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Trade Equations

by John D. Whitley*

1. Introduction

This Paper is concerned with the determination of trade flows in the five multi-country models which have been the subject of the SPES project. These models are those of DIW (the EEC's QUEST model); the MIMOSA model (developed jointly by the Centre d'Etudes Prospectives et d'Informationales (CEPII) and the Observatoire Francais des Conjonctures Economiques (OFCE); GEM (developed by the National Institute of Economic and Social Research (NIESR) and the London Business School (LBS); the OECD's 'Interlink'model and the multi-country model of Oxford Economic Forecasting (OEF). The emphasis placed in this paper is on describing and comparing the key properties of the trade equations insofar as they are relevant to full-model simulation properties of the different multi-country models. Therefore we concentrate almost exclusively upon trade in goods, and particularly on manufactures. The first section of the paper gives a brief descriptive account of the treatment of trade in the various models. The second section reviews the estimated relationships for exports and imports of goods and in the third section we raise some issues relating to the impact of the trade equations (and differences between them) on full-model simulation properties.

2. General approach

The approach to modelling trade in multi-country models is reasonably general across the models and differences largely arise from the extent of disaggregation. All the models contain systems for determining import and export volumes of goods which are related to a measure of demand or activity and competitiveness. Generally, the main industrialized countries are modelled in a more sophisticated fashion than the rest of the world. By weighting together total import volumes a measure of total world demand is constructed and this is then used to share out exports. In most cases this sharing out is modelled using estimated unrestricted relationships for exports rather than from the product of a system where the shares are restricted to sum to unity, although most of the models use a weighting process which reflects the relative importance of different export markets. The DIW/QUEST model treats exports differently from the other models in that they are determined within a bilateral trade flow model which

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Figure 1

Disaggregation in the multi-country models

		DIW	GEM	OECD	OEF	MIMOSA
Goods:	Imports:	Energie/ non-energie	Goods	4 categories food, raw materials, energy & manufacturing	Manufacturing ?	4 categories food, raw materials energy & manufacturing
	Exports	Bilateral model	Goods	as imports		asimports
Services:		Non-factor services	Non-factor services IPDs Transfers	Non-factor services IPDs	Total (exceptUK)	Non-factor services IPDs

specifies that the export volume share of country i in imports of country j is a function of relative prices. In this approach total export price elasticities are not estimated directly but are calculated from the bilateral elasticities.

3. Imports and exports of manufactures

Table 1 shows comparative long-run demand and competitiveness elasticities for imports and exports of manufactures both across models and four major European economies, together with estimated influences from other explanatory variables. In the case of GEM the relevant responses relate to trade in goods.

Export demand depends on a measure of world economic activity, usually total imports, relative prices or costs and occasionally a time trend or capacity utilization influence. Where only demand and competitiveness enter it is possible to interpret the export equations as a demand schedule, in which case the export price relationships in the model are the relevant supply equations. Where, however, there is an influence from capacity pressures the interpretation of the export equations in DIW, GEM and OEF all have the property that the long-run activity elasticity is unity whereas there are some deviations from this position for MIMOSA and OECD. In particular we note the very large demand elasticity for France in MIMOSA. We also note however that the unit elasticity restriction in the UK typically requires the addition of a time trend in the equation; its absence often causes a fall in the long-run activity elasticity. This problem is probably associated with the observation that the UK share in world trade fell steadily throughout much of the period although there is some evidence that this trend decline has now been halted. Similarly the strong time trend effect in the MIMOSA equation for France may help to explain the relatively high export activity elasticity.

Competitiveness is generally measured by relative prices but OEF use a relative cost measure for France and the UK. Some care must be taken in comparing relative cost elasticities with relative price responses since in full model simulations costs and prices may move quite differently. There is no clear consensus over competitiveness effects either across models or across countries although there are some features that are worthly of comment. First we note that the OECD model has larger estimated long-run elasticities for each corresponding country than the other models with the sole exception of OEF for Italy. Furthermore these relative price elasticities are all greater than unity in absolute value. In contrast, elasticities in GEM are typically small. The median elasticity is between 0.7 and 0.8 but models show quite marked variation across the four European countries, the prime exception being OECD where variation is relatively small.

Capacity utilization influences are found for some countries in MIMOSA and in France for OEF. MIMOSA uses a relative capacity utilization measure whereas the OEF measure relates to domestic utilization alone. MIMOSA finds that an increase in relative capacity utilization reduces exports in Germany and Italy but not for France or the UK whereas OEF's sole influence is for France.

