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Tourism demand and wages in a general equilibrium model of production

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Rising foreign income increases tourism demand and wages if tourism is labour-intensive relative to capital. This paper adds a third factor of production, skilled labour or natural resources, to delve more deeply into the potential income redistribution in general equilibrium due to rising foreign income. In a small open economy producing tourism and an import competing good, the wage may fall in spite of the expanding tourism sector if capital is a technical complement with the third factor. A model including a traditional export is also examined, as is a specific factors version of the model. The possibility of a falling wage with expanding labour-intensive tourism relates to a number of policy issues in touristic countries.

Keywords: tourism demand; wages; skilled wages; general equilibrium model

Tourism is a substantial and growing export sector for many countries, a trend that promises to continue with rising global incomes. Given that tourism is labour intensive, there is a presumption that wages will increase as tourism expands. The present paper examines conditions that lead to falling wages including a third factor of production along with capital and labour. The choice of skilled labour as the third factor is motivated by issues of education and skilled versus unskilled labour income. The choice of natural resources as the third factor are motivated by issues of the environment and depletion.

Consider a small open competitive economy with neoclassical constant returns and full employment producing labour intensive tourism and an import competing good. First, assume only capital and labour inputs. Tourism demand is specified as a positive function of exogenous foreign income and a decreasing function of its endogenous price that clears the market. Downward sloping tourism demand and zero profit are consistent with monopolistic competition.

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Rising foreign income moves the economy up along the general equilibrium tourism supply curve. The wage increases with increased production of labour intensive tourism in the general equilibrium.

The present model adds a third factor of production to delve more into the potential income redistribution due to rising foreign income. The direction and size of the wage adjustment depend on substitution as well as factor intensity. If the third factor is intensive in production of the import competing good, rising foreign income lowers the price of the third factor as import competing production declines.

If capital and the third factor are technical complements in production, a rising capital return would lower the cost minimizing labour input. Labour would be a strong substitute for the third factor, implying its falling price leads to substitution away from labour. An increased capital return combined with a decreased price of the third factor can lead to a falling wage, a seeming paradox given labour intensive tourism.

The paper examines a three good version of the model including a traditional export that addresses export diversion. Short-term adjustment is examined in a specific factors version of the model with separate capital for the tourism and import competing sectors.

Literature on tourism and the general equilibrium of production

The present paper is a version of the competitive general equilibrium model of production with a non-traded good developed by Komiya (1967), Ethier (1972), Jones (1974) and Rivera-Batiz (1982b). The model with a non-traded good and international capital is developed by Michael (1992) and Thompson (1997). The theoretical effects of migration with a non-traded good are examined by Rivera-Batiz (1982a) and Thompson (1984). Demand for the non-traded good is a function of domestic income as well as its endogenous price that clears the market. In the present model, demand for tourism is a function of foreign income.

The underlying foundation is the comparative static factor proportions model of Jones and Scheinkman (1977), Chang (1979) and Takayama (1982) that formalizes the factor proportions model of a small open economy with two factors of production. The Stolper–Samuelson (1941) theorem examines factor price adjustments to exogenous prices of the two traded goods. In the present three factor model, rising foreign income increases the price of tourism leading to factor price adjustments that depend on substitution as well as factor intensity.

The three factor production structure is examined by Ruffin (1981), Jones and Easton (1983) and Thompson (1985, 1986, 1993). The present results would extend to factor proportions models with more factors and goods as developed by Chipman (1966), Uekawa (1971), Uekawa *et al* (1973) and Ethier (1974).

A falling wage in the present model would be due to capital as a technical complement with the third factor. The technical relationship between capital and skilled labour is a critical issue in labour economics, growth theory and macroeconomics examined by Brogan and Erickson (1975), Hamermesh (1987),

Krussel *et al* (2000) and Goldin and Katz (2008). The falling skilled wage boosts the demand for capital and reduces demand for substitute labour. The net effects can be a falling skilled wage, increased capital return and a falling wage even with expanding labour intensive tourism production.

The technical issue of capital and natural resources as substitutes versus complements is critical in resource and energy economics as well as economic growth. Berndt and Wood (1975) find energy a substitute for labour but a technical complement with capital in US manufacturing, while Griffin and Gregory (1976) find energy a substitute for both. Empirical results vary considerably in the energy literature as reviewed by Thompson (2006). The issue of capital as a substitute or complement with natural resources is at the core of fundamental issues in resource utilization and growth theory.

