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Stimulation of Employment in Neo-Classical Models

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The Impact Project is a cooperative venture between the Australian Federal Government and the University of Melbourne, La Trobe University, and the Australian National University. By researching the structure of the Australian economy the Project is building a policy information system to assist others to carry out independent analysis. The Project is convened by the Industry Commission on behalf of the participating Commonwealth agencies (the Industry Commission, the Australian Bureau of Agricultural and Resource Economics, the Bureau of Industry Economics, the Department of Employment, Education and Training, the Department of Immigration, Local Government and Ethnic Affairs, and the Department of the Arts, Sport, the Environment, Tourism and Territories). The views expressed in this paper do not necessarily reflect the opinions of the participating agencies, nor of the Commonwealth Government.

ABSTRACT

This paper explores the possibility of a Keynesian-like employment response in multi-sectoral neo-classical models such as the ORANI model of the Australian economy. One of the more controversial applications of ORANI has been its use in designing a macroeconomic policy package which stimulates employment without worsening the external account. This package involves restraining real wages while simultaneously increasing aggregate demand. As expected of a model with a neo-classical structure, real wage restraint boosts employment in ORANI. However, employment responds positively to an expansion in aggregate demand — a result expected of a Keynesian rather than a neo-classical model. The conclusion is that relative price movements and compositional effects, which are entirely consistent with a neo-classical structure, explain the positive relationship between employment growth and aggregate demand in ORANI and kindred models.

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STIMULATION OF EMPLOYMENT IN NEO-CLASSICAL MODELS

by

Michael Malakellis and Matthew Peter*

1. Introduction

The economic experience of the 1970's caused economists and policy-makers to focus their attention on designing a macroeconomic package which would stimulate employment growth without generating excessive inflationary and balance-of-payments problems. The late 1970's saw the emergence of a proposal for a wage-tax bargain under which the trade-union movement would accept lower pre-tax real wages in return for lower tax rates.

In the ensuing academic debate, a number of prominent analysts (e.g., Corden and Dixon, (1981), Dixon, Powell and Parmenter, (1979), and Dixon, Parmenter, Sutton and Vincent (1982)) used the ORANI model of the Australian economy to quantify the impact of such a package. In order to simulate the wage-tax bargain, the models' variables representing the real wage rate and aggregate domestic demand were simultaneously shocked. Examination of the effects of these shocks revealed that both the reduction in the real wage and the increase in demand separately stimulated the level of employment in the model. That is, holding aggregate domestic demand constant, a fall in real wages causes the aggregate demand for labour to increase and, holding real wages constant, an increase in aggregate domestic demand causes the aggregate demand for labour to increase.

In typical neo-classical style, producers in ORANI behave as if to minimise costs subject to a production function in the context of perfectly competitive markets for all commodities and primary factor inputs. As would be anticipated, producers' demand for labour is a function of the real cost of employing labour and the capital stock[1]. In most short-run simulations, (including those described as "neo-classical" in the above-mentioned studies), the capital stock in each industry, and therefore in aggregate, is assumed to be fixed, leaving the demand for labour a function of the real wage rate alone. Given that, in ORANI, employment is determined solely by the demand for labour, the question arises as to why the model consistently projects an increase in aggregate employment in response to an increase in aggregate domestic demand in a setting of fixed real wages and capital stock? This positive relationship between employment and domestic demand became known as ORANI's *Keynesian employment response*.

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1 ORANI actually recognizes three primary factors for some industries including agricultural land in addition to capital and labour. The stock of agricultural land, however, is almost always assumed to be fixed both in the short and long runs and it is certainly assumed fixed throughout this paper including the cited studies.

A number of explanations of the demand/employment relationship were offered. ORANI is a large scale model with a high level of disaggregation and appeal to sectoral effects on labour demand formed the basis of one explanation for the model's Keynesian behaviour (Dixon, 1979). However, while it is true that the expansion in real demand favours the labour intensive sectors of the economy, a simple experiment (discussed in section 3.1.4) using a miniature version of ORANI suggests that, in the absence of any other changes to the model, ORANI would continue to exhibit Keynesian behaviour even if factor intensities were equalised across sectors.

Another explanation focused on wage indexing. In the context of a multisectoral model such as ORANI, the term 'real wage' is ambiguous. For workers the appropriate concept is nominal wages deflated by an index of consumer prices, (hereafter referred to as the workers' real wage). For producers, the appropriate concept of the real wage is nominal wages deflated by an index of producer prices (hereafter referred to as the producers' real wage).

In its standard short-run configuration, ORANI[2] models the real wage facing workers as being fixed in the sense that the money wage is fully indexed to the model's consumer price index (CPI).

Several authors (including DPP (1979), DPSV (1982) and Pagan and Shannon (1987)) argued that since domestic products are modelled as imperfect substitutes for foreign ones, an increase in domestic demand allows the price of domestic commodities to rise relative to those of foreign substitutes. Consequently, because at least some imports are consumed, the CPI shows a smaller increase than an appropriate aggregate price index of domestically produced commodities. Since money wages are fully indexed to the CPI, the real cost of employing labour for the average producer falls.

Corden and Dixon (1980) recognized both lines of argument. They suggested that an increase in domestic demand favours the non-traded sector because it is able to pass on cost increases. The traded-goods sector is less able to pass on cost increases and is caught in a price/cost squeeze induced by higher money wages. The price index for commodities in the non-traded sector tends to increase faster than the CPI because the latter includes the prices of traded commodities. On the other hand, the price index for to the traded-goods sector will increase at a slower rate than the CPI. Thus output and employment in the non-traded sector increases, while the contrary applies in the traded-goods sector. The positive employment response of the non-traded sector will be large relative to the negative employment response of the traded goods sector because in the ORANI data base the former sector happens to be relatively-labour intensive.

Despite the central importance of the employment/demand relationship to the outcome of the wage-tax bargain package, no formal attempt was made at reconciling the result with the structure of ORANI.

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2 That is, under the closure known as the neo-classical short-run with industry-specific capital stocks and the real wage held constant.

The purpose of this paper is to provide a complete, formal explanation of the ORANI employment response to an increase in domestic demand. In so doing, this study examines whether or not the apparent Keynesian result given by ORANI is consistent with the model's underlying neo-classical structure. The analysis begins in section 2 using a three-sector model designed to capture the essential structure of ORANI. In section 3 the theoretical insights obtained from this small model are tested using Miniature ORANI (MO). MO is in some respects more comprehensive than the three-sector model; in particular, MO recognises intermediate inputs which are absent from the former. Because MO has only two sectors, however, its treatment of non-traded goods is not adequate. Jointly, the two miniatures provide a suitable vehicle for developing hypotheses about the relevant mechanisms in ORANI. Having identified the main mechanisms, full scale simulations are conducted with ORANI itself. Due to its computational simplicity, MO proves to be a useful link between the three-sector model developed in this paper and ORANI, the complexity of which makes computation of the required large number of experiments unwieldy. Finally, section 4 provides some concluding remarks.

2. *A Stylized Three-Sector Model of the Economy*

In this section, a stylised three-sector model of the economy is developed. The model is used to derive the elasticity of employment with respect to domestic demand. By examining the algebraic expression for the resulting elasticity, the main mechanisms relating employment to domestic demand can easily be highlighted. The model is neo-classical in structure. It is also designed to capture the essential features of ORANI.

2.1 An Overview of the Model

The model describes an economy consisting of three productive sectors: a non-traded sector which produces a commodity for the domestic market in the absence of import competition: an import-competing sector which also produces a commodity for the domestic market but which faces import competition: and a sector which produces a commodity exclusively for export. Production by the non-traded and import-competing sectors are exclusively for consumption by a single household. The single import in the model is also consumed directly by the household. Therefore, no commodities are used as intermediate inputs in the production process, with the only inputs being the primary factors, capital and labour.

Producers seek to minimise costs subject to a constant-returns-to-scale production function and households attempt to maximise utility subject to a budget constraint. All goods markets are assumed to be perfectly competitive in that demand equals supply and zero profits are earned.

The absence of indirect taxes, subsidies and margins in the model, means that there is no difference between producer and purchaser prices. Also, there is no distinction between domestic and foreign prices meaning that the nominal exchange rate is assumed to be constant. As the model is homogeneous of degree zero in prices, the exchange rate assumption has no real effects.

Under the assumption of fixed capital stocks, the demand for labour in each industry is a function of the real cost of employing labour. Finally, aggregate employment is determined by the aggregate demand for labour.

Specifically, the equations of the model can be classified into five groups:

(i) equations describing household and other final demands;

(ii) equations describing industry demands for primary factors;

(iii) pricing equations setting pure profits from all activities to zero;

(iv) market clearing equations for primary factors and commodities; and

(v) miscellaneous equations defining various price indices.

These are described in detail in the following sub-sections.

2.1.1 *The Equations of the Model*

The equations of this stylised model are obtained via the solutions to a series of constrained optimisation problems and a set of definitional equations. In keeping with the Johansen approach adopted in ORANI, the equations are expressed in percentage changes of the variables. By convention, lower case symbols represent the percentage changes in the levels of the model's variables and upper case symbols represent coefficients (usually shares) which are treated as constants in deriving expressions for percentage changes.

2.1.2 *Household Demands*

In this stylised economy it is assumed that domestic households and foreigners are the only sources of final demand. Domestic households maximise a nested utility function subject to a budget constraint. At the first level, the utility function is Leontief in the sense that the importable commodity is not substitutable for the non-traded commodity. At the next level, the imported and import competing commodities substitute for each other according to a CES aggregation.

The percentage changes in the demands for the domestically produced import competing commodity (x_{ic}) and the imported commodity (x_m) may be expressed as:

$$x_j = z - \sigma^A M_h(p_j - p_h) \quad ; \qquad j,h \in \{ic, m\}, \quad j \neq h \qquad (1)$$

where (z) is the percentage change in the household sectors aggregate expenditure level; (p_{ic}) and (p_m) are the percentage changes in the price of the import-competing and imported commodities, respectively; (σ^A) is the elasticity of substitution between the domestically produced import-competing commodity and the imported commodity (that is, the Armington elasticity); and the M's are shares (summing to unity) in the consumption of the importable commodity from domestic sources (M_{ic}) and from foreign sources (M_m). Equation (1) implies that the demand for the imported and import-competing commodities depend on the household sector's aggregate expenditure level and on the appropriately weighted changes in relative prices.

