CHAPTER 6

Putting Services and Foreign Direct Investment with Endogenous Productivity Effects in Computable General Equilibrium Models

David G. Tarr
World Bank

Abstract

In this chapter I explain an innovative modeling approach that incorporates services, foreign direct investment (FDI) and endogenous productivity effects from services. I begin with a small stylized model to help understand the fundamental economics. The model shows that services liberalization yields welfare gains several multiples of the welfare gains obtained from a constant to returns to scale model. Further, the welfare gains are supported by the econometric estimates of the gains from trade or FDI liberalization. I then describe computable general equilibrium studies by my colleagues and I conducted for the Russian government on the potential effects of Russian accession to the World Trade Organization (WTO). We find that the projected welfare gains generated from liberalization of barriers against foreign direct investment are about 5% of consumption, with the total benefits of all aspects of WTO accession being about 7% of consumption. We find that almost every household in Russia would be expected to gain from WTO accession. We show, however, that a model of Russian WTO accession that fails to incorporate FDI in services and endogenous productivity effects from additional services would yield an estimated gain of less than 1% of consumption with about 7% of the households losing. Reviews of the work have indicated that the work has had a significant influence on the public debate and helped the Russian government to steer public opinion in favor of WTO accession. In the process of doing this work, T. Rutherford and I developed a technique for incorporating tens of thousands of households as agents of the model. All of the major results in the chapter are shown to be robust under sensitivity analysis.

Keywords

Services liberalization, foreign direct investment, endogenous productivity effects, WTO accession, trade and poverty, trade policy modeling

JEL classification codes

F12, F13, F23, C68, C63

Handbook of CGE Modeling - Vol. 1 SET
ISSN 2211-6885, http://dx.doi.org/10.1016/B978-0-444-59568-3.00006-7

6.1 INTRODUCTION

Services now constitute about 70% of global GDP.[1] Moreover, foreign direct investment (FDI) flows have shifted toward services and now constitute almost half of the total FDI flows in developing countries.[2] Recognizing their importance and the need to have special rules to treat trade in services, the General Agreement on Trade in Services (GATS) was incorporated into the World Trade Organization (WTO) when it was formed in the mid-1990s. Further, services are now a key part of the regional agreements of both the US and the EU.

Given that services cannot be stored, FDI, to achieve a domestic presence (what is known as the proximity burden), has historically been crucial to the effective delivery of services. While technological change has progressively allowed more services to be supplied on a cross-border basis, to effectively compete in services "trade," it still is likely that it requires more of a domestic presence than trade in goods.[3] Given the key role of FDI in the effective delivery of services, commitments to foreign investors are key aspects of trade negotiations in services. With the growing importance of services trade and FDI in services, it is important to have a framework with which we can analyze the impacts of the liberalization of barriers to FDI in services.

The way my coauthors and I have modeled services builds crucially on the growing body of empirical evidence that shows that increased access to services, increased FDI in services or services liberalization increases the productivity of the manufacturing sectors and of the economy as a whole (see Rutherford and Tarr, 2008, 2010; Markusen *et al.*, 2005a,b; Jensen *et al.*, 2006, 2007, 2010; Balistreri *et al.*, 2009; Jensen and Tarr, 2008, 2011; Balistreri and Tarr, 2011). Further there is evidence that increased access to imported intermediate goods increases economy-wide productivity. I summarize the computable general equilibrium (GCE) modeling literature on services in GCE modeling below, where I argue that our approach is the first to incorporate the liberalization of barriers against FDI in services where endogenous productivity impacts play an important role in the results. In our full applied models, we also incorporate the endogenous productivity impacts from increased access to intermediate goods. We have shown that in applications where liberalization of barriers against foreign investors in services is important, such as in accession to the WTO, the estimated welfare gains depend crucially on our modeling framework — the estimated welfare gains are several multiples of the estimated gains of models without FDI in services and endogenous productivity effects. Given the crucial importance of productivity impacts to our mo deling framework, I begin with a survey of the literature on the impact of services

1 Francois and Hoekman (2010, p. 644).
2 See World Bank (2004), *Global Development Finance*.
3 Data on the sales of foreign affiliates of US firms suggests that sales through FDI are the most important channels for US firms to sell services to foreigners (Francois and Hoekman, 2010, p. 655).

liberalization on economy-wide productivity and the impact of increased access to intermediate goods on productivity.

6.1.1 Impact of services availability and services liberalization on productivity[4]

First, several studies using firm-level data have established a link between increased access to services and increases in productivity. Using panel-level data and controlling for FDI endogeneity, Arnold *et al.* (2011) for the Czech Republic, Fernandes and Paunov (2012) for Chile, Shepotylo and Vakhitov (2012) for Ukraine, and Arnold *et al.* (2012) for India find a significant positive relationship between FDI in services following liberalization (especially allowing foreign entry) and the performance of downstream domestic firms in manufacturing. Arnold *et al.* (2008) find a statistically significant positive relationship between productivity in a sample of over 1000 firms in 10 Sub-Saharan countries and the performance of the three service industries for which they collected data. Several papers have shown (e.g. Fink *et al.*, 2005) that openness in a range of producer or intermediate service sectors is linked to increased export competitiveness and performance for high-technology sectors, for which services tend to be an important element of total cost.

Second, using cross-country growth regressions, several studies have found that open-services regimes induce greater growth rates. Mattoo *et al.* (2006) find (after controlling for other determinants of growth) that countries with open financial and telecommunications sectors grew about 1 percent faster than other countries.[5] Eschenbach and Hoekman (2006) find that measures of services sector reform were statistically significant explanatory variables in explaining growth in their sample of 20 transition countries. Fernandes (2009) finds that liberalization of services in transition countries had a positive and significant effect on labor productivity growth that was stronger the more distant the sector was from the technological frontier.

Several other studies also show a link to services availability and productivity. Triplett and Bosworth (2004) calculate that productivity growth in distribution and financial services fueled much of the post-1995 overall expansion in US productivity. Inklaar *et al.* (2008) show that differences in aggregate productivity levels and growth rates in seven Organization for Economic Cooperation and Development (OECD) countries are largely attributable to services sectors. That is, much of the differential in their sample is due to variation in business services performance. Ciccone and Hall (1996)

[4] This section draws on the survey paper by Francois and Hoekman (2010). The reader should consult that source for a more complete review of the literature on the impact of services availability and services liberalization on productivity and growth.

[5] Their results are consistent with several other studies that find a positive relationship between financial sector openness and economic growth. See Levine (2005).

show that firms operating in economically dense areas are more productive than firms operating in relative isolation. Hummels (1995) shows that most of the richest countries in the world are clustered in relatively small regions of Europe, North America and East Asia, while the poor countries are spread around the rest of the world. He argues this is partly explained by transportation costs for inputs since it is more expensive to buy specialized inputs in countries that are far away. The high cost of using far-away inputs is especially true of business services that are not provided locally, as Marshall (1988) shows that in three regions in the UK (Birmingham, Leeds and Manchester) almost 80% 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.

6.1.2 Endogenous productivity effects through the Dixit–Stiglitz mechanism

As early as the 1960s, the urban and regional economics literature (e.g. Chinitz, 1961; Vernon, 1960) argued that non-tradable intermediate goods (primarily producer services produced under conditions of increasing returns to scale) are an important source of agglomeration externalities that account for the formation of cities and industrial complexes, and account for differences in economic performance across regions. The more recent economic geography literature (e.g. Fujita *et al.*, 1999) has also focused on the fact that related economic activity is economically concentrated due to agglomeration externalities. I believe it is crucial to capture this endogenous productivity effect of better access to services providers. The key mechanism used in the economic geography literature, as well as in the endogenous growth theory (e.g. Romer, 1990), is the Dixit–Stiglitz mechanism. The Dixit–Stiglitz mechanism is so widely employed because it provides a micro-foundation for the link between a change in policy and productivity growth. The models in this paper capture the productivity effects of additional service suppliers through use of the Dixit–Stiglitz–Ethier[6] mechanism, whereby additional varieties of business services increase the productivity of the firms that use the services.

Similarly, beginning with the path-breaking work of Coe and Helpman (1995), a rich literature now exists (summarized in Section 6.3 below) that has empirically shown that total factor productivity increases due to the purchase of imported intermediate goods, and the productivity impact is stronger the more technologically advanced is the country

[6] Ethier (1982) made the key extension of the Dixit–Stiglitz framework for our purposes; he showed how liberalization of international trade could lead to productivity increases when imports are used as intermediate inputs. We use the phrases Dixit–Stiglitz framework and Dixit–Stiglitz–Ethier framework synonymously in the paper.

that is the source of the imports. Thus, we also employ the Dixit—Stiglitz—Ethier mechanism for varieties of goods in those goods sectors that are subject to imperfect competition and increasing returns to scale. In perfectly competitive goods or services sectors, there are no productivity effects from additional trade.

6.1.3 Small gains from trade without productivity impacts from trade

Further, focusing on the goods trade alone in international trade liberalization analysis in combination with constant returns to scale (CRTS) models has led to very small estimated welfare gains. Typically the estimated gains are less than 1% of GDP — a result that has loosely come to be known as the "Harberger constant." However, econometric estimates of the gains from an open trade regime suggest that the gains are much larger. Rutherford and Tarr (1998, appendix A) have analytically derived the relationship between a permanent increase in the steady-state growth rate and the equivalent variation. A welfare gain of between 10 and 35% of consumption corresponds to a permanent increase in the growth rate of between 0.4 and 1%. A policy-induced change in the growth rate of this magnitude is quite plausible in the context of the actual long-term *per capita* growth rates over the 25- to 30-year period beginning in 1962 and in the context of evidence on the impact of services liberalization cited above. For example, Sachs and Warner (1995) estimate that open economies have grown about 2.45% faster than closed economies, with even greater differences for open versus closed economies among developing countries. They note that trade liberalization is often accompanied by macro stabilization and other market reforms, and their open economy variable may be picking up these other effects as well. However, they argue that trade liberalization is the *sine qua non* of the overall reform process, because other interventions such as state subsidies are often unsustainable in an open economy. Although the estimates of the gains from trade liberalization based on cross-country growth regressions are controversial, there are a few reasons to believe that the gains are very substantial. Frankel and Romer (1999) have shown that adjusting for the simultaneity bias in cross-country regression studies such as Sachs and Warner does not reduce the estimated impact of openness on growth. Further, the significant literature, starting with Coe and Helpman (1995), on the productivity gains from imported intermediates is largely unchallenged at this time. Finally, the cross-country growth regressions focus on trade in goods, so the estimates of the gains from openness to FDI in services should further contribute to the gains.

Since trade policy is inherently controversial, policy makers wonder why they should undertake the exercise if so little is at stake. CRTS models without services, by missing the productivity gains, from an open trade regime and FDI regimes in service are missing most of what is important.

6.1.4 Literature

Christen *et al.*, in Chapter 25 of this Handbook, provide a review of the numerical general equilibrium modeling of services. I therefore focus here on the papers most closely related to the models in this chapter. There have been a number of theoretical papers modeling FDI liberalization in services, including Markusen (1989, 1990), Francois (1990a,b) , and Markusen and Venables (1998). The modeling here incorporates a key idea of Markusen, i.e. that when multinationals engage in FDI, they bring technology or expertise to the local production process. They therefore have a different cost structure than local firms in the same sector.

Brown *et al.* (1996), Robinson *et al.* (2002) and Francois *et al.* (2005) examined the liberalization of barriers in services, but focused on cross-border trade in services. The paper by Robinson *et al.* (2002) incorporated productivity impacts from additional services, but did so through exogenous productivity shocks.[7] Francois *et al.* (2005) incorporated monopolistic competition in manufacturing and services sectors, but did not incorporate productivity impacts.

Lejour *et al.* (2008) model FDI in services, but do not incorporate productivity effects. Brown and Stern (2001) and Dee *et al.* (2003) employ multicountry numerical models with many of the same features I outline in the models below. Their models contain three sectors: agriculture, manufacturing and services, and are thus rather stylized. Results in the Brown and Stern paper depend crucially on capital flows between nations, with capital importing nations typically gaining and capital exporting nations typically losing. In Dee *et al.* (2003), multinationals are assumed to capture the quota rents initially. So, the results of liberalization depend crucially on the fact that liberalization transfers rents to capital importing countries. Since their models contain only one services sector, it is not possible to estimate barriers at the level of a particular business services sector. Moreover, it appears that the productivity impacts of additional services are not significant in their models as they are not discussed in the interpretation of results.

6.1.5 Outline of the chapter

In this chapter, I report on the efforts of my coauthors and I to incorporate FDI in business services with endogenous productivity effects. I show that our approach results in estimated gains from liberalization that are several orders of magnitude larger than in

[7] In their approach they make the coefficient that multiplies the use of capital and labor into output a function of the trade intensity. For example, if the production function in a sector is Cobb–Douglas, i.e. $Y = A^{\pi}K^{\alpha}L^{(1-\alpha)}$, they introduce a parameter π that increases with the trade intensity of the sector and where the change in the parameter π depends on the region of the imports. Then trade liberalization has a positive productivity impact in their model. Since the change in the trade intensity of each sector is endogenous, the extent of the productivity increase in their model is endogenous. However, the specification of the production function lacks a micro-foundation for the productivity increase; it is analogous to Hicks neutral technical change in the exogenous growth theory.

models without services and endogenous productivity effects. In order to understand the key features, I begin in Section 6.2 with a stylized model where it is relatively straightforward to describe the model mathematically, have clearly understood the FDI and endogenous productivity mechanisms that are key to the results and important differences we may obtain incorporating FDI in services with endogenous productivity effects in the model. In Section 6.3, I describe the first full economy application of this model: the case of Russian accession to the WTO, where our model of Russia contains a single representative consumer. To capture the productivity effects of a more open trade regime, I also employ the Dixit–Stiglitz–Ethier mechanism in goods sectors subject to increasing returns to scale, but do not incorporate FDI in goods sectors. In Section 6.4, I extend the model to a "real household" model by incorporating all 50 000 plus households of the Russian Household Budget Survey (HBS) as agents in the model, while retaining the modeling features introduced in the representative household model described in Section 6.3. I conclude in Section 6.5 with some extensions and other applications of these models, and a discussion of how these models impacted policy discussions in Russia, Ukraine and Kazakhstan.

6.2 MODELING SERVICES AND FDI IN A STYLIZED SMALL CGE MODEL[8]

In order to gain intuition into the features of models with producer services and FDI, we begin with a small stylized model in which it will be relatively straightforward to illustrate how this class of models differs from CRTS models without FDI.

6.2.1 Model and calibration

6.2.1.1 Model

In this section, we will model producer services as intermediate inputs. In all the applied economy models in later sections, services are also used as final consumption goods. 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. 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 supplies and are immobile between countries. The production function for Y

[8] This section is based on the comparative static model in Markusen *et al.* (2000, 2005), where a dynamic version of the model may also be found. The computer code and data for calibration may be found as an appendix to Markusen *et al.* (2000).

is written in Cobb–Douglas form to facilitate comparison with X, but in the numerical model we allow the more general constant elasticity of substitution (CES) production function. In order to illustrate the importance of the intensity of services use in final goods production, we assume that only the X sector uses services as an intermediate input:

$$Y = S_y^{\alpha_y} L_y^{(1-\alpha_y)}. \tag{6.1}$$

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

$$X = S_x^{\alpha_x} L_x^{\beta_x} Z_x^{(1-\alpha_x-\beta_x)}. \tag{6.2}$$

In our central parameter assumptions, we will also 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 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:

$$Z_x = \left(ZD^{\gamma} + ZM^{\gamma}\right)^{1/\gamma} \tag{6.3}$$

$$ZD = \left[\sum\nolimits_{i=1}^{n_d} zd_i^{\delta}\right]^{1/\delta} \quad ZM = \left[\sum\nolimits_{i=1}^{n_m} zm_i^{\epsilon}\right]^{1/\epsilon} \tag{6.4}$$

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. Let C^D and C^M be the cost functions 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:

$$C^{\mathrm{D}}(r, w, zd) = cd(r, w)zd + fd(r, w) \tag{6.5}$$

$$C^{\mathrm{M}}(r, w, p_v, zm) = cm(r, w, p_v)zm + fm(r, w, p_v). \tag{6.6}$$

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:

$$L = L_y + L_x + n_{\mathrm{d}} C^{\mathrm{D}}_{\mathrm{w}} + n_{\mathrm{m}} C^{\mathrm{M}}_{\mathrm{w}} \tag{6.7}$$

$$S = S_y + S_x + n_{\mathrm{d}} C^{\mathrm{D}}_{\mathrm{r}} + n_{\mathrm{m}} C^{\mathrm{M}}_{\mathrm{r}}, \tag{6.8}$$

in which C^j_{w} and C^j_{r} represent the partial derivatives of unit cost for firm type j with respect to the unskilled wage rate and the wage rate of skilled labor, respectively, where j is equal to either D or M. (By Shephard's lemma, these are the compensated demand functions.)

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:

$$U = U(X_{\mathrm{c}}, Y_{\mathrm{c}}), \tag{6.9}$$

The trade balance condition 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). The trade balance is given by:

$$p^*_x(X_{\mathrm{p}} - X_{\mathrm{c}}) + p^*_y(Y_{\mathrm{p}} - Y_{\mathrm{c}}) - p^*_v V = 0, \tag{6.10}$$

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

$$V = n_{\mathrm{m}} C^{\mathrm{M}}_{\mathrm{p}_v}. \tag{6.11}$$

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.[9] From the chain rule, we have:

$$\frac{\partial X}{\partial zm_i} = \frac{\partial X}{\partial Z_x}\ \frac{\partial Z_x}{\partial ZM}\ \frac{\partial ZM}{\partial zm_i}. \tag{6.12}$$

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 composite prices and quantities as fixed except for its own output zm_i. Using Equations (6.2), (6.3) and (6.4), we have that the marginal product of zm_i is:

$$\frac{\partial X}{\partial zm_i} = (1-\alpha_x-\beta_x)S_x^{\alpha_x}L_x^{\beta_x}Z_x^{-\alpha_x-\beta_x}[ZD^{\gamma}+ZM^{\gamma}]^{\frac{1}{\gamma}-1}ZM^{\gamma-\epsilon}zm_i^{\epsilon-1}. \tag{6.13}$$

Let p_x denote the domestic price of X and p_{zm_i} denote the price received by the producer of a representative zm_i. Since final X production is assumed competitive, p_{zm_i} is the value of the marginal product of zm_i in producing X. That is:

$$p_{zm_i} = p_x(1-\alpha_x-\beta_x)S_x^{\alpha_x}L_x^{\beta_x}Z_x^{-\alpha_x-\beta_x}[ZD^{\gamma}+ZM^{\gamma}]^{\frac{1}{\gamma}-1}ZM^{\gamma-\epsilon}zm_i^{\epsilon-1}. \tag{6.14}$$

Revenue of an individual producer of zm_i is price times quantity:

$$zm_i p_{zm_i} = p_x(1-\alpha_x-\beta_x)S_x^{\alpha_x}L_x^{\beta_x}Z_x^{-\alpha_x-\beta_x}[ZD^{\gamma}+ZM^{\gamma}]^{\frac{1}{\gamma}-1}ZM^{\gamma-\epsilon}zm_i^{\epsilon}. \tag{6.15}$$

Then marginal revenue takes a very simple form:

$$MR_{zm_i} = p_x(1-\alpha_x-\beta_x)S_x^{\alpha_x}L_x^{\beta_x}Z_x^{-\alpha_x-\beta_x}[ZD^{\gamma}+ZM^{\gamma}]^{\frac{1}{\gamma}-1}ZM^{\gamma-\epsilon}\epsilon zm_i^{\epsilon-1} = \epsilon p_{zm_i}. \tag{6.16}$$

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 $p_{zm_i} = p_{zm}$ for all i. Similar conclusions follow for domestic firms.

Then equilibrium for a symmetric group of service firms (zm or zd) requires that two equations are satisfied: marginal revenue equals marginal cost; and zero profits:

$$MR = MC : p_{zm}\epsilon = cm(r,w,p_v) \tag{6.17}$$

$$p_{zm} = AC : p_{zm} = cm(r,w,p_v) + fm(r,w,p_v)/zm. \tag{6.18}$$

[9] A similar argument applies to zd_i.

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

$$zm = \frac{\epsilon}{1-\epsilon}\frac{fm(r,w,p_v)}{cm(r,w,p_v)} = (\sigma_m - 1)\frac{fm(r,w,p_v)}{cm(r,w,p_v)}. \tag{6.19}$$

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 (6.4) are cost functions. When firms minimize the cost of purchasing foreign (domestic) varieties of services, the cost of one unit of the composite foreign (domestic) variety ZM (ZD) is:

$$CM = \left[\sum_{i=1}^{n_m} p_{zm_i}^{1-\sigma_m}\right]^{\frac{1}{1-\sigma_m}}, \quad \sigma_m = \frac{1}{1-\epsilon} \tag{6.20}$$

$$CD = \left[\sum_{i=1}^{n_d} p_{zd_i}^{1-\sigma_d}\right]^{\frac{1}{1-\sigma_d}}, \quad \sigma_d = \frac{1}{1-\delta}. \tag{6.21}$$

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

$$CD = \frac{p_{zd}}{n_d^{\sigma_d - 1}} \quad CM = \frac{p_{zm}}{n_m^{\sigma_m - 1}}. \tag{6.22}$$

Since the elasticities of substitution exceed unity, the cost of obtaining an aggregate unit of foreign or domestic services declines as the number of varieties increases. That is, additional varieties convey an externality to the final goods sector X by lowering the cost of obtaining a unit of composite services. The elasticity of the cost of a unit of composite foreign services with respect to the number of foreign varieties is $(1-\sigma_m)$. Thus, if an additional 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.