The theory of tourism trade is developed by Copeland (1991), Hazari and Ng (1993) and Forsyth and Dwyer (2002). Nowak *et al* (2003) show the wage unambiguously increases with expanding tourism in a three sector model although decreased output of the traditional export sector with increasing returns to scale may result in a net welfare loss. The present paper includes a traditional export with constant returns in a three sector version of the model. The net decrease in output of the rest of the economy is a concern in the literature exemplified by Adams and Parmenter (1995) and Zhou *et al* (1997).

The present paper relates directly to the dependency tourism model of Hazari and Sgro (2004). Their neoclassical model including production and utility maximization determines the level of trade. The dependency model assumes tourism is produced along with a traditional export that is not consumed, while the import is not produced. The positive link between labour intensive tourism and the wage holds due to production of two goods with two factors. In the present model with separate skilled labour, the neoclassical trade structure of the dependency tourism model would remain intact with a wider range of potential income redistribution due to rising foreign income.

The 3 × 2 tourism model

Competitive firms hire labour L, capital K and skilled labour or natural resources S to produce tourism x_T and an import competing good x_M. The price p_M of the import competing good is exogenous for the small open economy as are the three factor endowments. The endogenous wage w, capital return r, price s of the third input, outputs x_T and x_M, and tourism price p_T adjust to maintain full employment and competitive pricing. Both sectors are assumed viable in the diversified neoclassical small open economy with constant returns to scale production.

Tourism demand $D_T(p_T, F)$ is specified as a function of its price as well as exogenous foreign income F. Tourism production equals demand with the endogenous price adjusting to clear the market:

$$x_T = D_T(p_T, F). \tag{1}$$

Tourism services are consumed by domestic residents although utility maximization and trade are not included in the present production model.

Domestic income increases with foreign income due to the gains from specialization and trade. Including home income would strengthen results in the present model.

Full employment leads to the first three equations in the system (2) where primes indicate percentage changes. Changes in endowments of labour L, capital K and the third factor S are matched by changes in factor demands in the comparative static relations. Substitution elasticities σ_{ik} relate the input of factor i to the price of factor k. Constant returns production implies the cost minimizing unit inputs depends only on the endogenous wage w, capital return r and skilled wage s. Industry shares λ_{hj} indicate the proportion of factor h employed in sector j.

Competitive pricing leads to the next two equations in (2) where price changes are met with cost adjustments. Factor shares θ_{ij} indicate the proportion of sector j revenue paid to factor i. The stated conditions rely on the cost minimizing envelope property. $x_T^{'}$

The last equation in (2) is tourism market clearing where a change in demand is met by a change in supply. The price elasticity of tourism demand is $\varepsilon_T < 0$ and the foreign income elasticity $\varepsilon_F > 0$. Exogenous variables are collected on the right:

$$\begin{pmatrix} \sigma_{LL} & \sigma_{LK} & \sigma_{LS} & \lambda_{LT} & \lambda_{LM} & 0 \\ \sigma_{KL} & \sigma_{KK} & \sigma_{KS} & \lambda_{KT} & \lambda_{KM} & 0 \\ \sigma_{SL} & \sigma_{SK} & \sigma_{SS} & \lambda_{ST} & \lambda_{SM} & 0 \\ \theta_{LT} & \theta_{KT} & \theta_{ST} & 0 & 0 & -1 \\ \theta_{LM} & \theta_{KM} & \theta_{SM} & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & -\varepsilon_T \end{pmatrix} \begin{pmatrix} w^{'} \\ r^{'} \\ s^{'} \\ x_T^{'} \\ x_M^{'} \\ p_T^{'} \end{pmatrix} = \begin{pmatrix} L^{'} \\ K^{'} \\ S^{'} \\ 0 \\ p_M^{'} \\ \varepsilon_F F^{'} \end{pmatrix} \tag{2}$$

One pair of factors may be technical complements indicated by a negative cross price elasticity. Negative σ_{KS} and σ_{SK} would indicate capital is a technical complement with skilled labour/natural resources. A falling skilled wage/resource price then increases the cost minimizing unit input of capital. The rising capital return lowers the unit input of the third factor. Technical complements lead to a larger decrease in the price of the third factor and a larger increase in the capital return as the relative price and output of the import competing good decrease.

