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Producer services, comparative advantage, and international trade patterns

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Abstract

We unite the theories of factor abundance and monopolistic competition to explore the general equilibrium relations between trade in producer services, economies of scale and factor markets. In our model, two final goods are produced using capital, labor, and a variety of differentiated producer services that are produced under increasing returns to scale. We analyze the implications for comparative advantage and trade in goods between two countries that differ in factor endowments and in technology of service provision. Moreover, we use the concept of the integrated world equilibrium to investigate trade in goods and services, also when services require foreign direct investments.

Key words: Heckscher–Ohlin model; Monopolistic-competition model; Producer services; Foreign direct investment

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1. Introduction

It has been widely recognized that services account for a large percentage of domestic production and labor employment in many economies of the world. Moreover, and despite difficulties with the measurement of international services flows, services also play an increasingly important role in international trade. Less documented, however, has been the fact that the growing importance of services in national economies is largely due to an increase in production of so-called producer services.[1] To gain cost advantages, manufacturing firms increasingly delegate intermediate-stage processing activities to specialized outside producers. These cost advantages can be achieved because outside producers are able to fully exploit scale economies by supplying producer services to several firms and are forced by market conditions to produce efficiently.

The possibility of large benefits through scale economies is especially present in the class of knowledge- and information-intensive producer services. To quote Markusen (1989, p. 85): 'Many producer services are both differentiated and knowledge-intensive. Knowledge intensity in turn suggests strong scale economies in that knowledge must be acquired at an initial learning cost, after which knowledge-based services can be provided at a very low marginal cost'. As such, the outsourcing of intermediate-stage processing activities can be seen as the incorporation of a knowledge- and information-intensive production factor in the production processes of final goods. Moreover, producer services are often specialized to the requirements of the buyer. Consequently, an economy's provision of producer services will consist of different varieties that are not only close substitutes of each other in terms of production technology, but also in demand.

Several papers have already investigated the consequences of incorporating producer services in international trade modeling. The central concern has been to deal with services as intermediates produced with constant returns to scale in either a Ricardo–Viner type model (Jones and Ruane, 1990) or a Heckscher–Ohlin type model (Hirsch, 1989; Melvin, 1989; Burgess, 1990; Djajic and Kierzkowski, 1989). In the context of producer services with increasing returns to scale, the literature is more scanty, though more appropriate. Markusen (1989), for instance, models two competitive sectors, one producing a final good by using capital and labor under constant returns to scale, the other generating a final good by costlessly assembling differentiated producer services. In a different set-up, Francois (1990) deals with a one-sector model in which producer services

[1] For a manifestation of this point, see, e.g., Grubel and Walker (1989), who show that in Canada producer services such as management consulting, data processing, financial services, etc, account almost entirely for the enormous rise in employment in the services sector. There is also a noted tendency for all countries to simultaneously increase production and eventually their trade of most categories of producer services (Summers, 1985).

coordinate the production process of differentiated final goods. Finally, Ishikawa (1992) considers production and trade patterns of a small open economy that produces two final goods by using labor and a homogeneous intermediate good that is produced under increasing returns to scale.

The purpose of this paper is to unite the factor-endowments theory of international trade with the Spence–Dixit–Stiglitz formalization of Chamberlinian monopolistic competition and to employ this model to systematically explore the general equilibrium relations between economies of scale, factor markets, and trade in goods and in services. The model consists of two sectors each producing a final good using physical capital, labor, and human capital.[2] Human capital is taken to consist of the costless assembling of differentiated producer services as in Markusen (1989). The features of producer services we highlight are therefore heterogeneity, scale economies (a fixed set-up cost and a constant marginal cost), and a monopolistically competitive market structure.[3] As such, the way in which we incorporate producer services into the analysis is analytically the same as the inclusion of intermediate goods, and our model thus partially resembles the intermediate inputs model of Helpman and Krugman (1985, Ch. 11). However, our approach differs in that we not only let both final goods sectors use physical capital and labor but in addition let services play a role in the production of both final goods. These two features, which make most existing models special cases of ours, allow us to reformulate the theory of trade in service products and enable us to go beyond the traditional positive analysis of international trade by including service related variables as additional determinants for two countries to trade in final goods. When discussing trade in services we do justice to the nature of services trade by not only considering trade in service products, but also by analyzing international services transactions that require a presence in the foreign country. We thereby focus on Foreign Direct Investment (FDI) as the mode by which services are provided abroad, and distinguish between FDI in services that requires the parent firm to make fixed and variable labor costs abroad, and FDI in services that only takes variable labor costs. This allows us to investigate the conditions under which the various modes of international services transactions lead to replication of the Integrated World Equilibrium.

The structure of the paper is as follows. Section 2 develops the model and specifies its underlying assumptions. Section 3 discusses autarkic equilibrium. Section 4 explains comparative advantage in goods and determines trade patterns when there is trade in goods only. Section 5 gives a graphical illustration of the trade equilibrium, discusses local stability and establishes the welfare effects of goods trade. Section 6 investigates trade patterns when countries trade in goods

[2] Human capital has repeatedly been shown to have empirical relevance in production functions, see Benhabib and Jovanovich (1991) or Mankiw et al. (1992).

[3] The non-storability aspect of services provision – also important for economic modeling of services – is rendered irrelevant by the static nature of our analysis.

and service products by means of the concept of the integrated world. We thereby focus on trade in service products. Section 7, in contrast, discusses international services transactions that require FDI. Section 8 concludes.

2. The model

Consider an economy in which the production of two final goods, X and Y, takes place using physical capital (K), labor (L) and human capital (H) under constant returns to scale:

$$Z = K_z^{\alpha_z} L_z^{\beta_z} H_z^{\delta_z} \tag{1}$$

for $Z = X, Y$ and where $\alpha_z + \beta_z + \delta_z = 1$ and α_z, β_z, and $\delta_z > 0$. Human capital refers to labor that has been trained to perform various knowledge- and information-related activities, and which can be obtained from specialized outside providers. The use of human capital in either sector is therefore modeled as the acquisition of a variety of differentiated producer services, S_j, which are imperfect substitutes for each other. More specifically:

$$H_z = \left[\sum_{j=1}^{n} S_{jz}^{\gamma} \right]^{\frac{1}{\gamma}} \tag{2}$$

where $0 < \gamma < 1$ is a positive monotone transformation of the elasticity of substitution (which equals $1/(1-\gamma)$). Hence the closer γ is to one the easier it is to substitute one type of producer service for another in the creation of human capital.

By using the Spence–Dixit–Stiglitz formalization of Chamberlinian monopolistic competition, which implies, for a given number of service firms, that the production of human capital exhibits constant returns to scale in individual differentiated service products, our approach generalizes important aspects of received theory on intermediates and producer services under increasing returns to scale.[4] First, note that our model reduces to the familiar Heckscher–Ohlin neoclassical model if neither final goods sector uses human capital ($\delta_x = \delta_y = 0$). Comparative advantage is then determined solely by capital intensities and factor abundance. Second, our model reduces to Krugman's (1979) variety model if both final goods sectors are identical and use only human capital [$\alpha_x = \alpha_y = \beta_x = \beta_y = 0$]. This can explain intra-industry trade in services. Third, the model reduces to Markusen (1989), which builds on Ethier (1982), if one final goods sector has human–capital related increasing returns to scale, and the other final goods sector has constant returns to scale with sector-specific capital ($\alpha_x = \beta_x = \delta_y = 0$). Fourth,

[4] This literature usually, but not always, uses specific functional forms, as we do.

and finally, the model reduces to Ishikawa (1992) if there is only one variety and no physical capital ($\alpha_y = \alpha_x = 0$ and $n = 1$).

The production of services is characterized by increasing returns to scale and requires the use of labor only. Scale economies follow from the existence of a fixed set-up cost $F > 0$ (in terms of labor) which is identical for all firms. There is also a constant marginal cost b associated with the production of services.[5] Hence:

$$F + bS_j = L_j \qquad j = 1,\dots n \tag{3}$$

for $S_j > 0$. Note that the production of each variety is limited to at most one firm, charging the price v_j, as it is always profitable to produce a slightly different variety rather than to share one's market with another firm. Each firm offers its service to both final goods sectors, so that

$$S_j = S_{jx} + S_{jy} \qquad j = 1,\dots,n \tag{4}$$

The amount of physical capital K and labor L available to the economy is assumed to be in inelastic supply. Full employment of these factors requires:

$$K_x + K_y = K \tag{5}$$

$$L_x + L_y + \sum_{j=1}^{n} L_j = L \tag{6}$$

It is clear by Eq. (6) that as service production requires labor, the labor supply to the final goods sectors is no longer inelastic with respect to variations in factor rewards.

