependent upon inputs of these goods (i.e. we have the usual Leontief effects via forward linkages). All repercussions become progressively weaker, of course, since as processing continues through successive stages in production, the imported steel diminishes in relative value compared to the whole product and at last disappears - but not before it has repeatedly provided opportunities for increased output and employment. Heuristically it can be appreciated that much depends on the import intensity of each industry as well as the degree of integration and economic specialization between industries which in turn determines the amount of intermediary inputs used at each stage in production and hence the leakage to final demand. It is possible to define the foreign exchange multiplier more rigorously in this multi-sector context, and in a fashion suitable for measurement.

Assume two types of demand for the output of the industrial sector, X : final demands, $F = fX$, and intermediary demand, $R = aX$, so that $X = fX + aX$. The production series initiated by the output increase, X_1 , can then be represented as a geometric progression:

$$X_1, (1 - f) X_1, (1 - f^2) X_1, \dots, \text{etc.}$$

When summed the total output is given by $X = 1/f X_1$ where $1/f$ equals the supply multiplier. Or since domestic output, $X = F + R$, then $f = (1 - a)$ and $X = 1/(1 - a) X_1$ which is the one sector equivalent of the Leontief supply multiplier. Allowing

¹For this reason the model presented represents an extreme case. However, the model is also applicable, but to a lesser degree, in the case of factor substitutability at sharply increasing cost.

²This assumption is not required. As Kennedy has pointed out "perhaps all that is required for any given total pattern of expenditures there is in the short-run a lower limit on the amount of expenditure and this lower limit is in fact operative, for in this case output can only increase" (Kennedy, 1969, p. 199).

imports to be related to industrial output by a constant import coefficient, m , so that $M = mX$, then the total increase in imported inputs required to maintain the total supply of output, including repercussions is given by:

$$(1) \quad \Delta M = m \cdot (1/1-a) \cdot \Delta X$$

Re-arranging equation (1), the total supply of domestic output maintained by a unit of imported input can be seen to be determined by the ratio of domestic value-added to the import-coefficient:

$$(2) \quad \Delta X/\Delta M = (1-a) \cdot 1/m$$

Stated in this manner it is clear that the value of the import multiplier derived from equation (2) can only be approximate since industry values of 'm' and 'a' will differ with each pattern of propagation and at each stage of production depending on the industries entering the propagation process. Dropping the assumption of average coefficients for all industries necessitates re-writing the above equations in matrix terms.

Let M diagonal matrix of industry import coefficients;

A matrix of industry input-output coefficients (e.g. a sub-matrix of the total input-output table for the economy);

I the unit matrix;

s column vector of final demands (= final supply);

x column vector of output levels.

Then from the basic input-output solution, the relationship between the vector of final supply, s , and the level of industry outputs, x , can be represented by:

$$(3) \quad (I - A) \Delta x = \Delta s$$

or

$$(4) \quad (I - A)^{-1} \Delta s = \Delta x$$

For such an increase in domestic output, inputs of imported intermediary goods are required. Such import requirements per unit of output are represented by the matrix M . Thus the required imports need to meet the increase in output is given by:

$$(5) \quad \begin{aligned} \Delta m &= M \cdot \Delta x \\ &= M \cdot (I - A)^{-1} \cdot \Delta s \end{aligned}$$

And the final supply per unit of imports equals:

$$(6) \quad \Delta s/\Delta m = [M \cdot (I - A)^{-1}]^{-1}$$

or

$$(7) \quad \Delta s/\Delta m = (I - A) (M^{-1})$$

Since M is a diagonal matrix of the industry import coefficients, then M^{-1} is a diagonal matrix formed by the reciprocal of these coefficients. This is the matrix equivalent of equation (2) above. Thus the total increase in final output consequent on an increase of one unit of imports is given by the ratio of the average domestic value-added, $(1 - A)$, of each industry in the industrial sector to its import coefficient. The overall import multiplier for the industrial sector as a whole can be seen to be a weighted average of the multipliers of the industries which compose it.

Concluding Remarks

This paper may be interpreted as an exercise in what Dudley Seers has called "the economics of the special case" (Seers, 1963). As such it illustrates the importance of initial assumptions: whether supply is assumed perfectly elastic in conditions of over-production, or as in this paper, output is assumed supply constrained in conditions of under-production. Also it should be clear that any increment in foreign exchange availability will be divided in some proportion between consumption, intermediate and capital goods imports and that the multiplier derived in this paper would, of course, be applicable only to the increased intermediate imports. In the former case the alleviation of economic slack depends on effective demand (as in the conventional Keynesian multiplier formulation), while in the latter case the supply of raw material inputs becomes the crucial factor (as in the foreign exchange multiplier model).

Obviously, taking a structural approach, there is no need for the two cases to be mutually exclusive. The possibility thus arises that an increase in the exports of a demand-constrained sector will not only relieve unemployment directly through the trade multiplier, but also, will provide employment-creating effects via the foreign exchange multiplier. The size of the latter multiplier indicates the maximum amount by which the foreign trade multiplier under-estimates the true extent of the impact of exports on domestic incomes. Unfortunately, the above exercise can provide only a rough indication of the extent of this under-estimation since there are important leakages in the case of exports which do not arise in the general case discussed above, that of foreign borrowing. What is implied is a trade-off between the increase in imports for the industrial sector resulting from foreign exchange earnings of agricultural exports, and the increase in import leakages caused by the trade multiplier effects of these exports throughout the economy.³

References

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