Since the non-traded commodity has no substitutes, the demand for this commodity by households (x_{nt}) may be expressed simply as:

$$x_{nt} = z \quad . \tag{2}$$

2.1.3 Export Demands

The export commodity is sold to foreigners only. The percentage change in the demand for the export commodity (x_e) is specified as :

$$p_e = -\gamma(x_e) + fe \quad ; \qquad \text{with } \gamma \geq 0 \tag{3}$$

where (γ) is minus the reciprocal of the own price elasticity of demand for the export commodity and p_e is the percentage change in the price of the export commodity and f_e is a shift variable.

2.1.4 Industry Demands for Primary Factors

The problem for firms in each sector is to choose amounts of labour and capital as inputs to the production process so as to minimise the costs of producing a given volume of output subject to a CES production function. The resulting input demand functions for the three sectors are:

$$x_{lj} = q_j - \sigma_{kl} S_{kj}(p_l - p_{kj}) \qquad j \in \{e, nt, ic\} \tag{4}$$

and

$$x_{kj} = q_j - \sigma_{kl} S_{lj}(p_{kj} - p_l) \quad ; \qquad j \in \{e, nt, ic\} \tag{5}$$

where the subscripts have the following connotations:

l ⇔ labour

k ⇔ capital

e ⇔ export sector

nt ⇔ non-traded sector

ic ⇔ import competing sector.

The S's are the factor shares in each sector's total factor costs while, σ_{kl} is the elasticity of substitution between labour and capital.[3] Note that,

$$S_{kj} + S_{lj} = 1 \qquad j \in \{e, nt, ic\} \ .$$

Equations (4) and (5) imply that factor demands (x's) depend upon the sectoral activity levels (q's) and on the appropriately weighted changes in relative factor prices (p's). The fact that the percentage change in the price of labour (p_l) is not subscripted with respect to a particular sector reflects the assumption that labour is fully mobile between sectors. Capital on the other hand is sector-specific.

2.1.5 Zero Pure Profits

The percentage change in commodity prices (p_j), $j \in \{e,nt,ic\}$ is related to costs by the following equation:

$$p_j = S_{lj}(p_l) + S_{kj}(p_{kj}) \ . \tag{6}$$

The assumption of zero pure profits means that in each sector the costs of production equal revenue. The assumption of constant returns to scale in the production process means that unit costs are independent of the scale of output. As firms in the model are also price-takers for their commodity, the terms on either side of the zero pure profits equation are independent of output.

2.1.6 Market Clearing for Commodities and Factors

It is assumed that the supply (q's) of domestically produced commodities is equal to the demand (x's) for these commodities so that:

$$x_j = q_j \ . \qquad j \in \{e, nt, ic\} \tag{7}$$

The market clearing equations for primary factors are[4]:

$$x_{kj} = k_j \qquad j \in \{e, nt, ic\} \tag{8}$$

and

$$l = L_e(x_{le}) + L_{nt}(x_{lnt}) + L_{ic}(x_{lic}) \ . \tag{9}$$

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3 The CES parameter σ_{kl} in this model, has the same value in all three sectors.

4 The categorisation of equation (9) as a market clearing equation should not be taken to imply that the model assumes full-employment. In the three-sector model, employment is demand determined so that equation (9) merely adds up employment demand in the three sectors.

Equation (8) implies that the percentage change in the demand for capital (x_{kj}) in sector j is equal to the percentage change in the supply of capital to sector j (x_{kj}). In equation (9), the percentage change in aggregate employment (l) is the sum of labour demands in each sector, where the L's denote the respective sectors' shares in aggregate employment with ($L_e + L_{nt} + L_{ic} = 1$).

2.1.7 Miscellaneous Equations

In order to distinguish between the producer and worker real-wage, two aggregate price deflators are constructed for this economy:

$$p_{ifc} = W_e(p_e) + W_{nt}(p_{nt}) + W_{ic}(p_{ic}) \tag{10}$$

and,

$$p_{id} = D_m(p_m) + D_{ic}(p_{ic}) + D_{nt}(p_{nt}) \quad ; \tag{11}$$

where (p_{ifc}) is interpreted as the percentage change in the deflator for domestic product at factor cost[5] and (p_{id}) as the percentage change in the domestic expenditure deflator. The W's denote shares in value added for the economy with ($W_e + W_{nt} + W_{ic} = 1$), and, the D's are shares in domestic expenditure with ($D_m + D_{ic} + D_{nt} = 1$)[6]. In this model, the factor-cost deflator (p_{ifc}) indicates the average price that domestic producers receive for their output. On the other hand, the domestic expenditure deflator indicates the average price that domestic consumers pay for goods and services.

Finally, to complete the model, real wages are fixed by fully indexing money wages to the the domestic expenditure deflator. That is:

$$p_l = p_{id} \quad . \tag{12}$$

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5 In this model it is implicitly assumed that there are no indirect taxes or subsidies so that GDP at factor cost is identical to GDP at market prices. It is for this reason that the price deflator represented by equation (10) may be interpreted in terms of factor prices.

6 For a detailed interpretation of the W's see Appendix Note 1. The W's and D's are also discussed in greater detail in section 2.3.1 below.

2.2 The Employment Response to an Expansion in Real Domestic Demand

2.2.1 Choice of Exogenous Variables

Tables 1 and 2 respectively list the equations and variables of this three-sector model. After subtracting the RHS from both sides of each equation in Table 1, the model could be expressed in the following matrix notation;

$$Av = 0 \quad ; \tag{13}$$

where A is a matrix of coefficients with dimensions 23 x 29 and v is a column vector of percentage-change variables with dimensions 29 x 1. As the model contains more variables than equations, a selection of variables to be determined exogenously must be made. The linearity of the system described in Table 1 and equation (13) allows the partitioning of the A matrix and the v vector so that (13) can be rewritten as,

$$A_1 v_1 + A_2 v_2 = 0 \quad ; \tag{14}$$

where A_1 is a 23 x 23 square matrix of coefficients, v_1 is a column vector of endogenous variables with dimensions 23 x 1, A_2 is another matrix of coefficients with dimensions 23 x 6, while v_2 is a 6 x 1 column vector of exogenous variables. The solution to the model in terms of values of the endogenous variables given values for the exogenous variables and coefficients can be expressed as:

$$v_1 = - A_1^{-1} A_2 v_2 \quad ; \tag{15}$$

where $- A_1^{-1} A_2$ is a matrix of elasticities of the endogenous variables with respect to the exogenous variables.

The purpose of choosing exogenous variables is to set the economic environment within which subsequent analysis is conducted. The environment itself is determined largely by the nature of the experiment. In this paper, the experiment is the short-run impact on aggregate employment of an increase in domestic demand under fixed real wages. The short-run nature of the experiment dictates that the percentage change in sectoral capital stocks (k_j's) should be set exogenously at zero. Also, as interest is in the response of employment to changes in domestic demand, aggregate household expenditure (z) is set exogenously so that shocks to domestic demand can be implemented through shocks to the z variable. The export demand shift variable (f_e) is set exogenously at zero thereby fixing the postion of the export demand curve. Finally, given that the model does

Table 1
The Equations of the Three Sector Model

Identifier	Equation		Number	Description
(1)	$x_j = z - \sigma^A M_h(p_i - p_h)$	$i,h \in \{ic, m\}, \quad i \neq h$	2	Household
(2)	$x_{nt} = z$		1	demands.
(3)	$p_e = -\gamma x_e + f_e$	$\gamma \geq 0$	1	Export demand.
(4)	$x_{lj} = q_j - \sigma_{kl} S_{kj}(p_l - p_{kj})$	$j \in \{e, nt, ic\}$	3	Sectoral
(5)	$x_{kj} = q_j - \sigma_{kl} S_{lj}(p_{kj} - p_l)$	$j \in \{e, nt, ic\}$	3	demands for primary factors.
(6)	$p_j = S_{lj}(p_l) + S_{kj}(p_{kj})$	$j \in \{e, nt, ic\}$	3	Zero pure profits in production.
(7)	$x_j = q_j$	$j \in \{e, nt, ic\}$	3	Market
(8)	$x_{kj} = k_j$	$j \in \{e, nt, ic\}$	3	clearing
(9)	$l = L_e(x_{le}) + L_{nt}(x_{lnt}) + L_{ic}(x_{lic})$		1	equations.
(10)	$p_{ifc} = W_e(p_e) + W_{nt}(p_{nt}) + W_{ic}(p_{ic})$		1	Price
(11)	$p_{id} = D_m(p_m) + D_{ic}(p_{ic}) + D_{nt}(p_{nt})$		1	deflators.
(12)	$p_l = p_{id}$		1	Wage indexation.
		Total =	23	

Table 2
The Variables of the Three Sector Model
(All variables are percentage changes)

Variable		Number	Description
Endogenous			
x_h	$h \in \{ic,m\}$	2	Household demands for domestic and imported commodities.
x_{nt}		1	
x_e		1	Demand for the export commodity.
P_j	$j \in \{e,nt,ic\}$	3	Price of domestically produced commodities.
x_{kj}	$j \in \{e,nt,ic\}$	3	Sectoral demands for primary factors.
x_{lj}	$j \in \{e,nt,ic\}$	3	
q_j	$j \in \{e,nt,ic\}$	3	Sectoral activity levels.
P_l		1	Economy-wide price of labour.
P_{kj}	$j \in \{e,nt,ic\}$	3	Price of capital for each sector.
l		1	Aggregate employment.
P_{ifc}		1	Factor cost deflator.
P_{id}		1	Expenditure deflator.
Exogenous			
z		1	Aggregate household expenditure.
k_j	$j \in \{e,nt,ic\}$	3	Capital stock for each sector.
P_m		1	Price of the imported commodity.
f_e		1	Shifts in export demand.
	Total =	29	

not describe foreign supply and demand conditions for imports, it is sensible to assume that the price of imports (p_m) is exogenous and set to zero. Being the only exogenously determined price, it is also the numeraire.