We make the "small country assumption," that prices to the country are fixed. This means we assume, in addition to fixed prices of X and Y, that there are a large number of potential foreign firms in production in the rest of the world so the domestic market has no "world" effect on the number of multinationals.

6.2.1.2 Calibration of the model

The computer code for this model (with explanations) and the social accounting matrix (SAM) for the calibration are available in an appendix to Markusen *et al.* (1999). In the initial equilibrium, the value of Y is 120 and the value of X is 80. Y does not use services and X uses 25 units of services. So services are 12.5% of the economy in the initial equilibrium. Imports of V are banned in the initial equilibrium, so there are no foreign

services initially. We assume that the world price of V is 0.2. The model is calibrated so that when imported inputs V have a price of one (a barrier of 400%), the costs of producing domestic and foreign services are equal, imported services ZM have a 10% value share in X production and V has a 40% value share in producing ZM. Thus, with $p_v = 1$, V has a 4.0% value share in X and about 2% of the income of the home country. The various shares and elasticities are assumed without empirical support.

6.2.2 Modeling issues

6.2.2.1 Initially inactive activities

Often 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 this case, this is not an appropriate procedure. We 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. In Section 6.3 below, we explain how we have approached this problem in full models.

6.2.2.2 Firm-level product differentiation or differentiation by region of origin and bang-bang solutions

We have chosen a structure of production that provides for firm-type product differentiation with national differences, see Equations (6.3) and (6.4). 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 or 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 is from only domestic services being produced to only foreign services. This has indeed occurred in our simulations.

On the other hand, we have set γ less than $\delta = \epsilon$ (which may be justified by economic arguments as noted above). We have set the elasticity of substitution between aggregate domestic services and aggregate multinational services at 3, and the elasticity of substitution among services of one firm type (domestic or foreign) at 5. In this case, domestic and foreign varieties have different impacts on the productivity of the final goods sector.

The total number of varieties is not all that is important, but also the share of foreign and domestic varieties are concerned. 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.

The same result could be achieved by adding preference parameters to Equation (6.3) as:

$$Z_x = [\alpha ZD^{\gamma} + (1-\alpha) ZM^{\gamma}]^{1/\gamma}. \tag{6.23}$$

In the full model applications discussed below, we have chosen a pure firm-level product differentiation; but have added sector-specific factors of production for each firm type, which limit bang-bang solutions. See Section 6.3 below for an elaboration of these issues.

6.2.3 Simulation results

6.2.3.1 What is the counterfactual

There are a myriad of barriers applied against FDI by multinational services providers. These include limitations on the use of expatriate labor, domestic content requirements, restrictions on the expatriation of profits, denial of licenses to operate or sell services, restraints on how a firm can do business (such as joint venture requirements with national entities), requirements to transfer technology and simply increasing the red tape costs of multinationals. Most, but not all such barriers, are non-tariff barriers that raise the costs to multinational firms of supplying services. Recent estimates of the *ad valorem* equivalence of barriers against multinational services providers exhibit an enormous variance, but for some countries and products, the cost of domestic services may be elevated by as much as 1000% (see, e.g. Kang, 2000; Warren, 2000). We model the variable V as the key input required for FDI and assume that any barriers imposed on multinational investment fall on the cost of importing V. In principle, the costs of barriers could fall on the output of the multinational firm or on the use of its domestic resources. However, insofar as many barriers restrain how the business operates or the nature of the firm, we prefer to assume that the cost of barriers falls on the foreign input V.

To understand the policy simulations requires further explanation of the value of p_v and the meaning of changes in its value. Since this is a real model, all prices are relative to the numéraire, which is the cost of one unit of utility using our specified utility function. Thus, p_v is the cost of a unit of V in terms of the basket of goods consumed by the representative agent. Our small country assumption implies that there is a foreign supply price of V, which we denote p^s_v, where again this supply price is relative to our numéraire. We assume that there are regulatory barriers or red tape that result in a difference between the foreign supply price of V and the price of a unit of V to the

Table 6.1 Impact of lowering the barriers against imported specialized inputs (skilled labor, blueprints, patents, etc.) of multinational services providers (price of specialized inputs V[a] to the home country or % ad valorem barrier against imported specialized inputs)

	Price/% barrier					
Variables	**+INF/+INF (1)**	**1.00/400 (2)**	**0.80/300 (3)**	**0.60/200 (4)**	**0.40/100 (5)**	**0.20/0 (6)**
1. Welfare	1.00	1.03	1.03	1.05	1.07	1.15
2. Real wage of skilled labor	1.00	1.07	1.07	1.11	1.14	1.40
3. Real price of other primary factor (the composite factor)	1.00	0.99	1.01	1.00	1.02	0.96
4. No. of domestic service firms	1.00	0.45	0.35	0.24	0.11	0.03
5. No. of foreign service firms	0.00	0.51	0.67	0.98	1.42	2.80
6. Net imports of X	1.00	0.00	0.00	−0.41	−0.63	−3.01
7. Net imports of Y	−1.00	−0.26	−0.31	0.00	0.11	2.18
8. Net imports of V	0.00	0.26	0.31	0.41	0.52	0.83

[a]We set 0.2 as the international supply price of the specialized input V. Prices above 0.2 are due to barriers against importing the input and represent real resource costs to the home country. The *ad valorem* equivalent of the barriers against the inputs are listed below the price of V.

importing country. The difference, $p_v - p^s{}_v$, is dissipated due to regulatory barriers. That is, p_v is the real resource cost to the domestic economy of an imported unit of V.[10]

In our policy simulations we shall lower the value of p_v toward the foreign supply price p^s_v. It is perhaps easier to think of this if we define t as the *ad valorem* equivalent of the barriers against imported inputs into FDI in services. Then $p_v = p^s{}_v\ (1 + t)$ and our simulations can be thought of as our small open economy (SOE) lowering t, the *ad valorem* equivalent of its barriers against imported inputs into multinational service production.

We assume that in the initial equilibrium of the model, the barriers against imported inputs into multinational production are so high that no imported inputs are permitted, so there is no foreign production in the domestic market. That is, the *ad valorem* equivalence of the barriers against imported inputs into multinational production are infinite. The first column of Table 6.1 shows results of this initial equilibrium, when imports of V are banned. Hence, the value zero is displayed in two rows of column (1): the number of foreign service firms and imports of the variable V. 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). We choose units of other variables displayed so that they are unity in the initial equilibrium.

[10] In our applied models of Russia below, we calculate the impact of assuming domestic rent capture of the barriers. An alternate 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 or Y the country must pay for the imported input V. From the point of view of the *domestic* economy, either interpretation is the same.

In Table 6.1, the columns are headed by various values of p_v and by the equivalent *ad valorem* barrier to imports of inputs of V (in percentage terms). We set the foreign supply price $p^s_v = 0.2$. Moving from the left to the right in Table 6.1, we progressively decrease the barriers against inputs to FDI from infinite to zero. The *ad valorem* equivalent of the barriers against imported specialized inputs falls from infinite and 400% in columns (1) and (2) and to zero in column (6) where $p_v = 0.2$.

6.2.3.2 Comparative static results

Table 6.1 shows some simulation results from the static model. When the barriers against foreign service providers are relaxed, the cost of using V in the production of services by multinationals falls and the imports of V increase monotonically across row 8. If there are positive profits, entry by foreign service providers must occur until the price of foreign services is driven down to restore equilibrium. However, the lower prices by foreign service providers results in a substitution in demand away from domestic service providers and a decline in the number of domestic service providers. Hence, moving from the left to right in Table 6.1, the number of foreign service providers (n_m) increases (row 5) and the number of domestic service providers (n_d) decreases (row 4).

Large welfare gains from the Dixit–Stiglitz externality

As explained, additional varieties convey an externality on the final goods sector X by lowering its costs of obtaining a unit of composite services. Equivalently, additional service varieties increase total factor productivity in the sector (X) that uses services. As the barriers against multinational service providers fall (from $p_v = 1$ to $p_v = 0.2$), the total number of varieties increases. The increase in total factor productivity from additional varieties results in an increase in welfare as shown in row 1.[11] Consider the very large changes in welfare in Table 6.1. Despite the fact that the cost of the V input is only about 2% of income of the country in the first counterfactual, column (2), comparing columns (2) and (6) of row 1, a fall in the cost of V from 1 to 0.2 produces a 12 percent increase in welfare (1.03 to 1.15) – result that is due to the productivity-variety effect.

Imported primary inputs: partial equilibrium substitute but general equilibrium complement for skilled labor

One of the most interesting results is displayed in row 2. The real wage of skilled labor rises monotonically across the row. As barriers to foreign service providers fall, the X sector substitutes foreign services for domestic services and there is a substitution effect away from domestic skilled labor because foreign service providers use skilled labor less intensively than domestic service providers (V economizes on domestic skilled labor in

[11] Although the total number of varieties decreases between columns (1) and (2), total factor productivity increases. Since there are zero foreign varieties in column (1), an additional foreign variety has higher marginal productivity than a domestic variety.

producing *ZM*). However, the reduction in the quality adjusted cost of services lowers the cost of final output in the *X* sector and induces an output expansion there. In the simulation, the expansion of output in the *X* sector increases the *X*-sector's direct demand for skilled labor. The output effect dominates the substitution effect resulting in an increase in the demand for skilled labor on balance. Thus, *V* and skilled labor are partial equilibrium substitutes but general equilibrium complements. 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.

Reversal of comparative advantage due to services liberalization

Results for the trade pattern are especially interesting. With high barriers to foreign service providers, the economy imports the service intensive good *X* and exports *Y*. As the barriers against foreign service providers fall, the economy can produce the good *X* more cheaply. In column (2), imports of *X* are eliminated, and trade consists of a small export of *Y* to pay for imported *V*. As the barriers fall further, the pattern of trade in goods is reversed in the right-hand two columns of Table 6.1. When *V* is sufficiently cheap, the country imports *Y* and exports *X*.

Real prices of both labor and capital can rise

Results for the primary factor *L*, which is a composite of unskilled labor and other primary factors are displayed in row 3. These results exhibit a tradeoff between the Stolper–Samuelson effect and the Dixit–Stiglitz (1977) effect. *L* is used intensively in *Y* and *Y* is the contracting sector. Thus, the Stolper–Samuelson theorem suggests that the real price of *L*, the factor used intensively in *Y*, should fall. On the other hand, increased variety lowers the cost (and therefore price) of producing a unit of the service composite, which, *ceteris paribus*, tends to reduce the price of the good of *X* (the good that uses services intensively). These competing effects just about cancel each other in the simulations. The price of skilled labor increases *relative* to the price of *L*, consistent with Stolper–Samuelson, but unlike the usual Heckscher–Ohlin model, the real prices of both can rise due to the Dixit–Stiglitz price index effect.

Product differentiation generates trade

Finally, column (2) of Table 6.1 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), we choose units of *V* such that $p_v = 1$ is the value of p_v that satisfies the equality:

$$cd(r_0, w_0)zd + fd(r_0, w_0) \;=\; cm(r_0, w_0, p_v)zm + fm(r_0, w_0, p_v).$$

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 homogeneous good competitive models, no

entry would occur and the initial no-FDI equilibrium would continue to be an equilibrium once entry is permitted. However, due to the demand for both foreign and domestic varieties, both must exist in equilibrium unless they are banned. Thus, even with no cost advantage, foreign service providers will enter. In a competitive model without variety productivity effects, the second column would be identical to the first; but in our model, the second column in fact shows a welfare increase of 3%. With the Armington assumption and perfect competition, however, we would also achieve trade.

6.2.3.3 Conclusions

Although there is a clear trend among developing countries to liberalize their policies with respect to inward FDI (UN Conference on Trade and Development, Division on Transnational Corporations and Investment, 1995, pp. 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 domestic skilled workers. For example, examination of the commitments on services of WTO members in their General Agreement on Trade in Services (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.

One of the more interesting results of our stylized 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. We show below that in a full general equilibrium model calibrated to a real economy, this result tends to hold, but not always.

We showed, with our static model, that liberalization could lead to gains of between 3 and 15% 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 the services of these firms 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.

6.3 IMPACT OF LIBERALIZING BARRIERS TO FDI IN SERVICES: THE CASE OF RUSSIAN ACCESSION TO THE WORLD TRADE ORGANIZATION

6.3.1 Introduction

Russia applied for membership in the General Agreement on Tariffs and Trade (GATT) in June 1993 and the GATT Working Party was transformed into the WTO Working Party in 1995. It became the largest Working Party on accession in WTO history and Russia's effort at accession was the longest in the history of the WTO. In December 2011, the WTO invited Russia to become a member of the WTO and Russia became a member in August 2012.

Within Russia, numerous industrialists, policy analysts and even the former Prime Minister called for an assessment of the gains and losses from WTO accession, and for an assessment of the impact on different sectors of the economy. Russian goods providers were concerned that a fall in tariffs will imply increased competition from foreign goods providers and a decline in their market share. Russian service providers were concerned that liberalized rules on new FDI will lead to increased competition from multinational service providers in Russia. The government attempted to assure the business community that it had little to fear from WTO accession and that Russian exporters will obtain improved access to the markets of WTO member countries. However, some commentators and many in the business community remained skeptical, in part because there was a lack of quantitative estimates of the impacts and in part because the sources of the gains mentioned by the government were not well articulated.

On behalf of the World Bank, my colleagues and I responded to a request from the government of Russia to estimate the impacts of Russian WTO accession (Jensen *et al.*, 2007). When we began the project, our assessment of the tariff regime of Russia was that the tariff barriers were not very high (about 12–13% average tariff in the first decade of the twenty-first century; see Shepotylo and Tarr, 2008). Although there were tough negotiations in some specific sectors such as aircraft and pork, on the whole we did not believe that the tariff regime would be the source of serious obstacles to Russian WTO accession. On the other hand, Russia had significant barriers to FDI in several important services sectors; and the Ministry of Trade was having enormous difficulty obtaining cooperation in its WTO accession effort from the agencies like the central bank (for banking and insurance) and the Ministry of Communications (regarding telecommunications). It appeared clear that services were going to be an area of very difficult negotiations for Russia, and we had to develop a model capable of assessing the impact of the liberalization of barriers against FDI in services for our model to be relevant to the major issues and impacts of WTO accession on Russia.

Although the government was interested in aggregate estimates of impacts on overall welfare and sector impacts at the country level, it had a much broader request for analysis. It also wanted an assessment of the household and poverty impacts; and, given the vast geographic scope of the country, impacts on the regions of Russia. We responded to the broader request with the analysis that we document in Rutherford and Tarr (2008, 2008a, 2010). In this section, we summarize Jensen *et al.* (2007), which was our first modeling effort to respond to the government's request; this model assesses impacts on an aggregate Russia with a single representative consumer model. We developed a 35-sector SOE comparative static CGE model of Russia that we believe was appropriate to evaluate the aggregate impacts of Russian accession to the WTO.

It is crucial to understand that WTO accession is a process. Russia implemented many of its commitments in advance of accession (such as the termination of the Rostelekom monopoly on long-distance land-line telephone services in Russia). Other commitments, such as allowing branches of foreign insurance companies 9 years after accession, will be implemented with an adjustment period following accession. The estimates of this model are intended to capture the cumulative impact of all these commitments, not just those that would be implemented on the day of accession.

We have built on the model is Section 6.2 above regarding our key modeling assumptions. That is, we assumed that a substantial portion of business services requires a domestic presence; multinational service providers import some specialized capital or labor as part of their decision to establish a domestic presence and business services supplied with a domestic presence are supplied by imperfectly competitive firms who produce a unique variety of the service. We adopted the Dixit–Stiglitz–Ethier structure for business services (and for increasing returns to scale goods) that implies endogenous productivity gains from the net introduction of new varieties. We have shown that the estimated welfare gains are 6 times the gains from a CRTS version of this model and that the inclusion of FDI in services with the Dixit–Stiglitz variety mechanism are the principle reasons for the larger estimated welfare gains.

The model in this section is innovative in a couple dimensions relative to Brown and Stern and Dee *et al.* papers discussed in Section 6.1. (i) It numerically assesses liberalization of barriers against foreign direct investors in business services in a model with considerable sector detail (35 sectors in our model). This allows the crucial estimates of the barriers to FDI in services to be estimated at the level of a particular business service. (ii) Unlike Brown and Stern and Dee *et al.*, the Dixit–Stiglitz endogenous productivity effects are important in interpreting the results from the impact of service sector liberalization.[12]

[12] There have also been numerical estimates of the benefits of services liberalization where services trade is treated analogously to goods trade, i.e. trade in services is assumed to be entirely cross-border and subject to tariffs. See, e.g. Brown *et al.* (1996).

The section is organized as follows. In Section 6.3.2 we describe the model, focusing on the key extensions of the model relative to the model in Section 6.2, and issues in robustness of the model with imperfect competition and Dixit–Stiglitz effects. In Section 6.3.3, we discuss the most important data, especially how we estimate the crucial *ad valorem* equivalents of the barriers against FDI in services. In Section 6.3.3, we present and interpret the large estimated welfare gains and why WTO accession is counter-productive to the government's objective of diversifying the economy. In Section 6.3.4, we examine the impact of different modeling assumptions (or model closures) on the results. In Section 6.3.5, we present the results of our piecemeal and systematic sensitivity analysis.

6.3.2 Overview of the model and key data

6.3.2.1 Overview of the model formulation

The model is an SOE model, with Russia modeled endogenously and an aggregate rest of the world modeled as vectors of perfectly elastic supply and demand prices for the sectors in the model. An algebraic formulation of the full model is available in Jensen *et al.* (2004). Here, we provide a general description. Primary factors include skilled and unskilled labor; mobile capital; sector-specific capital in the energy sectors reflecting the exhaustible resource; sector specific capital in imperfectly competitive sectors; and primary inputs imported by multinational service providers, reflecting specialized management expertise or technology of the firm. The existence of sector specific capital in several sectors implies that there are decreasing returns to scale in the use of the mobile factors and supply curves in these sectors slope up. There are 35 sectors as shown in Table 6.2. Regardless of sector, all firms minimize the cost of production.

In all sectors, firms optimize their sales between exports and the domestic market to maximize revenue for any composite output level, based on a constant elasticity of production transformation schedules. Prices on the export markets are perfectly elastic. Total capital and labor are in fixed supply, but mobile capital and labor move freely between sectors to equilibrate the returns to these factors across sectors. The balance of trade is fixed, so any increase in imports must be matched by an increase in exports. There is a single representative consumer, who maximizes utility subject to his/her income constraints; the consumer (and firms) have a love of variety, where the gains from variety are represented by the Dixit–Stiglitz structure.

6.3.2.2 Structure of production

Competitive goods and services sectors

One category of sectors is produced under CRTS, where the price equals marginal costs with zero profits. This includes agriculture, forestry and construction. It also includes

Table 6.2 Structure of value added in Russia: factor shares from the input-output table and after reconciliation with the Household Budget Survey (HBS)

			Input-output table			Reconciled with HBS		
	Value added	Value added (%)	Unskilled labor (%)	Skilled labor (%)	Capital (%)	Unskilled labor (%)	Skilled labor (%)	Capital (%)
Sectors total	*1354*	*100.0*	*28*	*12*	*61*	*21*	*63*	*16*
Business services								
Railway transportation	45	3.3	30	24	45	11	85	5
Truck transportation	20	1.5	31	33	36	8	88	4
Pipelines transportation	49	3.6	5	3	92	11	58	31
Maritime transportation	4	0.3	32	19	48	14	81	5
Air transportation	8	0.6	48	29	24	14	84	2
Other transportation	14	1.1	21	20	59	9	85	6
Telecommunications	16	1.2	31	16	53	16	79	5
Financial services	21	1.5	33	27	40	10	86	4
Science and science servicing	11	0.8	56	10	34	35	61	4
Subtotal	*188*	*13.9*	*2583*	*1794*	*5623*	*1244*	*7626*	*1130*
Differentiated goods								
Ferrous metallurgy	26	1.9	18	17	65	9	85	7
Non-ferrous metallurgy	31	2.3	18	13	69	12	81	7
Chemical and oil—chemical industry	24	1.8	28	10	61	20	74	7
Mechanical engineering and metal-working	71	5.2	48	11	41	30	66	4
Timber and woodworking and pulp and paper industry	19	1.4	37	17	45	17	79	5
Construction materials industry	21	1.6	33	13	54	19	75	5
Light industry	9	0.7	66	3	30	63	32	5
Food industry	45	3.3	25	11	64	17	76	7
Other industries	9	0.6	54	19	28	22	76	3
Subtotal	*255*	*18.8*	*3436*	*1226*	*5338*	*2125*	*7312*	*562*

(*Continued*)

Table 6.2 Structure of value added in Russia: factor shares from the input-output table and after reconciliation with the Household Budget Survey (HBS)—cont'd

			Input-output table			Reconciled with HBS		
	Value added	Value added (%)	Unskilled labor (%)	Skilled labor (%)	Capital (%)	Unskilled labor (%)	Skilled labor (%)	Capital (%)
Extractive industries								
Oil extraction	39	2.9	4	9	87	1	12	87
Gas	12	0.9	4	7	89	1	10	89
Coalmining	15	1.1	13	41	47	2	52	47
Subtotal	*67*	*4.9*	*581*	*1580*	*7840*	*76*	*2084*	*7840*
Constant returns industries								
Electric industry	48	3.6	19	17	64	9	84	6
Oil processing	10	0.8	7	17	77	3	89	8
Other fuel industries	0	0.0	30	2	68	49	33	18
Construction	116	8.6	30	26	44	10	86	4
Agriculture and forestry	103	7.6	25	2	73	47	31	22
Post	4	0.3	23	11	66	15	78	7
Trade	309	22.9	10	3	87	20	53	27
Public catering	2	0.1	67	28	5	19	81	1
Other goods-producing sectors	11	0.8	72	23	5	23	76	1
Communal and consumer services	76	5.6	24	9	67	19	72	9
Public health and sports and social security	42	3.1	59	7	34	44	52	4
Education and culture and art	54	4.0	68	5	28	56	40	4
Geology and hydrometeorology	3	0.2	63	7	30	45	52	3
Administration and public associations	65	4.8	66	22	12	22	76	1
Subtotal	*844*	*62.3*	*2806*	*957*	*6237*	*2486*	*5999*	*1515*

certain public services, like education and post office facilities, and key mineral industries.[13] In these sectors, products are differentiated by country of origin (i.e. we employ the Armington assumption). All Russian goods producing firms (including imperfectly competitive firms) can sell on the domestic market or export. Russian firms optimize their output decision between exports and domestic sales based on relative prices and their constant elasticity of transformation production function.