Homogeneity implies zero row sums in the substitution matrix, for instance $\sigma_{SS} = -(\sigma_{SL} + \sigma_{SK})$. If $\sigma_{SK} < 0$ then σ_{SL} would have to be strongly positive given convexity requires a negative σ_{SS}. Similarly, a negative σ_{KS} would be offset by a strongly positive σ_{KL}. Principle minors of the substitution matrix are positive, $M_{LL} \equiv \sigma_{KL}\sigma_{SL} + \sigma_{KL}\sigma_{SK} + \sigma_{KS}\sigma_{SL} > 0$, $M_{KK} \equiv \sigma_{LK}\sigma_{SL} + \sigma_{LK}\sigma_{SK} + \sigma_{LS}\sigma_{SK} > 0$ and $M_{SS} \equiv \sigma_{LK}\sigma_{KS} + \sigma_{LS}\sigma_{KL} + \sigma_{LS}\sigma_{KS} > 0$.

Factor intensity is described by $\lambda_{LK} \equiv \lambda_{LT}\lambda_{KM} - \lambda_{KT}\lambda_{LM}$, $\lambda_{KS} \equiv \lambda_{KT}\lambda_{SM} - \lambda_{ST}\lambda_{KM}$ and $\lambda_{LS} \equiv \lambda_{LT}\lambda_{SM} - \lambda_{ST}\lambda_{LM}$. Assume tourism is labour intensive relative to both capital and the third factor, $\lambda_{LK} > 0$ and $\lambda_{LS} > 0$, and capital intensive relative to the third factor $\lambda_{KS} > 0$. In a simpler way to state this intensity condition:

$$\lambda_{LT}/\lambda_{LM} > \lambda_{KT}/\lambda_{LM} > \lambda_{ST}/\lambda_{SM}. \tag{3}$$

Labour has the highest relative employment share in tourism, and skilled labour/natural resources in the import competing sector. The similarly defined factor intensity ranking also holds in terms of factor payment shares with the highest relative tourism factor share paid to labour and the highest relative import competing share to the third factor:

$$\theta_{LT}/\theta_{LM} > \theta_{KT}/\theta_{LM} > \theta_{ST}/\theta_{SM}. \tag{4}$$

The determinant Δ of Equation (1) is negative:

$$\Delta = -\varepsilon_T\Delta_{32} - \lambda_M < 0, \tag{5}$$

where Δ_{32} is the negative determinant of the underlying 3×2 model and $\lambda_M \equiv \lambda_{LM}M_{LL} + \lambda_{KM}M_{KK} + \lambda_{SM}M_{SS} > 0$. Cramer's rule leads to solutions for adjustments in endogenous w, r, s, x_T, x_M and p_T due to rising foreign income F holding L, K, S and p_M constant.

$x_T^{\prime}$

Adjustments to rising foreign income in the 3 × 2 model

Rising foreign income increases the price and output of tourism in general equilibrium along the production frontier:

$$p_T^{\prime}/F' = \varepsilon_F\Delta_{32}/\Delta > 0, \tag{6}$$

$$x_T^{\prime}/F^{\prime} = -\varepsilon_{FM}/\Delta > 0. \tag{7}$$

Figure 1 illustrates the increased tourism demand. Average cost increases up the general equilibrium supply curve S_{PPF} that tracks the production frontier. Adjustments in p_T and x_T increase in the income elasticity ε_F.

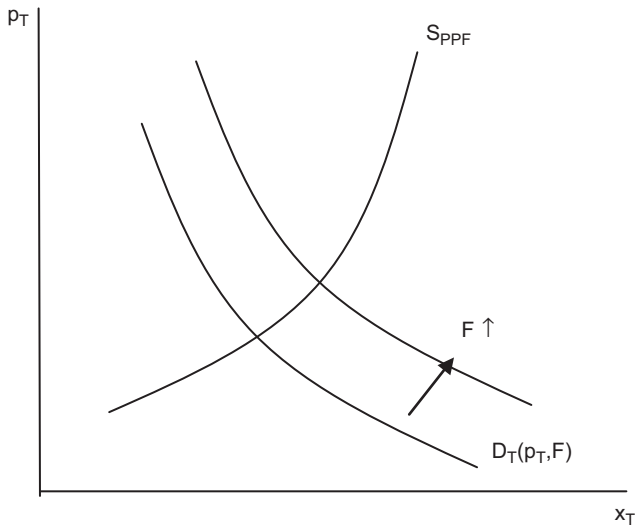

Figure 1. Rising foreign income F in the tourism market.

