Trade and Direct Investment in Producer Services and the Domestic Market for Expertise

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Abstract

Foreign producer services such as managerial and engineering consulting can provide substantial benefits of specialized knowledge that would be costly in terms of both time and money for domestic firms to develop on their own. This has important implications for public policy since policies that impact on trade and direct investment in services are often quite different from those that impact on trade in goods. We build on earlier monopolistic-competition models of intermediate producer services in this paper. Results show that: (1) while foreign services are partial-equilibrium substitutes for domestic skilled labor, they may be general-equilibrium complements, (2) service trade can provide crucial missing inputs that reverse comparative advantage in final goods, (3) the "optimal" tax on imported services may be a subsidy, and (4) in our dynamic formulation, there are disruptions along a transition path that suggest potentially important equity consequences of reform.

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1. Scope of the Paper

A growing body of evidence and economic theory suggests that the close availability of a diverse set of business services is important for economic growth. The key idea in the literature is that a diverse set (or higher quality set) of business services allows downstream users to purchase a quality adjusted unit of business services at lower cost. As early as the 1960s, the urban and regional economics literature (e.g., Greenfield, 1966; Jacobs, 1969, 1984; Chinitz 1961; Stanback, 1979) recognized the importance of non-tradable intermediate goods (primarily producer services produced under conditions of increasing returns to scale) as an important source of agglomeration externalities.

The more recent economic geography literature (e.g., Krugman, 1991; Porter, 1992; Fujita, Krugman and Venables, 1999) has also focused on the fact that related economic activity is economically concentrated due to agglomeration externalities. Ciccone and Hall (1996) show that firms operating in economically dense areas are more productive than firms operating in relative isolation. Caballero and Lyons (1992) show that productivity increases in industries when output of its input supplying industries increases. Marshall (1988) shows that in three regions in the United Kingdom (Birmingham, Leeds and Manchester) almost 80 percent of the services purchased by manufacturers were bought from suppliers within the same region. He cites studies which show that firm performance is enhanced by the local availability of producer services. In developing countries, McKee (1988) argues that the local availability of producer services is very important for the development of leading industrial sectors.

In this paper we develop a theoretical model to quantitatively assess the importance of liberalization of restraints on foreign providers of producer services. Based on the evidence we have mentioned, we make three key assumptions in our model: (1) a larger variety of producer services lower the quality adjusted costs of these services for downstream industries; and (2) producer services are produced under conditions of increasing returns to scale (Faini 1984), and (3) key inputs to producer services (e.g., foreign personnel) are affected by very different barriers than trade in goods.

We prefer to remain somewhat vague regarding a generic definition of producer services. The

types of activities we are interested in include: (1) managerial services, which improve organizational and decision-making efficiency. (2) engineering services, which improve technical efficiency and product quality. (3) financial services (not actual trade in capital) which provide expertise in financial management and decision making. (4) marketing services which improve firms' abilities to sell or purchase other goods and services. (5) information services in which the buyer receives some type of information or knowledge not just listed.

Several concepts emerge from this list. First, as emphasized above, our services are intermediate inputs. Second, the services we are interested in generally involve an exchange of knowledge, which has been accumulated by the seller through previous investments. Third, these services are generally customized to some extent, solving particular problems of the buyer, and they are not generally good substitutes for the services of other firms. Thus there is firm-level product differentiation.

Finally, our services generally require a personal presence in a country or at least personal contact and discussions between the service provider and the client. In particular, restrictions on goods trade only affect service trade indirectly, while restrictions on foreign investment, right of establishment, the movement of business personnel, and lack of intellectual property protection and contract enforcement have major, direct impacts.[1]

In summary then, we are interested in services have the following general characteristics.

(a) intermediate goods

(b) intensive in skilled labor and other knowledge capital

(c) produced with increasing returns.

(d) differentiated by firm and possibly by firm nationality

(e) traded inputs to services are subject to high or prohibitive transactions costs from barriers to foreign ownership, movement of business personnel, etc.

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[1]We do not formally model the distinction between “trade” (e.g., arm’s length, one-off contracts to provide a service) versus FDI where the foreign firm establishes an owned subsidiary.

"Imported" services (or more corrected services produced with imported inputs such as personnel) with these characteristics offer a number of important advantages to developing or transition economies. First, they may complement rather than substitute for domestic producer services, the differentiated-product characteristic just mentioned. Second, they economize on scarce domestic skilled labor which is then freed for other uses, the factor-intensity property noted above.

Third, imported services allow countries to obtain in the present expertise or crucial missing inputs that are not otherwise available and would take considerable time and/or resources to develop, the scale-economies property. In a static model, this could be captured by simple scale economies with fixed costs in terms of skilled labor, or in a dynamic model by a learning-by-doing or investment process which requires a time lag between skilled-labor inputs and service output.

The purpose of this paper is to take several steps toward incorporating the types of producer services just discussed into applied general equilibrium models. The first step in this process is to adopt a formal theoretical approach. Our formulation will build on existing work, including Markusen (1989), Francois (1990a,b), and Stibora and de Vaal (1995). The second, and more original, step of this paper will be to obtain a quantitative assessment of the impact of this approach by embedding it in *both* static and dynamic applied general-equilibrium models. The static model considers the implications of FDI in a model where the supply of domestic skilled labor is fixed. There have been some prior numerical efforts to quantitatively assess the implications of international liberalization against foreign service providers (Brown et al., 1996; Robinson and Wang, 1999).

Our dynamic model provides a means of assessing the time and disruption involved in moving from an initial equilibrium to a new steady-state equilibrium by modeling the transition under consistent expectations by firms and consumers. There are two reasons that the transitional dynamics are of interest. First, given an assumption of imperfect intersectoral immobility of existing workers, there are potentially important equity consequences of reform. Second, if there are wage rigidities or other distortions in the

economy that slow the adjustment of labor, service liberalization may generate transitional unemployment losses which could offset some fraction of the efficiency gains offered by the reform. For these reasons, in our dynamic extension we focus on adjustment in the stock of skilled labor within the economy, assuming that existing workers may be unable to move directly into the foreign service-firm enclave.

Before proceeding, we will mention of a couple of interesting results which may induce the reader to continue. First, we use a static model to show that liberalization of rules to permit inward trade and FDI in producer services may imply that these services are general-equilibrium complements to domestic skilled labor, even though they appear to substitute for domestic skilled labor in a partial-equilibrium sense. Thus, it is likely that foreign services may foster the accumulation of skilled workers. Second, allowing inward trade and FDI in producer services may significantly affect the pattern of trade in goods. As in the "key input" argument above, these services may reverse the direction of trade, permitting the host country to successfully export advanced products. Third, we find that the transitional process may involve substantial changes in the market for skilled labor, particularly if we assume that workers in foreign enterprises require specialized education. These effects depend on assumptions regarding the productivity of older skilled workers in the new market for services. If all workers in the new services sector must be new graduates, the reform imposes a significant burden on older workers, and the transition process could take a number of years to complete.