The producers of final goods maximize profits by varying the inputs, thereby taking the number of service firms n, the prices of X and Y, the wage w, the rental rate r, and the price v_j as given, subject to the production functions in Eq. (1). The outcome is that, if there are many service varieties, the price elasticity of demand for service S_{jz} is $\varepsilon = 1/(1-\gamma) > 1$.[6] For the producer of variety j, and by symmetry for all other firms as well, profit maximization amounts to equating marginal revenue and marginal cost:

[5] The assumption that the provision of services takes labor only can be taken as a stylized representation of the generally accepted notion that knowledge- and information-related services are labor intensive relative to final goods production. See, for instance, Bhagwati (1984), Markusen (1989), Ishikawa (1992).

[6] To see this, define the service price index $\underline{V}$ as follows: $\underline{V} = [\Sigma_{j=1}^{n} v_j^{-\gamma\varepsilon}]^{-1/\gamma\varepsilon}$. Then $S_{jz} = \delta Z \underline{V}^{\varepsilon} v_j^{-\varepsilon}$ follows directly from the first order conditions of profit maximization in sector Z. Thus, if service firm j ignores the indirect effects of its price change in sector Z through a change in the average service price level and production, as it would if the number of varieties is large, its price elasticity of demand in sector Z equals ε. Since this holds for both final goods sectors its average price elasticity of demand is also ε. See Dixit and Stiglitz (1977, pp. 298–299) for a further discussion of this approximation. Moreover, and as customary, we ignore the integer constraint on n.

$$(1-1/\varepsilon)\nu_j = \gamma\nu_j = bw \qquad j=1,\ldots,n. \tag{7}$$

As a consequence, for a given wage, all suppliers of producer services charge the same price $\nu = bw/\gamma$ and sell the same quantity of services. Making use of this information in the first order conditions for profit maximization for producers of X and Y we obtain:

$$k_z \equiv K_z/L_z = (\alpha_z/\beta_z)\omega \tag{8}$$

$$L_z/nS_{jz} = (\beta_z/\delta_z)b/\gamma \tag{9}$$

where ω is the wage–rental ratio (w/r). While the sectoral capital–labor ratios react to changes in the relative factor price ω, the sectoral labor–services ratio is constant. The latter derives from the constant mark-up over marginal cost in Eq. (7) and implies that, if for some reason profit opportunities in the X or Y sector lead to an increase in labor demand, the total demand for services will rise equiproportionally.

Eq. (8) and Eq. (9) enable us to calculate the minimum production cost of one unit of X and Y, at given factor prices. In a competitive economy this cost cannot be smaller than the value of one unit of the respective goods:[7]

$$(\alpha_z^{-\alpha_z}\beta_z^{-\beta_z}\delta_z^{-\delta_z})r^{\alpha_z}w^{\beta_z}\nu^{\delta_z}n^{-\delta_z/(\varepsilon-1)} \geq P_z \text{ with equality if } Z>0 \tag{10}$$

In the following we will take good Y as the numéraire, $P_y = 1$, and denote the relative price of X, that is P_x/P_y, by p. Obviously, with strict inequality, the cost of producing one unit of the good exceeds its price and the good in question is not produced. Note from Eq. (10) that an increase in the number of services, ceteris paribus, lowers the cost of producing one unit of a good. As such, an increase in n is a positive externality to final goods firms (Markusen and Melvin, 1981). In other words, firms gain by delegating to outside service providers activities that were formerly performed in-house.

When equality holds, Eq. (10) provides a relation between the relative price of good X, the number of service varieties and the relative factor price that ensures the simultaneous production of both goods:

$$n = Bp^{-\theta}\omega^{\eta} \tag{11}$$

with $B = [\alpha_y^{-\alpha_y}\beta_y^{-\beta_y}\delta_y^{-\delta_y}\alpha_x^{\alpha_x}\beta_x^{\beta_x}\delta_x^{\delta_x}b^{-(\delta_x-\delta_y)}\gamma^{\delta_x-\delta_y}]^{-\theta} > 0$, $\theta = (\varepsilon-1)/(\delta_x-\delta_y)$ and $\eta = (\alpha_y - \alpha_x)\theta$. We will henceforth refer to Eq. (11) as the relative cost equation R.

Firms, offering a new type of service, will enter the market until (excess) profits vanish. Combining this notion with the production function of services Eq. (3)

[7] Note that the left-hand-side of Eq. (10) is in fact the standard unit cost function belonging to a Cobb–Douglas production function. This becomes clear when one rewrites the left-hand-side of Eq. (10) as $(\alpha_z^{-\alpha_z}\beta_z^{-\beta_z}\delta_z^{-\delta_z})r^{\alpha_z}w^{\beta_z}\underline{V}^{\delta_z}$ with $\underline{V}$ being the service price index as defined in footnote 6.

leads to the zero-profit condition Eq. (12) below. By implementing the constant mark-up rule, it then follows that in equilibrium the level of production of an individual services firm is constant, see Eq. (13). As this gives $L_j = \varepsilon F$ as the amount of labor per variety of services, total labor employment by the service industry is as given in Eq. (14). Using this and the sectoral capital–labor ratios of Eq. (8) in the full employment conditions Eq. (5) and Eq. (6), the latter reduce to Eq. (15):

$$\nu S_j = wL_j = w(F + bS_j) \qquad j = 1,\dots n \tag{12}$$

$$S_j = (\varepsilon - 1)F/b \qquad j = 1,\dots n \tag{13}$$

$$n\varepsilon F = nF + nbS_j = nF + \gamma(\delta_x/\beta_x)L_x + \gamma(\delta_y/\beta_y)L_y \tag{14}$$

$$[(1-\alpha_x)/\beta_x]L_x + [(1-\alpha_y)/\beta_y]L_y = L$$

$$(\alpha_x/\beta_x)L_x + (\alpha_y/\beta_y)L_y = K/\omega \tag{15}$$

Solving Eq. (15) for L_x and L_y in terms of ω, K and L and substitution in Eq. (14) gives a relation between the number of service varieties in the economy and the wage–rental ratio, for which there is full employment and no entry in the services sector:

$$n = (E_1 L - E_2 K/\omega)/\varepsilon F; \tag{16}$$

with $E_1 = (\delta_x\alpha_y - \delta_y\alpha_x)/(\alpha_y - \alpha_x)$ and $E_2 = (\beta_y\delta_x - \beta_x\delta_y)/(\alpha_y - \alpha_x)$. This is the second relation between n and ω, and we will refer to it as the no-entry equation E. When combined with the relative cost equation, it solves for n and ω as a function of p, K, L, F and b.

The model also determines the economy's division of labor over the final goods sectors and the service sector. To see this, we define an industrial capital–labor ratio k, as opposed to the factor endowments ratio (K/L) and the sectoral capital–labor ratios k_x and k_y, as $k \equiv K/(L - nL_j)$. By substitution of the solutions to Eq. (15), we obtain:

$$k = \frac{K(\alpha_y - \alpha_x)}{(\alpha_y\beta_x - \alpha_x\beta_y)L + (\beta_y\delta_x - \beta_x\delta_y)K/\omega} \tag{17}$$

which is a function of ω, K and L. It is clear from Eq. (17) that as long as K and L are fixed, a change in k can only be caused by a change in ω and, hence, in nL_j. It thus measures the input substitution of service labor for industry labor in the production process, with an increase in k reflecting a larger proportion of service workers in a country's labor force.

