THE TERMS-OF-TRADE EFFECT ON EXPENDITURE
Some evidence from econometric models

Alan V. DEARDORFF and Robert M. STERN

University of Michigan, Ann Arbor, MI 48109, U.S.A.

The terms-of-trade effect on expenditure has been a long-recognized theoretical construct. In this paper, we examine the empirical credibility of this effect, using the expenditure equations of several large econometric models in terms of their formulation of real versus nominal variables. We find evidence of both positive and negative effects of import prices on various categories of expenditure. Thus, there is no consensus as to the direction of the terms-of-trade effect.

1. Introduction

The effect of the terms of trade on expenditure was first analyzed in articles by Laursen and Metzler (1950) and Harberger (1950). While on occasion the analysis has been criticized on theoretical grounds, as in White (1954), we examine here its empirical credibility. To do so we analyze the role of import prices in the expenditure equations of five large national econometric models. Since relative prices seldom appear directly as independent variables in such equations, we explore the more subtle implications of their formulation in terms of real versus nominal variables. This is done in section 3, after we first recall the theoretical motivation for the terms-of-trade effect in section 2.

2. Theoretical considerations

The original terms-of-trade effect is a byproduct of the effect of real income on real expenditure. More recent theoretical developments have contributed an additional role for import prices, acting on expenditure through wealth or liquidity effects [see Mundell (1971) and Dornbusch (1973)]. We, however, will consider only the more traditional link via real income.

Explanation of the terms-of-trade effect starts from the observation that certain components of real expenditure – consumption especially – depend inelastically on real income. In the short run, for example, the marginal propensity to consume is less than the average propensity. An increase in the domestic prices of imports relative to domestically produced goods, due to

either foreign inflation or devaluation of domestic currency, implies a worsening of the terms of trade and thus a fall in real income. If consumption is inelastic with respect to real income, it follows that, though real consumption falls absolutely, it will rise as a proportion of real income.

Now the demand for domestic goods must be measured in units of domestic product. In these units, consumption must therefore rise with the price of imports, if domestic production is unchanged, in order to rise as a proportion of income. We would thus expect theoretically a positive effect of foreign prices on domestic absorption.[1]

The foregoing argument is of interest partly because it implies negative international transmission of disturbances under flexible exchange rates. Consider an increase in income abroad. Under fixed exchange rates, the foreign propensity to import raises domestic exports and stimulates the domestic economy. Under flexible rates, abstracting from capital flows, this effect is nullified by exchange appreciation to leave the balance of trade unchanged. But the appreciation itself, following Laursen and Metzler, reduces the domestic price of imports, depressing expenditure and thus

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[1]To illustrate. let real absorption depend upon real income:

$$\frac{PA}{P_I} = f\left(\frac{PY}{P_I}, \ldots\right). \tag{i}$$

where P is the domestic price level, A and Y are absorption and income respectively, both measured in units of domestic product, and P_I is an index of the domestic prices of domestic and foreign goods, defined as:

$$P_I = P^{(1-\delta)}(RP')^\delta. \tag{ii}$$

where δ is the share of imports in expenditure, R is the exchange rate, and P' the foreign price level.

Substituting (ii) into (i) and defining the terms of trade as $T = P/RP'$, we have:

$$A = T^{-\delta}f(T^\delta Y, \ldots). \tag{iii}$$

Differentiating (iii) with respect to T and taking f' as the initial value of the first partial derivative, we have:

$$\frac{\partial A}{\partial T} = \delta T^{-1} Yf' - \delta T^{-\delta-1} f. \tag{iv}$$

Substituting from (iii) and noting that $\partial A/\partial Y = f'$, we obtain

$$\frac{\partial A}{\partial T} = \delta T^{-1} Y\left(\frac{\partial A}{\partial Y} - \frac{A}{Y}\right). \tag{v}$$

In the short run, the average propensity to consume is well known to be larger than the marginal propensity. If the same is true of total absorption, then A/Y is greater than $\partial A/\partial Y$ and (v) will be negative. Thus the effect of the terms of trade on absorption is negative and the effect of import prices (which enter the denominator of T) is positive.

income at home. Given this possibility of perverse international transmission, it seems worthwhile to examine any relevant expirical evidence.