Goods produced subject to increasing returns to scale

These goods are differentiated at the firm level. We assume that manufactured goods may be produced domestically or imported. Firms in these industries set prices such that marginal cost (which is constant with respect to output) equals marginal revenue and there is free entry, which drives profits to zero. For domestic firms, costs are defined by observed primary factors and intermediate inputs to that sector in the base year data. Foreigners produce the goods abroad at a constant marginal cost but incur a fixed cost of for operating in Russia. The c.i.f. (cost, insurance, and freight) import price of foreign goods is simply defined by the import price, and, by the zero profits assumption, in equilibrium the import price must cover fixed and marginal costs of foreign firms. We employ the standard Chamberlinian large-group monopolistic competition assumption within a Dixit–Stiglitz framework, which results in constant markups over marginal cost.

For simplicity we assume that the composition of fixed and marginal cost is identical in all firms producing under increasing returns to scale (in both goods and services). This assumption in a our Dixit–Stiglitz based Chamberlinian large-group model assures that output per firm for all firm types remains constant (i.e. the model does not produce rationalization gains or losses).

Due to the Dixit–Stiglitz formulation, the effective cost function for users of goods produced subject to increasing returns to scale declines in with the total number of firms in the industry.

Services sectors that are produced in Russia under increasing returns to scale and imperfect competition

This third category of sectors includes telecommunications, financial services, most business services and transportation services. For convenience, we call these services producer services, although all services are intermediate services in production. In services sectors, we observe that some services are provided by foreign service providers on a cross-border basis analogous to goods providers from abroad. However, a large share of business services are provided by service providers with a domestic presence, both

[13] Although electricity and gas are monopolistically controlled, prices are controlled by the government. Thus, market-determined pricing to exploit market power is excluded by the government and we maintain the assumption of price equal to marginal costs.

multinational and Russian.[14] Our model allows for both types of foreign service provision in these sectors. There are cross-border services allowed in this sector and they are provided from abroad at constant costs — this is analogous to competitive provision of goods from abroad. Cross-border services, however, are not good substitutes for service providers who have a presence in Russia.[15]

There are also multinational service firm providers that choose to establish a presence in Russia in order to compete with Russian firms directly in the Russian market. When multinationals service providers decide to establish a domestic presence in Russia, they will import some of their technology or management expertise. That is, FDI generally entails importing specialized foreign inputs. Thus, the cost structure of multinationals differs from Russian service providers. Multinationals incur costs related to both imported primary inputs and Russian primary factors, in addition to intermediate factor inputs. Foreign provision of services differs from foreign provision of goods, since the service providers use Russian primary inputs. Domestic service providers do not import the specialized primary factors available to the multinationals. Hence, domestic service firms incur primary factor costs related to Russian labor and capital only. These services are characterized by firm-level product differentiation. For multinational firms, the barriers to FDI affect their profitability and entry. Reduction in the constraints on FDI will induce foreign entry that will typically lead to productivity gains because when more varieties of service providers are available, buyers can obtain varieties that more closely fit their demands and needs (the Dixit—Stiglitz variety effect).

Value-added and producer services substitute for each other

In Figure 6.1, we depict how production of a representative good is produced. One departure from a standard formulation is that, as in Section 6.2, we allow producer services (services that are produced in Russia under increasing returns to scale) to substitute with value added in a CES nest. Other intermediate goods and services enter in to the production structure in the usual fixed coefficients, Leontief nests with the composite of value added and producer services. We believe that there is strong substitutability between producer services and value added which justifies this separate treatment. For example, transportation services clearly substitute well for value added. Firms have a choice of hiring a driver and buying or renting a truck for delivery services or else contracting with a trucking company or other transportation company for delivery services. With legal, accounting and most professional services, firms can employ a lawyer, accountant or engineer, or substitute for the use of their company capital and labor by purchasing these services from a firm.

[14] One estimate puts the worldwide cross-border share of trade in services at 41% and the share of trade in services provided by multinational affiliates at 38%. Travel expenditures 20% and compensation to employees working abroad 1% make up the difference. See Brown and Stern (2001, Table 1).

[15] Daniels (1985) found that service providers charge higher prices when the service is provided at a distance.

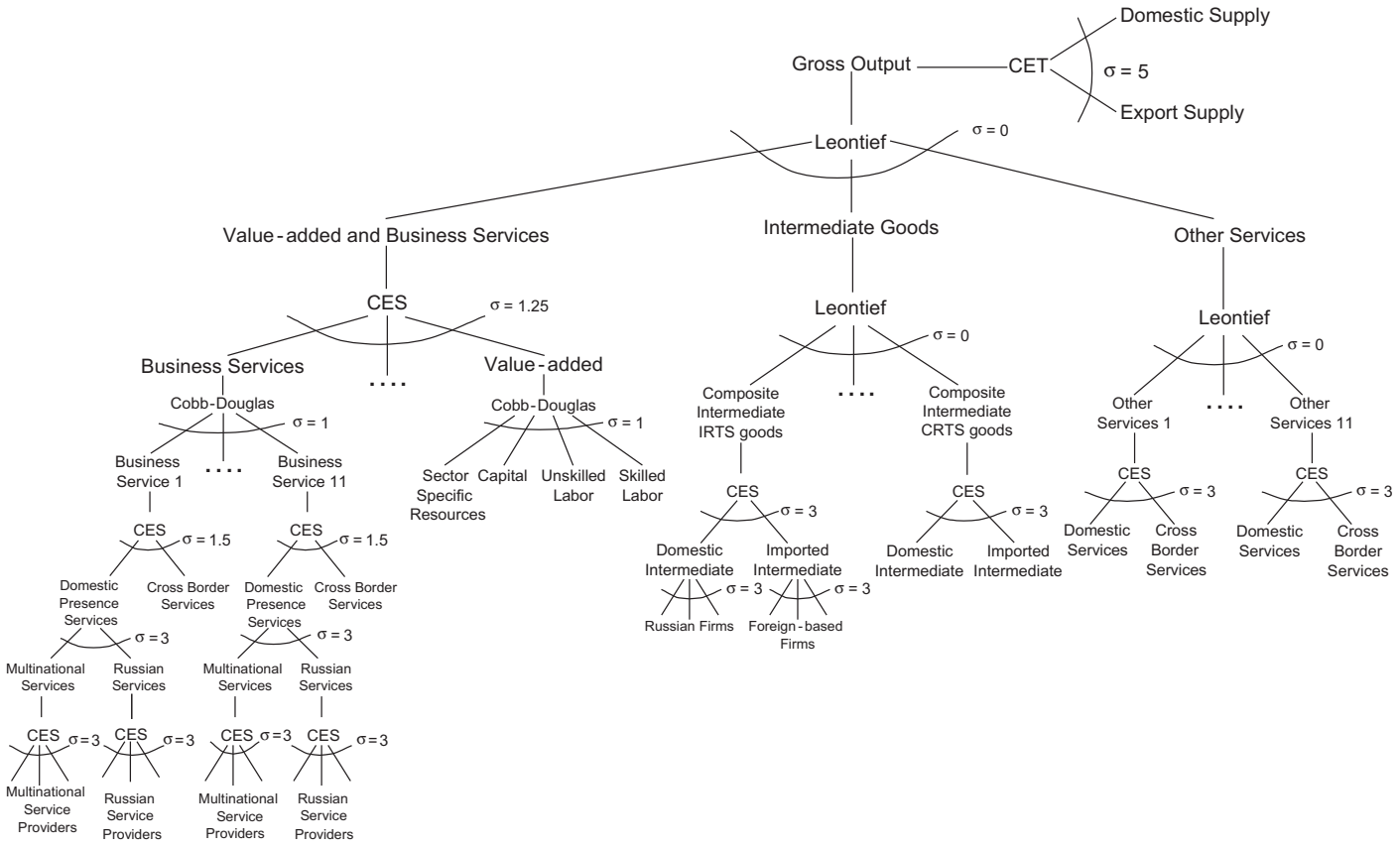

Figure 6.1 Production and allocation of output.

6.3.2.3 Comparative steady-state formulation

In this version of our model, we allow the capital stock to adjust to its steady-state equilibrium along with all of the model features we employ in our WTO reference case (i.e. we allow for tariff and FDI liberalization with endogenous productivity effects as above). We call this our comparative steady-state model. In the comparative static model, we assume that the capital stock is fixed and the rental rate on capital is endogenously determined. In the comparative steady-state model, the logic is reversed. We assume that the capital stock is in its initial steady-state equilibrium in the benchmark dataset, but that the capital stock will adjust to a new steady-state equilibrium based on a fixed rate of return demanded by investors.[16] That is, if the trade policy shock happens to induce and increase in the rate of return on capital so that it exceeds the initial rate of return, investors will invest and expand the capital stock. Expansion of the capital stock drives down the marginal product of capital, i.e., it drives down the rental rate on capital, until the rate of return on capital falls back to the initial level.[17] To analyze trade policy, this comparative steady-state approach has been employed by many authors, including Harrison *et al.* (1996, 1997), Baldwin *et al.* (1999) and Francois *et al.* (1996). The approach, however, dates back to the 1970s, when both Hansen and Koopmans (1972) and Dantzig and Manne (1974) used it. The approach ignores the foregone consumption necessary to achieve the higher level of investment and thus is an overestimate or an upper-bound estimate of the long-run gains within the framework of the model assumptions.[18]

6.3.2.4 Empirical basis for our modeling assumptions in imperfectly competitive sectors

The model assumes: (i) that discriminatory barriers against FDI in business services exist in Russia; (ii) that WTO accession will result in the reduction or removal of these barriers; (iii) that the removal or reduction of the barriers will stimulate an increase in FDI in business services; and (iv) that additional varieties of business services (and goods in imperfectly competitive sectors) will produce productivity gains in Russia. We now address each of these issues in turn.

Barriers to FDI in Russian services sectors

As Russia began seriously negotiating its barriers in services as part of its WTO accession, key barriers to FDI were the following. Rostelekom had a monopoly on long-distance fixed-line telephone services. In banking and insurance, foreign banks and foreign insurance companies were restrained to a maximum of about 15% of the market. Foreign insurance

16 Essentially, we use our one model, but alter the model closure rule for the rate of return on capital and the capital stock. Since the justification for allowing the capital stock to vary while keeping the rate of return on capital fixed is based on comparative long-run steady-state equilibria, we prefer to use the expression long-run steady-state model.

17 The rate of return on investment in our model is the rental rate on capital divided by the cost of a unit of the capital good.

18 Rutherford and Tarr (2002) have shown, however, that trade liberalization can produce considerably larger long run gains in an endogenous growth model. However, that is another model formulation.

companies were prohibited from selling insurance in the mandatory insurance markets, and branches of foreign banks and insurance companies were prohibited. In transportation services, China made liberalization of Russian barriers against its providers of truck transportation services a significant issue in its bilateral talks on Russian WTO accession. While several large multinational oil companies would like to construct a gas pipeline, only Gazprom may construct or operate a gas pipeline. Consequently, at least 20 billion cubic meters of gas that is associated with the production of oil must be flared each year.

Will WTO accession reduce the barriers to FDI in business services?

The business services sectors have been the subject of some of the most intense negotiations associated with Russian accession. Russia has made numerous commitments in this area. Some of the key concessions are the following. Russia has agreed to increase the quota on the maximum share that foreign banks and insurance companies can attain from 15 to 50%, and Russia will phase out the prohibition on foreign participation in mandatory insurance lines. Russia agreed to terminate the Rostelekom monopoly on long-distance fixed-line telephone services as part of the Russia—EU bilateral agreement. There are multinational telephone operators already operating in the Russian mobile telephone market, but the maximum equity restriction of 49% will be lifted. Russia will ensure national treatment and market access for a wide variety of professions, including lawyers, accountants, architects, engineers, marketing specialists and healthcare professionals. Foreign-owned companies will be permitted to engage in wholesale and retail trade, franchise sectors and express courier services.[19] The EU has negotiated intensely for the rights of companies other than Gazprom to construct a gas pipeline, but did not achieve success in this area.

Will reduction of the barriers against FDI increase FDI?

Potential foreign direct investors in Russia face many barriers including include lack of good governance in Russia, administrative barriers to investment and customs delays that inhibit Russia participating in international production chains as well as explicit barriers to FDI. Despite these problems faced by foreign investors, there are foreign providers of business services operating in Russia in virtually all of the business services sectors (estimates by our specialist service sector institutes of the shares of the market captured by multinationals are later in Table 6.5), which shows interest in the Russian market by foreign service providers.[20] And the intensity with which the negotiations have been conducted in the business services sectors is due in most cases to lobbying interests by foreign providers of services. This suggests that multinational service providers have a desire to expand operations in Russia. Consequently, it is natural to assume then that

[19] See Tarr (2007) for details.

[20] See Tarr and Volchkova (2007, Table 1) for data on FDI flows into Russia on an annual basis from 2000 to 2008.

a reduction of barriers against multinational providers of services will, at the margin, result in an increase in FDI in those sectors, at least given some time.[21]

Impact of additional varieties on productivity

We have discussed the evidence on the productivity impacts of additional varieties of services in Section 6.1. Here, we focus on goods, as we employ the Dixit–Stiglitz mechanism in the imperfectly competitive goods sectors as well. As Romer (1994) has argued, product variety is a crucial and often overlooked source of gains to the economy from trade liberalization. In our model, it is the greater availability of varieties that is the engine of productivity growth, but we believe there are other mechanisms as well through which trade may increase productivity.[22] Consequently, we take variety as a metaphor for the various ways increased trade can increase productivity. Winters *et al.* (2004) summarize the empirical literature by concluding that "the recent empirical evidence seems to suggest that openness and trade liberalization have a strong influence on productivity and its rate of change." Some of the key articles regarding product variety are the following. Broda and Weinstein (2004) find that increased product variety contributes to a fall of 1.2% per year in the "true" import price index. Hummels and Klenow (2005) and Schott (2004) have shown that product variety and quality are important in explaining trade between nations. Feenstra *et al.* (1999) show that increased variety of *exports* in a sector increases total factor productivity in most manufacturing sectors in Taiwan (China) and Korea, and they have some evidence that increased input variety also increases total factor productivity. Finally, Feenstra and Kee (2004) show that export variety and productivity of a country are positively correlated.

Beginning with the path-breaking work of Coe and Helpman (1995), a rich literature now exists that has empirically shown that total factor productivity increases due to the purchase of imported intermediate goods. Coe and Helpman found that OECD countries benefit from foreign research and development (R&D), and that they benefit more from trading with countries that have a larger stock of research and development. Further, the benefits are greater the more open the country is to foreign trade. Moreover, while in large countries, the elasticity of total factor productivity (TFP) with respect to domestic R&D capital stocks is larger than that with respect to foreign R&D capital stocks, the opposite holds in small countries (i.e., foreign R&D is more important for small countries). Coe *et al.* (1997) extend these results based on a sample of 77 developing countries. They find developing countries that do little R&D on their own have

[21] More systematically, Alessina *et al.* (2005) find, for a sample of a large number of OECD countries, that regulatory reform, especially liberalization of the barriers against entry, plays a strong role in increasing investment in the sector.

[22] Trade or services liberalization may increase growth indirectly through its positive impact on the development of institutions (see Rodrik *et al.*, 2004). It may also induce firms to move down their average cost curves, or import higher-quality products or shift production to more efficient firms within an industry. Tybout and Westbrook (1995) find evidence of this latter type of rationalization for Mexican manufacturing firms.

benefited substantially from industrialized country R&D through trade in intermediate products and capital equipment with industrialized countries. They find that R&D spillovers through trade with the US are the largest, since the US stock of R&D is the highest and it is the most important trading partner for many developing countries. A 1% increase in the R&D stock of the US raises total factor productivity for all 77 developing countries in their sample by 0.03%. By comparison, a 1% increase in the R&D stock of Japan, Germany, France or the UK raises total factor productivity only between 0.004 and 0.008%. Crucially, they find that countries that trade more with the US, such as the Latin American countries, get more productivity spillover increases from the US R&D stocks and that the relatively more open East Asian countries have benefited the most from foreign R&D through trade. Keller (2000) also finds that trade is an important conveyor of R&D and is especially important for small countries. Several other studies, including Lumenga-Neso *et al.* (2005), Schiff and Wang (2006), and Falvey *et al.* (2002), confirm these results. Lumenga-Neso *et al.* (2005) show that technological spillovers can occur from indirect trade with technologically advanced countries, i.e. imports from the UK embody some US technology due to UK imports from the US. Since the data show that OECD countries have the vast majority of R&D stocks,[23] it implies that it is important for small developing countries to trade with large technologically rich countries, such as the US and the EU, at least indirectly.

On the other hand, Hummels and Klenow (2005) have shown that, contrary to the standard Dixit–Stiglitz model, varieties expand less than proportionately to market size. Hummels and Logovskyy (2005) adopt an interesting approach that can explain this phenomenon: they modify the demand structure so that goods become more substitutable as more varieties enter the market; then the marginal benefit of new varieties falls with market size. In our model, varieties also expand less than proportionately with market size, but it is due to the costs of production. We assume that in each imperfectly competitive industry there are two specific factors – one used by domestic firms and one used by foreign firms. Both fixed and variable costs require the use of a specific factor. The expansion of the industry bids up the price of the specific factor, so additional varieties are acquired at increasing costs. We show in the sensitivity analysis that the welfare results are quite sensitive to the parameter in our model [$\epsilon(f_i)$] that is determined by the share of costs due to the specific factor.

6.3.2.5 Does the model have adequate convexity?

It is well known that monopolistic competition models do not necessarily have a general equilibrium. Arrow and Hahn (1971) have shown, however, that in an economy with both perfectly competitive and monopolistically competitive sectors, a general equilibrium can be guaranteed if the perfectly competitive sectors have enough resources available to support

[23] Coe *et al.* (1997) calculate that 96% of the world's R&D expenditures took place in industrial countries in 1990.

the expansion of the imperfectly competitive sectors.[24] Since we use models as a basis of policy discussions with governments who take assessments of industry output change seriously, we have a more binding constraint than the existence of an equilibrium – we must assure that the sector results are reasonable. For example, in a developmental stage of the model of Russia, we had a counterfactual equilibrium in which one sector essentially became the whole economy – an implausible result for a policy change such as WTO accession in an economy as diverse as the Russian. These issues imply that it is necessary to develop a model structure that limits potentially explosive expansions of the imperfectly competitive sectors. The following are four ways to introduce convexity in the model that we have employed in various applications. We have chosen to employ the first two in this model.

Sector-specific factors

By assuming that some share of the labor or capital is specific to the sector, expansion of the sector bids up the price of that factor and limits the expansion of the sector. In the applied models with monopolistic competition on which I have been a coauthor, in each imperfectly competitive sector, we have assumed that some share of capital *for each firm type* is sector-specific. That is, foreign and domestic firms have a different sector-specific factor. The elasticity of supply of output of the firm type (foreign or domestic firm types in each sector in the models in this paper) in the sector with respect to the price of its output is then related to the share of sector-specific capital for that firm type. [See Balistreri and Tarr (2011) for the mathematical representation.] Assuming some sector-specific factors has advantages. (i) It is economically reasonable to assume that some factors are specific, which explains lobbying for protection. (ii) As the demand for the output of a firm type declines, the price of the sector-specific factor declines, reducing costs of the firm type and allowing the firm type to maintain a share of the market. This also contributes to a pro-competitive effect of liberalization, as domestic firms will decrease prices and costs from this effect. (iii) If the model has multiple foreign firm types, representing say firms from different regions, there will be an elasticity of firm supply parameter for each region. As we discuss below, this parameter can play a very important role in policy discussions, such as with whom should a country form a regional trade agreement.