2. Modeling Trade and FDI in Producer Services

Our basic approach will be to model producer services as intermediate inputs. These intermediate inputs will be differentiated from one another and may also be differentiated according to whether or not they are produced domestically or by foreign firms.[2] Both types of services are produced with increasing returns to scale due to fixed costs.

There will be two final goods, *X* and *Y*, and two primary factors available on the domestic market, *S* and *L*. *S* will denote skilled labor and *L* will denote all other factors, aggregated into a composite factor to simplify the model. *S* and *L* are in fixed aggregate supply and immobile between countries. The production function for *Y* is written in Cobb-Douglas form to facilitate comparison with *X*, but in the numerical model we allow the more general CES production function.

(1) $$Y = S_y^{\alpha_y} L_y^{(1-\alpha_y)}$$

Services are an intermediate input into *X* production. The composite of all services inputs Z enters into the production of X:.

(2) $$X = S_x^{\alpha_x} L_x^{\beta_x} Z_x^{(1-\alpha_x-\beta_x)}$$

Later, in some illustrative simulations, we will assume that in direct *S* and *L* requirements, *X* is skilled-labor intensive relative to *Y*, in the sense that $\alpha_x/\beta_x > \alpha_y/\beta_y$.

Services are produced by imperfectly competitive firms. There is a one to one correspondence

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[2]Data on services list both exports and FDI in services, depending on whether or not the foreign company receiving the service is or is not a foreign affiliate of the exporter. This distinction is not modeled here: a "foreign firm" is simply one that uses imported knowledge/expertise such as personnel, blueprints, formulae, patents, etc.

between the firm and their differentiated service varieties. There are both domestic and foreign firms producing services inputs. Z_x is a CES function of *ZD* and *ZM*, each of which is in turn a CES function of the individual *ZD* and *ZM* varieties, zd_i and zm_j respectively.

(3) $$Z_x = (ZD^{\gamma} + ZM^{\gamma})^{1/\gamma}$$

(4) $$ZD = \left[\sum_i^{n_d} zd_i^{\delta}\right]^{1/\delta} \qquad ZM = \left[\sum_j^{n_m} zm_j^{\epsilon}\right]^{1/\epsilon}$$

where n_d and n_m are the number of domestic and imported service varieties, respectively. The elasticities of substitution within product groups are: $\sigma_d=1/(1-\delta)$ and $\sigma_m=1/(1-\epsilon)$. We require that δ and ϵ are between 0 and 1, which implies that the elasticities of substitution within product groups exceed unity.

Domestic intermediate inputs *ZD* are produced using domestic skilled labor and the composite factor. Imported services *ZM* are produced from domestic skilled labor the composite domestic factor and a composite imported factor. Examples of these imported inputs, which will be denoted *V*, are: specialized technical expertise, advanced technology, management expertise and marketing expertise. The variable *V* is thus quite general and denotes a key difference between foreign and domestic production structures.

zd_i and zm_i are produced with a fixed and a variable cost. Because of the two components of cost, it is normal to express technologies for these differentiated goods by a cost function rather than by a production function. Let *CD* and *CM* be the cost function for producing individual domestic and foreign varieties. We impose a symmetry assumption within firm types, i.e., all foreign firms have identical cost structures, and all domestic firms that operate have cost structures identical to other domestic firms. *cd* and *cm* represent unit variable cost functions and *fd* and *fm* represent the fixed costs functions for domestic and foreign varieties respectively. Let *r* be the price of *S*, *w* be the price of *L*, and p_v be the price of *V*. Cost functions for domestic and foreign intermediates are thus:

(5) $$C^D(r,w,zd) = cd(r,w)zd + fd(r,w)$$

(6) $$C^M(r, w, p_v, zm) = cm(r, w, p_v)zm + fm(r, w, p_v)$$

Let n_d and n_m as variables refer to the number of domestic and foreign service firms active in equilibrium. Recalling that the derivatives of cost function with respect to the price of factor i is the input demand for factor i, the market clearing equations for S and L can then be written as:

(7) $$L = L_y + L_x + n_d C_w^D + n_m C_w^M$$

(8) $$S = S_y + S_x + n_d C_r^D + n_m C_r^M$$

in which C_w^j and C_r^j represents the partial derivatives of unit cost for firm type $j \in \{D, M\}$ with respect to the unskilled wage rate and the rental price of skilled labor, respectively. Our factor-intensity assumption is that the unit S/L ratios in domestic and foreign services satisfy $C_r^M/C_w^M < C_r^D/C_w^D$ (Shephard's lemma): foreign services are less skilled-labor intensive than domestic services, the former substituting the imported input V for domestic skilled labor.

The demand side of the economy consists of a representative consumer, who derives income from factor supplies and possibly from tax revenues (net of subsidies). Let subscripts c and p distinguish consumption and production of X and Y. Preferences of the representative consumer are given by

(9) $$U = U(X_c, Y_c)$$

The model is closed with a trade balance condition that requires that net exports of X and Y equal net payments for foreign services. Let p_x^* and p_y^* denote the world prices of X and Y (which may differ from domestic prices if there are taxes or subsidies). Trade balance is given by:

(10) $$p_x^*(X_p - X_c) + p_y^*(Y_p - Y_c) - p_v^* V = 0$$

where the demand for foreign services is given by the number of foreign services times the derivative of the cost function for a given foreign service with respect to the cost of imports::

(11) $$V = n_m \, C^M_{p_v}$$

To simplify the interpretation of results, we assume "large-group monopolistic competition." That is, individual firms believe they are too small to influence the composite price of their group. Consider first the marginal product of an individual service zm_i in the aggregate output of the service sector Z_x Let p_x denote the domestic price of X and p_{zmi} denote the price received by the producer of a representative zm_i. Since final X production is assumed competitive, p_{zmi} is the value of the marginal product of zm_i in producing X.. From the chain rule, we have:

(12) $$p_{zmi} = p_x \frac{\partial X}{\partial zm_i} = p_x \frac{\partial X}{\partial Z_x} \frac{\partial Z_x}{\partial ZM} \frac{\partial ZM}{\partial zm_i}$$

Using (2), (3), and (4), this reduces to:

(13) $$p_{zm_i} = p_x \left(1 - \alpha_x - \beta_x\right) S_x^{\alpha_x} L_x^{\beta_x} Z_x^{-\alpha_x - \beta_x} \left[ZD^{\gamma} + ZM^{\gamma}\right]^{\frac{1}{\gamma} - 1} ZM^{\gamma - \varepsilon} zm_i^{\varepsilon - 1}$$

Revenue of an individual zm_i producer is price times quantity.