3. Autarky

To determine the autarkic equilibrium, assume Cobb–Douglas preferences and denote the fixed share of income spent on the purchase of good Z by μ_z.[8] For future reference define the demand weighted factor intensities $\pi = \Sigma_z \mu_z \pi_z$, for $z = x, y$ and $\pi = \alpha, \beta, \delta$. The supply of good X (X^s) can be written as a function of ω by using the first order conditions for profit maximization, the relative cost equation, and the solution for L_x from Eq. (15):

$$X^s(\omega) = C(\omega, n)[\alpha_y L - (1 - \alpha_y)K/\omega]/(\alpha_y - \alpha_x) \tag{18}$$

with $C(\omega, n) \equiv [\gamma^{\delta_x} b^{-\delta_x} \alpha_x^{\alpha_x} \beta_x^{\beta_x} \delta_x^{\delta_x} n^{\delta_x/(\varepsilon-1)} \omega^{\alpha_x}]$. Similarly, the demand for good X (X^d) can be written as a function of ω, using the definition of factor income ($wL + rK$):

$$X^d(\omega) = \mu_x(wL + rK)/p = C(\omega, n)\mu_x(L + K/\omega) \tag{19}$$

The autarkic equilibrium can be obtained by equating supply and demand, i.e., $X^s(\omega) = X^d(\omega)$. Note that although the slopes of demand and supply of X as a function of ω depend on the size of the various parameters, demand is upward sloping when supply is downward sloping and demand is downward sloping when supply is upward sloping[9]. The autarkic wage–rental ratio ω_a this yields can be used to sequentially determine the autarkic number of firms n_a (from Eq. (16)), the autarkic price p_a (from Eq. (11)), and the production levels of good X and Y by using Eq. (19) and the income-spending identity. The results are given in Eqs. (20–23).

$$\omega_a = [(1 - \alpha)/\alpha](K/L) \tag{20}$$

$$n_a = \frac{\delta}{1 - \alpha} \frac{L}{\varepsilon F} \tag{21}$$

$$Z_a = \Omega_z b^{-\delta_z} F^{-\delta_z/(\varepsilon-1)} K^{\alpha_z} L^{[(1-\alpha_z)+\delta_z/(\varepsilon-1)]}; \quad Z = X, Y \tag{22}$$

[8] We impose structure on the demand side of the model to keep the results analytically tractable. Our solution method can be modified to investigate general homothetic preferences, though. When preferences are homothetic, μ_x in Eq. (19) will vary with p. Treating μ_x as fixed for the moment we can determine the autarky ω as a function of μ_x, as in Eq. (20), and subsequently determine the autarky value of p. Obviously, the p thus found should be consistent with $\mu_x(p_a)$ and the procedure will have to be repeated until equilibrium is achieved. Whereas the solution method for general homothetic preferences is thus easy to compute, it at the same time precludes analytical results.

[9] The first derivative with respect to ω of X^s equals $[C(\omega, n)/(\omega(\alpha_y - \alpha_x))][\alpha_x \alpha_y L + (1 - \alpha_x)(1 - \alpha_y)K/\omega]$ which is positive if $(\alpha_y - \alpha_x) > 0$. The first derivative of X^d with respect to ω equals $[C(\omega, n)\mu_x/\omega][\alpha_x L - (1 - \alpha_x)K/\omega]$ and by solving Eq. (18) for L_x and L_y it follows that the expression between brackets is always positive if both goods are produced. Hence, if $(\alpha_y - \alpha_x) > 0$, X^d is downward sloping whereas X^s is upward sloping (and vice versa if $(\alpha_y - \alpha_x) < 0$).

$$\frac{\mu_y}{\mu_x} p_a \equiv \frac{X_a}{Y_a} = \Omega\left(\frac{1}{b}\right)^{(\delta_x-\delta_y)}\left(\frac{L}{F}\right)^{\frac{(\delta_x-\delta_y)}{(\varepsilon-1)}}\left(\frac{K}{L}\right)^{(\alpha_x-\alpha_y)} \tag{23}$$

with $\Omega_z = \mu_z \alpha_z^{\alpha_z} \beta_z^{\beta_z} \delta_z^{\delta_z} \alpha^{-\alpha_z}(1-\alpha)^{-(1-\alpha_z)} \gamma^{\delta_z}[(1-\gamma)\delta/(1-\alpha)]^{\delta_z/(\varepsilon-1)} > 0$; $\Omega = \Omega_x/\Omega_y$.

Several points characterize the equilibrium as contained in Eqs. (20–23). First, we note that the autarkic wage–rental ratio is unique and depends only on α (the demand-weighed capital intensity) and on the relative factor supplies. Moreover, as ω_a increases in the capital–labor ratio, Eq. (20) establishes a one-to-one relationship between the physical definition and the price definition of relative factor abundance. The explanation for this fact goes back to the fixed mark up over marginal labor cost in services production which establishes a constant relation between services input and labor input in final goods production. Second, the autarkic number of services firms n_a is for a large part determined by the absolute size of the population, rendering the stock of physical capital irrelevant. A decrease in the fixed cost F increases n_a – it becomes easier to start a firm – whereas an increase in γ (which amounts to an increase in the elasticity of substitution) decreases the number of firms through a reduction in the mark-up of price over marginal costs. Moreover, the autarkic number of services firms is always in between the two points of complete specialization, which can be obtained by putting $L_x = 0$ ($L_y = 0$) in Eq. (15) and substituting the resulting value for L_y (L_x) in the no-entry Eq. (16). As this yields $n^z = \delta_z \varepsilon L/(1-\alpha_z)F$, with n^z representing the value for n if the economy completely specializes in Z ($Z = X, Y$), it follows that n_a always lies in between n^x and n^y. Third, from Eq. (22) we see that the production levels of X and Y are sophisticated functions of the national endowments K and L, the fixed and marginal costs of services production b and F, and the share of income spent on good X, as well as several other parameters. Yet, by making use of the income-spending identity, as we did with respect to Eq. (23), we get an expression for the autarky price p_a that gives clear insight into the determinants of comparative advantage and trade patterns. Eq. (23) then provides the basis for the analysis we conduct in the next section. Finally, it is worth noting that Eq. (22) also settles the welfare effects of an incremental technology change in the services sector. The result derives directly from $\partial Z_a/\partial b = -\delta_z Z_a/b < 0$ and $\partial Z_a/\partial F = -\delta_z Z_a/F(\varepsilon-1) < 0$, for $Z = X, Y$. The adoption of a superior technology in the services industry, that is a lower marginal cost of production b and/or a lower fixed cost F, unambiguously increases both X_a and Y_a, which constitutes a welfare improvement in autarky.

4. Comparative advantage and trade in goods

This section uses the autarky equilibrium to investigate comparative advantage and to determine the trade pattern if services are not traded. In particular, we will ask whether it is Heckscher–Ohlin's factor-abundance or Krugman's variety-intensity that determines comparative advantage for final goods.

To streamline the analysis, and without loss of generality, we will henceforth assume that for all wage–rental ratios good Y is more capital-intensive than good X in a direct sense, that is we assume $\alpha_y/\beta_y > \alpha_x/\beta_x$, see Eq. (8). The phrasing we use to define relative capital intensity deviates from standard trade terminology in that we add direct. We do so because goods can also be earmarked capital-intensive based on the use of capital relative to labor and services. Since services can be referred to as indirect labor, we thus call good Y relatively capital-intensive in a direct plus indirect sense iff $\alpha_y > \alpha_x$. All other intensity combinations are referred to in the following straightforward manner: good Y is relatively service intensive iff $\delta_y > \delta_x$; good Y is service to labor intensive iff $\delta_y/\beta_y > \delta_x/\beta_x$; good Y is service to capital intensive if $\delta_y/\alpha_y > \delta_x/\alpha_x$, and so on.[10]

Our simple framework then provides a remarkably straightforward answer to the question of what determines comparative advantage and trade patterns in goods. It is summarized in Proposition 1.

Proposition 1 (endowments). Suppose good Y is capital intensive in a direct sense. Then Home will produce relatively more of good Y at a lower relative price in autarky than Foreign, and will therefore export good Y under Walrasian stability, if, other things being equal:

(i) Home has a larger capital stock and good Y is capital intensive in a direct plus indirect sense, i.e., $\alpha_y > \alpha_x$;

(ii) Home has a larger labor force and $(\alpha_y - \alpha_x) < (\delta_y - \delta_x)/(\varepsilon - 1)$.

The proof of Proposition 1 follows from Eq. (23). Suppose, for example, that Home has a larger capital stock than Foreign. The production level of both final goods in autarky is higher in Home than in Foreign, see Eq. (22). However, the production level of good Y rises relative to the production level of good X if, and only if, good Y is capital intensive relative to good X in a direct plus indirect sense ($\alpha_y > \alpha_x$). From Eq. (23) it then follows that the relative price of good X is higher in Home than in Foreign.

Proposition 1.(i) shows that Heckscher–Ohlin's factor-abundance approach (in

[10] Capital-intensity in a direct-plus-indirect sense is analytically defined by $K_z/(L_z + nL_{jz})$ and is unambiguously related to the notion of capital-intensity in a direct sense. To see this, assume that the labor a services firm uses to provide services for z is proportional to the share of S_z in total services production, that is assume $L_{jz}/L_j = S_{jz}/S_j$, which in zero-profit equilibrium implies $S_{jz} = (\gamma/b)L_{jz}$. Using this in the FOC of profit maximization as given by Eq. (9), we know that $nL_{jz}/L_z = \delta_z/\beta_z$ and the capital to direct-plus-indirect-labor ratio becomes $(1 + \delta_z/\beta_z)^{-1}[K_z/L_z]$. Using Eq. (8) we obtain $\alpha_z/(1 - \alpha_z)\omega$. Hence good Y is capital-intensive in a direct plus indirect sense iff $\alpha_y > \alpha_x$.

a direct plus indirect sense) explains the comparative advantage of nations based on differences in the capital stock. However, Proposition 1.(ii) shows that both capital-intensity and relative services-intensity play a role in determining comparative advantage based on differences in the size of the work force. Thus the relatively labor abundant country can export the capital intensive good *Y*, provided this good is also sufficiently services intensive. The dual role of labor in this respect is made clear in Eq. (22), where $L^{1-\alpha_z}$ refers to the factor-abundance effect and $L^{\delta_z/(\varepsilon-1)}$ refers to the variety externality effect. Note finally that once the sectoral services intensities are equal, i.e. $\delta_x = \delta_y$, comparative advantage can be fully explained by the standard Heckscher–Ohlin type of reasoning. The relative price of *X* then becomes independent of services related variables and only depends on the capital–labor endowment.