Excluding the Dixit–Stiglitz productivity gain for own use varieties

If a monopolistically-competitive sector has a large share of its costs due to the costs of inputs from its own sector, the Dixit–Stiglitz productivity improvement can cause an explosive expansion of the sector. That is, suppose the counterfactual shock induces an

[24] Arrow and Hahn (1971, p. 154) characterize their formal requirement as follows: "the extent of increasing returns there [in the monopolistic production possibility sets] is not too great relative to the resources that the competitive sector would be capable of supplying."

expansion of the sector. In monopolistic competition, this means there is an increase in varieties in the sector. The new entry has two effects – the price of the output is lowered (limiting expansion in the sector), but the additional varieties also lower the costs of the sector (inducing expansion in the sector). Entry into the sector continues as long as price exceeds average costs, but costs may fall faster than price, inducing explosive expansion. A solution to this problem was to exclude the Dixit–Stiglitz productivity gains from varieties in the same sector.

Since we have sector-specific factors of production, as the sector expands, the costs of the sector-specific factor increases and costs do not fall proportionately with varieties. In practice, we have always had an equilibrium in these models. However, in the case of the Russia model, the costs of non-ferrous metals inputs in the total costs of the non-ferrous metals sector were very high – about 40%. In the developmental stage of the model in this section, we observed dramatic expansion of the non-ferrous metals sector in our WTO accession counterfactual, while virtually all other sectors contracted. We assessed this to be due to an unrealistically large cost reduction due to the variety externality. Since businessmen, policy makers and political leaders had been calling for an assessment of the consequences of WTO accession at the sector level, it was crucial that we have results that could be explained with clear economic intuition. We modified the Dixit–Stiglitz formulation such that there was no productivity gain from additional intermediate varieties in the same sector. Subsequently, the sector results were very reasonable and easily interpreted. Moreover, surveys have revealed that policy makers and political leaders throughout Russia came to adopt the assessments of this model as their expected outcomes at the sector level of the impacts of Russian WTO accession.

Elasticity of substitution differences or preference parameters in the demand function

It is possible to avoid highly specialized solutions (or bang-bang solutions in the dynamic version of the model in Section 6.2) by using nested CES functions with elasticities of substitution that differ by firm type, as in Equations (6.3) and (6.4) or if there are preference parameters by firm type as in Equation (6.23). Then the marginal productivity of a particular firm type goes to infinity as the use of that firm type goes to zero, assuring all firm types will be used if they exist. We have chosen pure firm level product differentiation in this model. We have found that with sector-specific factors and the exclusion of the Dixit–Stiglitz own use productivity gains, there is adequate convexity in the model to avoid highly specialized solutions.

6.3.2.6 Export demand

This is a SOE model with perfectly elastic export demand in all sectors. As part of the counterfactual, the price of exports expands in a limited number of sectors, and firms in this sector increase output to supply the increased demand in the export markets. We employ a constant elasticity of transformation (CET) function between sales to the

domestic and export markets that allows sales to both the domestic and export markets. However, output expansion of the sector would be less pronounced if expanding sales on the export market were tempered by a downward sloping export demand curve. In our models of Kenya (Balistreri *et al.*, 2009) and Tanzania (Jensen *et al.*, 2010) we employ a downward sloping export demand curve in the imperfectly competitive sectors.

6.3.2.7 Can the large-group monopolistic competition model produce results regarding competition?

Contrary to a criticism that is sometimes leveled at the large-group monopolistic competition model, the models in this chapter exhibit the important pro-competitive effects of liberalization of barriers against foreigners. The criticism is that many of the services sectors are characterized by few firms and with large group monopolistic competition the markup of price over marginal cost is fixed by the Dixit–Stiglitz elasticity of substitution, see Equation (6.17). However, we have specific capital for each firm type in each imperfectly competitive sector. If there is entry into the sector by foreign or multinational firms, then rents to the sector-specific factor for domestic firms will decline. This will lead to a decline in both the costs and prices of the domestic firms. Further, the price charged by foreign firms will fall from the reduction of cost increasing barriers and the entry in to the sector will lead to a decline in the quality adjusted price to users of the Dixit–Stiglitz aggregate due to the Dixit–Stiglitz variety externality. Consequently, even though price-cost margins are fixed, our models capture what is crucial to consumers and firms about increased competition: a fall in foreign prices due to reduced barriers to foreigners, a fall in domestic prices due to reduced rents to the specific capital in domestic firms and a quality improvement of their products. All of these can be measured in this model. Further, the model captures what is important to producers and what can explain lobbying for protection – their own sector-specific rents.

6.3.2.8 Key data

Ad valorem equivalence of barriers to FDI in services sectors

Estimates of the *ad valorem* equivalents of barriers to FDI in services are key to the results. Consequently, we commissioned 20-page surveys from several Russian research institutes that specialize in these sectors and followed this with econometric estimates of these barriers based on these surveys.

These questionnaires provided us with data and descriptions and assessments of the regulatory environment in these sectors.[25] Using this information and interviews with

[25] This information was provided by the following Russian companies or research institutes: ZNIIS in the case of telecommunications; expert RA for banking, insurance and securities; Central Marine Research and Design Institute (CNIIMF) for maritime transportation services; and Infomost for air transportation services. The questionnaires are available at www.worldbank.org/trade/russia-wto. The same sources provided the data on the share of expatriate labor discussed below.

specialist staff in Russia, as well as supplementary information, Kimura *et al*. (2004a,b,c) then estimated the *ad valorem* equivalents of barriers to FDI in several Russian sectors, i.e., in telecommunications; banking, insurance and securities, and maritime and air transportation services. The process involved first converting the answers and data of the questionnaires into an index of restrictiveness in each industry. Kimura *et al*. then applied methodology explained in the volume by Findlay and Warren (2000), notably papers by Warren (2000), McGuire and Schulele (2000), and Kang (2000). For each of these service sectors, authors in the Findlay and Warren volume evaluated the regulatory environment across many countries and developed indices of trade restrictiveness for the sector they were studying in each of the countries in their sample. The price of services is then regressed against the regulatory barriers to determine the impact of any of the regulatory barriers on the price of services. Kimura *et al*. then assumed that the international regression applies to Russia. Applying that regression and their assessments of the regulatory environment in Russia from the questionnaires and other information sources, they estimated the *ad valorem* impact of a reduction in barriers to FDI in these services sectors.[26] The results of the estimates are listed in Table 6.3.[27] In the case of maritime and air transportation services, we assume that the barrier will only be cut by 15 percent since pressure from the Working Party in these sectors is not strong.

[26] Warren estimated quantity impacts and then using elasticity estimates was able to obtain price impacts. The estimates by Kimura *et al*. that we employ are for "discriminatory" barriers against FDI. Kimura *et al*. also estimate the impact of barriers on investment in services that are the sum of discriminatory and non-discriminatory barriers.

[27] Kimura *et al*. estimated that the prices of telecommunications services in Russia are elevated by 10% due to barriers to multinational service providers. We believe that in telecommunications it is crucial to employ a differentiated product model to characterize competition between multinational and Russian telecommunications providers. This means that we interpret the estimates of Kimura *et al*. to indicate that the discriminatory tax on multinational service providers results in a 10% increase in the *composite price* of domestic and multinational service provision. Then the *ad valorem* tax on multinationals, say at rate x, must be above 10% since there is no discriminatory tax on domestic service providers and the composite price is a weighted average of domestic prices (which are untaxed) and multinational prices that are taxed at a rate x. More precisely, if x is the *ad valorem* equivalent of the barriers to multinational investment in telecommunications in Russia, s is the share of the market in Russia of multinationals, 10% is the amount by which telecommunications prices are elevated due to the barriers and if we assume Russian domestic service providers prices are unaffected, then we may solve for x from: $sx + (1 - s) * 0 = 0.10$. That is, $x = 0.10/s$ Our data indicate that $s = 0.15$, then $x = 0.67$ or 67%.Barriers to FDI, however, have an indirect effect on the price of Russian telecommunications services. Consequently, $sx + (1 - s) * y = 0.10$ may be more appropriate, where y is the amount by which the price of Russian telecommunication services are increased in the benchmark as a result of barriers on multinational telecommunications service providers. The value of y would have to be less than the value of the increase in composite services (0.1). It is likely that the indirect effect of barriers to FDI on the price of domestic Russian telecommunications services is less than 0.05, since the composite price increased by only 0.1 and lower values of y yield higher estimates of x. However, if we take $y = 0.05$, then x equals 0.38, which is approximately the value estimated for financial services, of 0.33. We take a conservative estimate here of 0.33 for telecommunications.

Table 6.3 Tariff rates, export tax rates, estimated *ad valorem* equivalence of barriers to FDI in services sectors and estimated improved market access (*ad valorem* in %; by sector)

	Tariff rates	Export tax rates	Estimated change in world market price	Equivalent % barriers to FDI	
				Base year	Post-WTO Accession
Electric industry	4.5	0.0	0.0		
Oil extraction	0.0	7.9	0.0		
Oil processing	3.8	4.6	0.0		
Gas	0.5	18.8	0.0		
Coalmining	0.0	0.0	0.0		
Other fuel industries	2.6	2.6	0.0		
Ferrous metallurgy	2.9	0.4	1.5		
Non-ferrous metallurgy	7.4	5.3	1.5		
Chemical and oil—chemical industry	7.1	1.6	1.5		
Mechanical engineering and metal-working	7.2	0.0	0.0		
Timber and woodworking and pulp and paper industry	9.9	6.9	0.0		
Construction materials industry	10.6	1.6	0.0		
Light industry	11.8	4.1	0.5		
Food industry	11.3	3.1	0.5		
Other industries	6.4	0.0	0.5		
Agriculture and forestry	8.2	0.6	0.0		
Other goods-producing sectors	0.0	0.0	0.5		
Telecommunications				33.0	0.0
Science and science servicing (market)				33.0	0.0
Financial services				36.0	0.0
Railway transportation				33.0	0.0
Truck transportation				33.0	0.0
Pipelines transportation				33.0	0.0
Maritime transportation				95.0	80.0
Air transportation				90.0	75.0
Other transportation				33.0	0.0

Source: Author's estimates.

Share of expatriate labor employed by multinational service providers

In Section 6.2, we explained that imported foreign primary inputs in services production by multinationals are partial equilibrium substitutes, but could be general equilibrium complements. In our applied model, the impact of the liberalization of barriers to FDI in business services sectors on the demand for labor in these sectors will depend importantly on the share of expatriate labor used by multinational firms. We obtained estimates of the share of expatriate labor or specialized technology that is used by multinational service providers in Russia from Russian research institutes that specialize in these sectors. In general, we found that multinational service providers use mostly Russian primary factor inputs and only small amounts of expatriate labor or specialized technology. In particular, the estimated share of foreign inputs used by multinationals in Russia is: telecommunications, $10\% \pm 2\%$; financial services, $3\% \pm 2\%$; maritime transportation, $3\% \pm 2\%$; and air transportation, $12.5\% \pm 2.5\%$.

Tariff data

For about 1700 tariff lines, Russia employs a "mixed system" in which the maximum of the *ad valorem* or specific tariff applies. Due to the acquisition of trade flow data at the tariff line level, the actual tariffs were first calculated precisely by Shepotylo and Tarr (2008), and employed in Russian WTO accession analysis by Rutherford and Tarr (2008, 2010). The tariff rates for the analysis in this section were based on trade flow data at a slightly aggregated level and were therefore not precise. Shepotylo and Tarr have shown, however, that the tariff calculations used in this paper are not subject to significant errors.

Based on a mapping (of the Russian Statistical Office) from the tariff line data of the Customs Committee to the sectors in our input-output table, we calculated a weighted average tariff rate for the sectors of our model. We calculated these rates two ways: based on all imports (where the collected tariff rate as a percentage of all imports is 8.1%) and on non-CIS (Commonwealth of Independent States) imports (where the collected tariffs as a percentage of non-CIS imports is 11.1%). The rates we employ in the model are the rates based on all imports. The rates based on all imports are lower since the base on the calculation includes CIS imports on which no tariffs are imposed. We believe collected tariff rates more closely approximate the protection a sector receives and the incentives it faces. Similar procedures are applied for export taxes. The results at the sector level are in Table 6.3.

Applying these tariff rates across all sectors implies that tariff revenue in our model is about 1.6% of GDP in the initial equilibrium. Collected tariffs in Russia are closer to 1.1% of GDP.[28] There are several reasons that the collected tariffs in Russia are less than the legal rates on most favored nation (MFN) imports. Most notably, exemptions to the Russian tariff are available for regional agreements (most notably the CIS), personal

[28] See International Monetary Fund (2002).

imports and shuttle trade. We adjust for the CIS trade, so we are applying the MFN rates on all imports from the non-CIS. This slightly, but not significantly biases upward the rates we employ relative to collected rates.

Export tax data

Analogous to the import trade data, the Russian State Customs Committee publishes data on export volumes and values. Similar to the tariff data, the export taxes are sometimes *ad valorem* or sometimes the maximum of the *ad valorem* or specific tax rate. The results are reported in Table 6.3.

Input-output table

The core input-output table for this section is the 1995 table produced by Goskomstat. [This was updated for the applications in Rutherford and Tarr (2008, 2010).] The official table contained only 22 sectors and importantly has little service sector disaggregation. Consequently, Russian input-output expert S.P. Baranov disaggregated this table into a 35-sector input-output table. Baranov used unpublished data available to Goskomstat based on the surveys that were used to construct the 1995 table. The principal elements of this disaggregation were: a split of the oil and gas sector into oil, gas and oil processing; a split of the transport sector into railroad, maritime, air, pipeline, truck and other transportation services; the breakup of communication into post services and telecommunications; and disaggregation of the data in several business services sectors regarding market and non-market activities. The documentation by Baranov is available on the website www.worldbank.org/trade/russia-wto.

6.3.3 Results

In our general WTO scenario, we assume that: (i) Barriers against FDI are reduced as indicated in Table 6.3, (ii) seven sectors subject to anti-dumping actions in export markets receive slightly improved market access (this is implemented as an exogenous increase in their export price as shown in Table 6.3) and (iii) the tariff rates of all sectors are reduced by 50%.[29] We first discuss (and present in Table 6.4) our estimates of the impact of Russian WTO accession on aggregate variables such as welfare and the real exchange rate, aggregate exports, the return to capital, skilled labor and unskilled labor, and the percentage change in tariff revenue. In order to obtain an assessment of the adjustment costs, we estimate the percentage of labor and mobile capital that must change industries. The gains come from a combination of effects, so we also estimate the comparative static impacts of the various components of WTO accession in order to assess their relative importance.

[29] Actual tariff reductions were part of the accession negotiations and were not known when this study was done. The paper was finalized in January 2012, 1 month after Russia was offered membership in the WTO. The WTO reported that the Russian average tariff will decline to 7.8%, which is a tariff cut slightly less than we had assumed.

Table 6.4 Impact of WTO accession on economy-wide variables in Russia: policy results and decomposition of effects (results are percentage change from initial equilibrium)

	Benchmark	WTO accession (1)	Tariff reform only (2)	Improved market access only (3)	Reform of FDI barriers only (4)	WTO accession in steady-state model (5)	WTO accession with partial reform of FDI barriers (6)	WTO accession with domestic rent dissipation (7)	WTO accession in short run model (8)
Aggregate welfare									
Welfare (*EV* as % of consumption)		7.2	1.3	0.6	5.2	23.6	4.1	7.7	5.9
Welfare (*EV* as % of GDP)		3.3	0.6	0.3	2.4	11.0	1.9	3.6	2.8
Government budget									
Tariff revenue (% of GDP)	1.4	0.9	0.8	1.4	1.4	1.0	0.8	0.9	0.8
Tariff revenue (% change)		−33.4	−38.4	8.4	10.6	−23.3	−35.4	−33.2	−35.8
Aggregate trade									
Real exchange rate (% change)		2.6	2.0	−0.5	1.1	4.8	1.8	2.7	3.0
Aggregate exports (% change)		13.2	7.9	1.5	3.5	24.3	10.8	13.5	9.5
Returns to mobile factors									
Unskilled labor (% change)		2.5	0.4	0.1	1.9	13.2	1.0	2.7	1.9
Skilled labor (% change)		4.7	1.5	0.6	2.5	17.6	2.6	4.9	3.4
Capital (% change)		4.9	2.0	0.7	3.1	19.5	3.6	4.9	4.3
Factor adjustments									
Unskilled labor (% of non-sector specific workers who change jobs)		2.6	1.1	0.5	1.6	4.4	1.7	2.6	0.0
Skilled labor (% of non-sector specific workers who change jobs)		2.1	0.4	0.4	1.5	2.5	1.0	2.2	0.0
Capital		0.6	0.4	0.4	0.2	0.1	0.6	0.6	0.4

Source: Author's estimates.

First, we discuss the comparative static results. We shall also consider the results of assuming the time frame is long enough for capital to adjust to its new long run steady-state equilibrium in a scenario we call comparative steady state. In addition, we evaluate a "short-run" scenario, in which all labor is "sector-specific."

6.3.3.1 Aggregate welfare effects of WTO accession

We estimate that the welfare gains to Russia are equal to 7.2% of Russian consumption (or 3.3% of GDP) in the medium term. These gains derive from three key effects: (i) Improved access to the markets of non-CIS countries in selected products, (ii) Russian tariff reduction and (iii) liberalization of barriers to FDI in services sectors. We execute three scenarios that allow us to understand the relative impact of these various elements and the mechanisms through which they operate.

Impact of tariff reduction

The results for this scenario are presented in column (2) of Table 6.4. We lower tariffs by 50%, but there is no liberalization of the barriers to FDI or improved market access. The estimated welfare gains to the economy are 1.3% of consumption or 0.6% of GDP.

The gains to the economy from tariff reduction alone come about for two reasons. (i) The liberalization induces additional varieties in the imperfectly competitive sectors of Russia, which results in a productivity improvement for users of these goods through the Dixit—Stiglitz—Ethier effect. Additional varieties come from the fact that tariff reduction on imports in imperfectly competitive sectors raises the tariff-ridden demand curve for imports. This increases profitability for foreigners of selling in the Russian market thereby inducing new entry by foreign suppliers until zero profits are restored. Although there is a loss of domestic varieties due to increased foreign competition, there is a net increase in varieties. This result is analogous to the result found by Rutherford and Tarr (2002) in a fully dynamic model. (ii) Tariff reduction in Russia will lead to improved domestic resource allocation since tariff reduction will induce Russia to shift production to sectors where production is valued more highly based on world market prices. This is the fundamental comparative advantage effect from trade liberalization in CRTS models.

Impact of improved market access

In column (3) of Table 6.4, we present the results of a scenario in which we allow for improved market access (according to the terms-of-trade improvements of Table 6.3), but we do not lower tariffs or barriers to FDI in services sectors. We estimate that the impact of improved market access at 0.6% of consumption (0.3% of GDP). Gains derive from improved prices for exports. However, also a higher value for exports allows Russia to buy more imports and more varieties of imports increase productivity. Thus, the impact of improved market access is greater in a model with Dixit—Stiglitz variety effects than in a CRTS model.

Impact of FDI liberalization in business services

In this scenario, labeled reform of FDI barriers in column (4) of Table 6.4, we eliminate or reduce the discriminatory tax on multinationals in the services sectors (as shown in Table 6.3), but there is no reduction in tariffs or improved market access. The reduction in the discriminatory tax on multinationals increases profitability for provision of services in Russia by multinationals, thereby inducing new entry by multinational service providers until zero profits are restored. Although there is a loss of domestic service varieties due to increased multinational foreign competition, there is a net increase in varieties. Russian businesses will then have improved access to the services of multinational service providers in areas like telecommunication, banking, insurance, transportation and other business services. The additional service varieties in the business services sectors should lower the cost of doing business and result in a productivity improvement for users of these goods through the Dixit—Stiglitz—Ethier effect. We estimate that the gains to Russia from liberalization of barriers to FDI in services are about 5.2% of the value of Russian consumption or about 72% of the total gains to Russia of WTO accession.

6.3.3.2 Sector results

Expanding manufacturing sectors

Sectors we estimate will expand are those that either export a relatively large share of their output, obtain an exogenous increase in export prices as a result of WTO accession, are relatively unprotected initially compared to other sectors of the economy or experience a significant reduction in the cost of their intermediate inputs, typically because they have a large share of intermediate inputs that come from sectors that experience productivity advances due to trade or FDI liberalization.

The manufacturing sectors that we estimate are likely to expand their output the most are non-ferrous metals, ferrous metals and chemicals. These three sectors are among the sectors that we assume will gain an exogenous increase in the price of its exports upon WTO accession. They are also among those that export the highest share of their output — they all export over 30% of the value of their output. Export intensity is important because a reduction in tariffs generally depreciates the real exchange rate. Since the real exchange rate depreciates, sectors that export intensively will gain more domestic goods for a unit of their exports.[30]

[30] The real exchange must depreciate to restore equilibrium in the balance of trade. That is, the decline in tariffs induces an increase in the demand for imported goods and the reduction in barriers to multinational investment in the services sectors induces multinationals to import more foreign skilled labor. The depreciation of the real exchange rate encourages more exports and mutes the import expansion to restore equilibrium in the balance of trade constraint.

Declining manufacturing sectors

The sectors that contract the most are the sectors that are the most protected prior to tariff reduction and which have a relatively small share of exports. Most notably this includes machinery and equipment, food and light industry and construction materials. All of these sectors do little exporting and light industry and food are the sectors with the highest tariff rates.