(14) $$zm_i p_{zm_i} = p_x \left(1 - \alpha_x - \beta_x\right) S_x^{\alpha_x} L_x^{\beta_x} Z_x^{-\alpha_x - \beta_x} \left[ZD^{\gamma} + ZM^{\gamma}\right]^{\frac{1}{\gamma} - 1} ZM^{\gamma - \varepsilon} zm_i^{\varepsilon}$$

Large-group monopolistic competition is the assumption that an individual firm views Z_x as fixed or parametric, and here by extension views ZM and ZD as fixed. Thus, the individual firm views all variables on the right hand side of equation (18) as fixed except for its own output zm_i. This implies that marginal revenue takes on a very simple form.

$$\textbf{(15)} \qquad MR_{zm_i} = p_x(1-\alpha_x-\beta_x)S_x^{\alpha_x}L_x^{\beta_x}Z_x^{-\alpha_x-\beta_x}\left[ZD^{\gamma}+ZM^{\gamma}\right]^{\frac{1}{\gamma}-1}ZM^{\gamma-\epsilon}\epsilon zm_i^{\epsilon-1} = \epsilon p_{zm_i}$$

Setting marginal revenue equal to marginal cost implies that the ratio of price to marginal cost is $1/\epsilon$.

We have assumed that all foreign varieties have an identical cost structure and the demand for all foreign varieties is identical. These "symmetry" assumptions imply that the output and price of all foreign firms that operate will be identical. We can thus write $zm_i = zm$ and $p_{\text{zmi}} = p_{\text{zm}}$ for all i. Similar conclusions follow for domestic firms.

Then equilibrium for a symmetric group of service firms (*zm* or *zd*) is found as the solution to two equations and two unknowns. One equation is the individual firm's optimization condition, marginal revenue equals marginal cost. A second condition arising from the free-entry condition is that price equals average cost. This condition determines the number of firms in equilibrium. For our type-*zm* firms, these two conditions are given as follows (with corresponding equations for the type-*zd* firms).

$$\textbf{(16)} \qquad MR = MC: \qquad p_{zm}\epsilon = cm(r,w,p_v)$$

$$\textbf{(17)} \qquad p_{zm} = AC: \qquad p_{zm} = cm(r,w,p_v) + fm(r,w,p_v)/zm$$

Solving these equations to find *zm,* output per firm, we get:

$$\textbf{(18)} \qquad \frac{1}{\epsilon} = 1 + \frac{fm}{cm}\frac{1}{zm} \qquad \frac{1}{\epsilon} - 1 = \frac{1-\epsilon}{\epsilon} = \frac{fm}{cm}\frac{1}{zm}$$

and finally

$$\textbf{(19)} \qquad zm = \frac{\varepsilon}{1-\varepsilon}\frac{fm(r,w,p_v)}{cm(r,w,p_v)} = (\sigma_m - 1)\frac{fm(r,w,p_v)}{cm(r,w,p_v)}$$

The output of a given variety is larger when fixed costs are larger relative to marginal costs (scale economies are larger) and when the varieties are better substitutes. Similar results apply for domestic type

firms.

Dual to the output indices in equation 4 are cost functions. When firms minimize the cost of purchasing foreign (domestic) varieties, a cost of a unit of the composite foreign (domestic) input *ZM* (*ZD*) is:

$$\textbf{(20)} \qquad CM = \left[\sum_{i}^{n_m} p_{zm_i}^{1-\sigma_m}\right]^{\frac{1}{1-\sigma_m}} \qquad \sigma_m = \frac{1}{1-\epsilon}$$

$$\textbf{(21)} \qquad CD = \left[\sum_{i}^{n_m} p_{zd_i}^{1-\sigma_d}\right]^{\frac{1}{1-\sigma_d}} \qquad \sigma_d = \frac{1}{1-\delta}$$

where p_{zdi} is the price of the output of a domestic firm and n_d and n_m are the number of domestic and foreign firms.

Substituting the symmetry of the equilibrium into the cost functions for a unit of *ZM* or *ZD*, implies that *CM and CD* can be written as:

$$\textbf{(22)} \qquad CM = \frac{p_{zm}}{n_m^{\sigma_m - 1}} \qquad and \qquad CD = \frac{p_{zd}}{n_d^{\sigma_d - 1}}$$

Since the elasticities of substitution exceed unity, the cost of obtaining an aggregate unit of foreign or domestic services decreases as the number of varieties increases. That is, additional varieties convey an externality on the final goods sector *X* by lowering its costs of obtaining a unit of composite services. The elasticity of the cost of a composite unit of foreign services with respect to the number of foreign varieties is $1/(1-\sigma_m)$. Thus, an additional foreign variety conveys a smaller externality on the final goods sector the better foreign varieties substitute for each other. A similar argument applies for domestic varieties.

Alternatively, the externality can be viewed from the primal (equation 4). Symmetry implies that

$$\textbf{(23)} \qquad ZD = n_d^{1/\delta} zd \qquad ZM = n_m^{1/\epsilon} zm$$

The cost of purchasing the output of domestic firms is $nd*zd*p_{zd}$, which increases in proportion to the number of fimrs. But, since $\delta<1$, the effective supply to the firm increases more than proportionately with

the number of firms.

Note in the special case in which $\gamma = \delta = \epsilon$ and $zm = zd$, that Z_x can be written as:

(24) $$Z_x = (n_d + n_m)^{1/\gamma} z \qquad z = zm = zd$$

in which case domestic and imported firms, while differentiated, are perfect substitutes at the margin.

A final set of assumptions needed to complete the model formulation relate to the specification of the external sector, and in particular the endogeneity of prices. For our purposes, we will begin with a "small country assumption", that prices to our country are fixed. It is clear what this means with respect to *X* and *Y*, but less clear with respect to foreign producer services. We assume that there are a large number of potential foreign firms in production in the rest of the world. A fixed cost is needed to enter the domestic market (*fm*). Foreign firms will enter up to the point where the local markup revenues cover this fixed cost. In other words, the domestic market has no "world" effect on the number of multinationals.

3. Modeling Transitional Dynamics

In this section we present an extension of the static model above which we employ in the dynamic simulations. In this analysis we assume that liberalization of FDI in services is an unanticipated policy reform and the economy is initially on a steady-state growth path with FDI prohibited. We calibrate the dynamic model to precisely the same dataset employed to illustrate the static model. The model assumes a growth in new vintage labor and a utility discount factor consistent with a balanced baseline GDP growth rate of 2% per annum and an interest rate of 5% per annum.