There is far greater variation between the models in respect of the activity elasticity of imports. The typical activity is total final demand altough this is a weighted measure in OECD and is corrected for trade integration effects in DIW (although it is not clear how these adjustments are derived). MIMOSA and OEF for France and the UK use a measure of the domestic demand for manufactured goods. OEF argue that these measures are preferable to total final expenditure in that they produce lower long-run activity elasticities. This appears to be borne out in practice since MIMOSA and OEF do exhibit long-run activity elasticities which are about unity whereas the other models which use total final expenditure possess long-run elasticities typically well above unity and frequently as high as 2. However it is also relevant that OEF and MIMOSA include time trends in their equations and this captures more of the strong upward trend in import penetration and is probably a more convincing explanation of why the import demand elasticities differ so markedly. Although there is considerable divergence between the different models in respect of activity elasticities there is comparatively little variation between countries for a given model. Thus we conclude that the various estimates of import demand elasticities owe more modelling strategy than to different institutional characteristics.

Relative competitiveness elasticities tend to be somewhat larger for MIMOSA than for the other models but this is not always the case for DIW has a higher price elasticity for Germany. Import price elasticities of demand are usually less than unity and there is quite consensus across countries, however. For example, whereas DIW, OEF and MIMOSA imply longrun elasticities of unity or greater for Germany, the estimate from the OECD model is far smaller and that from GEM is close to zero. Some of the models, for some countries, include capacity utilization effects on imports but the proxy used differs between models (for example OEF's measure is the inverse of that used in the other models) and hence it is difficult to draw direct comparisons. In principle the inclusion of capacity utilization effects on imports can play an important supply-side role in model simulations. A particularly strong influence appears to be present for the OEF French equation.

There is little explicit allowance for non-price trade factors in the equations apart from the presence of time trends and the correction of the activity variable for trade integration effects in the DIW model. It is perhaps of interest to note that some of the UK domestic models use the ratio of world trade to world trade production as proxy for trade liberalization effects.

Table 1

Long-run export and import elasticities
goods

(a) Exports[a])	Activity variable					Relatice prices/costs				
	DIW	GEM[b])	OEF[c])	MIMOSA	OECD	DIW	GEM	OEF*	MIMOSA	OECD
Germany	1.00	1.00	1.00	1.19	1.10	−0.83	−0.68	−0.33	−0.62	−1.30
France	1.00	1.00	1.00	1.70	1.00	−0.73	−0.33	−0.36	−1.06	−1.60
Italy	1.00	1.00	1.00	0.89	0.80	−1.06	−0.22	−1.48	−0.98	−1.20
U.K.	1.00	1.00	1.00	0.90	0.80	−1.12	−0.42	−0.24	−0.57	−1.30
	Time trend % p.a.					Capacity utilisation				
	GEM	OEF	MIMOSA			OEF	MIMOSA[d])			
Germany	—	—	1.50			—	−0.48			
France	—	−2.20	−4.10			−0.43	—			
Italy	—	—	—			—	−0.42			
U.K.	−0.80	−0.22	−2.80			—	—			
(b) Imports	Activity variable (TFE)					Relative prices/costs				
	DIW[h])[i])	GEM[e])	OEF[f])	MIMOSA[f])	OECD	DIW[h])	GEM	OEF**	MIMOSA	OECD
Germany	1.38	1.70	1.20	1.00	2.20	−1.34	−0.07	−0.95	−0.95	−0.40
France	1.13	1.88	1.00	1.17	2.20	−0.80	−0.20	−0.31	−0.82	−0.40
Italy	—	1.80	1.06	1.21	1.90	—	−0.73	−0.39	−1.18	−0.80
U.K.	1.58	2.00	1.00	0.90	1.80	−0.27	−0.36	−0.55	−1.00	−0.70
	Time trend % p.a.					Capacity utilisation				
	EM	OEF	MIMOSA			DIW[h])	OEF	MIMOSA[d])	OECD[g])	
Germany	—	3.00	4.40			0.34	−0.0034	0.68	4.61	
France	—	3.30	3.10			1.10	−0.3286	—	3.90	
Italy	—	—	2.10			—	—	—	—	
U.K.	—	0.858	3.50			0.89	−0.0975	—	3.31	

[a]) Goods for GEM: manufactures for OEF, MIMOSA and OECD. — [b]) Weighted sum of OECD countries'imports. — [c]) World trade. — [d]) Relative capacity utilisation. — [e]) Goods. — [f]) Domestic demand for manufactured goods; OEF France and U.K. only. — [g]) Ratio of TFE to trend. — [h]) non-energy goods. — [i]) corrected for trade integration effects. — * Costs for France and U.K. — ** Costs for France and Italy, Domestic absorption.

4. Issues arising from the trade equations

In this section we discuss some specific issues that arise from the treatment of trade in models.