Business services sectors

Russian business and labor interests in these sectors are not the same, and we discuss the impact on labor in these sectors first. We find that skilled and unskilled employment will expand in most, but not all, of the business services sectors. This is an application to a full economy model of the result found by Markusen *et al.* (2000, 2005). They have shown in a more stylized model that even when FDI is a partial equilibrium substitute for domestic skilled labor, it may be a general equilibrium complement. The reason is as follows. As a result of a reduction in the barriers to FDI in these sectors, we estimate that there will be an expansion in the number of multinational firms who locate in Russia to provide business services from within Russia and a contraction in the number of purely Russian firms. Although multinationals also demand Russian labor, though they use Russian labor slightly less intensively than Russian firms, i.e. since multinationals import primary inputs, FDI is a partial equilibrium substitute for Russian labor. However, as more service firms enter the market, the quality adjusted price of services falls and industries that use services expand their demand for business services. On balance, the increase in labor demand from the increase in the demand for business services typically exceeds the decline in labor demand from the substitution of multinational supply for Russian supply in the Russian market. That is, FDI is a partial equilibrium substitute but a general equilibrium complement to Russian labor. Thus, we estimate that labor in the business services sectors will typically gain from an expansion in FDI and multinational provision of services in Russia.

Regarding capital, as a result of the removal of restrictions, we estimate there would be significant increase in FDI and an increase in multinational firms operating in Russia. We estimate that specific capital owners in imperfectly competitive sectors will lose from this increase in competition. We expect, however, that the increase in FDI to have diverse impacts on Russian firms. We define a firm as a multinational even if a foreign firm and a Russian firm have formed a joint venture. Multinationals will often look for Russian joint venture partners when they want to invest in Russia. Russian companies that become part of the joint ventures in the expanding multinational share of the business services market will likely preserve or increase the value of their investments. Russian capital owners in business services who remain wholly independent of multinational firms, either because they avoid joint ventures or are not

desired as joint venture partners, will likely see the value of their investments decline and the least efficient will exit the industry.[31]

This suggests that domestic lobbying interests within a service sector could be diverse regarding FDI liberalization. We estimate that labor should find it in their interest to support FDI liberalization even if capital owners in the sector oppose it. However, capital owners themselves may have diverse interests depending on their prospects for acquisition by multinationals.

6.3.4 Sensitivity analysis

The results depend on the choice of parameters in the model as well as certain assumptions or "closures." In this section, we evaluate the impact on the results of the changing the values of the key parameters or modeling assumptions in the model. We begin with key model assumptions. We then discuss the results of "piecemeal sensitivity" analysis on the parameters. Finally we discuss the results of our "systematic sensitivity" analysis.

6.3.4.1 Model assumptions

Sensitivity to results to a 50% cut in the barriers to FDI

In this scenario, we simulate a cut in the barriers by one-half as much as in our central scenario (shown in column (6) of Table 6.4). However, we allow for improved market access and a 50% cut in tariff barriers. We find that the gains to the economy are reduced to about 4.1% of consumption. From Table 6.4, we can see this is slightly less than the sum of three components: (i) Half of the gains from FDI liberalization, (ii) tariff reduction and (iii) improved market access.

Rent capture or dissipation

Resource loss from rent seeking of licenses is a significant problem in Russia. In our central scenario we have ignored these costs, i.e. we assume that Russians capture the rents from the barriers without dissipation of the rents. It may be appropriate, however, to assume that those that obtain the licenses used Russian capital and labor in wasteful license seeking activities and the like. Then the *ad valorem* equivalents of the barriers to multinational investment are a real resource cost. As a result, the estimated gains from WTO accession increase from 7.2 to 7.7% of consumption (as shown in column (7) of Table 6.4) because the resources that were used to capture the rents become available for productive activities.

Similarly, if foreigners capture the rents initially, liberalization of the barriers will allow competition among foreigners that will result in a transfer of the rents from

[31] Exit of least-efficient firms is an inference we make outside of our model results, since we do not have a heterogeneous firms model. We assume that firms in the business services sectors must use a specific factor in order to produce output. This specific factor results in an upward-sloping supply curve in each business services sector.

foreigners to Russia. Then we estimate the gains to Russia from WTO accession will increase from our central estimate of 7.2 to 7.5% of consumption.

Sector-specific labor

Although we have sector specific capital (varying by sector and firm type), in our central scenario all labor is mobile. To evaluate short-run effects, where a significant portion of labor will be unable to switch jobs between sectors, we assume that labor cannot move between sectors (i.e., labor is "sector-specific"). With sector-specific labor, wages of skilled and unskilled labor will vary across sectors in response to shifts in demand coming from WTO accession.

The aggregate results are presented in Table 6.4, column (8). The welfare gains fall to 5.9% of consumption. This decline in the gains is expected when labor is sector specific since when labor is immobile, it cannot move to the sectors where it is valued most highly. What is striking about this scenario is that the gains remain very substantial. This shows how important productivity effects are since without productivity effects, a model with no labor market resource reallocation would produce very small gains.

While the welfare gains are smaller, no labor changes jobs in this scenario (see the rows on factor adjustments in Table 6.4). So the "social" adjustment costs of labor are zero.[32] Despite no dislocation of labor, the wages of workers in each sector will have their wages go up or down relative to the average wage in the economy for skilled or unskilled labor; thus, there are private adjustment costs of WTO accession, even if there are no social costs of adjustment in this short-run model.[33]

CRTS model – no productivity effects

We also executed a CRTS version of our model where we reduced tariffs by 50%, allowed improved access and lowered FDI barriers. Without the Dixit–Stiglitz structure that provides the possibility of productivity gains, the welfare gains are reduced to 1.2% of consumption.[34]

Long-run comparative steady-state results of WTO accession

In a long-run analysis, we should allow for the fact that WTO accession could improve the investment climate in Russia. In this scenario, we employ our comparative steady-state model. As explained in Section 6.3.2, the principal feature is that we allow for the fact that accession to the WTO could increase the rate of return on investment. This

[32] We have not estimated the social adjustment costs, we only calculate the share of the workers in each sector that have to change jobs. See Dixon and Rimmer (2002) for an application that measures adjustment costs.

[33] See Matusz and Tarr (2000) for an elaboration of the distinction between private and social costs of adjustment.

[34] Without increasing returns to scale, removing barriers to FDI has no effect (recall that rents are not dissipated in the benchmark).

would induce an increase in the capital stock until the marginal productivity of capital declines sufficiently that the rate of return on investment is no higher than the initial steady-state equilibrium rate of return on investment.[35]

With our comparative steady-state model, we estimate that the gains to Russia from WTO accession are 23.7% of consumption (11% of GDP). This is more than 3 times the estimated comparative static welfare gains. The reason the gains are larger is that we estimate that WTO accession will induce an increase in the rental rate on capital in Russia in the comparative static model by 4.9 %. In the comparative steady-state model, this induces an expansion of the capital stock in the new equilibrium. We estimate that the capital stock will increase by about 14.4% of its initial level in the long-run steady-state equilibrium. With a higher capital stock, the economy is able to produce more output and there is more consumption. Under the assumptions of this model, we must remark that this type of model produces an overestimate or an upper-bound estimate of the welfare gains because the foregone consumption necessary to achieve the higher capital stock is not taken into account. However, this model is not the optimal tool to assess the long-run growth welfare impacts since we have not captured endogenous growth effects in our model. Rutherford and Tarr (2002) have shown that a fully dynamic model that incorporates productivity effects endogenously, and which takes into account foregone consumption from investment decisions, is likely to produce estimated welfare gains that are as large or larger than these comparative steady-state results (see Section 6.4.4 for an elaboration).

6.3.4.2 Piecemeal sensitivity analysis

In Table 6.5, we present the impact on welfare of varying the value of key parameters. In these scenarios, we retain the central value of all parameters except the parameter in question. In general, the gains to the economy (welfare gains) increase with an increase in elasticities, since higher elasticities imply that the economy is able to more easily shift

35 It is sometimes alleged that the capital stock should not be expected to increase in the comparative steady-state model. The argument is that trade liberalization could favor labor intensive industries as easily as capital intensive ones, so there should be no presumption that the rental rate of capital will increase relative to the wage rate. I have explained in Section 6.2, however, that the pessimism of Stolper–Samuelson is overcome with Dixit–Stiglitz productivity effects. Both the rental rate on capital and the wage rate can rise relative to the price of goods. However, even in a CRTS CGE trade model, I maintain that we should normally (but not always) expect an increase in the capital stock from trade liberalization. The reason is that the rate of return on investment depends on the ratio of the rental rate on capital to the price of a unit of capital. In a model of homogeneous goods, the Stolper–Samuelson theorem implies that if the rental rate falls relative to the wage rate, the rental rate must also fall relative to the price of goods in the model. However, CGE modelers typically employ the Armington assumption. Our cost function of the capital good is produced by both domestic and imported inputs as well as labor and capital, and trade liberalization will reduce the price of imported inputs. [See Rutherford and Tarr (2003) for a mathematical characterization of the CRTS dynamic and comparative steady-state models.] Thus, there is a general presumption that the cost of the capital good will decline. Even when trade liberalization induces a fall in the rental rate of capital relative to the wage rate, the price of a unit of capital could fall more, inducing a rise in the return on investment and the capital stock in the new equilibrium.

Table 6.5 Piecemeal sensitivity analysis—welfare effects

Parameter[a]	Parameter value Lower	Intermediate	Upper	Hicksian equivalent variation[b] with corresponding parameter Lower	Intermediate	Upper
esubs	0.5	1.25	2.0	5.6	7.2	9.7
esub	2.0	3.0	4.0	7.3	7.2	6.8
sigmadm	2.0	3.0	4.0	7.1	7.2	7.3
esubprimary	0.70	1.00	1.30	7.1	7.2	7.2
esubintermed	0.0	0.0	0.25	7.2	7.2	7.4
esubconsumer	0.5	1.0	1.5	6.8	7.2	7.5
etadx	3.0	5.0	7.0	7.1	7.2	7.2
etad	5.0	7.5	10.0	6.9	7.2	7.4
etaf	10.0	15.0	20.0	5.1	7.2	8.7
theta_m(i)	see table below			7.1	7.2	7.2
theta_fdi(i)	see table below			5.2	7.2	8.4

[a]The piecemeal sensitivity analysis employs central values for all parameters (see below) other than the tested parameter and lump sum tax replacement.
[b]Hicksian equivalent variation as a percentage of the value of consumption in the benchmark equilibrium.

Parameter	Central Value	Definitions of the parameter
esubs	1.25	Elasticity of substitution between value-added and business services
esub	3.0	Elasticity of substitution between firm varieties in imperfectly competitive sectors
sigmadm	3.0	"Armington" elasticity of substitution between imports and domestic goods in CRTS sectors
esubprimary	0.0	Elasticity of substitution between primary factors of production in value added
esubintermed	0.0	Elasticity of substitution in intermediate production between composite Armington aggregate goods
esubconsumer	1.0	Elasticity of substitution in consumer demand
etadx	5.0	Elasticity of transformation (domestic output versus exports)
etad	7.5	Elasticity of Russian service firm supply with respect to price of output
etaf	15.0	Elasticity of multinational service firm supply with respect to price of output
theta_m(i)	Varies	Share of specialized imports V as a share of value added in multinational firms in sector I in the benchmark equilibrium
theta_fdi(i)	Varies	Share of output of service sector I captured by multinationals firms in the benchmark equilibrium

Parameter values for	*theta_fdi(i)* Low	Central	High	*theta_m(i)* Low	Central	High
Railway transportation	0.01	0.03	0.05	0.02	0.04	0.06
Truck transportation	0.03	0.05	0.07	0.01	0.03	0.05
Pipelines transportation	0.01	0.03	0.05	0.05	0.1	0.15
Maritime transportation	0.25	0.35	0.4	0.01	0.03	0.05
Air transportation	0.15	0.25	0.35	0.1	0.125	0.15
Other transportation	0.02	0.04	0.06	0.03	0.05	0.07
Telecommunications	0.05	0.15	0.25	0.08	0.1	0.12
Science and science servicing (market)	0.05	0.1	0.15	0.1	0.15	0.2
Financial services	0.05	0.1	0.15	0.01	0.03	0.05

to sectors or products that are cheaper after trade and FDI liberalization.[36] There are three sets of parameters in Table 6.5 that have a strong impact on the results: the elasticity of substitution between value-added and business services (*esubs*), the elasticity of multinational firm supply (*etaf*) and the vector of initial multinational shares in the services sectors *theta_fdi*(*i*). A liberalization of the barriers to FDI will result in a reduction in the cost of business services, both from the direct effect of lowering the costs of doing business for multinational service providers and from the indirect effect that additional varieties of business services allow users to purchase a quality adjusted unit of services at less cost. When *esubs* (the elasticity of substitution between value-added and business services) is high, users have the greater potential to substitute the cheaper business services and this increases productivity. The elasticity of multinational and Russian firm supply (*etaf*, *etad*) is primarily dependent on the sector-specific factor for each firm type (foreign or domestic). The mathematical relationship between the elasticity of firm supply and sector-specific factors is elaborated in an appendix to Balistreri and Tarr (2011). When *etaf* is high, a reduction in the barriers to FDI results in a larger expansion in the number of multinational firms supplying the Russian market, and hence more gains from additional varieties of business services. Finally, *theta_fdi*(*i*) (the share of the services market captured by multinationals) has a strong effect, since a liberalization results in a larger number of new varieties introduced when multinationals have a large initial share.

Share of expatriate labor employed by multinational service providers

The impact of liberalization of barriers to FDI in business services on the demand for labor in the business services sectors will depend on the share of expatriate labor used by multinational firms. If multinationals use mostly Russian labor, their expansion is likely to increase the demand for Russian labor in these sectors. We employed the estimates of the share of expatriate labor or specialized technology not available to Russian firms that is used by multinational service providers in Russia provided by the various Russian research institutes mentioned above. Here, we estimate the impact of employing the upper or lower bound estimates of this share in all business services sectors.

We find that the impact on the welfare estimates of lower or higher share of imported inputs in the business services sectors is only 1/10th of one percent of consumption. However, the impact on labor demand in the business services sector is more significant. For example, skilled labor demand in telecommunications increases by 6.0% with our central estimates of labor demand change, but would increase by 7.5% with the lower shares of imported inputs by multinationals and by 4.5% with higher shares of labor demand by multinationals. There is a similar range of results for labor demand in most of

[36] An increase in the elasticity of substitution between varieties reduces the welfare gain. This is because when varieties are good substitutes, additional varieties are worth less to firms and consumers.

the business services sectors. With sufficiently high share of expatriate labor use by the multinationals, the demand for labor in the business services sectors would decline, but based on the expert estimates of the use of expatriate labor, we expect to see an increase in the demand for labor in telecommunications, financial services and truck transportation, but a decline in air transportation services and science servicing. In all these cases, the shift in employment is less than 15% of initial employment.

6.3.4.3 Systematic sensitivity analysis

Piecemeal sensitivity analysis shows how the results change when we vary the value of key parameters one-by-one, with central values of all parameters except the one under consideration. In the systematic sensitivity analysis, we allow all parameters to change simultaneously. A probability distribution for each parameter is chosen. We typically choose uniform probability distributions, with the lower and upper bounds for the values of the parameters taken from the lower and upper values of the key parameters presented in Table 6.5. We furthermore assume that all distributions are stochastically independent.

We then run the model 30,000 times. Each time the program chooses a random configuration of parameters and executes the model with this configuration. For each variable in our model, we then harvest the sample distribution based on the 30,000 solutions. Consequently the sample distribution is not dependent on any particular set of parameter values, but represents results representative of the full distribution of parameter values.

We present the distribution of the results below for three key variables: welfare change as a percentage of consumption, output change and skilled employment changes. A full compendium or results with the sample distributions and confidence intervals is in Jensen *et al.* (2004). For each report variable, we calculate the percentage of solutions associated with a given result for the variable. Figure 6.2 shows that the welfare gains as a percentage of consumption are, in most cases, between 6 and 8%. The minimum value is 4.5% and the maximum value is 11.4%. The statistics show that only 6.4% of the solutions are below a welfare gain of 6% and that 13.0% are above a gain of 8%. More than 80% of the solutions yield a gain between 6 and 8%. This shows that the welfare results are very robust within the six to eight percent of the consumption range.

In Figure 6.3, we focus on the employment impacts in the six sectors where the impacts are the greatest: the three sectors with the largest increase in employment and the three sectors with the largest decline in employment. We only show the results for skilled labor, as the results for unskilled labor are very close to the results for skilled labor. We assume total employment is unchanged, so employment must expand in some sectors and contract in others. The sectors where employment expands the most are: ferrous metallurgy, non-ferrous metallurgy and chemical industry. The manufacturing sectors where employment declines the most are: mechanical engineering, light industry and

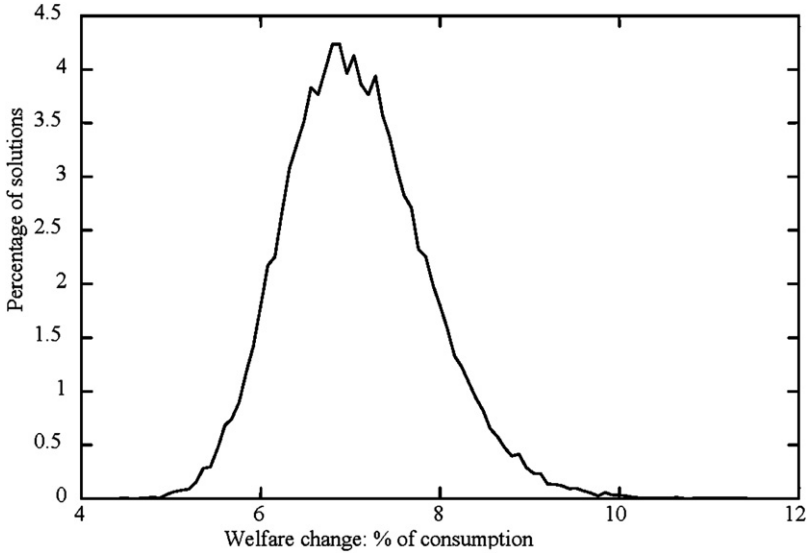

Figure 6.2 Frequency distribution of welfare change as a percentage of consumption. More than 80% of the solutions are in the interval 6—8%; 6.4% of the solutions below 6%; 13.0% of the solutions above 8%; minimum value: 4.5%; maximum value: 11.4%; mean value: 7.1%; median value: 7.1%. *Source: Jensen* et al. *(2007)*.

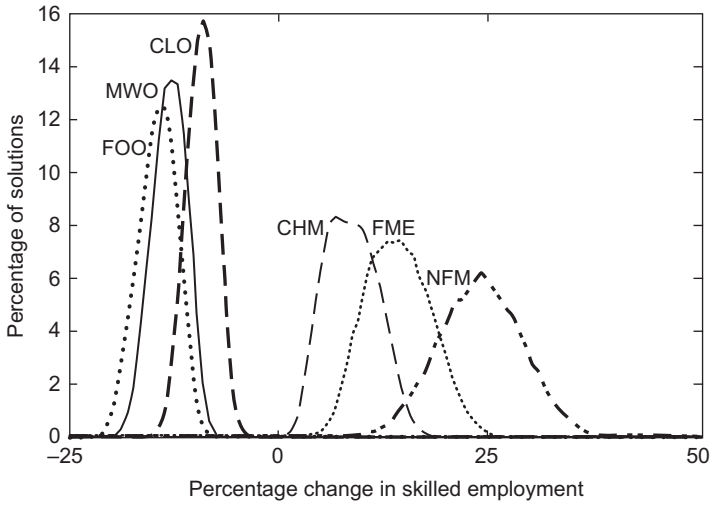

Figure 6.3 Frequency distribution of skilled employment impacts.

food industry. The results for all six sectors show that our central results are robust to most parameter configurations, and in particular that the expanding (declining) sectors are expanding (declining) for virtually all configurations. Figure 6.3 also shows that the magnitude of the results for the expanding sectors is more uncertain than the results for

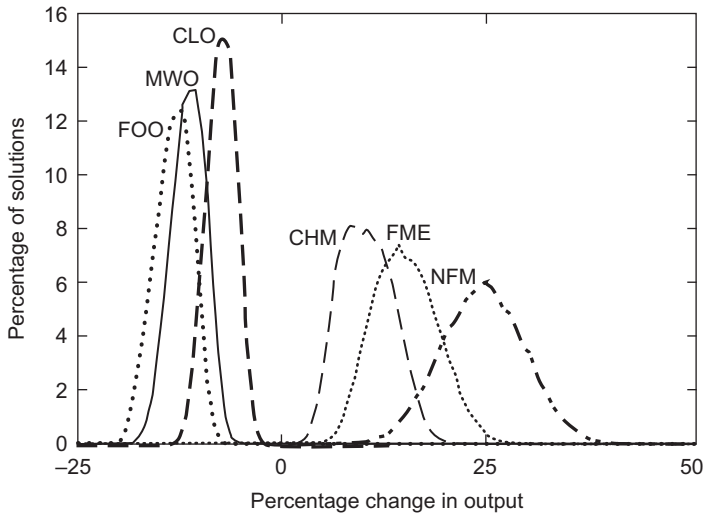

Figure 6.4 Frequency distribution of output impacts.

the declining sectors. This is explained by the relatively greater use of business services and goods from imperfectly competitive sectors.[37]

In Figure 6.4, we display the frequency distributions of the output changes in the same six sectors. The pattern with which sectors expand or contract is the same as for employment, but the results are more positive. Whereas economy-wide employment is fixed by assumption, output increases overall. Output expands due to greater efficiency in the use of resources, and, more importantly, due to the greater productivity of factors of production from the increase in varieties of business services and differentiated goods.