Savings and investment are determined implicitly by the consumption decisions of a forward-looking representative agent who allocates wealth to maximize intertemporal welfare:

(25) $$W = \sum_t \Delta^t U_t(X_{c_t}, Y_{c_t})$$

Consistent with a labor market in which workers enter the workforce at age 20 and retire at age 70, we assume an exogenous retirement rate of 2% per year. Along the dynamic growth path new vintage workers enter the labor market in each period, and they must choose whether to enter school or the unskilled workforce. School graduates subsequently choose either to work in the domestic or FDI service industry. The new-vintage labor market clearance condition, where n is the number of new workers, is:

$$\ell_t + s_t^{\beta} = n_t \quad \textbf{(26)}$$

in which $\beta>1$ reflects diminishing returns in the production of skilled workers, i.e. marginal graduates are less productive than the earlier participants.[3] New skilled workers (new graduates) may subsequently choose to enter the domestic or FDI (multinational) skilled labor markets:

$$s_t^D + s_t^M = s_t \quad \textbf{(27)}$$

while the unskilled workforce likewise evolves:

$$L_{t+1} = \lambda L_t + \ell_t \quad \textbf{(28)}$$

We assume in the dynamic model that the cost of producing a new skilled worker for the domestic or FDI markets is identical.

Given a dynamic model, we have the capacity to assess the adjustment costs of workers. Cross-country evidence on the adjustment costs of labor indicates that the *social* adjustment costs of trade and FDI liberalization are typically rather low relative to the fears of policy-makers, unless there are significant labor market distortions present. Moreover, even the private costs of adjustment are low for workers who were not earning rents (Matusz and Tarr, forthcoming). Restrictions on the ability of firms to terminate labor and other labor market distortions that limit mobility, as well as a poor climate for investment (due to macroecomic instability or lack of the rule of law) can, however, lead to prolonged periods of adjustment to trade and FDI liberalization for labor.

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[3] In this model unskilled workers are measured in units proportional to population, but skilled workers are measured in efficiency units. For our reference calculations we take $\beta=10/7$.

In this paper we take a proxy for these various distortions that can lead to large adjustment costs of workers. We assume that some fraction of *existing* skilled workers have human capital that is specific to the firm type in which they work and cannot be trained for the other type firms, i.e., a fraction of the workforce is unable to gain employment in foreign firms. (All new workers can freely choose between domestic and multinational firms.) The base year supply of skilled workers is then divided between those working in the domestic and multinational firms:

$$\textbf{(29)} \qquad \bar{S}_0 = S_0^D + S_0^M$$

and there is an upper bound on the share working in the multinational sector:

$$\textbf{(30)} \qquad S_0^M \le \phi \, \bar{S}_0$$

In the central scenarios, we take ϕ=0.5. Subsequent to the initial reallocation of skilled workers across the two sectors, these human capital stocks evolve according to the standard capital accounting relationship:

$$\textbf{(31)} \qquad S_{t+1}^k = \lambda \, S_t^k + s_t^k \qquad k \in \{D,M\}$$

When skilled workers are immobile (ϕ is small), there may be an initial disparity in real wages between workers in different types of firms during the adjustment process.[4] As new skilled workers enter the workforce, they move into the sector paying the highest return, and wage differences between foreign and domestic firms disappear. The model formulation in a complementarity format does not rule out "bang-bang" adjustment paths, so that during a transition period where (34) is binding,, all new graduates adopt jobs in the FDI service sector.

In differentiating domestic and multinational skilled workers, we replace equation (8) by two equations, one for domestic workers:

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[4] Since the skilled workers remain employed during the transition, the adjustment costs are private not social.

(32) $$S_t^D = S_{yt} + S_{xt}^D + n_{dt} C_{rt}^D$$

and a second for skilled workers employed in multinational firms:

(33) $$S_t^M = S_{xt}^M + n_{mt} C_{rt}^M$$

Prior to liberalization, skill-intensive services (Z) and skill-intensive goods (X) are produced using only domestic inputs. In the long-run, following reform, both are produced using both domestic and multinational inputs (see equation 3). During the transition, however, the relative cost of new- versus old production techniques determines how these goods are supplied. During the transition, the supply of X is therefore the sum of production from *conventional* domestic sources and new multinational firms:

(34) $$X_t = (S_{xt}^D)^{\alpha_x} (L_{xt}^D)^{\beta_x} (Z_t^D)^{1-\alpha_x-\beta_x} + (S_{xt}^M)^{\alpha_x} (L_{xt}^M)^{\beta_x} (Z_t^M)^{1-\alpha_x-\beta_x}$$

4. Implementation Issues

Before illustrating how the model described above can be coded into an applied general-equilibrium model, we present a brief discussion of some important practical issues.

(a) Initially - inactive activities Often AGE models avoid initial calibrations in which there are no initially-inactive production activities or trade links. Or, if there is an initially inactive trade link (aircraft exports from Sri Lanka to the US), the link is omitted from the model: i.e., an inactive link is always inactive.

In our case, this is not an appropriate procedure. We very much want to consider initial situations in which FDI is prohibited in a sector, and liberalization opens the closed sector. In a complementarity framework this is not a technical difficulty. The difficulty is economic. We would like to know how profitable the excluded activity would be if the barrier were removed. This will obviously be very

quantitatively important to the results, which can range from zero in a perfectly competitive model (the barrier was redundant, the activity is not profitable with no barrier) to extremely high values. But there are no easily obtainable data for the "shadow price" of these restrictions.

(d) Bang-Bang Solutions We have chosen a structure of production that provides for firm-type product differentiation with national differences (see equation (3)). When the elasticities of substitution are equal at all levels, i.e., $\gamma = \delta = \epsilon$, the CES function reduces to strictly firm-level product differentiation. In this case, the final good sector is completely indifferent between a domestic of foreign variety. Decreasing n_m by one is perfectly matched in final sector productivity by increasing n_d by one; only the total number of varieties matters. If the costs of producing domestic or foreign services are not that different, and they are collectively a small part of total GDP, then we can get bang-bang solutions in which a small change in relative costs shift us from only domestic services being produced to only foreign services. This has indeed occurred in our simulations.

We have therefore set γ less than $\delta = \epsilon$: a domestic and foreign variety are poorer substitutes for one another than two domestic (or two foreign) varieties are for each other. In particular, the marginal productivity of either the domestic or foreign aggregate *ZD* and *ZM* goes to infinity as its share goes to zero. Then, as long as either foreign or domestic varieties are permitted to be produced and sold, they will both exist in the market and we will not have bang-bang solutions.

5. Simulation Results

Table 1 shows some simulation results from the static model. In these calculations, the elasticity of substitution among services of one firm type (domestic or foreign) is set at 5 while the elasticity of substitution between firm types is set at 3.

The model is benchmarked such that key variables have the values of one or zero initially. The first column of Table 1 shows results when imports of *V* are banned and hence *ZM* is zero. The country exports *Y* and imports *X*, and there is no trade in *V* (trade balance requires that the last three entries in a

column sum to zero). The prices for skilled and unskilled labor are real prices, the nominal price divided by the consumer price index.

Columns 2-6 of Table 1 gives results for counterfactuals with alternative values of p_v. Some explanation of this exercise is required and we begin first with the interpretation of alternative values of pv . One interpretation of p_v is the international "term-of-trade" for V. A lower p_v denotes better terms of trade insofar as how much X and/or Y the country must pay for the imported input V. Alternatively, p_v can be interpreted as a domestic price that must be paid for imported V, with this price above the foreign supply price due to a regulatory barrier or red tape. The difference between p_v and the foreign supply price is captured by the foreign supplier or is dissipated on regulatory procedures or red tape. That is, p_v is the real resource cost to the domestic economy of an imported unit of V. From the point of view of the *domestic* economy, either interpretation is the same.