The variety approach also explains comparative advantage when countries differ in services technology only. This is summarized in Proposition 2.

Proposition 2 (service technology). Home will produce relatively more of good X at a lower price in autarky than Foreign, and will therefore export good X under Walrasian stability, if, other things being equal, Home has a superior service production technology (lower marginal and/or fixed cost) and good X is relatively services intensive, i.e., $\delta_x > \delta_y$.

The proof of Proposition 2 is analogous to that of Proposition 1 and follows from Eq. (23).

5. Graphics, stability and welfare

The conclusions derived in the previous section on trade in goods and comparative advantage can be illustrated in (ω, n) space using the relative cost equation *R* and the no-entry equation *E* that were introduced in Section 2, see Eq. (11) and Eq. (16). This procedure simultaneously points at some complications which were momentarily swept under the rug in the previous section. For concreteness, we will analyze a situation in which the constants θ, η, E_1 and E_2 in Eq. (11) and Eq. (16) are all positive. Think of good *Y* as steel production, which unambiguously uses physical capital intensively, and of good *X* as the computer industry, which unambiguously uses human–capital intensively.[11]

[11] To simplify the discussion we momentarily assume that good *Y* is capital-intensive relative to good *X*, both in a direct sense and in a direct plus indirect sense, i.e., $\alpha_y/\beta_y > \alpha_x/\beta_x$ and $\alpha_y > \alpha_x$. Moreover, we assume that good *X* is services intensive relative to good *Y* ($\delta_x > \delta_y$) and relative to labor ($\delta_x/\beta_x > \delta_y/\beta_y$). In an earlier version of this paper, we refer to this situation as Case 1, and analyze three more cases. Knife-edge situations such as $\delta_x = \delta_y$, resulting in a vertical relative cost equation, and $\delta_x/\beta_x = \delta_y/\beta_y$, resulting in a horizontal no-entry equation in Figs. 1 and 2, were excluded from this analysis. See van Marrewijk et al. (1993) for further details.

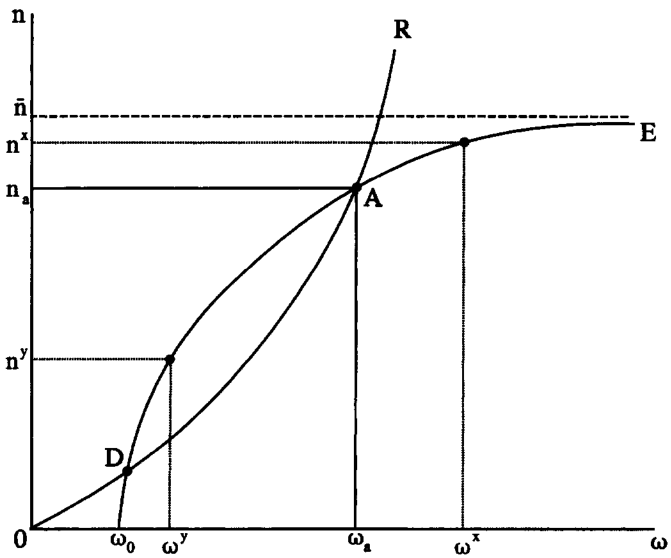

Fig. 1. The production structure.

The situation is graphically represented in Fig. 1, which depicts the relative cost equation R and the no-entry equation E in (ω, n)-space. The E-curve is positively sloped since $E_1>0$ and $E_2>0$, and tends towards an asymptotic number of firms $\bar{n}$ as ω approaches infinity.[12] Any n that lies above the no-entry curve means losses to services firms, and firms therefore exit the industry until the situation of zero profits has been re-established. A similar but opposite reasoning holds for any n below the E-curve. The positive slope of the R-curve[13] can be understood as follows. If, for given n and p, the wage rate goes up, it follows that the cost of producing X increases by more than for Y. To restore relative cost equilibrium, good X should therefore face a sharper decline in costs, which is accomplished by an increase in n due to the difference in services intensity $(\delta_x > \delta_y)$.

The intersection of the no-entry curve with the relative cost curve gives the equilibrium solution(s) for n and ω. The autarky price level cannot be directly obtained from Fig. 1 as it is only implicitly present. To see this, recall that the R-curve gives the combinations of ω and n for which both goods are produced for some price level. As such, the price belonging to the R-curve as drawn in the

[12] The point of intersection of the no-entry equation with the horizontal axis, ω_0 say, equals $[(\beta_y\delta_x - \beta_x\delta_y)/(\alpha_y\delta_x - \alpha_x\delta_y)](K/L)$, which is positive and increasing in the national capital–labor ratio. If ω approaches infinity the number of firms approaches an asymptotic value $\bar{n}$ that equals $[(\alpha_y\delta_x - \alpha_x\delta_y)/(\alpha_y - \alpha_x)][L/F\varepsilon]$.

[13] The convex shape has been chosen for expository reasons, as the second derivative of the relative cost equation with respect to ω can have either sign.

figure must be the equilibrium price level. As is clear from the figure, the relative cost equation either intersects the no-entry equation twice (at the points A and D) or not at all: a sufficiently large decrease in p would indeed rotate the relative cost equation counterclockwise around the origin until no intersection with the no-entry equation occurs.[14]

The problem of potential multiplicity did not show up in our earlier analysis, and we have to investigate which equilibrium, A or D, is the stable one. Propositions 1 and 2 use Walrasian stability of the goods market only, and thus implicitly assume instantaneous clearing of the market for services. A more satisfactory dynamic approach is to analyze sluggish adjustment in both markets, i.e., to assume that n and p adjust over time as a function of, respectively, excess profits in the services sector and excess demand in the goods markets. In the appendix we show that in such a case local stability is assured if the number of services available exceeds some threshold level $\tilde{n}$.

While referring to the appendix for details, graphically $n > \tilde{n}$ translates into a condition that selects which of the two equilibria in Fig. 1 is the autarky one. It states that the stable equilibrium is the point at which the slope of the R-curve is steeper than the slope of the E-curve, which is the case at point A. Empirically, $n > \tilde{n}$ can be translated into a threshold for the share of the labor force employed in the service industry. It follows that if two countries have identical tastes and technology, but differ in factor endowments, their economies in autarky are characterized by the same type of equilibrium. Moreover, stability is guaranteed when the role of producer services is more or less the same across sectors, that is when δ_y approaches δ_x.

The graphical representation of the equilibrium can also be used to illustrate what happens when two countries start to trade in goods. This is accomplished in Fig. 2, where we consider an endowment situation in which Foreign's capital stock is larger than Home's, that is we assume $K^* = \lambda K$ with $\lambda > 1$. An asterisk denotes variables in Foreign, so that E^* and R^* respectively reflect the no-entry and relative cost curves of Foreign. With all other parameters and exogenous variables being the same in both countries, thus including labor endowments, both countries have the same number of services firms in autarky, $n_{\mathrm{a}}^* = n_{\mathrm{a}}$. Relative prices differ though as $\omega_{\mathrm{a}}^* = \lambda\omega_{\mathrm{a}} > \omega_{\mathrm{a}}$ and $p_{\mathrm{a}}^* = \lambda^{(\alpha_y - \alpha_x)} p_{\mathrm{a}} > p_{\mathrm{a}}$, i.e., Foreign's autarky price of good X exceeds home's.

If the two countries open up to trade in goods it follows that the labor abundant domestic country will export the service intensive good X, see Proposition 1.(i). With a single world commodity price, the relative cost-curve is common to both countries (R_e) and the factor price ratios are determined as in Fig. 2 by the intersection of R_e with the E- and E^*-curves. The equilibrium wage–rental ratios are ω_e and ω_e^* with $\omega_e > \omega_e^*$. Given this, any world price that lies in between the

[14] Note that as drawn point D in Fig. 1 is not a viable equilibrium as it falls outside the range of incomplete specialization $[n^y, n^x]$. See Section 3 for the analytic expression of n^y and n^x.