Import competing output falls along the production frontier given the fixed factor endowments as seen in:

$$x_M^{\prime}/F^{\prime} = \varepsilon_F(\lambda_{LT}M_{LL} + \lambda_{KT}M_{KK} + \lambda_{ST}M_{SS})/\Delta < 0. \quad (8)$$

The wage adjusts according to:

$$w^{\prime}/F^{\prime} = [\varepsilon_F(\lambda_{LK}(\theta_{KM}\sigma_1 + \theta_{SM}\sigma_2) + \lambda_{KS}(\theta_{KM}(\sigma_{LS} - \sigma_{KS}) + \theta_{SM}\sigma_3)]/\Delta, \quad (9)$$

where $\sigma_1 \equiv \sigma_{SS} - \sigma_{KS}$, $\sigma_2 \equiv \sigma_{KK} - \sigma_{SK}$ and $\sigma_3 \equiv \sigma_{KK} - \sigma_{LK}$. There is a presumption that $w^{\prime}/F^{\prime} > 0$ but a negative σ_{KS} and highly positive σ_{LS} favour a falling wage. The comparative static adjustments in r and s are similarly analysed with presumptions that $r^{\prime}/F^{\prime} > 0$ and $s^{\prime}/F^{\prime} < 0$ although the qualitative adjustments depend on substitution as well as intensity.

If capital is a technical complement relative to the skilled wage/resource price with a negative σ_{KS} then the falling skilled wage increases the cost minimizing unit input of capital. The demand for capital would increase more than if capital were a substitute for skilled labour. Labour would also be a strong substitute relative to the skilled wage/resource price leading to a large decrease in the unit input for labour. This substitution puts downward pressure on labour demand. A larger decrease in the price of the third factor and larger increase in the capital return favour a falling wage in Equation (9).

The negative σ_{KS} and σ_{SK} would also imply σ_1 and σ_2 in Equation (9) are closer to zero with less of a positive wage effect. The implied weak own substitution for both capital and the third factor would also favour σ_1, σ_2 and σ_3 closer to zero. The possibility of a falling wage in Equation (9) cannot be ruled out.

Total domestic factor income $Y = wL + rK + sS$ changes according to $Y^{\prime} = \theta_L w^{\prime} + \theta_K r^{\prime} + \theta_S s^{\prime}$ where θ_i is the share of factor i in income. With rising foreign income, the change in income is derived from $w^{\prime}/F^{\prime}$ in Equation (9) and similar solutions for $r^{\prime}/F^{\prime}$ and $s^{\prime}/F$. Domestic income increases consistent with the implicit gains from trade.

In the underlying 3 × 2 model an increase in the exogenous price of exports affects the factor price vector (w r s) in the familiar (+ + –) pattern as well as the present possibility of a falling wage in (– + –). Thompson (1985) shows the two other possible factor price adjustments across the range of factor intensity and substitution are (+ – –) and (+ – +) .

Figures 2 and 3 illustrate adjustments in the cost minimizing input mix. Figure 2 illustrates the two factor model with the increased tourism price. Isoquants represent unit values or one numeraire of each product. The wage w rises and the capital rent r falls in the two factor model.

Figure 3 illustrates possible unit isocost shifts in the present three factor model. The shifts based on substitution are a rising wage w and capital return r coupled with a declining skilled wage/resource price s. With technical complements, the larger decrease in the skilled wage/resource price and larger increase in the capital return are illustrated with a falling wage. Differences in shapes of isoquants with substitutes versus complements are subtle and maintain convexity.

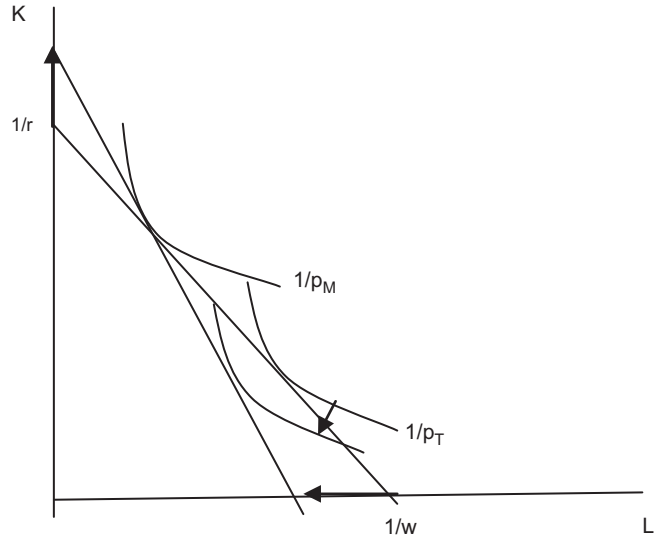

Figure 2. Rising foreign income in the *KL* cost minimization.