Column 2 of Table 1 in which $p_v = 1$ is a very important special case and requires some explanation. Let w_0 and r_0 be the initial equilibrium values of w and r in column 1, where foreign FDI is banned. For $zd = zm$ (domestic and imported varieties produced in the same quantity), $p_v = 1$ is the value of p_v that satisfies the equality

$$\textbf{(39)} \qquad cd(r_0, w_0)zd + fd(r_0, w_0) = cm(r_0, w_0, p_v)zm + fm(r_0, w_0, p_v) \ .$$

That is, at the initial prices with FDI-banned, $p_v = 1$ means that cost of one unit of output from a representative foreign firm is equal to cost of a unit of output from a domestic firm. This is an interesting case because, in traditional competitive models, no entry would occur and the initial no-FDI equilibrium would continue to be an equilibrium once entry is permitted. However, at the initial price for a given variety, entry reduces the price index for intermediates, generating more demand thus supporting entry.

Column 2 of Table 1 confirms that there is a strong productivity (inverse of the price index) and welfare boost even at this price of V. In a competitive model without scale economies this second column would be identical to the first as just noted. The second column in fact shows a welfare increase of 3%.

One of the most interesting results is that the real wage of skilled labor rises by 7.0%. This is an

effects suggested earlier, in which the substitution effect away from domestic skilled labor (*V* economizes on domestic skilled labor in producing *ZM*) is outweighed by a scale effect. Imported services produce a sort of productivity effect that lowers the cost of final output and increases the *X*-sector's direct demand for skilled labor. A final interesting result in the second column is change in the trade pattern. Imports of X are eliminated due economy's increased ability to produce it domestically, and trade consists of a small export of *Y* to pay for imported *V*.

As the price of *V* falls, these results are amplified. This lower price for *V* may be economically reasonable, insofar as foreign multinationals have made large sunk investments and are willing to supply *V* at a low marginal cost when competing with one another. The number of domestic service firms continues to fall as the price of *V* falls, but this fall in demand for domestic skilled labor is outweighed by the scale effect in *X* production so that the real wage of skilled labor continues to rise. In the right-hand column of Table 1, the skilled-labor wage has risen by 40% while the real wage of the composite factor has fallen by 4%. These results are particularly dramatic if we want to think of *V* as largely consisting of imported skilled workers: they are clearly a general-equilibrium complement to domestic skilled labor.

Note the reversal of the pattern of trade in goods in the right-hand two columns of Table 1. When *V* is sufficiently cheap, the country imports *Y* and exports *X*. Finally, we might draw attention to the very large changes in welfare in Table 1. The model is calibrated so that imported services *ZM* have only a 10% value share in *X* production at the initial price of 1.0 for *V*, and *V* has only a 40% value share in producing *ZM*. Thus *V* has a 4.0% value share in *X* initially. Yet a fall in the cost of *V* to 20% of its initial value produces a 14.6% increase in welfare, a result that is due to scale/variety effect.

Earlier, we noted that the entry of a new service producer confers a positive productivity boost or "externality" on existing producers. To put is somewhat differently, a well-known result in this type of model is that the number of firms in market equilibrium is below the optimal number. In Figure 1, we therefore present results when we impose a tax/subsidy on imported *V*. Figure 1 uses column five of Table 1 (Price of *V* is 40%), and welfare changes are measured relative to the no-tax reference point (i.e., 1.07 in Table 1 is the basis for equivalent variations in income depicted in Figure 1). Figure 1 shows that the

optimal tax on V is in fact negative, the optimum is a subsidy of about 25%.

There are two opposing effects of a tax on V (the same would apply to a tax on zm). A tax on imported services or intermediate goods induces a substitution effect in favor of domestic "varieties". This effect shows up in models of differentiated final goods and leads to a positive optimal tax.

However, in addition to this "substitution" effect there is a "scale" effect. The extra imported varieties could be thought of as having a productivity-enhancing effect on final production: final production exhibits increasing returns in the range of intermediates. There is no general theoretical result as to which effect will dominate, the latter does in this model. The productivity effect is reflected in Table 1 by the fact that the real prices of *both* factors may increase relative to the benchmark. A related result is found in Lopez-de-Silanes, Markusen, and Rutherford (1994), where the authors find that the optimal tariff on auto parts imported into Mexico is negative. For theoretical foundations of this problem, see Markusen (1989, 1990).

The dynamic transition could require significant changes in the labor market, as illustrated in Figure 2 (recall that a lower-case *s* is a flow of new skilled workers, an upper case *S* is a stock). In this simulation, based on parameter values as described above, the transition to a new steady state takes about 7 years. During approximately the first seven years, all new entrants to the skilled labor market choose to work in the FDI sector.

The reason for this corner solution is indicated in Figure 3. In the long run, the wages for skilled workers in domestic and FDI firms are equalized, but during the transitional process, our assumption of imperfect mobility results in substantial differences in these wages. As indicated in the figure, liberalization raises the return to skilled workers in the FDI sector (r^M) by 15% while the return to skilled workers in the domestic sector (r^D) falls by about 12.5% initially and does not return to its initial value for five years. During this time the unskilled wage (w^U) rises by over 10%.

Figure 4 indicates how trade in goods (*X* and *Y*) and imported services (*V*) adjust through the transition process. The initial impact on service-intensive trade is to produce substantial imports in *X*. As

the number of FDI service firms rises, however, imports of these goods decline until, after 5 years, the economy becomes a net exporter of X. On the new steady-state, both X and Y are exported, and only V is imported.

The rate of transition depends crucially on the assumed mobility of (old) skilled workers between domestic and multinational firms as shown in Figure 5. Recall that the central case in Figures 2-4 sets this share at 50%. When the mobile fraction increases to 60% of the initial workforce, the return to these workers increases almost immediately. When the fraction is smaller, the wage of skilled workers falls and remains low for a number of years.

6. Conclusions

Although there is a clear trend among developing countries to liberalize their policies with respect to inward foreign direct investment (UNCTAD, 1995, 272-275), many developing countries continue to impose restraints on FDI in general and in services in particular. These policies may be motivated by the fear that foreign service providers will harm the domestic skilled workers that provide these services in domestic firms. For example, examination of the commitments on services of WTO members in their GATS schedules reveals that 32 countries (mainly in Africa and Latin America) have scheduled "horizontal restrictions" that require foreign firms to use and train domestic skilled workers. In many cases these restraints may impede the foreign firm from importing the specialized people it would desire.