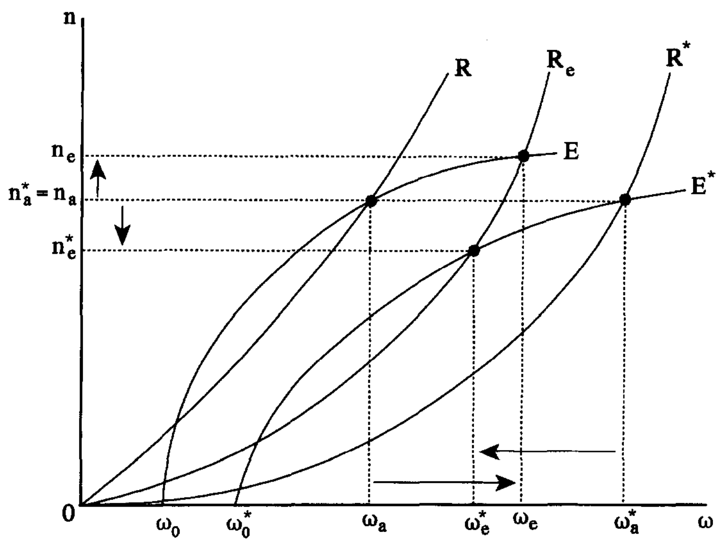

Fig. 2. Differences in capital–labor ratios.

two autarkic prices will not lead to factor price equalization, but instead to factor price reversal. As home exports the service intensive good X, it also needs a larger number of services than the foreign country. The role of the service sector thus becomes more important in the labor abundant domestic country whereas it becomes less important in the capital abundant foreign country. A uniform relative price then implies that the wage–rental ratio at home must exceed that of abroad and factor price reversal has occurred.[15]

We now address the question whether both countries can gain from trade in goods. As we will show, the country that faces an increase in services production unambiguously gains from goods trade, whereas the country that witnesses a decline in services production may lose from such trade. As such, our findings are in line with the result that in the context of scale economies welfare effects are closely related to the effects on production of the good that incurs economies of scale, see, e.g., Markusen (1989).

We make our point graphically in (n, ω)-space. First we derive utility as a function of n and ω when both goods are produced. This is accomplished by substituting the expressions for X^d and Y^d in the utility function, yielding (a similar expression can be obtained for Foreign):

[15] It can similarly be shown that trade in goods between two countries that have different fixed and/or marginal costs in service provision drives a wedge between their factor price ratios.

$$U = \Psi\omega^{\alpha} n^{\delta/(\varepsilon-1)}[L + K/\omega] \tag{24}$$

with Ψ a positive constant. Note that this expression can be interpreted as an iso-utility curve, giving all (n, ω)-combinations that lead to utility level U. By construction Eq. (24) holds only when both goods are produced and implies full employment of both production factors.

Fig. 3 depicts the situation in (n, ω)-space, for two different parameter configurations. Both panels essentially depict the same situation as in Fig. 2 so that the only difference between the two countries is that Foreign has a higher stock of capital. However, panel A represents a moderate level of the elasticity of substitution ($\varepsilon=4$), whereas panel B features a high level of the elasticity of substitution ($\varepsilon=10$).[16] In line with earlier notation, the autarkic iso-utility curves are depicted by $\bar{U}_a$ and $\bar{U}_a^*$.

Before we discuss the welfare effects of trade in goods, it is important to note two things. First, the autarkic iso-utility curves reach their highest points at the autarky equilibrium wage–rental ratio. In fact, by taking the total derivative of Eq. (24) it is easy to show that the slope of the iso-utility curve is positive up to ω_a and negative thereafter. Second, from the shape of the autarkic iso-utility function, which is similar for all parameter configurations, we can infer that a country for which the services sector expands as a result of trade in final goods always gains from such trade. This follows from $dn/d\omega = 0$ at ω_a, see Fig. 3. A country for which the services sector expands not only benefits from the traditional (Heckscher–Ohlin) gains from exchange and specialization but also enjoys a positive externality associated with the expanding services sector. In contrast, therefore, a country for which the services sector contracts as a result of trade in goods may either gain or lose from such trade depending on the balance of the Heckscher–Ohlin related gains from trade and the externality-related loss of a contracting services sector. Obviously, the negative externality is smaller, and the country with a contracting services sector is more likely to gain, if it is easy to substitute one service for another, that is when γ increases.

Fig. 3A, B illustrate exactly this point. In panel A, the intersection points of R_e with E and E^* are such that Home's welfare increases vis-á-vis autarky (as $n_e > n_a$), but that Foreign's welfare decreases (the point on the Foreign no-entry equation that represents trade equilibrium lies below the autarkic iso-utility curve). However, in Panel B, the situation is such that both countries gain from trade in goods (the intersection of R_e with E^* now also lies above the autarkic iso-utility curve). Note that in both panels we consider trade equilibria in which both countries remain incompletely specialized, as can be inferred from the fact that in both cases the number of services varieties in trade equilibrium lies in between the points of specialisation n^y and n^x. We summarize our findings in Proposition 3.

[16] The values of the other parameters and exogenous variables are: $L=L^*=2000$, $K=2000$, $K^*=2650$, $F=0.5$, $b=0.1$, $\alpha_x=\beta_x=\beta_y=0.3$, $\alpha_y=0.4$, $\mu_x=0.6$ and $\mu_y=0.4$.

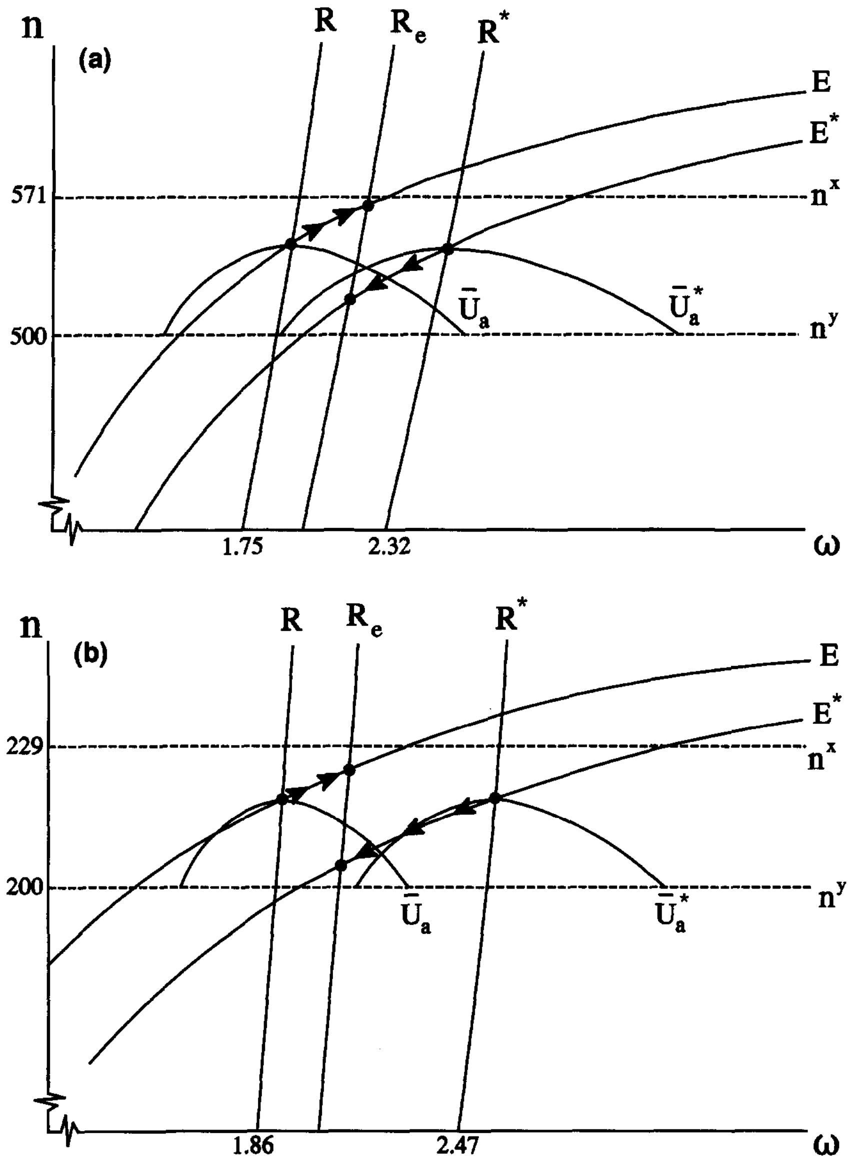

Fig. 3. Welfare effects of trade in goods.

Proposition 3 (welfare effects). When two countries start to trade in goods, but remain incompletely specialized, the country for which the services sector expands will unambiguously gain. The other country may either gain or lose.