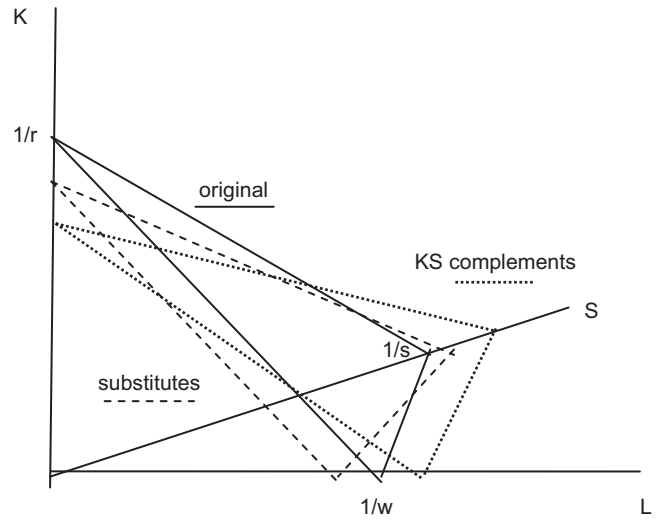

Figure 3. Unit isocost adjustments in the 3x2 tourism model.

Other general equilibrium models of tourism production

The tourism model with two inputs offers a straightforward comparative static solution. Eliminate the third factor column and row in the three factor model of Equation (2). The determinant of the 2 × 2 tourism model is:

$$\Delta_{LK} = -\varepsilon_T \Delta_{22} - (\lambda_{KT}\sigma_{LK} + \lambda_{LT}\sigma_{KL}) > 0, \tag{10}$$

where $\Delta_{22} > 0$ is the determinant of the underlying 2 × 2 Heckscher–Ohlin

model. Stronger substitution implies a larger Δ_{LK}. The price and output of tourism increase with rising foreign income:

$$p_T'/F' = \varepsilon_F\Delta_{22}/\Delta_{LK} > 0, \text{ and} \tag{11}$$

$$x_T'/F' = 2\varepsilon_F\theta_{KM}\lambda_{LM}(\sigma_{LK} + \sigma_{KL})/\Delta_{LK} > 0. \tag{12}$$

The wage rises:

$$w'/F' = \varepsilon_F\theta_{KM}\lambda_{LK}/\Delta_{LK} > 0, \tag{13}$$

while the capital return falls:

$$r'/F' = -\varepsilon_F\theta_{LM}\lambda_{LK}/\Delta_{LK} < 0. \tag{14}$$

Stronger substitution and weaker income elasticity diminish adjustments in the price of tourism and factor prices. This two factor model is the basis of intuition that expanding tourism raises the wage. Income $Y = wL + rK$ adjusts according to $Y'/F' = \varepsilon_F\lambda(\theta_K\theta_{LT} - \theta_L\theta_{KT})/\Delta_{LK}$ where θ_i is the factor share of income. Input ratios must span the endowment ratio for production in both goods implying the familiar condition $\theta_{KM}/\theta_{LM} > \theta_K/\theta_L > \theta_{KT}\theta_{LT}$. Domestic income rises with foreign income augmenting the effects of rising foreign income in the model.