Finally, in order to display systematic sensitivity results for all industries in one figure, in the upper panel of Figure 6.5, we display bars that represent 50% confidence intervals for aggregate output (export plus domestic sales) for all industries (the point on the bar is our point estimate). In the lower panel of Figure 6.5, we show 50% confidence intervals for domestic output by industry. Similar figures for other variables are in appendix B of Jensen *et al.* (2004).

6.3.5 Conclusions

In this section we have developed an innovative SOE CGE model of the Russian economy that is capable of assessing the impact of the liberalization of barriers against FDI. Surveys and estimates of the *ad valorem* equivalents of the barriers against FDI were prepared for this model. We find that the source of the largest gains to Russia from WTO accession is that additional multinational service providers will reduce the

[37] Thus, variation in the values of *etaf*, *esubs* and *theta_fdi* have a greater impact on these sectors.

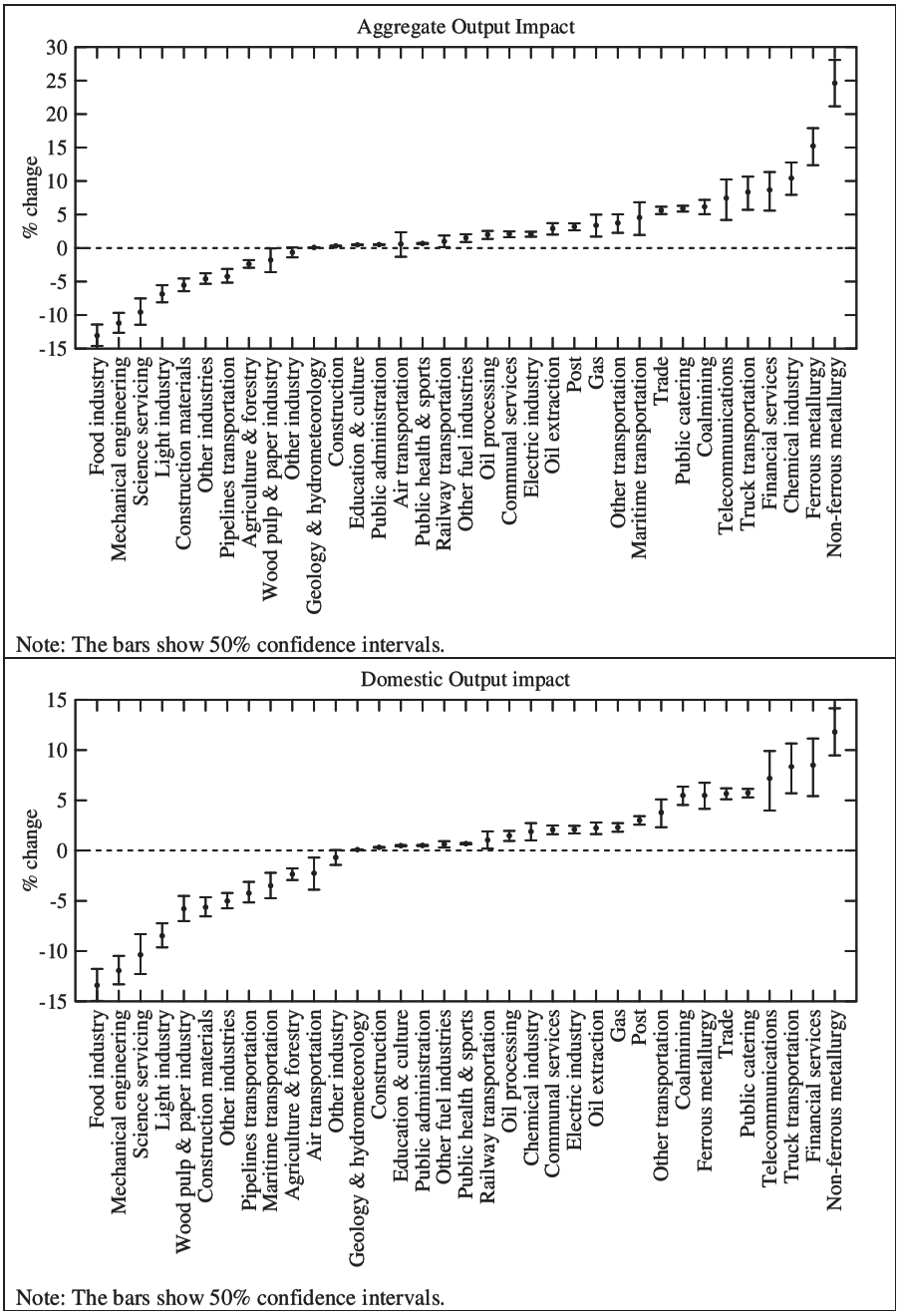

Figure 6.5 Aggregate output and domestic output.

quality-adjusted cost of purchasing business services in Russia and that these gains are rather substantial when compared with the typical gains from CRTS models of tariff liberalization. We believe that these results are supported by the empirical literature cited in Section 6.1 that indicates that access to a diverse set of service providers with a domestic presence is crucial for growth.

6.4 POVERTY EFFECTS OF RUSSIA'S WTO ACCESSION: MODELING "REAL" HOUSEHOLDS WITH FDI IN SERVICES AND ENDOGENOUS PRODUCTIVITY EFFECTS

6.4.1 Introduction[38]

The work discussed in this section originated from a request by the Government of Russia to the World Bank for development of a methodology to assess the impact of WTO accession on poverty and social issues in Russia. In Russia, as in many countries, policy makers are concerned with not only the aggregate effects and impacts on productive sectors of the economy, but they are also concerned with impacts on the poor and other distributional effects.

We extend the model of Russia discussed above to assess the poverty and distribution effects of Russia's WTO accession. In particular, the model again incorporates FDI in imperfectly competitive business service sectors, and we adopt the Dixit–Stiglitz framework in both business services and imperfectly competitive goods sectors, which implies that we have endogenous productivity effects from additional varieties in these sectors. We show that these features are crucial to the distributional and aggregate results. What is innovative in this model is that we integrated all the 55,098 households of the Russian HBS as agents in the model. Thus, our model is a "real household" model.

Interest in the impact of trade policy on poverty has dramatically increased in recent years. Some modelers have assessed impacts with a CGE multiple representative agent approach. The pioneering papers on multihousehold models in CGE models were done by Adelman and Robinson (1978) and Piggott and Whalley (1985); recent examples include Harrison *et al.* (2003, 2004). However, this approach can mask large differences among the households within each representative household. In order to incorporate information on all available households, but given the difficulty in incorporating large household datasets as multiple agents of a CGE model, several authors (e.g. Bourguignon *et al.*, 1991; Chen and Ravallion, 2004) have adopted a sequential (also called "open-loop" or "top-down") microsimulation approach. In the first step a single representative agent CGE model is employed to obtain the estimated price changes from a trade policy change. These price changes are then fed into a microsimulation household model for predicted household effects. However, the sequential approach ignores feedback effects

[38] This section is based on Rutherford and Tarr (2008) and Rutherford *et al.* (2005).

of the quantity changes in the microsimulation household model on the equilibrium prices in the representative agent general equilibrium model. Moreover, although efforts are sometimes made at data reconciliation, the sequential approach does not require reconciliation of inconsistent information on household income from the National Accounts (which report factor payments) and the household surveys (which report factor income).[39] Consequently, in summarizing the state of the literature, Bourguignon and Perreira (2003, p. 343) have argued that one of the major challenges for the analysis of the impact of economic policies on poverty and income distribution is to integrate a CGE model with "real" households from the household survey rather than representative households, but they note that this is empirically difficult.

The first successful integration of a full household survey into a CGE model was by Cockburn (2001) when he integrated the 3373 households in the household survey into his CRTS CGE model of Nepal. Subsequently, Cororaton and Cockburn (2007) integrated the 24,979 households in the household survey into their CRTS model of the Philippines.[40] The solution techniques used by Cockburn and his coauthors, however, will not typically allow incorporation of larger household datasets, and increasing returns to scale models present greater challenges for robust solutions. In this section, however, we employ a new solution algorithm for an increasing returns to scale CGE model with essentially no significant bound on the number of household agents.

In our central model, we estimate that the mean welfare gains to Russia, averaged over all households, from WTO accession are a rather substantial 7.3% of Russian consumption (with a standard deviation of 2.2% of consumption) in the medium run. Decomposition analysis reveals that over 70% of the gains are due to the liberalization of barriers against foreign investors in services. We estimate that 99.9% of the households will gain from 2% to 25% of their household income. We find that poor households gain slightly more than rich households on average, since the return on capital does not increase as much as the wages of skilled and unskilled labor. We conduct both piecemeal sensitivity analysis and systematic sensitivity analysis (the latter by executing the model 30,000 times with random parameter selection), and find that our results are robust with respect to parameter specification. However, without FDI, services liberalization and Dixit–Stiglitz externalities, the welfare gains are only one-sixth of the gains in our model and 7% of the households are estimated to lose. Our results show that, while incorporating the diversity of households though a real household model is important, incorporating FDI in business services with Dixit–Stiglitz effects is as important for assessing household impacts.

[39] Without data reconciliation the household model and the representative agent model can produce very different results. Ianchovichina and Martin (2004) estimated that China will gain from WTO accession based on their representative agent model. However, Chen and Ravallion (2004) estimate overall losses for China from WTO accession based on their household model using price changes from Ianchovichina and Martin.

[40] See also Annabi *et al.* (2005), who have incorporated 3278 households into a CRTS CGE model.

We describe the model, algorithm and data in Sections 6.4.2 and 6.4.3. Results are presented in Section 6.4.4. We show the results of piecemeal and systematic sensitivity analysis in Section 6.4.5. Also in Section 6.4.5, we assess the estimation error in the sequential approach and suggest conditions under which the sequential approach may be a good approximation for our integrated approach.

6.4.2 The model

Since we have described the structure of that single representative agent model in Section 6.3, we only briefly describe the structure of the representative model here. Rather, we focus on the features of the model that are necessary to generalize the model to 55,098 households.

6.4.2.1 Household consumer demand[41]

Based on the data work described below, we aggregate individuals within each of the 55 098 households to obtain household factor income shares, expenditure shares on the commodities in our model, and transfers between the household and the government and savings. We assume each household maximizes a Cobb–Douglas utility function of the aggregate 35 goods in our model subject to its budget constraint (which is factor income net of transfers). Each of the 35 aggregate commodities is a CES ("Armington") aggregate of imported goods or services and goods or services produced in Russia. In imperfectly competitive goods sectors, imported and Russian-produced goods are Dixit–Stiglitz aggregates of the outputs of foreign or Russian firms. (Since consumer demand is analogous to firm level demand, the structure is depicted in Figure 6.1 under "Composite intermediate IRTS goods") The structure of consumer demand for imperfectly competitive services sectors (equivalent to business services in our model) is depicted on the left side of Figure 6.1 under "Business Services" (value-added does not enter the demand function of consumers). The structure of production is identical to the single representative agent model.

Consumer demand, as well as firm level demand, exhibits love of variety in imperfectly competitive goods. Given that we have weak separability and homothetic functions at all levels of consumer demand, the conditions for two-stage (or multistage) budgeting are satisfied. Given the initial data on each of the households and our assumptions on the structure of demand, we solve for the parameter values in each of the 55,098 household utility functions that are consistent with optimization by the households. Thus, the demand functions of all households are dependent on their initial choices and, in general, differ from one another.

41 For a mathematical treatment of the algorithm we have developed see the appendices to Rutherford *et al.* (2005). We also provide a graphical interpretation there to intuitively explain the algorithm and why it allows us to integrate all households from any household budget survey into a general equilibrium model, i.e., it has essentially eliminated the constraint on the number of households that can be integrated into a general equilibrium model.

6.4.3 Data

Here, we focus on the data relevant to development of the multihousehold model. Unless otherwise specified, we use parameters and data from the single representative agent model.

6.4.3.1 Households

Households are modeled endogenously based on the 55 098 households of the Russian HBS. The HBS, which is representative at the regional level, has very detailed information on household consumption expenditures, and information about age, gender, education and occupation of each member of the household. It also has information about expenditures and savings, and by implication household income.

The major shortcoming of the HBS for our purposes is that it does not contain information on the sources of income of the households. For sources of household income, we must turn to the Russian Longitudinal Monitoring Survey (RLMS). The RMLS has less than 5000 observations and is not representative of the population on the regional level. However, is has extensive information on individual and household sources of income: wages and profits from first, second and third jobs; pensions and unemployment benefits; profits and dividends from accumulated assets.

We have employed both small area estimation (SAE) and Matching techniques (see Rao, 1999; Elbers *et al*., 2003; Moriarity and Scheuren, 2003) to generate sources of income data for all 55 098 households in the HBS. We describe our procedures in appendix B of Rutherford *et al.* (2005). Results from both techniques yield similar results.

The key point is that we chose characteristics of the two datasets that are common to both datasets and which we expect influence factor shares of income. These characteristics, which can be found in both the HBS and the RLMS, are personal, household and geographic characteristics. Personal characteristics include age, gender, skilled or unskilled worker, head of the household, primary, secondary and other occupation, and income. Household characteristics are family size, members of the household who work and gender of the head of household. Geographic characteristics are the region of Russia and urban or rural.

Using the RLMS data, we then estimate regression equations where the independent variables are the characteristics mentioned above and factor shares are the dependent variables. In the SAE procedure, we assume that the estimated equations based on the RLMS data apply to all the households in the HBS. Using the data on the household characteristics in the HBS, we thereby generate factor shares for the larger HBS. Factor shares and consumption shares aggregated to deciles are presented in Rutherford *et al.* (2005).

6.4.3.2 Reconciliation of the National Account data and HBS data

We have two sources of data for aggregate factor incomes: data from National Accounts and data from the HBS. In our Russian data, capital's share of factor income is much larger in the National Account data than in the HBS (see Table 6.2). This is typical. Ivanic (2004) mapped income from the Living Standards Measurement Surveys (LSMS)

in 14 countries into factor shares and compared factor shares with the input-output tables in these countries. Capital's average share from the LSMS surveys was 21% of household income, but it was 52% of household income based on National Account information (based on the "GTAP" dataset).[42]

We must produce a balanced SAM in order to implement our integrated model, which means we must reconcile those differences. There are biases in both the collection of National Account and HBS data so that neither source is clearly correct. A key problem with the factor share data from the National Accounts is that capital's share is calculated residually in the input-output tables. Then in sectors where labor payments are under-reported, as in agriculture (where sole proprietors do not report their labor income and temporary workers are often informal workers) and services, the share of capital is biased up. Unprofitable sectors that receive state subsidies will be reported as labor-intensive, despite the fact that in developing countries these are typically the capital-intensive sectors. Harrison *et al*. (2003) have shown that this bias can lead to perverse reporting of which sectors are labor-intensive in developing countries. On the other hand, income estimates from LSMS surveys are known to be less than income estimates from National Accounts. Deaton (2003) explains that one of the most likely explanations of the difference is that households fail to respond to the survey and that the probability of non-response plausibly increases monotonically with income. This presumed pattern of non-response to the household survey would also help explain this difference in capital's share, since the rich are likely to have more capital than the poor.

For our central model, we took total value added by sector from the National Accounts, but given our desire to preserve "real households" and our focus on poverty, we did not want to alter the HBS factor shares. Thus, we did not alter the HBS data or value-added data by industry from the National Accounts. Rather we adjusted factor shares at the industry level to be consistent with the factor payments implied by the HBS. This reconciliation of the two sets of data significantly decreased the share of capital reported by the input-output table, especially in some of the more capital intensive sectors like ferrous and non-ferrous metals (see Table 6.2).[43]

[42] Household income (net of taxes and transfers) in Russia exceeds household consumption for almost all households. Part of the reason is savings for investment. However, in the case of Russia, an important part of the reason is that Russia has a large current account surplus. Consistency between the macro balances and the household data in construction of the SAM implies that household factor income must be larger than household consumption for most households to allow for the transfer of capital to foreigners. It follows that the change in factor income as a percent of consumption will be larger than the change in factor income as a percent of household income.

[43] Of course as capital's share decreases, labor's share must increase, but reconciliation of data with the household data, also resulted in an increase in the relative share of skilled labor to unskilled labor. This is because, lacking more specific data at the household level, we defined all labor income as skilled labor income if the worker had any post-secondary education. Russia has a highly educated labor force, so this reconciliation resulted in an increase in the share of labor income going to skilled labor.

Table 6.6 Impact of WTO accession in 55,098 household model on economy-wide variables in Russia—policy results and decomposition of effects (results are percentage change from initial equilibrium)

	Benchmark	WTO accession (1)	WTO accession (equal Ruble transfers) (2)	Improved market access only (3)	Tariff reform only (4)	Reform of FDI barriers only (5)	CRTS Model (6)	WTO Accession with partial reform of FDI barriers (7)
Aggregate welfare								
Mean welfare (*EV* as % of consumption)		7.3	7.2	0.7	1.3	5.3	1.2	4.1
Standard deviation of *EV* as % of consumption[a]		*(2.2)*	*(2.2)*	*(0.5)*	*(0.8)*	*(1.5)*	*(0.7)*	(1.3)
Welfare (*EV* as % of GDP)		3.4	3.4	0.3	0.6	2.4	0.6	1.9
Government budget								
Tariff revenue (% of GDP)	1.4	0.9	0.9	1.4	0.8	1.4	0.9	0.8
Tariff revenue (% change)		−33.2	−33.2	8.7	−38.3	10.9	−43.5	−35.2
Aggregate trade								
Real exchange rate (% change)		2.6	2.6	−0.5	2.0	1.1	0.3	1.8
Aggregate exports (% change)		14.4	14.4	2.3	8.1	3.7	5.9	11.9

(*Continued*)

Table 6.6 Impact of WTO accession in 55,098 household model on economy-wide variables in Russia—policy results and decomposition of effects (results are percentage change from initial equilibrium)—cont'd

	Benchmark	WTO accession (1)	WTO accession (equal Ruble transfers) (2)	Improved market access only (3)	Tariff reform only (4)	Reform of FDI barriers only (5)	CRTS Model (6)	WTO Accession with partial reform of FDI barriers (7)
Returns to mobile factors								
Unskilled labor (% change)		3.7	3.7	0.1	0.6	2.9	1.0	1.7
Skilled labor (% change)		5.3	5.3	0.7	1.7	2.8	1.9	3.2
Capital (% change)		1.8	1.8	−0.6	1.0	1.4	0.9	2.2
Percent of factors that must adjust								
Unskilled labor		1.2	1.2	0.3	1.2	0.4	0.8	1.3
Skilled labor		1.4	1.4	0.5	0.6	0.7	0.6	1.0
Capital		0.5	0.5	0.1	0.3	0.1	0.3	0.4

[a]The means and standard deviations are the population weighted means and standard deviations of the 55,098 estimates.
Source: Author's estimates.

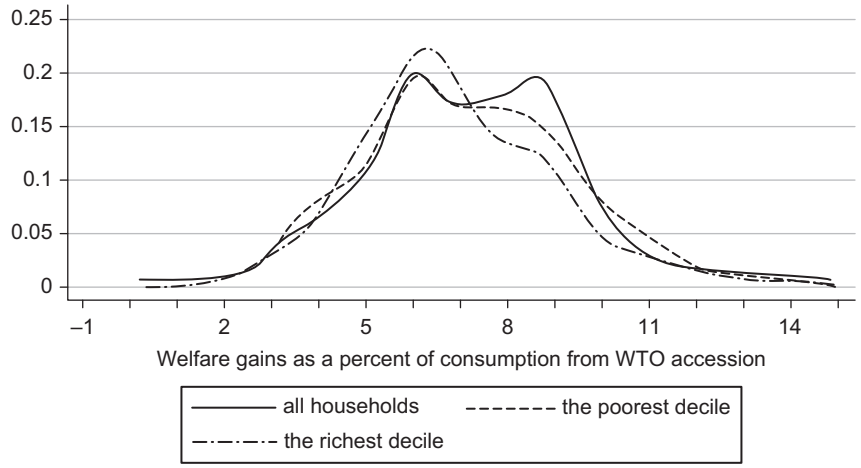

Figure 6.6 Distributions of estimated welfare gains from Russian WTO accession for the entire sample, the poorest decile and the richest decile. Observations in the range of 0% to 5% are shown. Details are constructed to be representative of 10% of the Russian population based on the weights of the HBS.

We acknowledge that alternate methods of reconciliation are valid. For the purposes of sensitivity analysis, therefore, we have also run the model with the opposite reconciliation. That is, we adjusted factor shares at the household level to be consistent with the factor payments of the National Accounts. We report these results in the sensitivity results.