6. Trade in goods and services

In our discussion so far we have relied on a model in which firms are able to exploit scale economies in the production of services, but are limited by the extent of the market in their attempt to reduce unit production costs. Whereas in the previous sections the extent of the market increased by permitting trade in goods, this section considers an increase in the extent of the market by allowing for trade in services, either by itself, or in addition to goods.

To start with the former, it was pointed out by Markusen (1989) that trade in services is Pareto-superior to autarky. In our model the basis for the welfare improvement is Krugman's (1979) love for variety. That is, if two identical countries open up to trade in services the production level of both goods in both countries increases as a result of the positive externality associated with an increase in the number of varieties. Each country demands twice the autarkic number of service varieties for its production of final goods but only accounts for half the world service production. Trade in services is therefore of the intra-industry type.

To study the effects of trade in goods and services, we use the concept of the Integrated World Equilibrium (IWE). See, for instance, Dixit and Norman (1980) and Helpman and Krugman (1985). More specifically, we will investigate the limits to K, K^*, L and L^* such that (costless) trade in goods and services replicates the equilibrium of a country with factor endowment $K^w = K + K^*$ and $L^w = L + L^*$.

Before we do so, note that differences in services technology between countries do not matter for such an analysis, as in an integrated world only the most efficient service technology can survive. To see this, suppose that two countries differ in their fixed cost requirement of services production. Given that the price a services firm charges is the same mark-up over marginal labor costs throughout the integrated world, see Eq. (7), any uniform wage rate at which less-efficient services producers operate at zero profits leads to excess profits for the most-efficient services producers. Consequently, entry occurs, driving overall profits down, and the less efficient services producers will exit the market. When, alternatively, two countries differ in the marginal costs of services provision, any uniform wage rate implies a higher services price charged by the less-efficient producer, say $v > v^*$. Since operating profits are proportional to sales and it follows from the first-order conditions that the value of sales for the efficient services provider is $(v/v^*)^{(\varepsilon-1)}$ times as high as the value of sales for the inefficient services provider, we conclude that the latter is making a loss when the former is breaking even. Thus, inefficient producers will be driven out of the market.

The IWE can be calculated by substituting the world endowments in Eqs. (20–23), to give the world autarky equilibrium ω_a^w, n_a^w and p_a^w. Fig. 4 illustrates the IWE in a world endowment box. In the figure vectors OS and O*S* represent labor employed in the services industry. Vectors SP and S*P* depict labor and

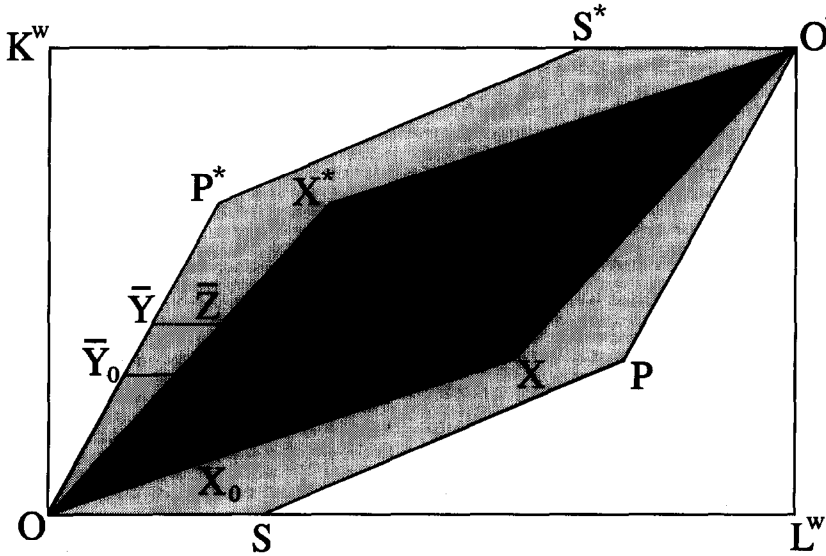

Fig. 4. Trade in goods and services.

capital directly employed in world production of good *X*, and the vectors OX and O*X* represent direct-plus-indirect labor and capital in *X*. Likewise, vectors PO* and P*O give direct labor and capital for *Y* production, while XO* and X*O depict the direct-plus-indirect capital and labor used in *Y*.[17]

With service products tradeable it is the world scale of final goods production and not the level of production in any one country that matters. Capital–labor endowments (K, L) and (K^*, L^*) inside the hexagon OSPO*S*P*O in Fig. 4, adding up to (K^w, L^w), enable factor price equalization (FPE) and replication of the IWE. The area of this hexagon tends to be large because employment in the producer services sector (the vectors OS and O*S*) tends to be large. Trade patterns inside this IWE hexagon are indeterminate since different production levels of services, and final goods, with concomitant input requirements can add up to the available domestic (or foreign) supply. Thus, in principle there might be a surplus on the trade balance and a deficit on the services balance, or vice versa. Capital–labor endowments inside the diamond OXO*X*O make it possible to uniquely set up production levels for final goods in both countries such that both

[17] The figure has been drawn such that good *Y* incorporates relatively more direct-plus-indirect capital than good *X*. As noted before, for other parameter configurations, this capital intensity could be reversed, even if good *Y* is always more capital intensive than good *X* in a direct sense. The division of indirect labor over the two final goods industries is also dependent upon the specific parameter configuration. In the figure we have taken this to be a half for each country. Note that the diamond OXO*X*O always lies within the hexagon OSPO*S*P*O.

the trade balance and the service balance are in equilibrium. To see this, we discuss two production combinations for Home to reach endowment point E in Fig. 4, one with a surplus on the services account and one with equilibrium on both accounts. Many other combinations are possible.

First, suppose Home does not produce final good X. Since all capital must be employed in the Y sector, vector $O\bar{Y}$ represents the direct use of capital and labor for the production of good Y. The remaining labor force $\bar{Y}E$ must be employed in the services sector. Part of this labor, namely $\bar{Y}\bar{Z}$, represents the labor requirement for the production of service products used in sector Y (recall, however, that all services are used for the production of good Y). Thus, $\bar{Z}E$ represents a surplus on the services account which, since Home is not producing good X, exactly compensates a deficit on the goods balance.

Second, suppose Home employs $O\bar{Y}_0$ capital and labor directly for the production of good Y. Direct employment for the production of good X and in the services sector then follows from the requirement that the total must add to endowment point E. $\bar{Y}_0Y_0$ represents labor required for the production of service products used in sector Y. Thus OY_0 is the total capital and labor requirement for the production of good Y in Home, which is supplied by Home. By construction the same holds for OX_0 and Home supplies all the labor required for the production of its final goods (which also represents its value). Trade in service products still takes place. Thus, the services account is in balance, and hence so must be the goods account.[18]

7. Foreign direct investment in services

In the previous section we assumed that services are tradeable in a goods-like sense, that is there is trade in service products. Although for some knowledge-intensive producer services this might often be the case, e.g., accounting and management consulting, it has also been widely noted that international services transactions frequently require the (permanent) cross-border movement of either the services producer, services consumer, or both.[19] For example, for producer services such as banking and advertising it is usually FDI by which trade in service products takes place.[20] This section therefore analyzes services exchange that requires FDI, and investigates to what extent FDI in services can be a substitute for the cross-border movement of tradeable services.

[18] On the OO* diagonal equilibrium on the goods account implies that no trade in final goods takes place. Thus, replication of the IWE on this diagonal is possible through trade in service products only.

[19] See, in particular, the classification of Sampson and Snape (1985), which is widely agreed upon in the literature on conceptual issues of trade in service products. Moreover, also institutions like the World Bank and UNCTAD adhere to Sampson and Snape's classification. See World Bank and UNCTAD (1994).

[20] See Hoekman (1994).

When service products are non-tradeable, but instead must be provided abroad by means of FDI, we have to specify the exact mode by which FDI takes place. To streamline the analysis we distinguish two ways of modeling FDI: either through a transfer of technology or by setting up foreign subsidiaries.[21] The question we pose is whether under either of these two scenarios FDI in services can be a substitute for trade in service products. In other words: can FDI replicate the IWE?

The transfer of technology scenario assumes that FDI consists of services firms that use their specific know-how to set up services firms in the other country. The fixed and variable labor requirements for services provision are in labor of the host country, and identical to the requirements at home. Naturally, services firms will continue to set up firms abroad until the profits from doing so are driven to zero. In equilibrium the repatriation of profits is thus zero. It is easy to see that FDI cannot replicate the IWE. Replication of the IWE requires that both countries have access to the same number of service varieties as in the IWE, n_a^w say. This, in turn, implies that all firms have to be established in both countries, which requires a double investment in fixed labor ($2n_a^wF$). The remaining number of laborers is then not sufficient to replicate the production levels of the final goods in the IWE.