The 3 × 3 model that adds a traditional export offers a simpler solution than the 3 × 2 tourism model in Equation (2). The role of substitution diminishes due to the same number of factors and goods. The factor income redistribution due to a rising foreign income depends only on factor intensity. Add a column and a row for the export X similar to the column and row for the import competing sector in Equation (1). The negative determinant of this 3 × 3 tourism model is:

$$\Delta_X = -\varepsilon_T\Delta_{33} < 0, \tag{15}$$

where Δ_{33} is the negative determinant of the underlying 3 × 3 model. Assume tourism is labour intensive relative to both other factors and sectors, exports are similarly capital intensive, and imports similarly skilled labour intensive. Rising foreign income then increases the wage regardless of substitution according to:

$$w'/F' = -\varepsilon_F\theta^X_{KS}\lambda_{33}/\Delta_X > 0, \tag{16}$$

where $\theta_{KS}{}^X \equiv \theta_{KX}\theta_{SM} - \theta_{KM}\theta_{SX} > 0$ and λ_{33} is the positive determinant of the industry share matrix. The capital return falls:

$$r'/F' = \varepsilon_F\theta^X_{LS}\lambda_{33}/\Delta_X < 0, \tag{17}$$

and the skilled wage/resource price rises:

$$s'/F' = -\varepsilon_F\theta^X_{LK}\lambda_{33}/\Delta_X > 0, \tag{18}$$

where θ^X_{LS} and θ^X_{LK} are defined similarly to θ^X_{KS}. This 3 × 3 tourism model relaxes

the assumption of the Hazari–Sgro (2004) tourism dependency model that the traditional export is not consumed and the import is not produced, and leads to the same neoclassical trade structure.

In a specific factors model with two goods and labour the only shared input, rising foreign income increases the return to tourism capital while the import competing capital return falls. The wage rises but perhaps not enough to offset the higher price level in the neoclassical ambiguity analysed by Ruffin and Jones (1977).

In the specific factors model adding a second shared factor, skilled labour or natural resources, Thompson (1989) shows the wage as well as the tourism capital return r_T might fall due to the potential of technical complements and strong substitution as in the 3×2 model. Possible adjustments in (w r_T s) to rising foreign income are the familiar (+ + –) as well as the falling wage in (– + +) and (– – +). An increase in the endowment of tourism capital lowers r_T and by reciprocity lowers tourism output in the (– – +) adjustment. Investors in tourism would be advised to avoid such situations.

Conclusion and related policy issues

Rising foreign income may decrease the wage in spite of the increased price and output of labour intensive tourism in a small open neoclassical economy with three factors of production. The decreased wage would be due to capital and the third factor as technical complements. The potential technical complements increases the range of adjustments in competitive economic models. As an example, when wages do not rise with expanding labour intensive production attention may too readily turns to market imperfections.

The possibility of a falling wage with expanding labour intensive tourism should be considered in a wide range of policy debates. Production and income distribution in touristic countries are affected by border, visa and tourist taxes as well as taxes and subsidies on imports and exports. The present model expands the theoretical foundation to analyse these issues.

The model including skilled labour can be applied to address issues of subsidies for education or training. The model with natural resources can address the effects of policies on the environment and depletion. Predictions of the effects of income, capital, corporate, and sales taxes in touristic economies should be based on a reliable structure of production. The present results suggest including a third factor of production with capital and labour to analyse these policy issues.

References

Adams, P., and Parmenter, B. (1995), 'An applied general equilibrium analysis of the economic effects of tourism in a quite small, quite open economy', *Applied Econometrics*, Vol 27, pp 985–994.

Bernt, E., and Wood, D. (1975), 'Technology, prices and the derived demand for labor', *Review of Economics and Statistics*, Vol 57, pp 376–384.

Brogan, R.D., and Erickson, E.W. (1975), 'Capital-skill complementarity and labor earnings', *Southern Economic Journal*, Vol 42, pp 83–48.

Chang, W. (1979), 'Some theorems of trade and general equilibrium with many goods and factors', *Econometrica*, Vol 47, pp 709–726.