3. Evidence on the terms-of-trade effect

The evidence we report comes from Deardorff and Stern (1977), which is a larger study of how international economic interdependence has been represented in selected large-scale econometric models. The models analyzed included the 1974–75 versions of the RDX-2 and TRACE models of Canada, the London Business School (LBS) and U.K. Treasury (UKT) models of the United Kingdom, and the Kyoto University (KYQ75) model of Japan.

Straightforward inspection of the expenditure equations in these models seldom revealed any appearance of foreign prices or of import prices as explanatory variables. However most of the models were estimated during the period of pegged exchange rates and we have no evidence from the write-ups of the models that a terms-of-trade effect was even considered in trial formulations of the equations. Thus, the absence of foreign prices from these equations is hardly conclusive evidence that they do not belong.

A more careful examination of these equations, however, revealed some evidence of a terms-of-trade effect entering in a more subtle manner than through separate explanatory variables. Several of the equations were specified in real terms using price indexes or deflators that included prices of imports. To the extent that the equations displayed less than unitary elasticities with respect to incomes deflated in part by foreign prices, then foreign prices did enter the models as suggested by Laursen and Metzler. However, different price indexes were often used to deflate income and expenditure, making the role of import prices more complex than in the simple Laursen–Metzler formulation.

This can be clarified with an example that is typical, in its treatment of incomes and prices, of most expenditure equations in the models. Consider a category of nominal expenditure or absorption, AV, and its corresponding price index, PA. Let YV be a nominal income variable which, when deflated by another price index, PY, determines that expenditure in real terms. A typical expenditure equation would take the following form:

$$\frac{AV}{PA} = \alpha + \beta\left(\frac{YV}{PY}\right),$$

(1)

where the constant, α, incorporates all other determinants of expenditure which depend on neither income nor price. The price indexes may or may not depend on the price of imports, PM:

$$PA = a(PM)^{\gamma}, \qquad PY = b(PM)^{\delta},$$

(2)

where a and b incorporate domestic prices and γ and δ are the elasticities of the two indexes with respect to import prices. Substituting (2) into (1) we get:

$$\frac{AV}{a(PM)^{\gamma}} = \alpha + \beta \left(\frac{YV}{b(PM)^{\delta}} \right),$$ (3)

or

$$AV = \alpha a (PM)^{\gamma} + \frac{\beta a}{b} YV(PM)^{\gamma - \delta}.$$ (4)

From (3) *real* expenditure on the left-hand-side will depend *negatively* on import prices whenever β, b, and δ are all positive. This, however, is not the terms-of-trade effect, since it is not *real* (or price-deflated) expenditure that determines GNP. The appropriate measure of expenditure for this purpose is in units of domestically produced goods. And this is readily found by holding domestic prices, and therefore YV, constant, and looking at *nominal* expenditure. Thus, we wish to examine the role of import prices in equation (4). If AV depends *positively* on import prices in (4), then we have evidence for the Laursen-Metzler effect. If, however, AV depends negatively on PM in (4), a terms-of-trade effect is present but in the opposite direction from that described by Laursen and Metzler.

Differentiate (4) with respect to PM and use (2):

$$\frac{d AV}{d PM} = \gamma \alpha \frac{PA}{PM} + (\gamma - \delta)\beta \frac{PA}{PY \cdot PM} YV.$$ (5)

Since prices and income are positive, we will have the expected positive import-price effect if $\gamma \alpha$ and $(\gamma - \delta)\beta$ are both positive (or only one zero) and a negative import price effect if γ or α are zero and $\gamma < \delta$. Both cases arose in several of the expenditure equations of the econometric models. Also, the two terms in (5) may have opposite signs, requiring more information to infer the net effect.

The results are shown in table 1. Since some equations in particular models included lagged variables, we distinguish both short- and long-run effects. Where possible, we report numerical values of the elasticities, γ and δ. The crucial columns are those headed dAV/dPM, which give the sign of the import-price effect for the expenditure items shown. When the two terms in (5) have opposite signs, we estimate the net effect in parentheses. The results are mixed. Of the 17 equations examined, 7 have the expected positive sign, 8 a negative sign, and 2 are ambiguous or zero. There is no consensus on the direction of the terms-of-trade effect.