The model is now fully specified so that the percentage change in employment can be solved as the sum of the products of the percentage changes in the exogenous variables and their respective elasticities, that is:

$$l = \sum_j \eta_{l\,kj}\, k_j + \eta_{l\,pm}\, p_m + \eta_{l\,z}\, z; \qquad j \in \{e, nt, ic\} \tag{16}$$

where $\eta_{l\,kj}$ is the employment elasticity with respect to sector j's capital stock, $\eta_{l\,pm}$ is the employment elasticity with respect to the foreign price of imports and $\eta_{l\,z}$ is the employment elasticity with respect to aggregate household expenditure. As noted above, the k_j's and p_m are set at zero, therefore (16) reduces to:

$$l = \eta_{l\,z}\, z \quad . \tag{17}$$

The following subsection is concerned with the derivation of $\eta_{l\,z}$.

2.2.2 *The Elasticity of Aggregate Employment with Respect to Real Domestic Demand*

An expression for the aggregate employment elasticity with respect to domestic demand can be derived via equation (9). The reduced form expressions for the percentage change in sectoral labour demands (that is, the x_{lj}'s where $j \in \{e, nt, ic\}$) are as follows[7]:

$$x_{lnt} = \frac{z}{S_{lnt}} \quad ; \tag{18}$$

$$x_{lic} = \frac{z}{(E - C\, D_{nt})} \left[\sigma_{kl}\, D_m - \sigma^A \frac{M_m\, S_{knt}}{S_{lnt}} D_{nt} \right] \quad ; \tag{19}$$

$$x_{le} = - \frac{z}{N(E - C\, D_{nt})} \left[D_{ic}\, S_{kic}\, \sigma_{kl} + \frac{C\, D_{nt}\, S_{knt}}{S_{lnt}} \right] \quad ; \tag{20}$$

where

$$E = C - D_{ic}\ \sigma_{kl}\ S_{lic} \quad ,$$

$$N = S_{ke} + \gamma\, \sigma_{kl}\ S_{le} \quad ,$$

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7 A more detailed derivation of the aggregate employment elasticity with respect to domestic demand is provided in Appendix note 1.

and

$$C = \sigma_{kl} S_{lic} + \sigma^A M_m S_{kic} .$$

Sectoral shares in aggregate employment (L's) may be expressed as:

$$L_j = \frac{W_j S_{lj}}{\sum_j W_j S_{lj}} . \qquad j \in (e, nt, ic) \qquad (21)$$

The aggregate employment elasticity with respect to domestic demand can now be derived by substituting equations (18) - (20) into the RHS of equation (9) giving equation (17) where:

$$\eta l z = \frac{1}{r}\left[W_{nt} + \frac{W_{ic}S_{lic}}{E - C D_{nt}}\left(\sigma_{kl} D_m - \frac{\sigma^A M_m S_{knt} D_{nt}}{S_{lnt}} \right) - \frac{W_e S_{le}}{N(E - C D_{nt})}\left(D_{ic} S_{kic} \sigma_{kl} + \frac{C D_{nt} S_{knt}}{S_{lnt}} \right)\right] \qquad (22)$$

and $$r = [W_e S_{le} + W_{nt} S_{lnt} + W_{ic} S_{lic}] .$$

2.3 *Interpretation of the Aggregate Employment Elasticity with Respect to a Change in Domestic Demand*

The employment elasticity represented by equation (22) can be used to highlight the role of three key mechanisms which explain the aggregate employment response in the three-sector model. Two of these mechanisms, labelled below as the *balance-of-trade* and *terms-of-trade* effects, identify conditions which cause changes in the producer real wage. The third mechanism, the factor-share effect, identifies how the distribution of labour and capital between sectors influences aggregate employment. In addition equation (22) provides scope for examining the role of import competition (which featured prominently in previous explanations of ORANI employment results). In subsections 2.3.1 to 2.3.3 the impact of each of the three mechanisms is considered separately by assuming away the effects of the remaining mechanisms.

2.3.1 The Balance-of-Trade Effect

The balance-of-trade effect encompasses the role of a trade deficit/surplus on the aggregate employment elasticity. To facilitate the analysis, the aggregate employment elasticity represented by equation (22) may be simplified by assuming that $(-\gamma)$, the reciprocal of the own price elasticity of demand for the export commodity, is zero; the Armington elasticity (σ^A) is set to zero[8]; and, all three sectors of the economy have identical capital/labour ratios. These assumptions eliminate the terms-of-trade, import-competition and factor-share effects. Under these conditions, equation (22) simplifies to;

$$\eta_{l\,z} = \frac{1}{S_{le}}\left[(W_{nt} + W_{ic}) - (\frac{W_e}{D_m}\{D_{ic} + D_{nt}\})\right] \quad . \qquad (23)$$

The sign of $\eta_{l\,z}$ in (23) depends on which term in round brackets on the RHS is larger. This in turn depends on the relative values of the W's which, as mentioned, are sectoral shares in value added, and the D's which are shares in domestic expenditure. These are defined respectively as:

$$W_j = \frac{P_l X_{lj} + P_{kj} X_{kj}}{\sum_j P_l X_{lj} + \sum_j P_{kj} X_{kj}} \qquad j \in \{e, nt, ic\} \qquad (24)$$

and

$$D_i = \frac{P_i X_i}{\sum_i P_i X_i} \quad ; \qquad i \in \{m, nt, ic\} \qquad (25)$$

where, P_i and X_i are the price and quantity, respectively, of the i^{th} commodity.

In this model, if the value of imports is equal to the value of exports so that trade is balanced, then

$$P_m X_m = P_e X_e \quad ; \qquad (26)$$

where

$$P_e X_e = P_l X_{le} + P_{le} X_{ke}$$

and following the assumption of zero pure profits,

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8 Note that setting $\sigma^A = 0$ effectively transforms the import-competing sector into a non-trading sector. However, for ease of exposition the subscript (ic) is not replaced on those terms which continue to appear in the employment elasticity after the transformation. The intuition behind setting $\sigma^A = 0$ is that imports are not precluded - rather, they are allowed to be consumed in fixed proportions with the domestically produced importable.

$$P_g \; X_g \; = P_l \; X_{lg} \; + P_{kg} \; X_{kg} \quad . \qquad g \in \{nt, ic\} \qquad (27)$$

From equations (26) and (27) a balanced trade account also implies that:

$$\sum_i P_i \; X_i \; = \sum_j P_l \; X_{lj} \; + \sum_i P_{kj} \; X_{kj} \quad j \in \{e, nt, ic\}$$

$$i \in \{m, nt, ic\} \quad .$$

Hence, under conditions of a balanced trade account the following relationships between the sectoral shares in value added and the domestic expenditure shares apply[9] :

$$W_e \; = D_m \quad ,$$

$$W_{nt} \; = D_{nt}$$

and

$$W_{ic} \; = D_{ic} \quad .$$

In the case of a trade deficit:

$$W_e \; < D_m \quad ,$$

$$W_{nt} \; > D_{nt}$$

and

$$W_{ic} \; > D_{ic} \quad .$$

These inequalities will be reversed in the case of a trade surplus.

According to equation (23), if trade is balanced, the employment elasticity would be equal to zero[10]. Equation (23) indicates that the larger the trade deficit in the initial data base, the larger will be the employment elasticity. The opposite is true for an initial trade surplus.

Holding the terms-of-trade constant means that the difference between the domestic expenditure deflator and the factor-cost deflator in the three sector

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9 Whilst not explicitly modelled, indirect taxes and subsidies could also place a wedge between the W's and the D's and therefore impact upon the employment response. This issue is addressed in Appendix note 2.

10 See Appendix note 3.

model, is the relative weights, the W's and D's. With a trade deficit, the relative weighting on the prices of the import-competing and non-traded goods is higher in the factor-cost deflator than in the domestic expenditure deflator; therefore, with export and import prices constant, an increase in the prices of the other sectors, in response to an increase in domestic demand, causes the factor-cost deflator to increase more rapidly than the domestic expenditure deflator. As nominal wages are indexed to the domestic expenditure deflator, it is movements in this deflator that indicate changes to producers' costs. Changes in the average price to producers of their output, however, is given by movements in the factor-cost deflator. Thus a situation in which the domestic factor-cost deflator increases relative to the domestic expenditure deflator can be interpreted as a decrease in the average producer's real wage cost which will prompt an increase in employment.

2.3.2 The Terms-of-Trade Effect

The terms-of-trade effect captures the impact that the price elasticity of demand for the export commodity has on aggregate employment. The aggregate employment elasticity represented by equation (22) may be simplified to highlight this effect by assuming that trade is balanced, that all three sectors of the economy have identical capital/labour ratios and that the Armington elasticity (σ^A) is zero. Under this set of assumptions equation (22) reduces to:

$$\eta_{l\,z} = \frac{1}{S_{le}}\left[W_{nt}\left(1 - \frac{S_{knt}}{S_{ke} + \gamma\sigma_{kl}\,S_{le}}\right) + W_{ic}\left(1 - \frac{S_{kic}}{S_{ke} + \gamma\sigma_{kl}\,S_{le}}\right)\right]. \qquad (28)$$

Since $\gamma > 0$, the employment elasticity represented by equation (28) will be smaller the smaller is γ.

In explaining this effect, note that the assumptions of balanced trade and zero change in the price of imports (from the closure of the model), imply that the factor-cost deflator will rise at a faster rate than the domestic expenditure deflator if the price of the export commodity is allowed to rise as costs increase in the face of an increase in domestic demand. The assumption that $\gamma > 0$ (i.e., that the price elasticity of demand for exports is less than infinite) means that exporters are able to pass on some increase in costs in the form of higher prices. As noted in the previous subsection, the significance of the factor-cost deflator rising at a more rapid rate than the domestic expenditure deflator is that the average real wage faced by producers is falling. This leads to an increase in employment.