Chipman, J. (1966), 'A survey of the theory of international trade: Part 3, the modern theory', *Econometrica*, Vol 34, pp 18–76.
Copeland, B. (1991), 'Tourism, welfare and industrialization in a small open economy', *Economica*, Vol 58, 515–529.
Ethier, W. (1972), 'Nontraded goods and the Heckscher–Ohlin model, *International Economic Review*, Vol 12, pp 357–366.
Ethier, W. (1974), 'Some theorems of international trade with many goods and factors', *Journal of International Economics*, Vol 4, 199–206.
Forsyth, P. and Dwyer, L. (2002), 'Market power and the taxation of domestic and international tourism', *Tourism Economics*, Vol 8, pp 377–399.
Goldin, C., and Katz, L. (2008), *The Race between Education and Technology*, Harvard University Press, Cambridge, MA.
Griffin, J., and Gregory, P. (1976), 'An intercountry translog model of energy substitution responses', *American Economic Review*, Vol 66, pp 845–857.
Hamermesh, D. (1987), 'The demand for labor in the long run', in Ashenfelter, O., and Larard, R., eds, *Handbook of Labor Economics*, Elsevier, Amsterdam, pp 429–471.
Hazari, B., and Sgro, P. (2004), *Tourism, Trade and National Welfare*, Elsevier, Amsterdam.
Hazari, B., and Ng, A. (1993), 'An analysis of tourists consumption of non-traded goods and services on the welfare of domestic consumers', *International Review of Economics and Finance*, Vol 2, pp 3–58.
Jones, R. (1974), 'Trade with non-traded goods: the anatomy of inter-connected markets', *Economica*, Vol 41, pp 121–138.
Jones, R., and Scheinkman, J. (1977), 'The relevance of the two sector production model in trade theory', *Journal of Political Economy*, Vol 89, pp 909–935.
Jones, R., and Easton, S. (1983), 'Factor intensities and factor substitution in general equilibrium', *Journal of International Economics*, Vol 15, pp 65–99.
Komiya, R. (1967), 'Non-traded goods and the pure theory of international trade', *International Economic Review*, Vol 8, 132–152.
Krussel, P., Ohanian, L., Ríos-Rull, J., and Violante, G. (2000), 'Capital-skill complementarity and inequality: a macroeconomic analysis', *Econometrica*, Vol 68, pp 1029–1053.
Michael, M. (1992), 'International factor mobility, non-traded goods, tariffs, and the terms of trade', *Canadian Journal of Economics*, Vol 25, pp 493–499.
Nowak, J., Sahli, M., and Sgro, P. (2003), 'Tourism, trade and domestic welfare', *Pacific Economic Review*, Vol 8, pp 45–58.
Rivera-Batiz, F. (1982a), 'International migration, nontraded goods and economic welfare in the source country', *Journal of Development Economics*, Vol 11, pp 81–90.
Rivera-Batiz, F. (1985b), 'Nontraded goods and the pure theory of international trade with equal numbers of goods and factors', *International Economic Review*, Vol 23, pp 401–409.
Ruffin, R. (1981), 'Trade and factor movements with three factors and two goods', *Economics Letters*, Vol 7, pp 177–182.
Ruffin, R., and Jones, R. (1977), 'Protection and real wages: the neoclassical ambiguity', *Journal of Economic Theory*, Vol 14, pp 337–348.
Stolper, W., and Samuelson, P. (1941), 'Protection and real wages', *Review of Economic Studies*, Vol 9, pp 58–73.
Takayama, A. (1982), 'On theorems of general competitive equilibrium of production and trade: a survey of some recent developments in the theory of international trade', *Keio Economic Studies*, Vol 19, pp 1–37.
Thompson, H. (1984), 'International migration, non traded goods, and economic welfare in the source country: a comment', *Journal of Development Economics*, Vol 86, pp 321–324.
Thompson, H. (1985), 'Complementarity in a simple general equilibrium model', *Canadian Journal of Economics*, Vol 17, pp 616–621.
Thompson, H. (1986), 'Free trade and factor price polarization', *European Economic Review*, Vol 30, pp 419 425.
Thompson, H. (1989), 'Do tariffs protect specific factors?' *Canadian Journal of Economics*, Vol 21, pp 406–412.
Thompson, H. (1993), 'The magnification effect with three factors', *Keio Economic Studies*, Vol 30, pp 57–64.
Thompson, H. (1997), 'International capital and nontraded goods in the long run', *International Review of Economics and Finance*, Vol 6, 379–390.

Thompson, H. (2006), 'The applied theory of energy substitution in production', *Energy Economics*, Vol 36, 410–425.

Uekawa, Y. (1971), 'Generalization of the Stolper–Samuelson theorem', *Econometrica*, Vol 39, pp 197–217.

Uekawa, Y., Kemp, M., and Wegge, L. (1973), 'P and PN matrices, Minkowski and Metzler matrices, and generalization of the Stolper–Samuelson and Samuelson Rybczynski theorems', *Journal of International Economics*, Vol 3, 53–76.

Zhou, D., Yanagida, J., Chakravorty, U., and Leung, P. (1997), 'Estimating economic impacts from tourism', *Annals of Tourism Research*, Vol 24, pp 76–89.