In this paper we have examined the impact of the liberalization of policies to allow the formation of foreign firms that provide intermediate services. The foreign service providers import an input (which we interpret as a composite of foreign skilled labor and specialized technology), and economize on the use of domestic skilled labor compared to domestic firms that provide the substitute service.

We first examined this issue with a static model and showed that liberalization could lead to gains between 3 and 15 percent of GDP, depending on parameter assumptions. These are very large gains relative to what we might expect from a static model given that the imported input is only about 4% of X

output, or about half that as a share of host-country income. The source of these large gains is that additional intermediate service firms increase the productivity of the final goods sector that uses these firms services as intermediate inputs. More service firms allow final goods producers to use more specialized expertise, in the same way that larger markets allow for more specialized machine tools.

We have also constructed a dynamic model, which allows us to assess the transition path to a new steady state growth path and the adjustment costs. In our model, while the total number of firms and total factor productivity in the economy increases steadily from the first period, for the first 5 years the domestic industry progressively declines. Consequently, all new domestic entrants to the skilled labor force enter foreign firms, where real wages are higher for the first 5 years. Eventually the domestic industry stabilizes (the marginal product of domestic firms increases as the number of domestic firms declines). The potential losers during the transition are skilled workers in the domestic industry. These workers incur losses only when we make rather strong assumptions regarding the immobility of skilled workers and we assume that their human capital is specific to domestic firms and that only new entrants to the workforce can be trained to work in the foreign owned firms. When we assume that 50% of the workforce is immobile, after 5 years real wages of skilled workers are equalized across foreign and domestic owned service firms and are higher as a result of the liberalization of FDI in the service sector.

One of the more interesting results of the static and (in the long run) dynamic model is that the real wage of domestic skilled labor increases with liberalization of policies against foreign service providers, and the more foreign firms there are in the domestic market the more the real wage of domestic skilled workers increases. Thus, despite the fact that foreign firms import an input (V) and thereby use domestic skilled labor less intensively than domestic firms, additional foreign firms benefit domestic skilled labor. The reason is that additional foreign firms lower the cost of the intermediate service product in final goods production and thereby increase the relative importance of the final good sector (X), which uses services relatively intensively. Thus, in a general equilibrium sense, domestic skilled labor and the specialized foreign input V are complements. One possible interpretation of this result is that the policies of certain

developing countries that restrain the import of foreign inputs or force foreign multinationals to use domestic skilled factors in place of foreign inputs may not only result in lost national income, but may hurt the factor of production they are designed to assist.

Finally, in the dynamic model , the real prices of both skilled and unskilled labor rise over the long run, and thus the economy avoids the curse of Stolper-Samuelson in which one factor must be made worse off. Everyone gains in the long run, and the economy switches (in our example) to exporting a good that was previously imported due to “missing inputs”.

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Table 1 Welfare and Growth Impacts

	IRS-CAPFLOW			CRT-CAPFLOW	IRS-BOPCON
	$p_s = 0.95$ $\gamma = 0.25$	$p_s = 0.90$ $\gamma = 0.25$	$p_s = 0.95$ $\gamma = 0$	$p_s = 0.95$ $\gamma = 0.25$	$p_s = 0.95$ $\gamma = 0.25$
Hicksian EV (%)	3.13	6.63	1.65	0.07	0.93
G_{2010} (%)	2.19	2.40	2.09	2.01	2.02
G_{2050} (%)	2.09	2.18	2.05	2.00	2.03

Table 2 Sensitivity Analyses

	Armington elasticity of substitution between imports and domestic goods in intermediate and final demand		
	1	2	4
Hicksian EV (%)	3.13	3.40	4.79
G_{2010} (%)	2.19	2.22	2.35
G_{2050} (%)	2.09	2.09	2.12

	Elasticity of transformation between goods produced for the domestic and export markets:		
	1	2	4
Hicksian EV (%)	3.13	4.59	5.73
G_{2010} (%)	2.19	2.32	2.44
G_{2050} (%)	2.09	2.12	2.14

	Maximum market share of foreign consultants in the domestic market.		
	10%	15%	25%
Hicksian EV (%)	3.13	3.40	3.71
G_{2010} (%)	2.19	2.21	2.23
G_{2050} (%)	2.09	2.09	2.10

Table 3 Welfare and Growth Impacts of a Subsidy to Foreign Consultants

	IRS-CAPFLOW		
		γ=0.25	
	$p_s = 0.95$	$p_s = 1.188$	$p_s = 0.95$
	$s = 0$	$s = 0.20$	$s = 0.20$
Hicksian EV (%)	3.13	3.09	13.46
G_{2010} (%)	2.19	2.19	2.70
G_{2050} (%)	2.09	2.08	2.36
Subsidy cost (%)	0	0.02	0.07

Figure 1: Consultant Share of Domestic Market (%)

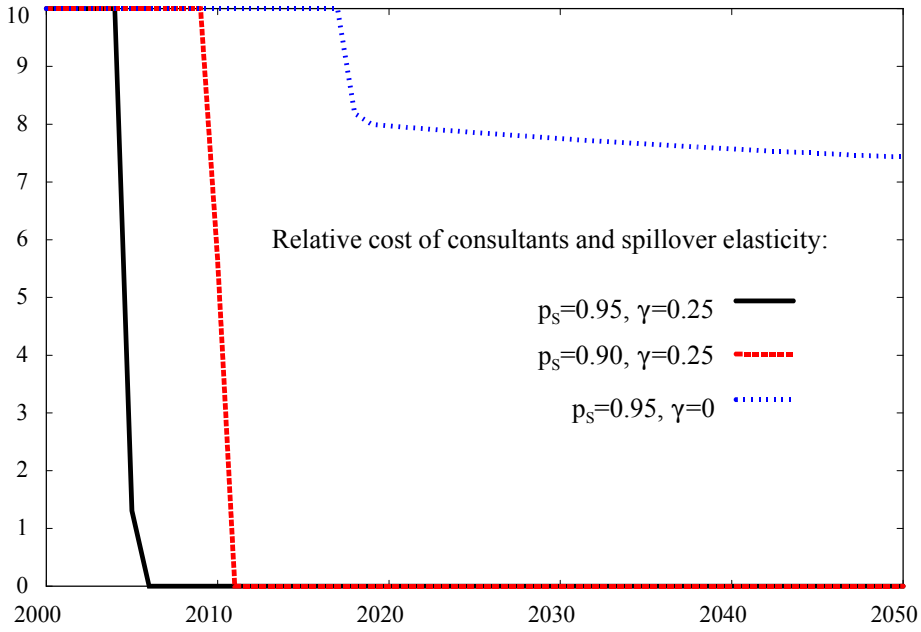

Figure 2: Rate of Entry for New Firms (% change)