The size of the terms-of-trade effect, (i.e., the magnitude of the change in p_e) will depend on the slopes of both the demand and supply curves for the export commodity which are in turn determined by the values of γ and $\sigma_{kl}\,S_{le}$, respectively. This is illustrated in Figures 1 and 2. In these diagrams the price level and quantity of exports are measured on the vertical and horizontal axes, respectively. Figure 1 depicts a situation where the own price elasticity of demand

$(-1/\gamma)$ for curve D_2 exceeds that of curve D_1 at each of the price levels P_E, P_{E1} and P_{E2}.

An increase in domestic demand increases the costs of production in the export sector shifting the supply curve in Figure 1 to the left from S to S′. Clearly, the rise in the price level (and, given a common initial price level, the percentage change in price) will be higher the lower the absolute value of the price elasticity of demand (and, therefore, the higher the value of its reciprocal, γ).

In Figure 2, the effect of variations in the own price elasticity of supply is examined by plotting movements of two supply curves, S_1 and S_2 along a common demand curve. An increase in domestic demand and therefore costs, causes both supply curves to shift by the same amount in a vertical direction. Figure 2 shows that the rise in foreign price is greater in the case of the more elastic supply curve S_1. The degree of elasticity of supply reflects the flexibility of the production process. In this model the capital stock is fixed and is sector-specific so that supply will be more elastic the greater the intensity of labour in the production process (as measured by S_{le} and the greater the elasticity of factor substitution σ_{kl}. Thus, according to equation (28), the magnitude of the terms-of-trade effect will be reflected by the term $(\gamma\sigma_{kl} S_{le})$; the greater the values of these magnitudes the larger will be the aggregate employment elasticity.

2.3.3 The Factor-Share Effect

The role of the factor shares may be highlighted by assuming that the balance-of-trade, terms-of-trade and import-competition effects are set to zero. Under these conditions, the employment elasticity represented by equation (22) reduces to:

$$\eta_{l\,z} = \frac{1}{r}\left\{W_{nt}\left[1 - \left(\frac{S_{knt}}{S_{lnt}} \times \frac{S_{le}}{S_{ke}}\right)\right] + W_{ic}\left[1 - \left(\frac{S_{le}}{S_{ke}} \times \frac{S_{kic}}{S_{lic}}\right)\right]\right\} \quad . \tag{29}$$

According to equation (29), if all sectors have identical factor intensities, then because the terms in round parentheses become unity, an expansion in domestic aggregate demand will not impact upon aggregate employment (that is, $\eta_{lz} = 0$). Equation (29) suggests that the more labour-intensive the import-

Figure 1

The terms-of-trade effect, demand side

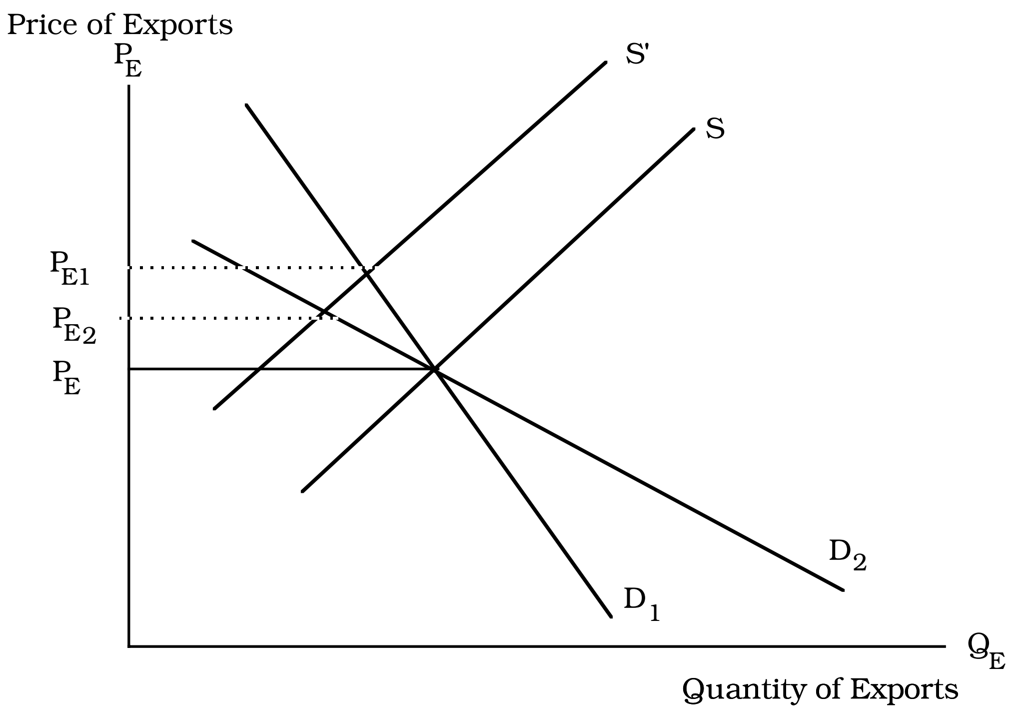
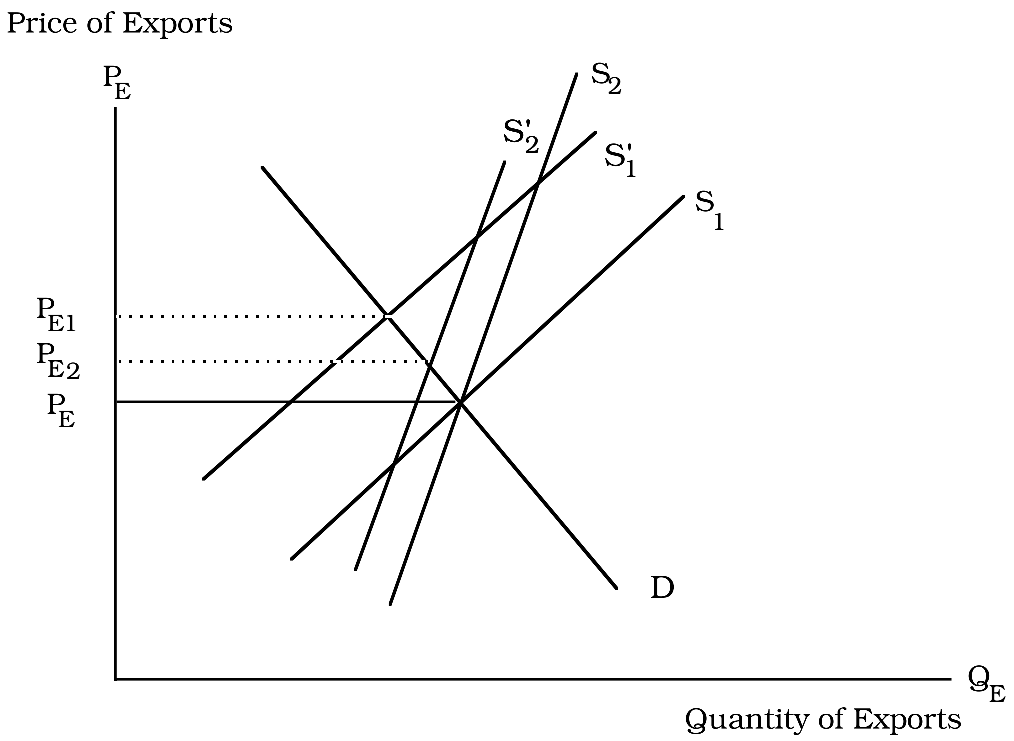


Figure 2

The terms-of-trade effect, supply side



competing sector relative to the export sector and the more labour-intensive the non-traded sector relative to the export sector, the greater will be the employment response to an increase in domestic demand, and *vice-versa*. In the event that

$$S_{lnt} > S_{le} > S_{lic} \quad ,$$

the employment response will depend on the relative sizes of the non-traded and import-competing sectors as represented by the shares in value-added (that is, the W's).

Intuitively, the factor share effect may be explained as follows: a sector which experiences an improvement in its price/cost situation following an expansion in domestic demand will increase output and employment and *vice-versa*. The magnitude of the increase or decrease in aggregate employment will depend in part on the relative factor intensities of the respective sectors. To illustrate, consider the special case where there are only two sectors; an import-competing sector which uses some labour and an export sector which is 100 per cent capital intensive. The demand expansion increases the price of the import-competing commodity which leads to an increase in the expenditure deflator and the price of labour to both sectors via the wage indexation rule. With the prices of imports and exports held constant, the percentage change in the price of the import-competing commodity is greater than the percentage change in the expenditure deflator which in turn is greater than the percentage change in the price of exports. As the export sector uses no labour, the rising cost of labour has no impact on the costs of that sector and hence its price/cost situation remains unchanged. The price/cost situation of the import-competing sector is improved so that sectoral and hence aggregate output and employment increase.

2.3.4 The Role of the Import-Competing Sector

The role of import competition has featured prominently in previous (intuitive) explanations of ORANI's employment response (for example, DPP (1979), DPSV (1982) and, Pagan and Shannon (1987)). However, equation (22) indicates that the employment elasticity is zero if the balance-of-trade, terms-of-trade and factor-share effects are simultaneously set to zero. This implies that under such conditions, changes in the economy that are related to the import-competing sector in response to an expansion in domestic demand have no impact upon aggregate employment. However, in the presence of one or more of the three effects, the inclusion of the import-competing sector does influence the employment response in the stylized model presented in this paper. Rather than reversing or eliminating the employment response, the inclusion of the import-competing sector is found to scale the magnitude of the employment response resulting from the balance-of-trade, terms-of-trade and factor-share effects.

The above mentioned authors did not isolate the mechanisms which determine qualitatively the ORANI employment response. Hence, in focusing on the role of the import-competing sector they attributed central importance to a mechanism that influences quantitatively rather than qualitatively the ORANI employment response.