One important issue is that of the nature of the fundamental equilibrium exchange rates (FEERs) in the various models since this will be highly relevant to the choice of relative exchange rates in a European exchange rate system. The approach adopted by Bareli and In't Veld (1991) is a very useful way of examining the full implications of the trade equations in the models but unfortunately we have not had enough time to extend this analysis from GEM to the other models. However we can draw out some of the implications for FEER analysis from the various estimates presented in Table 1.

First we observe that the relative estimates of the activity elasticities for exports and imports imply that a balanced growth in the individual country and the rest of the world will tend to result in a deterioration of the balance of payments for DIW, GEM and OECD, implying that the exchange rate either has to fall or that domestic growth must be at a lower rate than the rest of the world. (In contrast MIMOSA implies that France will gain.) However since these results hold for each of the European economies (and the remainder of the G7 countries) this implies that the real exchange rate must depreciate for G7 as a whole or that trend growth in G7 must be less than in the rest of the world. This appears implausible. A second property of these high import activity elasticities is that a balanced expansion in Europe will tend to generate larger spillover effects on the rest of the world (through raising total world trade) than will occur in the multi-country models with unit import elasticities (OEF and MIMOSA). Higher world trade will in turn result in some feedback to the countries experiencing the initial expansion but this effect will still be dominated by their higher

Table 2 **Export price equations**
long-run elasticities

		Germany	France	Italy	UK
GEM	domestic costs/prices	0.87	0.56	0.68	0.68
	foreign prices	0.13	0.44	0.32	0.32
OECD	domestic costs/Prices	0.84	0.58	0.39	0.74
	foreign prices	0.16	0.42	0.61	0.26
OEF	domestic costs/prices	0.86	0.70	0.57	0.80
	foreign prices	0.06	0.30	0.43	0.20
MIMOSA	domestic costs/prices	0.84	0.51	0.66	0.77
	foreign prices	0.16	0.49	0.34	0.23

marginal import penetration levels. For the world as a whole it is not clear whether the net result is to bias total world output upwards relative to models with unit import elasticities. Another uncomfortable feel to these higher import demand elasticities is in their long-run implications for marginal propensities to import, for there is no explicit mechanism to prevent them exceeding 100 per cent. If the combination of import and export activity elasticities suggests that, for some of the models at least, some real depreciation might be necessary, the sum of the price elasticities are very low for GEM (which sum to less than unity) and for France and the UK in the OEF model (although the use of costs complicates the analysis). The elasticities easily exceed the static Marshall-Lerner condition for the OECD and MIMOSA models and for three of the countries modelled by DIW. However a full examination of exchange rate effects needs to take account of export pricing behaviour since if the law of one price holds no competitive price advantage can be gained.

The models all determine export prices as a weighted average of domestic prices or costs and foreign prices with a fairly large degree of agreement in the relative weights assigned to each component (Table 2). Thus the influence of domestic costs is relatively more important than foreign prices in the setting of export prices for Germany and the UK than France and Italy. Static price homogeneity is present in the models with the exception of the OEF German export price equation.

There are some difficulties in interpreting the behavioural assumptions underlying the determination of exports. As we have noted above, it is not clear whether the volume equations are to be interpreted as demand equations or reduced from relationships. If they can be treated as demand equations then the export price relationships might be reasonably regarded as supply equations. However if the volume equation is a reduced form then presumably the price equation should be derived from the same behavioural considerations. This raises a potential problem of internal consistency. If, for example, the underlying hypothesis were of a small economy trading in a homogeneous good then we would expect the price elasticity of demand to be infinite (as measured by the price coefficient in the volume equation) and this should coincide with a pricing rule which equates export prices with those ruling on the world market. The converse is that for an exporter with monopoly power the price elasticity of demand is likely to be well below infinity and export prices will be determined by domestic costs (albeit marginal rather than average costs). If the reduced form interpretation of the equations in the models were appropriate we would expect relatively low price elasticities in the volume equations given the characteristics of the price relationships. This is broadly borne out although the judgement as to whether the elasticities are 'low' is very difficult to make; for example if the OEF responses are low are those of OECD large?

Finally we consider the issue of global accounting elasticities. If the relevant import and export activity elasticities were unity and appropriate restrictions were imposed on competitiveness terms across countries, then global imports and exports would be consistent in model simulation exercises. Although total imports are allocated across exports in the models there is no guarantee that the accounting identity will hold in practise since the required restrictions are not imposed. In practice, resulting imbalances are removed by scaling and the suggestion is that necessary adjustments are not excessive.

5. Conclusion

This brief survey of the trade equations in the multi-country models shows considerable variation between models in respect of competitiveness and import activity elasticities. Some of the differences in the latter appear capable of resolution by appropriate model specification. The differences in competitiveness elasticities do not appear to be so easily reconciled yet these are obviously of key importance in full-model simulations. In particular it is of some concern that apparently very similar specifications for the same country over very similar time periods result in very different empirical results.

Reference

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