We should point out that we omit from the table many expenditure

Table 1

Estimated import-price effects on expenditures in selected econometric models.

Model	Expenditure category	Short-run effects						Long-run effects					
		α	β	γ	δ	$\gamma-\delta$	$\frac{dAV^*}{dPM}$	α	β	γ	δ	$\gamma-\delta$	$\frac{dAV^*}{dPM}$
(1) RDX2	Consumption of nondurables & semidurables	+	+	0.12	0.064	+0.06	+	+	+	0.023	0.060	−0.037	?(−)
(2)	Consumption of services	?	+	0	+	−	−	?	+	0	+	−	−
(3)	Consumption of motor vehicles	?	+	0.009	0.064	−0.055	?(−)	?	+	0.551	0.060	+0.491	?(+)
(4)	Consumption of other durables	?	+	0	+	−	−	?	+	0	+	−	−
(5)	Investment in machinery & equip.	+	+	0.137	0.137	0	+	+	0	0.473	0.473	0	+
(6) TRACE	Consumption of durables	−	+	0	+	−	−	−	+	0	+	−	−
(7)	Consumption of nondurables, semidurables, & services	0	+	+	+	+	+	0	+	+	+	+	+
(8)	Investment in res. construction	?	+	0	+	−	−	?	+	0	+	−	−
(9) LBS	Consumption of nondurables	+	+	+	+	0	+	+	+	+	+	0	+
(10)	Consumption of durables	+	+	0	0	0	0	+	+	0	0	0	0
(11)	Investment in plant & machinery	na	na	na	na	na	−	na	na	na	na	na	−
(12)	Investment in vehicles and industrial buildings	na	na	na	na	na	−	na	na	na	na	na	−
(13) UKT	Consumption	+	+	0.02	+	−	?(+)	+	+	0.18	+	−	?(+)
(14)	Private investment	+	+	0.10	0.048	0.052	+	+	+	0.28	0.224	0.056	+
(15) KYQ75	Consumption	+	+	+	+	0	+	+	+	+	+	0	+
(16)	Private housing investment	−	+	+	+	0	−	−	+	+	+	0	−
(17)	Business fixed investment	?	+	+	+	?	?	?	+	+	+	?	?

*Positive effect of import price on expenditure (+) confirms Laursen–Metzler analysis of the terms-of-trade effect. Negative sign contradicts their analysis.

categories for which no effect was found in either direction. These include all government expenditure, most investment, and several peripheral consumption categories. Also, certain investment equations include import prices in ways not represented by equation (5). Two such equations in the LBS model, lines (11–12) in table 1, show direct negative dependence of investment on import prices, contrary to the Laursen–Metzler analysis.[2] Import prices also play an ambiguous role in equations for inventory investment in all five models.

4. Conclusion

Our purpose has been to examine the empirical relevance of the terms-of-trade effect on expenditure. While our procedure was indirect and our evidence selected from particular large-scale econometric models, we nevertheless concluded that there is not much empirical support for the Laursen–Metzler phenomenon. This is not to say that terms-of-trade effects in themselves are not important. Rather, it suggests that as good a case can be made for a *direct* relation between the terms of trade and total expenditure as for an inverse relation.

[2]This effect, which was not found in any of the other models, seems quite plausible, especially if investment goods are themselves imported or if imports are used as intermediate inputs in domestic production.

References

Deardorff, Alan V. and Robert M. Stern, 1977, International economic interdependence: Evidence from econometric models, Seminar Discussion Paper No. 71, Research Seminar in International Economics, University of Michigan.
Dornbusch, Rudiger, 1973, Devaluation, money, and nontraded goods, American Economic Review 63, 871–880.
Harberger, Arnold C., 1950, Currency depreciation, income and the balance of trade, Journal of Political Economy 58, 47–60.
Laursen, Svend and Lloyd A. Metzler, 1950, Flexible exchange rates and the theory of employment, Review of Economics and Statistics 32, 281–299.
Mundell, Robert A., 1971, Monetary theory (Goodyear, Pacific Palisades, CA).
White, William H., 1954, The employment insulating advantages of flexible exchanges: A comment on Professors Laursen and Metzler, Review of Economics and Statistics 36, 225–228.