To illustrate the role of the import-competing sector, consider the case represented by equation (28) where the balance-of-trade effect was isolated. In deriving equation (28) from equation (22), the import-competing effect was effectively eliminated by setting the Armington elasticity to zero. Allowing for positive values of the Armington elasticity (i.e., reinstating the import-competing effect), the employment elasticity representing the balance-of-trade effect becomes:

$$\eta_{lz} = \frac{1}{S_{le}} \left\{ W_{nt} + \frac{1}{[E - C\, D_{nt}]} \left[\sigma_{kl}\, S_{lic} (W_{ic}\, D_m - W_e\, D_{ic} - W_e\, D_{nt}) - \sigma^A\, M_m\, S_{knt}\, D_{nt}\, (W_{ic} + W_e) \right] \right\} \quad ; \qquad (30)$$

where

$$[E - C\, D_{nt}] = \sigma_{kl}\; S_{lic}\; D_m + \sigma^A\; M_m\; S_{kic}\, (D_{ic} + D_m) > 0 \quad .$$

As with equation (28), when trade is balanced (i.e., $W_e = D_m$) the employment elasticity in equation (30) is zero reconfirming the irrelevance of the import-competing sector to the employment outcome in the absence of the balance-of-trade, terms-of-trade and factor-share effects[11].

In the absence of the import-competition effect, the result of section 2.3.1 showed, that under conditions of a balance-of-trade deficit, the employment elasticity is positive. From equation (30), the inclusion of the import-competition effect does not qualitatively change the result of section 2.3.1 as the value of (30) is positive for any positive value of σ^A, the Armington elasticity[12].

In equation (30), for a given value of M_m, the value of the Armington elasticity (σ^A) indicates the strength of the substitution possibility existing between the imported and domestically produced import-competing commodity. Since the value of (30) is positive for any positive value of σ^A and the partial derivative of (30) with respect to σ^A is strictly negative[13], the inclusion of the import-competion effect dampens but does not eliminate or reverse the employment response due to the balance-of-trade effect.

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11 See Appendix note 3.

12 See Appendix note 4.

13 See Appendix note 4.

Further manipulations of (22) focusing on the terms-of-trade and factor-share-effects reveal that the inclusion of the import competition effect has a similar role to that illustrated above for the balance-of-trade effect.

Intuitively, it is not surprising that the inclusion of the import-competition effect dampens the employment response to an increase in aggregate domestic demand. The increase in demand generates an increase in the prices of the non-traded and import-competing commodities, the expenditure deflator, and hence wages via the indexation rule. The subsequent rise in costs causes a further increase in the price of the import-competing commodity relative to the import and in substitution towards the import hence dampening the output and employment responses in the import-competing sector and in aggregate. The greater the value of the Armington elasticity (σ^A), the greater the substitution toward the imported commodity and the weaker the employment response.

2.4 *Summary of the Results Obtained From the Three Sector Model*

The three-sector model suggests that employment responds positively to an expansion in domestic demand under circumstances in which the demand stimulus entails a fall in the producer real wage cost (as given by the increase in the domestic factor cost deflator relative to the domestic expenditure deflator) and/or in which the labour-intensive sectors are favoured by the stimulus in demand.

In this model, aggregate employment is demand determined. Thus, the initial choice of deflator for indexing money wages is important. If money wages are initially indexed to the factor cost deflator (p_{ifc}), (so that the producer real wage is fixed), rather than the expenditure deflator (p_{id}), then an employment response due to an increase in aggregate domestic demand would be possible only if factor intensities differed among sectors. However, when money wages are indexed to the expenditure deflator, aggregate employment may also respond via a change in the producer real wage. The three-sector model identified an initial trade deficit and the existence of a positive terms-of-trade effect as two conditions which individually and jointly are consistent with the producer real wage falling in response to an increase in aggregate domestic demand. Finally, it is shown that the role of the import-competing sector is to change the employment result quantitatively rather than qualitatively.

3. *Empirical Results*

The intuition gained from the three sector model developed in the previous section is tested using MO initially. The tractable dimensions of MO make it a useful precursor to full-scale ORANI experiments. The small size and simplicity of the model allows for easy alterations to the equations and/or data base using the GEMPACK software (see Pearson (1988) and Codsi and Pearson (1988)). This feature of MO means that a large number of experiments is feasible. In addition, the results obtained from MO help minimise the number of ORANI experiments by identifying the principal mechanisms responsible for the employment response unencumbered by the details of the main model.

Figure 3

Hypothetical Input-Output Data Base for MO
(All values in Australian dollars)

		Industries 1	Industries 2	Households	Exports	-Duty	Row totals
Domestic commodities	1	10	8	17	19		54
	2	15	1	34	1		51
Imported commodities	1	1	8	1		-1	9
	2	5	2	10		-5	12
Labour			20	20			40
Capital		10	5				15
		61	44				
Domestic commodity outputs	1	45	9				54
	2	16	35				51
		61	44	62	20		

Source: DPSV (1982 p. 12).

3.1 MO Results

MO consists of two industries and four commodities (two domestically produced and two imported). The hypothetical input-output data base for MO is presented in DPSV (1982) and reproduced in Figure 3. The numbers in Figure 3 represent Australian dollar amounts for some base year. In contrast to the three-sector model developed in the previous section, MO does not model a non-traded sector; the domestically produced commodities are both import-competing and exportable; intermediate inputs of both domestic and foreign commodities are allowed; and the elasticity of substitution between the domestically produced and imported commodities is unity.

The model has 39 equations and 52 variables meaning that 13 of the variables must be exogenously determined. The closure adopted in the following experiments is the standard one described in DPSV (1982 p. 34). This closure includes the neo-classical assumptions of adjustments occurring via relative price changes. The expansion in demand is simulated by shocking real aggregate household expenditure by 1 per cent. Real wages as income are held constant by allowing the standard assumption of full indexation of money wages to the consumer price index to hold.

The aggregate employment results of a selection of six MO experiments are reported in Table 3 and discussed sequentially below.

3.1.1 Experiment 1

In this experiment, MO was run in its standard short-run configuration. The results of this experiment show that a 1 per cent increase in real aggregate household expenditure under conditions of fixed real wages leads to a 0.64 per cent increase in aggregate employment. Experiment 1 forms the base case against which experiments 2 to 6 are compared.

3.1.2 Experiment 2

The MO data base as presented in Figure 3 reflects a base-period balance-of-trade deficit of $A1. The purpose of this experiment is to test the proposition derived in section 2.3.1 that a trade deficit in the base period has a positive impact on the aggregate employment elasticity. Unlike the three sector model, MO allows for duties on imports. Thus, eliminating the so-called balance-of-trade effect from

Table 3
Selected MO Employment Results

Experiment→ Variable ↓	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6
	Standard short-run closure as described in DPSV (1982 p. 34) with 1% increase in real aggregate household expenditure and real wages fixed.	Experiment 1 repeated with trade balanced	Experiment 1 repeated with the percentage change in the terms of trade set to zero	Experiment 1 repeated with the factor shares for the two industries equalized	Experiment 1 repeated with trade balanced, the percentage change in the terms of trade set to zero and factor shares equalized	Experiment 4 repeated with money wages fully indexed to GDP at factor cost deflator
Percentage change in aggregate employment	0.635309	0.632082	0.304149	0.582618	0.096663	0.000000
Percentage change in the consumer price index					0.186031	
Percentage change in the GDP at factor cost deflator					0.212394	

MO requires that the market value of imports less duty is equal to the value-added of exports[14]. Accordingly, the data base was modified by removing $A1 worth of imported commodity 2 from household expenditure so that the trade deficit is eliminated. Experiment 1 was then re-run using the new data base. As the employment result in Table 3 (0.632082) shows, the removal of the deficit decreases the employment response as predicted.

3.1.3 Experiment 3

In its standard short-run configuration MO adopts the small country assumption for both of the imported commodities and for exports of commodity 2. The percentage change in the foreign currency price of commodity 1 is modelled as depending on foreign demand with the foreign elasticity of demand for this commodity set at 2.0. An increase in domestic demand increases the costs of production and exporters of commodity 1 are able to pass on some of these costs to foreigners allowing for an improvement in the terms-of-trade. To examine the impact of the terms-of-trade improvement, experiment 1 was re-run with the adoption of the small country assumption for commodity 1 (i.e., the foreign elasticity of demand for commodity 1 was set to infinity). The removal of the positive terms-of-trade movement reduces the employment response from 0.635309 to 0.304149 per cent. This result confirms the prediction of the three sector model developed in section 2.

3.1.4 Experiment 4

The MO data base indicates that industry 2 is relatively labour-intensive and that this industry sells most of its output to domestic households. Due to its exposure to domestic households, the increase in real aggregate household expenditure will favour industry 2. According to the three-sector model developed in section 2, the fact that industry 1 is relatively labour-intensive and is favoured by the demand expansion means that the employment response will be favourable. This prediction is confirmed by the results. The original MO data base was modified by setting factor shares in both industries equal to the economy-wide average[15]. The removal of the factor-share effect reduces the employment response to 0.582618 per cent.

3.1.5 Experiment 5

In the three-sector model developed in section 2 it was shown that the removal of the balance-of-trade, terms-of-trade and factor-share effects would reduce the employment response to zero. This result is tested by re-running

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14 Appendix note 2 briefly examines the role of indirect taxes in the context of the balance-of-trade effect.

15 The economy wide labour/capital ratio is 0.727272 so that the inputs of labour and capital for industry 1 become 21.818182 and 8.181818, respectively. Similarly, for industry 2, the input of labour becomes 18.181818 and the input of capital 6.818182.

experiment 1 with the simultaneous removal of the balance-of-trade, terms-of-trade and factor-share effects as per experiments 2 to 4. As the results in Table 3 show, the percentage change in the consumer price index (0.186031) is less than the percentage change in the GDP at factor cost deflator (0.212394)[16]. This implies that the real cost of employing labour is falling for the average domestic firm resulting in a positive employment response (0.096663).

In the three-sector model the removal of the balance-of-trade and terms-of-trade effects means that the expenditure deflator (p_{id}) and the factor cost deflator (p_{ifc}) move together. Under these conditions with nominal wages indexed to the expenditure deflator both the producer and worker real wage are effectively held constant. In contrast, eliminating the balance-of-trade and terms-of-trade effects from MO is not sufficient to cause the CPI and GDP at factor cost deflator to move together.

Unlike the three-sector model MO includes subsidies and the difference between the two deflators reported for this experiment is accounted for by the positive percentage change in one plus the *ad-valorem* subsidy on export commodity 1.