Instead, trade in goods and FDI in services by means of a transfer of technology is equivalent to trade in goods only. The only difference is that now a services firm in Home may be owned by Foreign, and vice versa. Any zero-profit equilibrium namely implies that the service balance is in equilibrium and therefore it does not matter which country owns the services firms needed to accomplish the goods-trade equilibrium. In principle, it might even occur that all services firms are owned by one and the same country. In the framework of the current model it is not possible to make definite statements about the determination of the ownership pattern of services firms, except to say that it will be a matter of chance or history. Proposition 4 summarizes the results for the transfer of technology scenario.

Proposition 4 FDI in services by means of a transfer of technology cannot replicate the IWE, and is therefore not a substitute for trade in service products. Instead, such FDI is equivalent to trade in goods only, except that the distribution of ownership of services firms over the two countries cannot be determined.

In the subsidiary scenario we assume that FDI consists of services firms using their know-how to establish subsidiaries in the other country, which are to be operated by laborers from the host country, but which do not involve additional fixed costs. The subsidiary abroad faces an identical elasticity of demand and

[21] See also van Marrewijk et al. (1996). As will become clear, as an example of the transfer of technology scenario one can think of banking services, since these usually require local headquarters in the host country. As an example of the subsidiary scenario one can think of a chemical cleaning company where the fixed cost represents investment in technical know-how to clean up appropriately, while the actual cleaning can be done by either domestic or foreign laborers following company guidelines. In both examples the fixed costs are thus the costs of developing a new variety, as in Grossman and Helpman (1991).

therefore charges the same mark-up over marginal production costs. The latter are in terms of labor of the host country, however, so that the price for services abroad is higher than at home if, and only if, the wage rate abroad exceeds that of home. The subsidiary abroad always makes operating profits as the price it charges exceeds marginal production cost, whereas it does not have to account for the fixed cost of production. These profits are repatriated to the company's headquarters where they are used to cover part of the fixed costs.

When FDI in services takes place under the subsidiary scenario, replication of the IWE implies that the available number of varieties in each country must be equal to that of the IWE. However, as each services firm can have a subsidiary in the other country without having to incur additional fixed costs, the world number of varieties can be achieved without each country having labor in the amount OS=O*S* captured in their respective services sectors. The situation is depicted in Fig. 5.

The vectors OT and O*T* represent the fixed labor requirement of the world services provision, i.e., $n_a^w F$ and the vectors TS and T*S* represent the marginal labor requirement of the services production, that is $n_a^w(\varepsilon-1)F$, see Eq. (3) and Eq. (13).[22] Suppose, for concreteness, that the endowment is at point R in Fig. 5. The IWE equilibrium can be replicated as follows. All services firms are

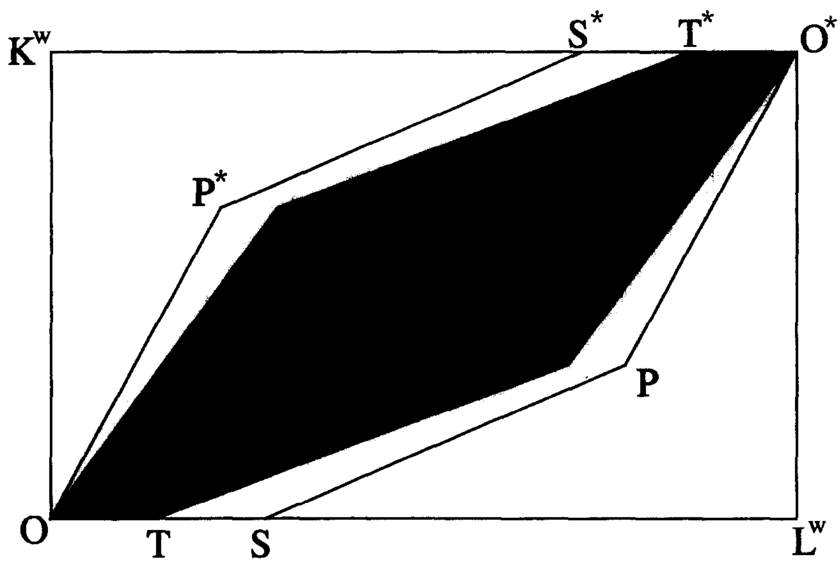

Fig. 5. FDI in services.

[22] Note that S and T can never coincide as this would contradict the production function of services. In fact, it is easy to see that $OT/OS = 1/\varepsilon$ and only when services become perfect substitutes of each other ($\varepsilon \rightarrow \infty$) the production of services takes marginal labor only.

established in Home, which requires OT laborers for fixed costs. Home specializes in the production of good X, requiring TR of labor and capital, with the labor requirement inclusive of the marginal labor required for the services production incorporated in good X. At the same time all Home services firms set up subsidiaries abroad and employ foreign labor in the amount of RP to account for the marginal labor requirement of services production that is needed to sustain the production of good Y. Thus, vector O*R depicts capital and labor involved in the production of good Y inclusive of the marginal labor requirement for the services production incorporated in good Y. As wages and thus services prices in both countries are the same, the division of marginal services labor over the two final goods sector is equal to that of the IWE. By similar reasoning it then follows that endowment ratios within the subsidiary-hexagon OTRO*T*R*O, which is a strict subset of the IWE hexagon, make it possible to set up production levels of goods and services that replicate the IWE. Thus, inside OTRO*T*R*O subsidiary FDI can substitute for trade in service products. Outside this hexagon one would, in addition, require international factor mobility. Proposition 5 summarizes the results.

Proposition 5 The FPE set that replicates the IWE when there is trade in goods and FDI in services by means of subsidiaries is smaller than when there is trade in goods and service products. Thus FDI by means of subsidiaries can to a certain extent substitute for trade in service products.

8. Concluding remarks

We investigate the comparative advantage of final goods and producer services in a framework that unites the factor-endowments theory with the Spence–Dixit–Stiglitz formalization of monopolistic competition. The model is a two-country, three-sector general equilibrium model where two final goods are produced under constant returns to scale with each of them using different intensities of physical capital, labor and service varieties. The service sector is characterized by product differentiation and economies of scale. Our model replicates the multiple equilibria feature that is customary of models with increasing returns to scale. Of these equilibria, only the one in which the share of the labor force employed in the service sector exceeds a positive threshold level as determined by taste and technology has the local stability property. The autarkic equilibrium and Integrated World Equilibrium are unique.

The model allows for an analysis that goes beyond the traditional factor endowments type of reasoning by including differences in service technology and differences in service intensities between final goods as additional reasons for two countries to trade. Comparative advantage in goods is not only determined by (direct) relative capital-intensities, but also by the number and technology of services. Depending on the relative magnitudes of these effects, a country that is relatively capital-abundant can have a comparative advantage in the labor-intensive good. The results are summarized in Propositions 1 and 2. With respect to the welfare effects of trade in goods we show that these are always positive for the country that expands its services sector. The country that faces a contraction of the services sector may, however, lose from trade in final goods only (Proposition 3).

We show that in an Integrated World Equilibrium only the most efficient services providers can survive. We also show positive welfare results associated with free trade in services and with service technology improvements. This indicates that any policy introducing barriers to entry to protect the interest of inefficient service firms or using non-tariff barriers to shelter the service sector from foreign competition might leave the protected country with an unambiguous welfare loss (Section 3).

Trade in final goods only does not result in factor price equalization, unless both countries have an equal number of services firms after opening up to trade in goods. Factor price equalization may be restored when countries open up to trade in service products as well. In this respect, the mode of trade in services was shown to be of importance. Trade in service products replicates the Integrated World Equilibrium once the division of endowments over the two countries lies within the IWE hexagon. When, on the other hand, the exchange of services requires Foreign Direct Investment, such FDI can substitute for trade in service products under certain conditions. The results are summarized in Propositions 4 and 5.

Acknowledgments

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Appendix 1

This appendix derives the condition for local stability of the autarky equilibrium when adjustment is sluggish in both markets. That is we assume that changes in p and n over time can be written as functions of the excess demand for good X (EDX) and the excess profits in the service sector (EP) in the following way (an overdot denotes a time derivative):

$$\dot{n} = g(\mathrm{EP}) = g(E_1 L - E_2 K / [\omega(n, p)] - n\varepsilon F) \quad \text{(S1)}$$

$$\dot{p} = h(EDX[\omega(n, p)])$$
$$= h\left(C_x(\gamma/\beta)^{\delta_x} n^{\delta_x/\varepsilon F}[(1-\alpha)K\omega^{\alpha_x - 1}\alpha L\omega^{\alpha_x}]/(\alpha_y - \alpha_x)\right) \quad \text{(S2)}$$

with $g(0) = h(0) = 0$, $C_x \equiv \alpha_x^{\alpha_x}\beta_x^{\beta_x}\delta_x^{\delta_x}$, and where we assume $g'(0) > 0$ and $h'(0) > 0$. Note that whereas Eq. (S1) is in fact a simple reformulation of the no-entry equation, Eq. (S2) gives the Walrasian condition for stability in the goods market.