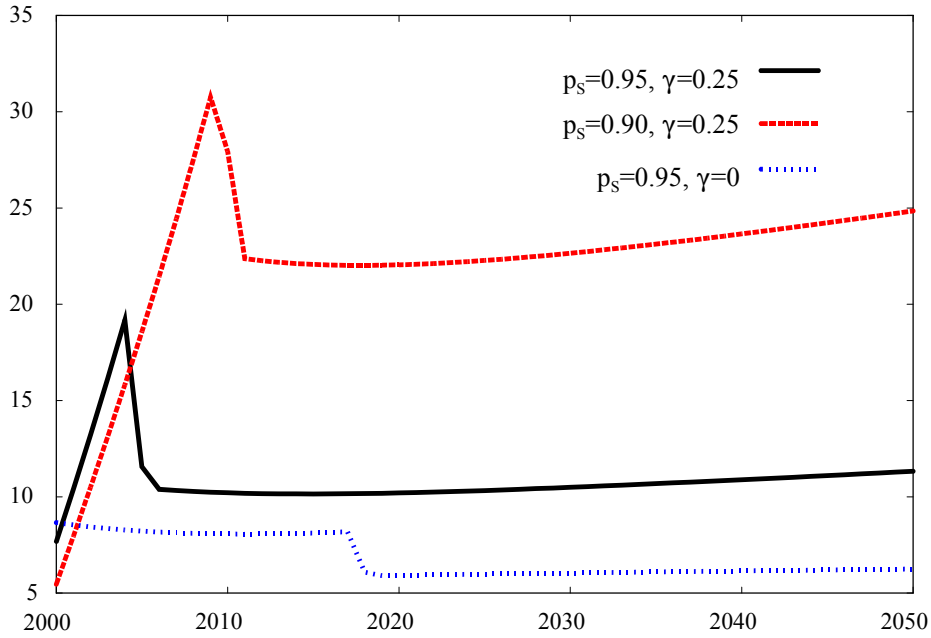

Figure 3: Macroeconomic impacts for p_S=0.95 (% change)

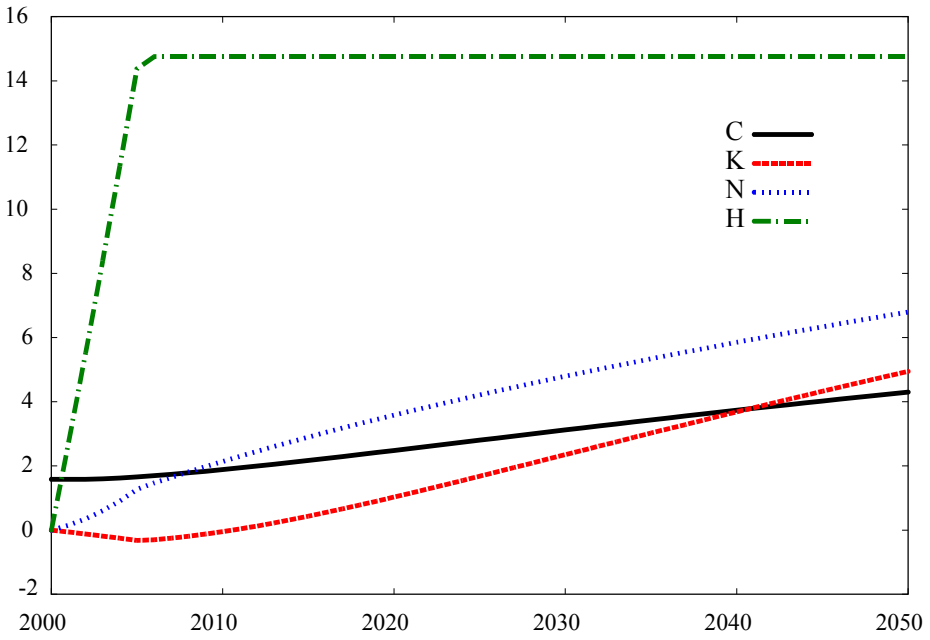

Figure 4: Current Account Deficit (% change)

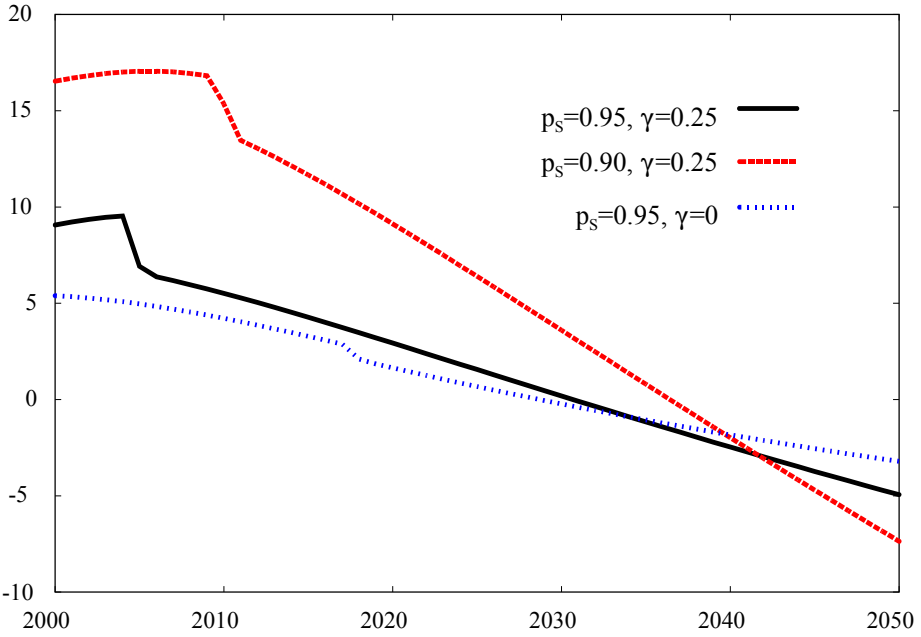

Figure 5: Firm Entry (% change)

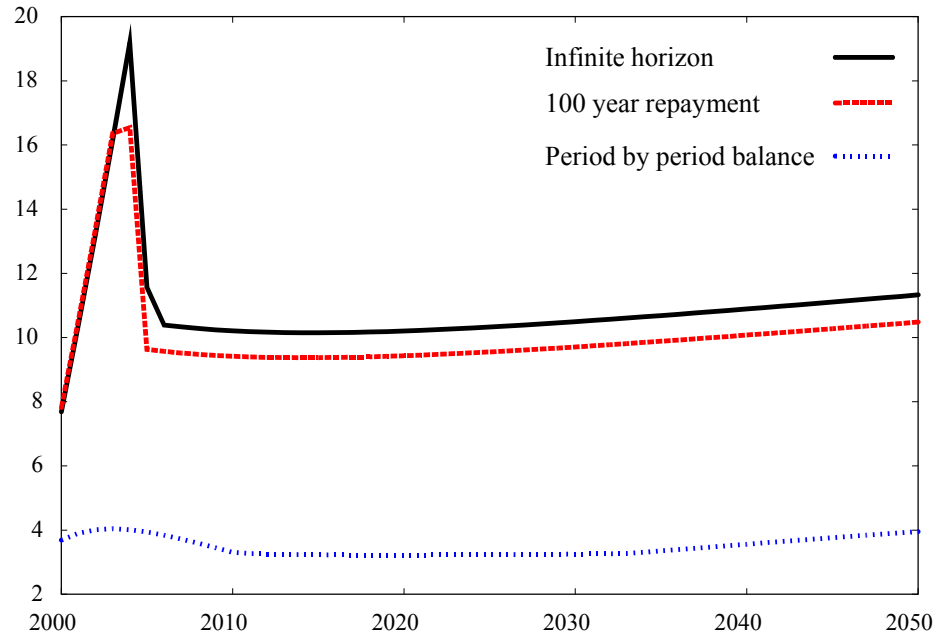

Figure 6: Subsidies and Firm Entry (%change)