In MO the percentage change in the consumer price index (cpi) is defined as:

$$cpi = \sum_{i=1}^{2} \sum_{s=1}^{2} H_{is} \; p_{is} \quad ; \qquad i,s = 1,2$$

where subscripts i and s refer to the type of commodity and the source of production, respectively (i.e., s=1 denotes domestic and s=2 denotes foreign source); H_{is} is the share of the total household budget devoted to commodity (is); and p_{is} is the percentage change in the price of commodity (is). The results of experiment 5 show a zero percentage change in the price of all commodities except for domestically produced commodity 2 whose price increases by 0.333762 per cent. From the appropriate data base, $H_{(21)}$ = (34/61) so that:

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16 The expenditure deflator and the factor cost deflator defined in the three-sector model are the parallels of the CPI and GDP at factor cost deflator, respectively, in MO.

$$cpi = 0.186031 \quad .$$

The percentage change in the GDP at market prices deflator ($pgdp_m$) is:

$$pgdp_m = G_c\,(cpi) + G_E\,(\sum_{i=1}^{2} D_{i1}\, p^*_{i1}) - G_m\,(\sum_{i=1}^{2} M_{i2}\, p^*_{i2}) \quad ;$$

where subscripts are as above; the G's are the shares of consumption, exports and imports in GDP, respectively; under conditions of a constant exchange rate, p^* is the percentage change in the foreign currency price of commodity (is); the D's are the shares of commodity i in total exports; and the M's are the shares of commodity i in total imports. Under the conditions of experiment 5, $p^*_{i1} = 0 = p^*_{i2}$ (i = 1,2) so that:

$$pgdp_m = G_c\,(cpi) \quad .$$

The value of G_c in the modified data base[17] is 1 so that:

$$pgdp_m = cpi = 0.186031.$$

The percentage change in the GDP at factor cost deflator ($pgdp_{fc}$) can be obtained by noting that:

$$GDP_m - \text{Indirect Taxes} + \text{Subsidies} = GDP_{fc} \quad .$$

Therefore,

$$pgdp_{fc} = F_g\,(gdp_m) - F_m\,(\sum_{i=1}^{2} M_{i2}\, t_{i2}) + F_e\,(\sum_{i=1}^{2} D_{i1}\, s_{i1}) \quad ;$$

where the F's represent shares in total factor costs of GDP_m, imports and exports, respectively; t is the percentage change in one plus the ad-valorem tariff on imported commodity i; and s is the percentage change in one plus the ad-valorem subsidy on export commodity i. In experiment 5, the t_{i2} and s_{11} are exogenously set to zero so that:

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17 Note that the relevant data base for this experiment is the modified one used in experiment 2 where one unit of imported commodity 2 is taken away from households to balance the trade account.

$$pgdp_{fc} = F_g\,(pgdp_m) + F_e\,(D_{21}\, s_{21}) \quad .$$

From the data base, the values of the shares are: $F_g = 61/55$; $F_e = 20/55$; and $D_{21} = 1/20$. The results of experiment 5 show that $s_{21} = .333762$, so that:

$$pgdp_{fc} = .212394 \quad .$$

These calculations confirm that the reported difference between the percentage change in the CPI and the percentage change in the GDP at factor cost deflator in experiment 5 is fully accounted for by the subsidy on export commodity 1.

The employment response obtained in this experiment could be eliminated by setting the percentage change in one plus the *ad-valorem* subsidy on export commodity 1 to zero. In effect this fixes the producer real wage because the CPI and GDP at factor cost deflator will now move together. Alternatively, the results of the three-sector model imply that the employment response could be eliminated by indexing money wages directly to the factor cost deflator so that the producer real wage only is fixed. This proposition is tested in the following experiment.

3.1.6 Experiment 6

In this experiment the real cost of employing labour (the producer real wage) is held constant by indexing money wages to the GDP at factor cost deflator[18] and the factor shares are equalised as per experiment 4. The zero employment response obtained from this experiment confirms the conclusions of section 2.4 that if the producer real wage is held constant then aggregate employment can respond to a change in domestic demand only if factor intensities differ across sectors.

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18 To index money wages to GDP at factor costs an additional variable and equation defining the percentage change in GDP at factor costs ($pgdp_{fc}$) was added to MO as follows:

$$pgdp_{fc} = p_{ki}\, S_{ki} + p_l\, S_{li} \quad ; \qquad\qquad i=1,\,2$$

where subscripts k = capital
l = labour
i = sector

and p is the percentage change in factor prices and the S's denote shares in total factor costs.

3.2 ORANI Results

In the following experiments, the short-run version of ORANI TABLO[19] is employed to verify the extent to which the mechanisms identified in MO explain the ORANI employment response. The aggregate employment results of a selection of 4 ORANI simulations are reported in Table 4 and discussed below.

3.2.1 Experiment 1

This is the base experiment where the short-run version of ORANI TABLO using the 1978-79 data base (see Kenderes and Strzelecki (1988)) is employed to quantify the effect on aggregate employment of a balanced one per cent increase in real domestic demand under conditions of fixed real wages. The closure adopted for this experiment is the standard one reported in DPSV (1982 p. 143). The balanced increase in real domestic demand was modelled by increasing real private consumption, private investment and government expenditures by 1 per cent, respectively. The results of this experiment indicate that in its standard short-run configuration, ORANI produces a 0.523698 per cent increase in aggregate employment in response to a balanced 1 per cent increase in real domestic demand. The positive employment response obtained in this experiment lends support to the findings of the three-sector model. The expansion in real domestic demand favours the non-traded sector which is labour-intensive relative to the traded-goods sector in the ORANI data base. In addition, the export industries face downwardly-sloping demand curves. These two features imply, respectively, that the factor-share and terms-of-trade effects will both have a positive impact on the employment response.

3.2.2 Experiment 2

The purpose of this experiment is to quantify the factor share effect in ORANI. Accordingly, simulation 1 was re-run with appropriate modification made to the 1978-79 data base so that the labour/fixed factor ratio in each of the 112 ORANI industries was set equal to the economy-wide average. The result reported in Table 2 shows the aggregate employment response is reduced to 0.466323 per cent when the factor share effect is removed.

3.2.3 Experiment 3

The results of MO highlighted the importance of the price index chosen to deflate money wages. In its standard short-run configuration ORANI models money wages as being fully indexed to the CPI. This experiment examines the implications of indexing money wages to the GDP at factor cost deflator rather than the CPI. Since the ORANI model does not identify the GDP at factor cost deflator it

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[19] ORANI TABLO is an implementation of ORANI using the GEMPACK program TABLO as described in Codsi, Horridge and Pearson (1988).

Table 4
Selected ORANI Employment Results

Experiment →	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Variable↓	Standard short-run configuration as described in DPSV (1982) with a balanced 1% increase in aggregate absorption[1]	Experiment 1 repeated with the factor shares of all industries set to the economy-wide average	Experiment 1 repeated with money wages fully indexed to the GDP at factor cost deflator rather than the CPI	Experiment 3 repeated with the factor shares of all industries set to economy-wide average
Percentage change in aggregate employment	0.523698	0.466323	0.431382	0.000074

1 That is, a 1 per cent increase in consumption, private investment and government expenditure, respectively.

was necessary to add an equation to the model which defined this deflator. The indexing equation in ORANI was then changed appropriately and simulation 1 re-run. The results of this simulation show that the percentage change in the GDP at factor cost deflator is greater than the percentage change in the CPI. Table 2 shows that the employment response is reduced to 0.431382 per cent since the real cost of hiring labour has increased relative to experiment 1.

3.2.4 Experiment 4

In the simulation experiments 2 and 3 are combined so that the labour/fixed factor ratio for each industry is equal to the economy-wide average and money wages are fully indexed to the GDP at factor cost deflator. As the results in Table 2 indicate, the equalisation of the factor shares removes any compositional effects remaining after money wages are indexed to the GDP at factor cost deflator as per experiment 3. Consequently, as predicted by the three-sector model developed in section 2 and the results of MO, the ORANI employment response is equal to zero after allowing for rounding errors and the increase in domestic demand is accommodated fully by a deterioration in the balance of trade.

An interesting feature of the ORANI employment results presented in Table 4 is that the factor-share effect and the effect of indexing money wages to the GPD at factor cost deflator are not additive. As the results of experiment 2 and 3 indicate, these two effects individually, have a relatively small impact on the employment elasticity. On the other hand, the results of experiment 4 indicate that in combination, these two effects explain the whole ORANI employment response to an increase in domestic demand.

An example of non-additivity among the effects identified as generating the employment response is found in the inter-related nature of the terms-of-trade and factor-share effects. In section 2.3.2, it was shown that the terms-of-trade effect increased as the share of labour in the export sector was increased. However, in section 2.3.3, it was shown that the factor-share effect was diminished by increasing the share of labour in the export sector. In ORANI experiment 2, the factor-share effect was eliminated by setting the share of labour in all industries to the economy-wide average. This involved increasing the share of labour in the export sector with the dual impact of dampening the employment response as the factor-share effect is eliminated but increasing the employment response as the terms-of-trade effect is strengthened.

4 *Concluding Remarks*

This paper demonstrates that Keynesian type employment responses in multisectoral neo-classical models such as ORANI may be explained in terms of relative price movements and compositional effects.

It is argued that the wage fixing rule for the economy is of paramount importance. In multi-sectoral models, the real wage is not necessarily defined uniquely for the economy as a whole. This paper identifies the producer real wage as being money wages deflated by the GDP at factor cost deflator; whilst for workers, the real wage is money wages deflated by the expenditure deflator (e.g., the CPI). In countries such as Australia where money wages are indexed, typically the price deflator used is the CPI. Therefore, with money wages indexed to the CPI, the real wage as seen by producers is determined by the relative movements in the GDP at factor cost deflator and the CPI. This paper identifies two effects, labelled the terms-of-trade effect and the balance-of-trade effect, where demand management policies cause the GDP at factor cost deflator to rise relative to the CPI, thereby increasing aggregate employment. For these effects to be operative it is only necessary that the export demand curves are downward sloping and that the trade balance is in deficit.