6.4.4 Estimated impacts of Russian WTO accession

6.4.4.1 Aggregate results in the full 55 098 household model

In our general WTO scenario, we make the same assumptions regarding the counterfactual changes in parameters as in Section 6.3. Aggregate results are summarized in Table 6.6. Aggregate welfare results in Table 6.6 are obtained by aggregating the equivalent variation gains (as a% of consumption) of the 55 thousand consumers, using population weights. We report both the mean and the standard deviation of the welfare results across the 55,098 households.[44] The overall results are very similar to the results for the single representative consumer model. For our central WTO scenario, column

[44] For each of our 55,098 households h, we estimate its equivalent variation (EV_h) and we have the value of the household's initial consumption (C_h). Define 100 $ev_h = 100(EV_h/C_h)$, which is the increase in the equivalent variation of household h as a percentage of its initial consumption. To calculate the mean and standard deviation of the 55,098 values of 100 ev_h we need to take into account that the households in the sample are statistically representative of the Russian population and each household in the HBS has a weight w_h that reflects the number of people it represents in the overall Russian population. We normalize the household weights by defining $\alpha_h = w_h / \sum_h w_h$. The weights α_h for $h = 1, \ldots, 55{,}098$ are each household's share of the total Russian population. Thus, our estimated weighted average increase in equivalent variation as a percent of initial household consumption is $100\sum_h \alpha_h ev_h = \mu$. Calculation of the weighted average variance of the increase in equivalent variation as a percent of initial consumption follows similar principles; it is defined as: $\sum_h [\alpha_h 100^2 (ev_h - \mu)^2]$. We report the positive square root of this value in Table 6.6, i.e., the standard deviation.

(1), we obtain rather substantial aggregate gains for a comparative state trade model equal to 7.3% of aggregate consumption. To determine what is driving these results, we decompose the WTO scenario into its three components. The results are shown in columns (3)−(5). The key result is that liberalization of barriers to FDI is responsible for an estimated welfare gain of 5.3% of consumption, or over 70% of the total welfare gain.

To put these numbers in perspective, Rutherford and Tarr (2002) have analytically derived the relationship between a permanent increase in the steady-state growth rate and equivalent variation. A welfare gain of 10% of consumption corresponds to a permanent increase in the growth rate of about 0.4%. Although cross-country assessments of the impact of trade liberalization on growth have been criticized, several authors have estimated that trade liberalization could increase the growth rate by between 1 and 2.5%.[45]

Similar to the single-consumer model, if we assume CRTS in all sectors of the economy, the estimated gains, column (6) are reduced to 1.2% of consumption. These results again show that incorporating liberalization of barriers to FDI in the analysis as well as the Dixit−Stiglitz−Ethier formulation for endogenous productivity effects are both crucial in explaining the rather substantial estimated gains from Russian WTO accession.

In the WTO scenario, the wage rate of skilled labor increases by 5.3%, the wage rate of unskilled labor increases by 3.7% and the return on capital increases by 1.8%. Although the return to capital rises relative to a basket of consumption goods, it does not rise as much as wages. The return to capital increases less than wages because owners of "specific capital" in imperfectly competitive sectors that are subject to increased competition from imports or from FDI will see a reduction in the value of their returns. Returns to mobile capital increase by over 6%, even faster than returns to skilled labor because the economy shifts resources into the more capital-intensive sectors and away from more unskilled labor-intensive sectors such as light industry and mechanical engineering and metal working (see Rutherford *et al.*, 2005, Table 6). However, the return on sector-specific capital in all imperfectly competitive sectors falls, so that the total return on capital rises less than wages. The ratio of skilled to unskilled labor in the expanding sectors is greater than in the contracting sectors. As a result, the wage of skilled labor rises faster than the wage rate of unskilled labor.

[45] These cross-country regression results are controversial, since trade liberalization is often accompanied by macro stabilization and other market reforms, and the open economy variable in the regressions can be picking up these other effects as well. Moreover, institutional reforms may also be rather important. However, trade reform may compel complementary reforms, such as the elimination of state subsidies, which are often unsustainable in an open economy. WTO accession also involves a number of institutional reforms. For example, liberalization of FDI in services will put great pressure on the regulatory authorities to improve the institutional environment.

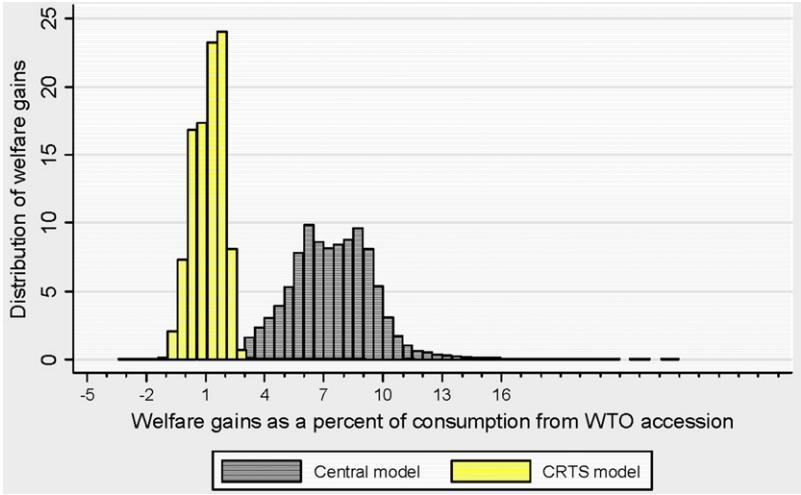

Figure 6.7 Distributions of estimated welfare gains from Russian WTO accession. Central and CRTS models comparison. Households sampled = 55,098. Observations in the range of −5% to 25% are shown.

6.4.4.2 Results for individual households

Distribution of the results

The distribution of gains from Russian WTO accession across all 55,098 households is summarized in Figures 6.6 and 6.7. In Figure 6.6, we display the distribution of gains for the poorest and richest deciles of the population, along with the distribution of the gains for all households. We find that gains are rather evenly distributed across income groups, but we find that the poor gain slightly more than the wealthy because the wage rate of unskilled labor increases more than the rate of return on capital. The Gini coefficient is only marginally affected: it declines from 0.401 to 0.399.[46] We also find that rural households gain less than urban households because the wage rate of skilled labor increases more than the other factors of production and rural households are less endowed with skilled labor than urban households.

Figure 6.7 shows there is a distribution of income changes across the 55,098 households that is centered around a mean gain of income of 7.3%.[47] Except for 14 households, we estimate that all households will gain in the new equilibrium relative to the *status quo*.[48] These results highlight in a real household model what we showed in

46 Our estimate of the Gini coefficient is virtually identical to Rostat (the statistical agency of Russia). Rostat estimates the Gini coefficient at 0.400 in 2003.

47 Of the 55,098 households, there are 59 with gains less than 2% and seven households with gains above 25%. Thus, 99.9% of all households have gains that fall in the range of 2−25%. Fourteen households, or two-hundredths of 1% of the households, are estimated to lose.

48 Households that depend disproportionately on specific capital that falls in return would be expected to lose from WTO accession, but the data do not allow this distinction.

Section 6.2 in a stylized model: with Dixit–Stiglitz productivity impacts, we escape the pessimism of Stolper–Samuelson. The fact that the model has FDI in business services yields Dixit–Stiglitz productivity effects from services liberalization and further contributes to increase in real returns to all mobile factors. The principal caveat to the widespread gains is the potential loss of income to owners of specific capital in sectors subject to increased competition from FDI.[49]

In Figure 6.7 we compare the results across 55,098 households based on two models. On the right side of the diagram is the histogram of results for all households from our central model. Despite diversity among households, virtually none are estimated to lose. On the left side of the diagram, we present the histogram of results for all households with a CRTS model. The CRTS distribution is centered around 1.2% of gains in consumption and about 7% of the households are estimated to lose from accession to the WTO.[50]

The striking aspect of Figure 6.7 is that the distribution of gains from our central model is centered sufficiently far to the right of the CRTS distribution that there is only a slight overlap of the two distributions in the tails. *Figure 6.7 encapsulates the central point of this section: to estimate household impacts, it is important to incorporate household diversity through a real household model. However, incorporating FDI in business services and Dixit–Stiglitz effects in imperfectly competitive sectors is as important for our policy simulation.* It is evident that incorporating FDI liberalization and endogenous productivity effects will decisively affect the results.

6.4.4.3 What is left out of the analysis?

Transition costs

We have not modeled the transition costs of achieving a new equilibrium. During a transition period it is likely that many households will lose, so the gains will be less that we estimate to that extent.

[49] While households that are heavily endowed with specific capital in declining sectors will lose on average from WTO accession, those who can form joint ventures with foreign investors will likely see the value of their specific capital holdings increase.

[50] The fact that only 7% of households lose with liberalization under CRTS may be surprising in view of the Stolper–Samuelson theorem. However, one should not apply intuition from Stolper–Samuelson in our model. (i) We have specific factors in our CRTS model. (ii) Ethier (1984) has shown that "the Stolper–Samuelson result in its strong form is inherently a 2×2 property and offers no hope for generalization." More importantly, we maintain the assumption of product differentiation by country of origin in CRTS sectors (the "Armington" assumption). To see why this is crucial, consider a two-sector CRTS model with products differentiated by country of origin. Suppose factor intensities are identical in the two sectors. Trade will exist due to the product differentiation assumption. Suppose there is one distortion: a tariff on one of the goods and it is removed. Welfare and real incomes increase on average due to the tariff removal. However, since factor intensities are identical, relative factor returns can not change and the returns to both factors increase, i.e. Stolper–Samuelson does not hold as a general principle. Stolper–Samuelson results are more likely to hold, the better the products substitute for each other and the larger the factor intensity differences across sectors.

Table 6.7 Data reconciliation and the welfare impacts of WTO accession—with a decomposition of the impacts

		Percentage change in *EV* due to changes in factor prices, goods prices or transfers, by aggregated deciles[a]					
		Skilled wages	Unskilled wages	Return to capital	Taxes and transfers	Goods prices	Aggregate *EV*
Decile 1 (0−10%) − overall	unreconciled sequential approach	5.3	2.2	0.2	−0.5	0.0	7.2
	integrated model	5.4	2.8	0.1	−0.3	0.3	7.6
Decile 2 (11−20%) − overall	unreconciled sequential approach	5.3	2.0	0.3	−0.4	0.0	7.3
	integrated model	5.5	2.5	0.1	−0.3	0.3	7.6
Decile 3 (21−30%) − overall	unreconciled sequential approach	5.8	1.7	0.5	−0.5	−0.1	7.6
	integrated model	5.9	2.2	0.2	−0.3	0.2	7.7
Decile 4 (31−40%) − overall	unreconciled sequential approach	5.8	1.6	0.6	−0.4	−0.1	7.6
	integrated model	5.9	2.0	0.2	−0.3	0.2	7.7
Decile 5 (41−50%) − overall	unreconciled sequential approach	5.7	1.5	0.9	−0.4	−0.1	7.8
	integrated model	5.9	1.8	0.3	−0.3	0.1	7.7
Decile 6 (51−60%) − overall	unreconciled sequential approach	5.6	1.4	1.2	−0.5	−0.1	7.9
	integrated model	5.8	1.7	0.5	−0.3	0.1	7.5
Decile 7 (61−70%) − overall	unreconciled sequential approach	5.7	1.1	1.6	−0.5	−0.1	8.1
	integrated model	5.8	1.4	0.6	−0.3	0.0	7.5
Decile 8 (71−80%) − overall	unreconciled sequential approach	5.9	0.9	1.9	−0.5	−0.1	8.4
	integrated model	6.0	1.2	0.7	−0.4	0.1	7.5
Decile 9 (81−90%) − overall	unreconciled sequential approach	5.1	0.9	2.6	−0.5	−0.2	8.3
	integrated model	5.3	1.1	1.0	−0.3	−0.1	7.2

(*Continued*)

Table 6.7 Data reconciliation and the welfare impacts of WTO accession—with a decomposition of the impacts—cont'd

		Percentage change in *EV* due to changes in factor prices, goods prices or transfers, by aggregated deciles[a]					
		Skilled wages	Unskilled wages	Return to capital	Taxes and transfers	Goods prices	Aggregate *EV*
Decile 10 (91−100%) − overall	unreconciled sequential approach	4.4	0.6	3.8	−0.5	0.0	8.3
	integrated model	4.5	0.8	1.4	−0.3	−0.3	6.8

[a]In the integrated (sequential) approach, the percentage change in skilled wages, unskilled wages and return on capital is 5.3% (5.1%), 3.7% (3.0%) and 1.8% (4.9%), respectively. All households face the same factor prices, but depending on the factor endowments of the different households, this will impact the *EV* of the households differently. Similarly, for goods price changes. We have estimated the decomposed impacts as shown in the table. Aggregate *EV* for each decile is approximately the horizontal sum of the elements in the same row.

Intellectual property

The most important part of WTO accession that we have not modeled is the strengthening of the intellectual property regime in Russia, especially enforcement. Contrary to the transition cost issue, it is difficult to assess the direction of the impact on Russia from better intellectual property enforcement. On the one hand, Russia will have to pay more for goods like imported DVDs, software and drugs. However, Russia is a high human capital country and has the potential to significantly expand its marketable research. As President, Vladimir Putin reportedly considered the balance of these issues to favor Russia and encouraged more vigorous enforcement of intellectual property laws in Russia.

6.4.5 Sensitivity analysis

The results depend on the choice of parameters in the model, alternate ways of reconciling data and method of solution of the model. In this section, we begin with an assessment of the bias from the sequential approach to microsimulation analysis. We then assess the impact on the results if we adjust the household data to be consistent with the input-output data. We then turn to "piecemeal sensitivity" analysis on the parameters. Finally, we discuss the results of our "systematic sensitivity analysis."

6.4.5.1 Decomposition of the gains and biases from the sequential approach to microsimulation analysis

We have aggregated the households in our model into deciles, from poorest to richest. Then we have decomposed the equivalent variation gains (as a percentage of consumption) of the 10 aggregated households into changes in factor prices, goods prices and taxes and transfers. The results are in Table 6.7 labeled "integrated model." For all the deciles of aggregated households the impact of goods prices is relatively unimportant compared with

the impact of factor prices. In part because households cannot easily change their factor endowments between unskilled labor, skilled labor and capital, but they can substitute among commodities consumed, impacts on factor incomes through changes in factor prices tend to dominate the household welfare impacts in these kinds of models.[51]

We have also executed a single representative consumer model based on input-output data that is not reconciled with the household data. We feed the factor and good price changes into a household model for the determination of household equivalent variation of the 55,098 households. Aggregation of the household welfare results for households within each decile provides the results at the decile level labeled "unreconciled sequential approach" in Table 6.7. We find that the richer households are estimated to gain significantly more in the unreconciled sequential approach, since the return to capital increases more in the unreconciled approach (this is not a general result). On the other hand, we find that the bias from ignoring the quantity feedback effects on prices is very small if the data are reconciled first between the household and representative consumer models. See Rutherford *et al.* (2005) for further details.[52]

Based on these results, we believe that a sequential approach to assess household impacts of trade policy changes is likely to be a good approximation to the results of a more difficult to implement integrated approach, provided three conditions are satisfied: (i) the household data are reconciled with National Accounts data, (ii) the factor and consumption shares of the representative agent in the sequential approach are equal to factor and consumption shares that are the sum over all households, and (iii) the representative agent and the households exhibit the same optimizing behavior. The latter implies that the first order effects are the same.

6.4.5.2 Alternate reconciliation of the National Account and HBS data

As opposed to our central model, in this "National Accounts"-based model we allow the household factor shares to adjust while keeping the factor shares from the National Accounts fixed. Taking a weighted average of the 55 098 household welfare gains, we get an estimated 7.2% of consumption; this is only trivially different than the 7.3% gain in our central model (and coincides with our representative agent model that is based on the national income accounts data). At the household level, we again estimate that virtually all households should gain from WTO accession.

There are, however, differences in the distribution of gains among households, the standard deviation of the estimated gains is somewhat larger and the Gini coefficient

51 See, e.g. Harrison *et al.* (2003).

52 We have also shown that if we are only interested in results at the decile level (as opposed to household results), running a model with thousands of households and then aggregating results to deciles (as we have done in Table 6.7) does not appear to make much difference compared with aggregating the households to 10 households first and then running the model with 10 households. See Rutherford *et al.* (2005) for details regarding this section.

slightly increases, rather than slightly decreases. As a result of the National Accounts-based reconciliation of the factor shares, several sectors are considerably more capital intensive, and among them are three key expanding export intensive sectors — ferrous metals, non-ferrous metals and chemicals. Consequently the return to capital expands considerably more than in our central model based on the HBS data. The percentage change in skilled wages, unskilled wages and return on capital in the National Accounts based (central model) is 4.7% (5.3%), 2.5% (3.7%) and 4.4% (1.8%), respectively. Then, since rich households depend more on capital income, we estimate slightly regressive results with the National Accounts-based model, as opposed to very slightly progressive results with our central model based on the HBS-based data reconciliation.[53]

We conclude that the aggregate results and the shape of the distribution of gains across all households are not significantly affected by the principal choice of data reconciliation. Although virtually all households gain due to the Dixit—Stiglitz variety effect, which households gain more or less, however, is affected by the choice of how we reconcile the data.

6.4.5.3 Piecemeal sensitivity analysis

In table 5 of Rutherford and Tarr (2008) we present the impact on welfare of varying the value of key parameters. The results are extremely close to the results presented in Table 6.5 so are not reproduced here. We have verified that in the household model as well, the same three parameters have a strong impact on the results: the elasticity of substitution between value-added and business services, *esubs*; the elasticity of multinational firm supply, etaf; and *theta_fdi*(*i*), the share of output of service sector *i* captured by multinational firms in the benchmark equilibrium.

Finally, we have executed a variant of the model with land as a specific factor in agriculture; this reduced the variable capital in agriculture by 50% relative to our central model. The mean of the estimated gains is slightly reduced, from 7.3 to 7.1%, which is explained by the Le Chatelier principle.

6.4.5.4 Systematic sensitivity analysis

Piecemeal sensitivity analysis shows how the results change when we vary the value of key parameters one-by-one, with central values of all parameters except the one under consideration. In the systematic sensitivity analysis, we allow all parameters to change simultaneously. A probability distribution for each parameter is chosen. We typically choose uniform probability distributions, with the lower and upper bounds for the

[53] Results, based on the national accounts model, for *EV* as a percent of consumption by decile are: decile 1, 5.7; decile 2, 5.7; decile 3, 6.1; decile 4, 6.2; decile 5, 6.5; decile 6, 6.6; decile 7, 7.0; decile 8, 7.3; decile 9, 7.5; decile 10, 8.0. With the data reconciled based on the national accounts data, the Gini coefficient is 0.403 in this benchmark equilibrium, and it increases to 0.405 after our WTO accession scenario.

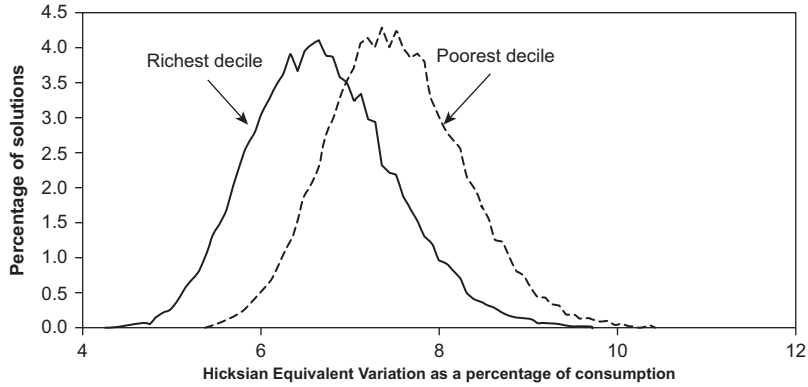

Figure 6.8 Systematic sensitivity analysis—sample frequency distributions from 30,000 simulations for the richest and poorest deciles: 95% confidence intervals (assuming a normal distribution), poor (6.1, 9.0); rich (5.1, 8.3); 99% confidence intervals (assuming a normal distribution), poor (5.6, 9.5); rich (4.6, 8.8).

values of the parameters taken from the lower and upper values of the key parameters presented in Table 6.5. We furthermore assume that all distributions are stochastically independent.

We have executed the model with all 55,098 households 30,000 times.[54] Each time the program chooses a random configuration of parameters and executes the model with this configuration. For each variable in our model, we then harvest the sample distribution based on the 30,000 solutions. Consequently, the sample distribution is not dependent on any particular set of parameter values, but represents results representative of the full distribution of parameter values.

We present the distribution of the weighted average welfare results in Figure 6.8 for the poorest and richest deciles of the population. Results for each decile are the aggregated equivalent variations, as a percentage of consumption, for the households in the decile. Figure 6.8 shows that there is virtually no chance that the weighted average welfare gains as a percentage of consumption for the poorest decile of the population is less than 5% or more than 11%; a 99% confidence interval is 5.6—9.5%. For the richest decile, the gains are slightly smaller; a 99% confidence interval for the richest decile of the population is 4.6—8.8%. These results are consistent with the central parameter value estimates, where we had the poorest decile gaining 7.6% and the richest 6.8%.[55]

54 The systematic sensitivity analysis took about 4 months to complete. We produced about 2300 solutions of the model per week on a 2.8-GHz computer dedicated fully to this task.

55 Note that these systematic sensitivity distributions are the sample probability distributions for the weighted average welfare gains of the households in the decile being considered, based on random parameter selection; whereas the distributions of Figures 6.6 and 6.7 are distributions of welfare gains across all the different households based on our specified central parameter values.

6.4.6 Conclusions

We estimate that in the medium term, virtually all households will gain from Russian WTO accession. We have shown that our estimates of the distribution of gains across the 55,098 households are decisively affected the inclusion of liberalization of barriers against FDI in business services sectors and endogenous productivity effects in business services and goods.