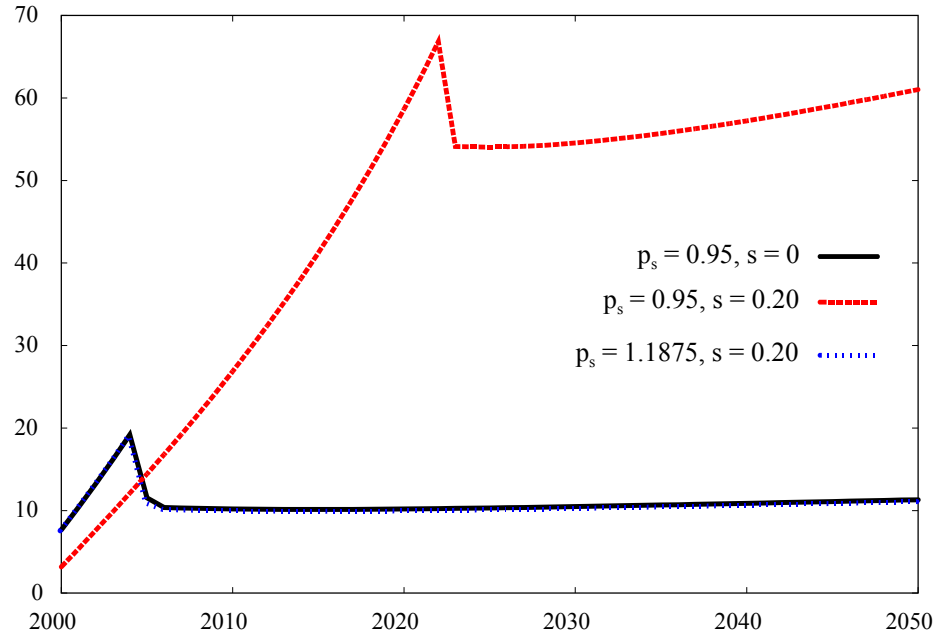

Figure 7: Subsidies and the Return to Human Capital 1 (% change)

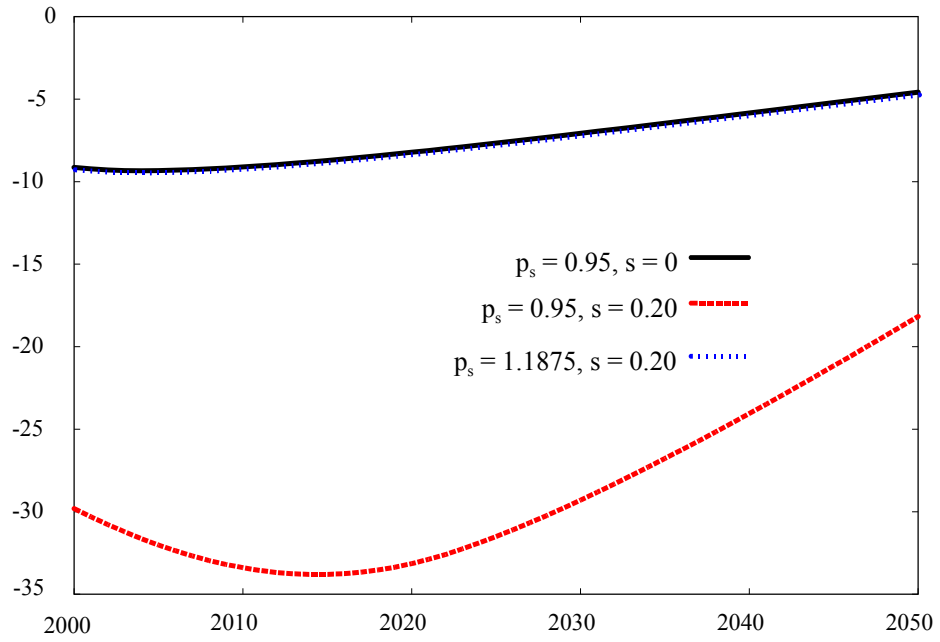

Figure 8: Subsidies and the Return to Human Capital 2 (% change)

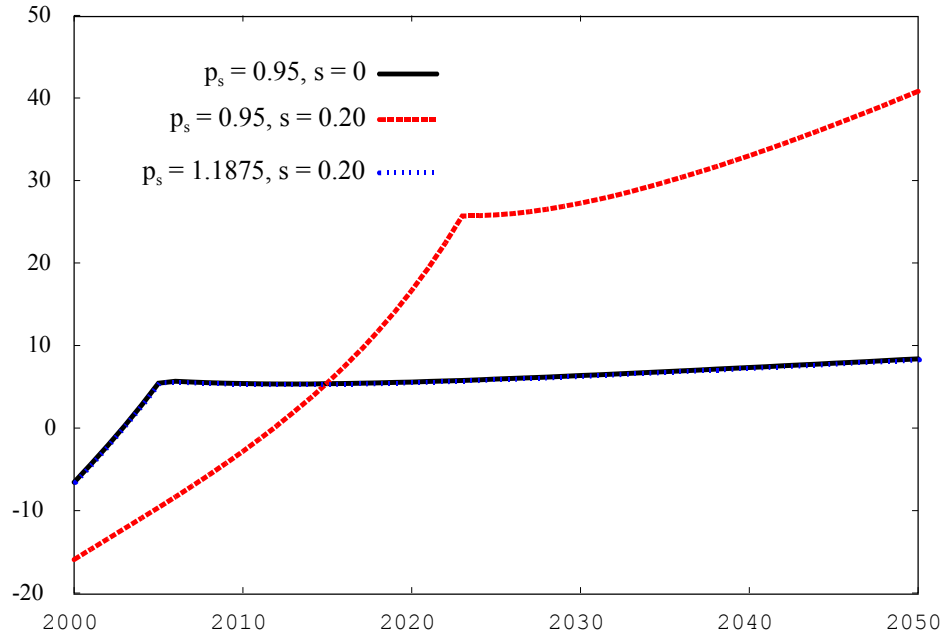

Figure 9: Subsidies and Consumption (% change)