In addition, the paper shows that in the case where the demand expansion favours the labour intensive industries, an increase in aggregate employment is possible even when the real wage forced by the producer is fixed.

A further contribution of this paper has been to clarify the role of the import-competing sector in explaining why ORANI produces a Keynesian employment response. The principal explanation offered by previous studies revolved around the degree of substitutability between domestic products and foreign ones. This paper illustrates that this explanation is inadequate. The degree of substitutability between domestic and foreign goods (as reflected by the Armington elasticity) is a quantitative mechanism which serves only to *scale* the employment response, the sign (+, -, or 0) of which is determined by other considerations.

The policy implications of this paper are important. There is an onus on the user of an economic model to be aware of the mechanisms which are responsible for particular results. The analysis identifies conditions under which demand management policies are effective in stimulating aggregate employment. If the insights obtained from the models discussed above are accepted as relevant to the actual Australian economy, then it is crucial that policy makers recognise the impact that demand management policies have on the real wage cost faced by producers and how the configuration of factor intensities across sectors effects the aggregate employment response.

Wage indexation emerges as a critical issue for employment with each approach to indexation (full, partial, plateau, etc.) having its own implications for the relationship between movements in consumer prices (as measured by some expanditure deflator such as the CPI) and movements in producer prices (as measured by the GDP at factor cost deflator). Even within the different approaches to wage indexation, the exact details of how indexation formulas are applied (after what lag, with what discounting provisions for other elements of the social wage, etc.), may be crucial for Australian's competitiveness and the employment result.

Appendix Note 1

Derivation of the Aggregate Employment Elasticity with Respect to Real Domestic Demand

An expression for the aggregate employment elasticity can be derived in the following way: equation (6) together with the assumption that capital stocks are held constant imply that:

$$q_e = \sigma_{kl} \; S_{le} \; [p_{ke} - p_l] \; . \tag{A1.1}$$

Substituting (A1.1) into (5) gives:

$$x_{le} = \sigma_{kl} \; [p_{ke} - p_l] \; . \tag{A1.2}$$

Using equation (11), the following expression for p_{ke} is obtained:

$$p_{ke} = \frac{p_e - S_{le}\,(p_l)}{S_{ke}} \; . \tag{A1.3}$$

Substituting (A1.3) into (A1.2), observing the wage indexation rule (equation (21)), and rearranging yields:

$$x_{le} = \frac{\sigma_{kl}}{S_{ke}} \; [p_e - p_{id}] \; . \tag{A1.4}$$

Using the appropriate equations, similar expressions for x_{lic} and x_{lnt} can be obtained in an analogous manner. Thus for the import-competing sector:

$$q_{ic} = \sigma_{kl} \; S_{lic} \; [p_{kic} - p_l] \; ; \tag{A1.5}$$

$$x_{lic} = \sigma_{kl} \; [p_{kic} - p_l] \; ; \tag{A1.6}$$

yielding

$$x_{lic} = \frac{\sigma_{kl}}{S_{kic}} \; [p_{ic} - p_{id}] \; . \tag{A1.7}$$

For the non-trading sector:

$$q_{nt} = \sigma_{kl} \; S_{knt} \; [p_{knt} - p_l] \; ; \tag{A1.8}$$

$$x_{lnt} = \sigma_{kl} \; [p_{knt} - p_l] \; ; \tag{A1.9}$$

giving

$$x_{lnt} = \frac{\sigma_{kl}}{S_{knt}} [p_{nt} - p_{id}] \ . \tag{A1.10}$$

Multiplying both sides of (A1.6) by S_{lic} gives:

$$x_{lic} \ S_{lic} = \sigma_{kl} \ S_{lic} \ [p_{kic} - p_l] \ . \tag{A1.11}$$

The RHS of (A1.11) is equal to (A1.5) so that

$$x_{lic} \ S_{lic} = q_{ic} \ . \tag{A1.12}$$

From the closure of the model, $p_m = 0$ so that equation (1) reduces to:

$$x_{ic} = z - \sigma^A \ M_m \ p_{ic} \ . \tag{A1.13}$$

Substituting equation (A1.13) into (15) gives:

$$q_{ic} = z - \sigma^A \ M_m \ p_{ic} \ . \tag{A1.14}$$

Finally, substituting (A1.14) into (A1.12) and rearranging yields:

$$x_{lic} = \frac{z - \sigma^A M_m p_{ic}}{S_{lic}} \ . \tag{A1.15}$$

From equations (A1.7) and (A1.15) it follows that:

$$p_{ic} - p_{id} = \frac{z \ S_{kic}}{\sigma_{kl} \ S_{lic}} - \frac{\sigma^A M_m S_{kic} \ p_{ic}}{\sigma_{kl} \ S_{lic}} \ . \tag{A1.16}$$

Analogously, for the non-trader:

$$x_{lnt} \ S_{lnt} = \sigma_{kl} \ S_{lnt} \ [p_{knt} - p_l] \ ; \tag{A1.17}$$

$$x_{lnt} \ S_{lnt} = q_{nt} \ . \tag{A1.18}$$

From equations (3) and (14),

$$q_{nt} = z \ , \tag{A1.19}$$

so that

$$x_{lnt} = \frac{z}{S_{lnt}} , \tag{A1.20}$$

and

$$p_{nt} - p_{id} = \frac{z \, S_{knt}}{\sigma_{kl} \, S_{lnt}} . \tag{A1.21}$$

Noting that $p_m = 0$, equation (20) reduces to

$$p_{id} = D_{ic}(p_{ic}) + D_{nt}(p_{nt}) . \tag{A1.22}$$

Using (A1.22) the following expressions for p_{ic} and p_{nt} are obtained:

$$p_{ic} = \frac{p_{id} - D_{nt}(p_{nt})}{D_{ic}} , \tag{A1.23}$$

and

$$p_{nt} = \frac{p_{id} - D_{ic}(p_{ic})}{D_{nt}} . \tag{A1.24}$$

Equation (A1.16) may be re-written as:

$$p_{ic} = \frac{z \, S_{kic}}{C} + \frac{\sigma_{kl} \, S_{lic}}{C} \, p_{id} ; \tag{A1.25}$$

where $C = \sigma_{kl} \, S_{lic} + \sigma^A \, M_m \, S_{kic}$.

An expression for p_{id} may be obtained by substituting equation (A1.23) into (A1.25) and rearranging as:

$$p_{id} = \frac{1}{E} \, [z \, D_{ic} \, S_{kic} + C \, D_{nt} \, p_{nt}] ; \tag{A1.26}$$

where $E = C - D_{ic} \, \sigma_{kl} \, S_{lic}$.

Equation (A1.21) may be used to eliminate p_{nt} from (A1.26), yielding:

$$p_{id} = \frac{z}{(E - C \, D_{nt})} \left[D_{ic} \, S_{kic} + \frac{C \, D_{nt} \, S_{knt}}{\sigma_{kl} \, S_{lnt}} \right] . \tag{A1.27}$$

Substituting equation (A1.27) into (A1.25) and rearranging gives:

$$p_{ic} = z\left[\frac{S_{kic}}{C} + \frac{S_{lic}}{(E - C\,D_{nt})}\left(\frac{\sigma_{kl}\,D_{ic}\,S_{kic}}{C} + \frac{S_{knt}}{S_{lnt}}\,D_{nt}\right)\right] . \qquad (A1.28)$$

A reduced form expression for x_{lic} may now be obtained by substituting equation (A1.28) into (A1.15) and rearranging:

$$x_{lic} = \frac{Z}{(E\text{-}C\,D_{nt})}\left[\frac{\sigma_{KL}}{C}(E - CD_{nt} - \sigma^{A}M_m\,S_{kic}\,D_{ic}) - \sigma^{A}\,M_m\,\frac{S_{knt}}{S_{lnt}}\,D_{nt}\right] . \qquad (A1.29)$$

Noting that,

$$E - CD_{nt} - S^{A}\,M_m\;S_{kic}\;D_{ic} = C\,D_m ,$$

expression (A1.29) may be simplified to:

$$x_{lic} = \frac{z}{(E - C\,D_{nt})}\left[\sigma_{kl}\,D_m - \sigma^{A}\,\frac{M_m\,S_{knt}}{S_{lnt}}\,D_{nt}\right] . \qquad (A1.30)$$

To obtain the reduced form expression for (x_{le}) equation (4) is substituted into (A1.4) giving:

$$x_{le} = -\frac{\sigma_{kl}}{S_{ke}}\,[\gamma q_e + p_{id}] . \qquad (A1.31)$$

Analogous to the import-competing and non-traded sectors, the activity level for the export sector may be expressed as:

$$q_e = S_{le}\;x_{le} , \qquad (A1.32)$$

and equation (A1.31) may be re-written as:

$$x_{le} = -\frac{\sigma_{kl}}{N}\;p_{id} ; \qquad (A1.33)$$

where $N = S_{ke} + \gamma\,\sigma_{kl}\;S_{le}$.