The dynamic system can be approximated by a first-order Taylor expansion evaluated in equilibrium. In matrix notation this yields:

$$\begin{bmatrix} \dot{n} \\ \dot{p} \end{bmatrix} = \begin{bmatrix} g_n & g_p \\ h_n & h_p \end{bmatrix} \begin{bmatrix} dn \\ dp \end{bmatrix} = J_E \begin{bmatrix} dn \\ dp \end{bmatrix}$$

.The partial derivatives can be calculated as:

$$g_p = \frac{g'(.)}{p} \frac{E_2 K}{(\alpha_y - \alpha_x)\omega} \qquad g_n = g'(.)\left[\frac{E_2 K}{\omega(\varepsilon - 1)n} \frac{(\delta_y - \delta_x)}{(\alpha_x - \alpha_y)} - \varepsilon F\right]$$

$$h_p = -\frac{h'(.)C}{p(\alpha_y - \alpha_x)^2}[(1 - \alpha_x)(1 - \alpha)K/\omega + \alpha_x \alpha L]$$

$$h_n = \frac{h'(.)C}{n(\varepsilon - 1)(\alpha_y - \alpha_x)^2}[(\beta_x\delta_y - \beta_y\delta_x)(1 - \alpha)K/\omega - (\alpha_y\delta_x - \alpha_x\delta_y)\alpha L],$$

with $C = [\gamma^{\delta_x} b^{-\delta_x} \alpha_x^{\alpha_x} \beta_x^{\beta_x} \delta_x^{\delta_x} n^{\delta_x/(\varepsilon - 1)} \omega^{\alpha_x}]$. A necessary and sufficient condition for local stability is $|J_E| > 0$ and $Tr(J_E) < 0$. In our set-up the expressions for the determinant and trace can then be calculated to become

$$|J_E| = C(.)g'(.)h'(.)\frac{\varepsilon F \alpha L}{p_a(\alpha_y - \alpha_x)^2} > 0$$

$$Tr(J_E) = g'(.)\varepsilon F\left[\frac{\alpha}{1 - \alpha} \frac{E_2}{(\varepsilon - 1)} \frac{(\delta_y - \delta_x)}{(\alpha_x - \alpha_y)} \frac{L}{n} - 1\right] - h'(.)\frac{C(.)\alpha L}{p_a(\alpha_y - \alpha_x)^2} \gtrless 0$$

where we substituted for the autarky value of ω as given by Eq. (20). As $h'(.) > 0$ by assumption, in our set-up a sufficient condition for local stability becomes to require $g_n < 0$. Local stability thus boils down to demanding the equilibrium number of service firms to exceed some threshold level $\tilde{n}$ for which $g_n = 0$, i.e.,

$$n > \frac{E_2 K}{\omega(\varepsilon - 1)\varepsilon F} \frac{(\delta_y - \delta_x)}{(\alpha_x - \alpha_y)} \equiv \tilde{n}. \quad \text{(K1)}$$

Note that Eq. (K1) is necessary and sufficient if the services market adjusts quickly enough, i.e., if $g'()$ becomes arbitrarily large.

Substitution of the autarky value for ω and n as given by Eq. (20) and Eq. (21) gives a condition that underlies the graphical interpretation to Eq. (K1):

$$\left|(\varepsilon-1)\frac{(\alpha_y-\alpha_x)}{(\delta_x-\delta_y)}\right| > \left|(\alpha/\delta)\frac{(\beta_y\delta_x-\beta_x\delta_y)}{(\alpha_y-\alpha_x)}\right| \tag{K2}$$

and the stable equilibrium is the point in Fig. 1 at which the slope of the R-curve is steeper than the slope of the E-curve.

Substitution of only the autarky value for ω yields the condition that underlies the empirical interpretation of Eq. (K1), namely

$$\frac{n_a L_j}{L} = \frac{n_a \varepsilon F}{L} > \frac{E_2(\delta_y-\delta_x)}{(\varepsilon-1)(\alpha_x-\alpha_y)}\frac{\alpha}{(1-\alpha)}. \tag{K3}$$

The right-hand-side of Eq. (K3)) establishes a threshold for the share of the labor force employed in the service industry, which depends only on the parameters characterizing the production of final goods, the elasticity of substitution of services, and the expenditure share. Whether or not condition Eq. (K3) holds depends to a large extent on the size of ε, and hence of γ. The higher the elasticity of substitution between different services, the lower the threshold and the more likely the economy will be in the stable equilibrium A. Moreover, Eq. (K3) reveals that stability is guaranteed when the role of producer services is more or less the same across sectors, that is when δ_y approaches δ_x.

References

Benhabib, J. and B. Jovanovich, 1991, Externalities and growth accounting, American Economic Review 81, 82–113.

Bhagwati, J.N., 1984, Why are services cheaper in the poor countries?, The Economic Journal 94, 279–286.

Burgess, D.F., 1990, Services as intermediate goods: the issue of trade liberalization, in: R.W. Jones and A.D. Krueger, eds., The Political Economy of International Trade, (Basil Blackwell, Cambridge) 122–139.

Dixit, A. and V. Norman, 1980, Theory of International Trade (Cambridge University Press, Cambridge).

Djajic, S. and H. Kierzkowski, 1989, Goods, services and trade, Economica 56, 83–94.

Dixit, A.K. and J.E. Stiglitz, 1977, Monopolistic competition and optimum product diversification, American Economic Review 67, 297–308.

Ethier, W., 1982, National and international returns to scale in the modern theory of international trade, American Economic Review 72, 389–405.

Francois, J.F., 1990, Trade in producer services and returns due to specialization under monopolistic competition, Canadian Journal of Economics 23, 109–124.

Grossman, G.M. and E. Helpman, 1991, Innovation and Growth in the Global Economy (MIT Press, Cambridge, MA).

Grubel, H.G. and M. Walker, 1989, Service Industry Growth (Fraser Institute, Vancouver).

Helpman, E. and P.R. Krugman, 1985, Market structure and foreign trade (MIT Press, Cambridge, MA).

Hirsch, S., 1989, Services and service intensity in international trade, Weltwirtschaftliches Archiv 19, 45–59.

Hoekman, B.M., 1994, Conceptual and political economy issues in liberalizing international transactions in services, in: A.V. Deardorff and R.M. Stern, eds., Analytical and negotiating issues in the global trading system (Univ. Michigan Press, Ann Arbor, MI) 501–538.

Ishikawa, J., 1992, Trade patterns and gains from trade with an intermediate good produced under increasing returns to scale, Journal of International Economics 32, 57–81.

Jones, R.W. and F. Ruane, 1990, Appraising the options for international trade in services, Oxford Economic Papers 42, 672–687.

Krugman, P.R., 1979, Increasing returns, monopolistic competition, and international trade, Journal of International Economics 9, 469–479.

Mankiw, N.G., D. Romer and D.N. Weil, 1992, A contribution to the empirics of economic growth, Quarterly Journal of Economics 107, 407–437.

Markusen, J.R., 1989, Trade in producer services and in other specialized intermediate inputs, American Economic Review, 85–95.

Markusen, J.R. and J. Melvin, 1981, Trade, factor prices, and gains from trade with increasing returns to scale, Canadian Journal of Economics 14, 450–469.

Marrewijk, C. van, J. Stibora, A. de Vaal and J.-M. Viaene, 1993, Producer services, comparative advantage, and international trade patterns, Tinbergen Institute Discussion Paper, TI 93–155 (Tinbergen Institute, Rotterdam).

Marrewijk, C. van, J. Stibora and A. de Vaal, 1996, Services tradability, trade liberalization and foreign direct investment, Economica 63, 611–631.

Melvin, J.R., 1989, Trade in producer services: a Heckscher–Ohlin approach, Journal of Political Economy 97, 1180–1196.

Sampson, G.P. and R.H. Snape, 1985, Identifying the issues in trade in services, The World Economy 8, 171–182.

Summers, B., 1985, Services in the international economy, in: R.P. Inman, ed., Managing the service economy: prospects and problems (Cambridge University Press, Cambridge) 27–48.

World Bank and UNCTAD, 1994, Liberalizing international transactions in services (World Bank and UNCTAD, Geneva).