Substituting equation (A1.27) into (A1.33) and re-arranging yields:

$$x_{le} = -\frac{z}{N(E - C\,D_{nt})}\left[D_{ic}\,S_{kic}\,\sigma_{kl} + \frac{C\,D_{nt}\,S_{knt}}{S_{lnt}}\right] . \qquad (A1.34)$$

Finally, it is necessary to derive expressions for L_e , L_{nt} and L_{ic} , which are the shares in aggregate employment for the respective sectors. Note that:

$$L_j = \frac{X_{lj}}{\sum_j X_{lj}} \quad ; \qquad j \in (e, nt, ic) \qquad (A1.35)$$

where X_{lj} is the level of employment in the j^{th} sector. Also note that:

$$S_{lj} = \frac{P_l X_{lj}}{P_l X_{lj} + P_{kj} X_{kj}} \quad ; \qquad j \in (e, nt, ic) \qquad (A1.36)$$

where P_l , P_{kj} and X_{kj} are the price of labour, the price of capital and the amount of capital employed by the j^{th} sector. It follows then, that the coefficients in equation (19) are:

$$W_j = \frac{P_l X_{lj} + P_{kj} X_{kj}}{\sum_j P_l X_{lj} + \sum_j P_{kj} X_{kj}} \quad . \qquad j \in (e, nt, ic) \qquad (A1.37)$$

From equations (A1.35) - (A1.37) it is evident that:

$$L_j = \frac{X_{lj}}{\sum_j X_{lj}} = \frac{W_j S_{lj}}{\sum_j W_j S_{lj}} \quad . \qquad j \in (e, nt, ic) \quad (A1.38)$$

The aggregate employment elasticity with respect to domestic demand ($\eta_{l\,z}$) can now be derived by substituting equations (A1.20), (A1.30), (A1.34) and (A1.38) into (18) as follows:

$$\eta_{l\,z} = \frac{Z}{r}\left[W_{nt} + \frac{W_{ic}S_{lic}}{E - C\,D_{nt}}\left(\sigma_{kl}\,D_m - \frac{\sigma^A\,M_{icm}\,S_{knt}\,D_{nt}}{S_{lnt}} \right) - \frac{W_e S_{le}}{N(E - C\,D_{nt})} \left(D_{ic}S_{kic}\,\sigma_{kl} + \frac{C\,D_{nt}\,S_{knt}}{S_{lnt}} \right) \right] \quad ; \qquad (A1.39)$$

where $\qquad r = [W_e\ S_{le} + W_{nt}\ S_{lnt} + W_{ic}\ S_{lic}] \quad .$

Appendix Note 2

The Balance of Trade Effect and the Role of Indirect Taxes/ Subsidies

Whilst not explicitly modelled, indirect taxes and subsidies could also place a wedge between the W's and the D's and therefore impact upon the employment response. In section 2.3.1 it was shown that balanced trade in the three-sector model implies that:

$$P_m \ Q_m = P_l \ X_{le} + P_{ke} \ X_{ke} \quad . \tag{A2.1}$$

The introduction of a positive ad-valorem tax on the imported commodity means that:

$$(1 + T) \, P_m \ Q_m > P_l \ X_{le} + P_{ke} \ X_{ke} \quad .$$

Given the definitions of D_m and W_e (see section 2.3.1) , the above inequality implies that:

$$D_m > W_e \quad ,$$

$$D_{nt} < W_{nt} \quad ,$$

$$\text{and } \ D_{ic} < W_{ic} \quad .$$

These inequalities will be reversed if a positive ad-valorem tax is levied on the non-trading or import-competing commodity only. An ad-valorem subsidy will act in a manner analogous to a negative ad-valorem tax. Thus, a positive ad-valorem subsidy on both the non-trading and import competing commodities only, implies that:

$$D_m > W_e \quad ,$$

$$D_{nt} < W_{nt} \quad ,$$

$$\text{and } \ D_{ic} < W_{ic} \quad .$$

On the other hand, a positive ad-valorem subsidy on the export commodity only, means that:

$$D_m < W_e \quad ,$$

$$D_{nt} > W_{nt} \quad ,$$

$$\text{and } D_{ic} > W_{ic} \quad .$$

As a final note, if all commodities face a uniform ad-valorem tax/subsidy and trade is balanced then:

$$D_m = W_e \quad ,$$

$$D_{nt} = W_{nt} \quad ,$$

$$\text{and } \quad D_{ic} = W_{ic} \quad .$$

Appendix Note 3

The Employment Elasticity with the Terms-of-Trade, Factor-Share and Balance-of-Trade Effects Set to Zero:

The aggregate employment elasticity with respect to domestic demand is given by equation (17) as:

$$l = \eta_{l\,z}\, z \quad ; \tag{A3.1}$$

where

$$\eta_{l\,z} = \frac{1}{r}\left[W_{nt} + \frac{W_{ic}S_{lic}}{E - C\,D_{nt}}\left(\sigma_{kl}\,D_m - \frac{\sigma^A\,M_m\,S_{knt}\,D_{nt}}{S_{lnt}} \right) - \frac{W_e S_{le}}{N(E - C\,D_{nt})} \left(D_{ic}S_{kic}\,\sigma_{kl} + \frac{C\,D_{nt}\,S_{knt}}{S_{lnt}} \right)\right] \tag{A3.2}$$

and,

$$r = [W_e\ S_{le} + W_{nt}\ S_{lnt} + W_{ic}\ S_{lic}] \quad ,$$

$$C = \sigma_{kl}\ S_{lic} + \sigma^A\ M_m\ S_{kic} \quad ,$$

$$E = C - D_{ic}\ \sigma_{kl}\ S_{lic} \quad ,$$

$$N = S_{ke} + \gamma\,\sigma_{kl}\ S_{le} \quad .$$

The terms-of-trade, factor-share and balance-of-trade effects may be, respectively, set to zero by assuming that:

$$\gamma = 0 \quad ,$$

$$S_{lj} = S_{lk} \qquad\qquad j,\ k\ \varepsilon\ \{e,\ nt,\ ic\}\ j \neq k$$

and

$$D_m = W_e \quad .$$

Under the above assumptions, equation (A3.2) may be re-written as:

$$\eta_{lz} = \frac{1}{S_l}\left[W_{nt} + \frac{W_{ic}\,S_l}{[E - C\,W_{nt}]}\left(\sigma_{KL}\,W_e - \sigma^A\,M_m\,\frac{S_k W_{nt}}{S_l}\right)\right.$$

$$\left. - \frac{W_e\,S_l}{S_k[E - C\,W_{nt}]}\left(W_{ic}\,S_k\,\sigma_{kl} + \frac{C\,W_{nt}\,S_k}{S_l}\right)\right] \quad . \qquad \text{(A3.3)}$$

Since factor shares are identical across sectors there is no need to subscript these shares with respect to a particular sector.

Expanding equation (A3.3), making appropriate cancellations and rearranging yields:

$$\eta_{lz} = \frac{W_{nt}}{S_l\,[E - C\,W_{nt}]}\Big[E - C(1 - W_{ic}) - \sigma^A\,M_m\,S_k\,W_{ic}\Big] \quad .$$

(A3.4)

When the expressions for E and C are substituted into equation (A3.4), the term in the square brackets in the numerator reduces to zero. Thus, the employment elasticity represented by equation (A3.2) reduces to zero when the terms-of-trade, factor-share and balance-of-trade effects are set to zero.

Appendix Note 4

The Role of the Import-Competing Sector

In section 2.3.4 the role of the import-competing sector is analysed in the context of the balance-of-trade effect using equation (29) which is reproduced below as equation A4.1:

$$\eta_{lz} = \frac{1}{S_{le}} \left\{ W_{nt} + \frac{1}{[E - C\,D_{nt}]} \left[\sigma_{kl}\, S_{lic}(W_{ic}\, D_m - W_e\, D_{ic} - W_e\, D_{nt}) - \sigma^A\, M_m\, S_{knt}\, D_{nt}\,(W_{ic} + W_e) \right] \right\} \quad . \tag{A4.1}$$

where

$$[E - C\,D_{nt}] = \sigma_{kl}\;\; S_{lic}\;\; D_m \;+ \sigma^A\;\; M_m\;\; S_{kic}\,(D_{ic} + D_m) \;\; > 0 \quad .$$

Substituting the expression for $[E - C\,D_{nt}]$ into the numerator on the RHS of equation (A4.1), making appropriate cancellations and rearranging, yields:

$$\eta_{lz} = \frac{1}{[E - C\,D_{nt}]\, S_{lnt}} \left[\sigma_{kl}\, S_{lic}\,(D_m\, W_{nt} - W_e\, D_{nt} + W_{ic}\, D_m - W_c\, D_{ic}) + \sigma^A\, M_m\, S_{kic}\,(W_{nt} - D_{nt}) \right] \quad . \tag{A4.2}$$

Given that the expression $(E - (1)_{nt}]$ is positive, the employment elasticity represented by equation (A4.2) must be positive (negative) under conditions of a balance-of-trade deficit (surplus). When trade is balanced, equation (A4.2) reduces to zero. These results verify that the inclusion of the import-competing sector does not qualitatively change the results of section 2.3.1 (i.e., the balance-of-trade effect).

The introduction of the import-competing sector however, does affect the quantitative results of section 2.3.1. This may be illustrated by using equation (A4.2) to examine the impact that different values of the Armington elasticity σ^A have on the employment result. To simplify, let:

$$F = \sigma_{kl}\;\; S_{lic}\,(D_m\, W_{nt} - W_e\, D_{nt} + W_{ic}\, D_m - W_c\, D_{ic})$$

$$G = M_m\;\; S_{kic}\,(W_{nt} - D_{nt})$$

$$H = \sigma_{kl}\;\; S_{lic}\;\; D_m$$

$$I = M_m\;\; S_{kic}\,(D_{ic} + D_m) \quad ,$$

so that equation (A4.2) may be compactly expressed as:

$$\eta_{lz} = \frac{F + \sigma^A G}{(H + \sigma^A I)\, S_{lnt}} \quad . \qquad \text{(A4.3)}$$

Partially differentiating equation (A4.3) with respect to the Armington elasticity σ^A yields:

$$\frac{\partial \eta_{lz}}{\partial \sigma^A} = \frac{GH - IF}{S_{lnt}\, [H + \sigma^A I]^2} \quad ; \qquad \text{(A4.4)}$$

where

$$GH - IF = \sigma_{kl}\ S_{lic}\ M_m\ S_{kic}\ [D_m\,(W_{nt} - D_{nt})$$

$$- (D_{ic} + D_m)(D_m\ W_{nt} - W_e\ D_{nt} + W_{ic}\ D_m - W_e\ D_{ic})] \quad .$$
(A4.5)

Expanding expression (A4.5), making appropriate cancellations and rearranging yields:

$$GH - IF = \sigma_{kl}\ S_{lic}\ M_m\ S_{kic}\ [W_e\ D_{ic} - W_{ic}\ D_m - 2\, W_e\ D_m\ D_{nt}] \quad . \qquad \text{(A4.6)}$$

Under conditions of a trade deficit $W_e\ D_{ic}$, $W_{ic}\ D_m$ so that $GH - IF < 0$ (and vice versa for a trade surplus). Thus, the partial derivative of η_{lz} with respect to s^A will be negative (positive) depending on whether trade is in deficit (surplus).

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