Figure 6.7 encapsulates the key point of this section. To estimate income distribution effects, a microsimulation model is important, given that there is great diversity of impacts for trade liberalization across households. However, incorporating FDI in business services with Dixit–Stiglitz effects in imperfectly competitive sectors is as important since these modeling features displace the distribution of results across households to the right from a CRTS model based distribution.

6.5 POLICY IMPACTS AND OTHER MODEL APPLICATIONS AND EXTENSIONS

6.5.1 Policy impacts

This models and results of this paper were the core contribution in the effort of the World Bank to assist the government of Russia in its WTO accession effort, especially in its public awareness campaign. It was, however, only part of multifaceted research and dissemination effort that was sustained over several years.[56] Although the Russian government was convinced of the benefits of WTO accession, prior to this work there was widespread public skepticism and Russian businessmen were calling for an explanation of the impacts on their sectors. Russian leaders and independent internal World Bank evaluators of the work have concluded that the work was instrumental in shifting public opinion in favor of WTO accession, and in explaining to businessmen and politicians in convincing terms the consequences of WTO at the sector level. Surveys taken after this work was done showed that, regarding the impacts of WTO accession on the sectors of Russia, the views of informed laymen (such as political leaders in the regions of Russia) were coincident with the assessments of the models discussed above. The latest internal review by a World Bank evaluation team (as part of a broader review of economic work on Russia by World Bank teams) concluded the following:

> *The WTO analytical work for Russia consists of a large number of very high quality papers and publications assessing the economic and social effects of Russia's planned accession to WTO…. The body of analytical work (about 15 papers) was disseminated through training events (a number of them requested by the authorities) attended by (prospective) civil servants, representatives of labor and industry and the academic community. It has clearly made*

[56] Research papers included the following: Jensen *et al.* (2004, 2006, 2007); Rutherford and Tarr (2008; 2008a, 2010); Rutherford *et al.* (2005); Shepotylo and Tarr (2008); Tarr (2006, 2007, 2010a, 2010b); Tarr and Thomson (2004); Tarr and Volchkova (2010, 2012).

a contribution to the policy dialogue and is seen as instrumental for establishing a sense that WTO accession would be beneficial for Russia among the government's trade reform team and parts of the research community. Prior to this project, editorials were rampant in the Russian press expressing fears of WTO accession and focusing on the fact that the government has not explained the consequences of WTO accession or the source of the benefits. Now polls of regional politicians reveal that they anticipate exactly the impacts suggested by the analytic studies. Moreover, polls of the public have shown progressively increasing endorsement, and now significant majority supporting WTO accession. Finally, as the analytic studies strongly emphasized the crucial role of liberalization against barriers to FDI in business services, Russian has agreed to major openings in the business services markets as part of its bilateral market access agreements in the WTO negotiations (Tarr, 2007).

As noted in the review, the work was very widely disseminated over a period of years.[57] Crucially the dissemination efforts involved writing several short policy papers and op-eds, where the results could be explained in clear terms understandable to a non-technical audience. We regard the extensive and sustained dissemination efforts over several years as a key aspect of the success on the policy front, possibly equally important as the innovative feature of incorporating FDI in services with endogenous productivity impacts.

In addition to the impact of this work and model in Russia, lead negotiators for WTO accession in both Kazakhstan and Ukraine became aware of the work in Russia,

57 The evaluation noted that dissemination was good on several fronts. It stated: "First, the information was presented in a readable way that was easy to follow for non-experts. A selection of the materials were summarized in book form for teaching purposes and translated into Russian. Second, an intensive training course on Trade policies and WTO accession was organized with the World Bank Institute and held twice. In addition to the World Bank Institute training (attended by about 200 participants from civil service and academia), the findings were presented in several conferences in Russia and abroad. A two day workshop for Russian counterparts was organized in London in 2006 to help assist the government in formulating an international trade strategy. Two GDLN events (80 participants each) organized by the World Bank Institute linking up several Russian, one Belarusian university and one Kazak location were held in 2008 and 2009. Third, findings were reflected in the Bank's poverty assessment and highlighted in one of the country office on-line reports to the country. Fourth, a bilingual website was established listing the key outputs of this exercise and other relevant publications. www.worldbank.org/trade/russia-wto. Fifth, in order to transfer the model to Russian experts, seven days of training on the model was provided to economic modelers from Russia and the CIS during which they were provided with the software to run for the models and were given the software. Summaries and PowerPoint presentations were prepared for various audiences including a conference organized with the Ministry of Communications; the CEFIR trade conference; the New Economic School tenth anniversary conference; the CEFIR conference on telecommunications; the conference of labor, business and government officials in Saint Petersburg led by the International Labor Organization; a GDLN presentation to Russian regional officials through the RAGS network; presentations were made to: 800 participants in the conference organized by the Russian Union of Industrialists and Entrepreneurs in Moscow in 2007; to 110 Russian small and medium businessmen in Washington; to a large conference of CIS businessmen in Evian France; to the Russia–US Business Council in Washington; to the government officials representing the CAREC countries at their meetings in Mongolia in 2009, and several smaller gatherings of Russian business interests in both Moscow and visiting in Washington. Short policy papers appeared in the bilingual journal of the American Chamber of Commerce in Russia, the International Labor Organization and a short policy paper was prepared for the Ministry of Economic Development and Trade website. Two op-eds were published in Russia, and other Russian researchers, such as Ksenia Yudaeva, also wrote op-eds based on results of the analytic work. In Moscow, there were three large press conferences, several additional interviews with members of the press as well as a television interview on the network *Russia Today*."

and requested similar studies in their countries. The model was adapted and applied in Ukraine and Kazakhstan, and had a significant impact in those countries in developing a framework for assessing the gains from WTO accession. This helped the lead negotiators with their public awareness obligations.

In requesting the involvement of the team that executed this work in Russia, the Ukrainian lead negotiator said that he had people telling him the impact of WTO accession in agriculture, or in various services sectors or in manufacturing. However, he needed to know how it all fit together. This is a perspective that a general equilibrium modeler can love. Jesper Jensen and colleagues working in the Institute for Economic Research in Kiev adapted the model developed for Russia to Ukraine, and helped the lead negotiator with his public awareness need (see Copenhagen Economics *et al.*, 2006).

In Kazakhstan, Jensen and Tarr (2008) adapted the Russia model to assess the impact of WTO accession in Kazakhstan. The lead negotiator in Kazakhstan wanted to know how WTO accession could be used to increase the productivity and competitiveness of manufacturing in Kazakhstan. As in Russia, the results showed that the largest gains to Kazakhstan would come from its own liberalization in services, due to the productivity gains to industry, agriculture and services in Kazakhstan from additional providers of services. Subsequent to this work, the lead negotiator for WTO accession in Kazakhstan has repeatedly made it her message that the principal benefit to Kazakhstan from WTO accession will be the increase in productivity it will reap from the liberalization of services barriers.

6.5.2 Model extensions

6.5.2.1 Multiregion trade model

In Rutherford and Tarr (2010), we extended the model of the single representative consumer model of Section 6.3 into a 10-region model of Russia (with a single representative consumer in each region). Russia in aggregate was modeled as a SOE, but within Russia, the model was a multiregion trade model with FDI in each of the 10 regions. The principal explanation for the differences across regions is the ability of the different regions to benefit from a reduction in barriers against FDI. The three regions with the largest welfare gains are clearly the regions with the estimated largest shares of multinational investment. Moreover, regions may gain more from WTO accession if they can succeed in creating a good investment climate.

6.5.2.2 Impact of liberalization of non-discriminatory services barriers

In Balistreri *et al.* (2009) and Jensen *et al.* (2010), we applied the methodology of Section 6.3 to Kenya and Tanzania, respectively. Our empirical assessment of the barriers revealed that the most important barriers in both countries were barriers that increased costs, but which restricted both local and multinational providers of services. The estimates showed very substantial potential gains (over 10% of consumption in the case of

Kenya) from a 50% reduction of all barriers against potential providers of services (both local and multinational).

6.5.2.3 Preferential trade arrangements

In Balistreri and Tarr (2011) and Jensen and Tarr (2010), we extended our models of Kenya and Tanzania, respectively, to be able to assess preferential liberalization of trade and services barriers. We decomposed the rest of the world into the EU, an Africa partner region and a residual rest of the world. We show that there is an imperfect competition extension of the idea of trade diversion. That is, preferential liberalization of barriers against partner country services providers will result in fewer varieties of services from excluded countries. Immizering preferential liberalization of services is more likely the more technologically advanced the excluded regions are relative to the partner region and the greater the share of rents from the services barriers captured by the home country initially.

In Jensen and Tarr (2011), we applied this model of preferential commitments in goods and services to Armenia to assess the potential "Deep and Comprehensive Free Trade Agreement" under negotiation between Armenia and the EU. We showed that it was only the deep aspects of the agreement that would benefit Armenia, especially the trade facilitation and services liberalization aspects of the agreement.

6.5.2.4 Heterogeneous firms

Balistreri *et al.* (2011) have succeeded in incorporating heterogeneous firms into a multiregion trade model. It would be valuable to extend that approach to include services with FDI and endogenous productivity effects. Heterogeneous firms add another element of gain from trade liberalization; it comes from more efficient use of resources, by shifting resources from less efficient firms to more efficient firms.

However, is the welfare gain from the improved resource allocation of incorporating heterogeneous firms of the same small order of magnitude as the welfare gains from improved resource allocation in perfect competition models? Moreover, it remains to be investigated whether there are significant quantitative differences between the heterogeneous firms model, on the one hand, and a model with homogeneous monopolistically competitive firms, Dixit–Stiglitz productivity effects and sector-specific factors that give rise to increasing industry marginal costs, on the other hand.

ACKNOWLEDGMENTS

Parts of this paper appeared in the following publications: Markusen *et al.* (2005a), Jensen *et al.* (2007), Rutherford and Tarr (2008), and Rutherford, Tarr and Shepotylo (2006). I thank my coauthors of these papers and Ed Balistreri for their many contributions to these collective works. I thank Brian Parmenter for comments as a referee of this paper, and Peter Dixon for very stimulating exchanges and comments. I thank the World Bank and the Department for International Development (DFID) of the UK for its financial support. All views expressed in this chapter are my own and do not necessarily reflect those of the World Bank, its Executive Directors, DFID or the Russian Government.

REFERENCES

Adelman, I., Robinson, S., 1978. Income Distribution Policies in Developing Countries. Stanford University Press, Stanford, CA.

Alessina, A., Ardagna, S., Nicoletti, G., Schiantarelli, F., 2005. Regulation and investment. J. Eur. Econ. Assoc. 3, 791–825.

Annabi, N., Cisse, F., Cockburn, J., Decaluwe, B., 2005. Trade liberalization, growth and poverty in senegal: A dynamic microsimulation CGE model analysis, CEPII Research Paper. CEPII, Paris.

Arnold, J.M., Javorcik, B.S., Matoo, A., 2011. Does services liberalization benefit manufacturing firms: Evidence from the Czech Republic. J. Int. Econ. 85, 136–146.

Arnold, J.M., Javorcik, B.S., Lipscomb, M., Matoo, A., 2012. Services reform and manufacturing performance: evidence from India. World Bank Policy Research Working Paper 5948. World Bank, Washington, DC.

Arnold, J., Mattoo, A., Narciso, G., 2008. Services inputs and firm productivity in Sub-Saharan Africa: evidence from firm level data. J. Afr. Econ. 17, 578–599.

Baldwin, R.E., Forslid, R., Haaland, J., 1999. Investment creation and investment diversion: Simulation analysis of the single market programme. In: Baldwin, R., Francois, J. (Eds), Dynamic Issues in Applied Commercial Policy Analysis. Cambridge University Press, Cambridge, pp. 228–265.

Balistreri, E.J., Tarr, D.G., 2011. Services liberalization in preferential trade arrangements: the case of Kenya. World Bank Policy and Research Working Paper 5552. World Bank, Washington, DC.

Balistreri, E.J., Rutherford, T.F., Tarr, D.G., 2009. Modeling services liberalization: the case of Kenya. Econ. Model. 26, 668–679.

Balistreri, E.J., Hillberry, R.H., Rutherford, T.F., 2011. Structural estimation and solution of international trade models with heterogeneous firms. J. Int. Econ. 83, 95–108.

Baranov, S.P., 2000. Compiling the disaggregated version of "input-output" tables of the Russian Federation for 1995 year for consequent use as a basic data for building the general equilibrium model for the Russian Federation. Available at: http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Accession/Baranov_equilibrium.pdf

Bourguignon, F., Pereira da Silva, L., 2003. Conclusion: Where do we go from here? In: Bourguignon, F., Pereira da Silva, L. (Eds), The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools. World Bank and Oxford University Press, New York, pp. 1–26.

Bourguignon, F., de Melo, J., Morrison, C., 1991. Poverty and income distribution during adjustment: Issues and evidence from the OECD project. World Dev. 19, 1485–1508.

Broda, C., Weinstein, D., 2004. Variety, growth and world welfare. Am. Econ. Rev. 94, 139–144.

Brown, D., Deardorf, A., Fox, A., Stern, R., 1996. Liberalization of services trade. In: Martin, W., Winters, L.A. (Eds), The Uruguay Round and the Developing Countries. Cambridge University Press, Cambridge, pp. 292–315.

Brown, D., Stern, R., 2001. Measurement and modeling of the economic effects of trade and investment barriers in services. Rev. Int. Econ. 9, 262–286.

Coe, D.T., Helpman, E., 1995. International R&D spillovers. Eur. Econ. Rev. 39, 859–887.

Coe, D.T., Hoffinaister, A.W., 1999. Are there international R&D spillovers among randomly matched trade partners? A response to Keller, International Monetary Fund Working Paper. IMF, Washington, DC.

Coe, D.T., Helpman, E., Hoffinaister, A.W., 1997. North–south R&D spillovers. Economic Journal 107, 134–149.

Chen, S., Ravallion, M., 2004. Welfare impacts of China's accession to the WTO. World Bank Econ. Rev. 18, 29–57.

Chinitz, B., 1961. Contrast in agglomeration: New York and Pittsburgh. Am. Econ. Rev., Papers Proceedings 51, 279–289.

Ciccone, A., Hall, R., 1996. Productivity and the density of economic activity. Am. Econ. Rev. 86, 54–70.

Cockburn, J., 2001. Trade Liberalisation and Poverty in Nepal: A Computable General Equilibrium Micro Simulation Analysis, Discussion paper 01-18. Centre de Recherche en Économie et Finance Appliquées, Universite Laval, Quebec.

Copenhagen Economics, East Europe Institute of Munich and the Institute for Economic Research and Policy Consulting (2006) Analysis of Economic Impacts of Ukraine's WTO Accession to the WTO: Overall Impact Assessment, Available from: www.ier.kiev.ua.
Cororaton, C.B., Cockburn, J., 2007. Trade reform and poverty—lessons from the Philippines: A CGE micro-simulation analysis. J. Policy Model. 29, 141–163.
Daniels, P.W., 1985. Service Industries: A Geographical Appraisal. Methuen & Co, New York.
Dantzig, G., Manne, A., 1974. A Complementary algorithm for an optimal capital path with invariant proportions,. J. Econ. Theory 9, 312–323.
Dee, P., Hanslow, K., Phamduc, T., 2003. Measuring the costs of barriers to trade in services. In: Ito, T., Krueger, A. (Eds), Trade in Services in the Asia-Pacific Region. University of Chicago Press, Chicago, IL, pp. 11–46.
de Melo, J., Tarr, D.G., 1992. A General Equilibrium Analysis of US Foreign Trade Policy. MIT Press, Cambridge, MA.
Dixit, A., Stiglitz, J., 1977. Monopolistic competition and optimum product diversity. Am. Econ. Rev. 76, 297–308.
Dixon, P.B., Rimmer, M.T., 2002. Dynamic General Equilibrium Modeling for Forecasting and Policy: A Practical Guide and Documentation on MONASH. In: Contributions to Economic Analysis 256. North-Holland, AMsterdam.
Eschenbach, F., Hoekman, B., 2006. Services policy reform and economic growth in transition economies. Rev. World Econ. 142, 746–762.
Elbers, C., Lanjouw, J.O., Lanjouw, P., 2003. Micro-level estimation of poverty and inequality. Econometrica 71, 355–364.
Ethier, W.J., 1982. National and international returns to scale in the modern theory of international trade. Am. Econ. Rev. 72, 389–405.
Ethier, W., 1984. Higher dimensional issues in trade theory. In: Jones, R., Kenen, P. (Eds), Handbook of International Economics. International Trade, Vol. I. North-Holland, Amsterdam, pp. 131–184.
Falvey, R., Foster, N., Greenaway, D., 2002. Imports, exports, knowledge spillovers and growth. Econ. Lett. 85, 209–213.
Feenstra, R., Madani, D., Yang, T.H., Liang, C.Y., 1999. Testing endogenous growth in South Korea and Taiwan. J. Dev. Econ. 60, 317–341.
Feenstra, R., Kee, H., 2004. On the measurement of product variety in trade. Am. Econ. Rev. 94, 145–149.
Fernandes, A.M., 2009. Structure and performance of the services sector in transition economies. Econ. Transit. 17, 467–501.
Fernandes, A.M., Paunov, C., 2012. Foreign direct investment in services and manufacturing productivity: evidence for Chile. J. Dev. Econ. 97, 305–321.
Findlay, C., Warren, T., 2000. Impediments to Trade in Services: Measurement and Policy Implications. Routledge, London.
Fink, C., Mattoo, A., Neagu, I.C., 2005. Assessing the impact of communications costs on international trade. J. Int. Econ. 67 428–425.
Frankel, J., Romer, D., 1999. Does trade cause growth. Am. Econ. Rev. 89, 379–399.
Francois, J., McDonald, B., Nordstom, H., 1996. Assessing the Uruguay Round. In: Martin, W., Winters, L.A. (Eds), The Uruguay Round and the Developing Countries. Cambridge University Press, Cambridge, pp. 253–291.
Francois, J.F., 1990a. Trade in producer services and returns due to specialization under monopolistic competition. Can. J. Econ. 23, 109–124.
Francois, J.F., 1990b. Producer services, scale, and the division of labor. Oxf. Econ. Papers 42, 715–729.
Francois, J., Hoekman, B., 2010. Services trade and policy. J. Econ. Lit. 48, 642–692.
Francois, J., van Meijl, H., van Tongeren, F., 2005. Trade liberalization and the Doha Development Round. Econ. Policy 42, 342–379.
Fujita, M., Krugman, P., Venables, A.J., 1999. The Spatial Economy: Cities, Regions, and International Trade. MIT Press, Cambridge, MA.

Hansen, T., Koopmans, T., 1972. On the definition and the computation of a capital stock invariant under optimization. J. Econ. Theor. 5, 487–523.
Harrison, G.H., Rutherford, T.F., Tarr, D.G., 1997a. Economic implications for Turkey of a customs union with the European Union. Eur. Econ. Rev. 41, 861–870.
Harrison, G.H., Rutherford, T.F., Tarr, D.G., 1997b. Quantifying the Uruguay Round. Economic Journal 107, 1405–1430.
Harrison, G.H., Rutherford, T.F., Tarr, D.G., 2003. Trade liberalization, poverty and efficient equity. J. Dev. Econ. 71, 97–128.
Harrison, G.H., Rutherford, T.F., Tarr, D.G., Gurgel, A., 2004. Trade policy and poverty reduction in Brazil. World Bank Econ. Rev. 18, 289–317.
Holmes, T., 1995. Localization of Industry and Vertical Disintegration. Federal Reserve Bank of Minneapolis, Minneapolis, MN.
Hummels, D., 1995. Global Income Clustering and Trade in Intermediate Goods, Graduate School of Business. University of Chicago, Chicago, IL.
Hummels, D., Klenow, P., 2005. The variety and quality of a nation's trade. Am. Econ. Rev. 95, 704–723.
Hummels, D., Lugovsky, V., 2005. Trade in ideal varieties: Theory and evidence. NBER Working Paper 11828. NBER, Cambridge, MA.
Ianchovichina, E., Martin, W., 2004. Impacts of China's Aaccession to the World Trade Organization. World Bank Econ. Rev. 18, 3–27.
Inklaar, R., Timmer, M.P., van Ark, B., 2008. Market services productivity across Europe and the US. Econ. Policy 53, 139–171. 178–194.
International Monetary Fund, 2002. Russian Federation: Selected Issues and Statistical Appendix. IMF, Washington, DC.
Ivanic, M., 2004. Reconciliation of the GTAP and household survey data. GTAP Resource Memorandum 1408 Available at: http://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1408.
Jensen, J., Tarr, D.G., 2003. Trade, exchange rate and energy pricing reform in Iran: Potentially large efficiency effects and gains to the poor. Rev. Dev. Econ. 7, 543–662.
Jensen, J., Tarr, D.G., 2008. Impact of local content restrictions and barriers against foreign direct investment in services: The case of Kazakhstan accession to the WTO. E. Eur. Econ. 46 (5), 5–26.
Jensen, J., Tarr, D.G., 2010. Regional trade policy options for Tanzania: the importance of services commitments. World Bank Policy and Research Working Paper 5481. World Bank, Washington, DC.
Jensen, J., Tarr, D.G., 2011. Deep trade policy options for Armenia: The importance of trade facilitation, services and standards liberalization. Economics: The Open Access-Open Assessment E-Journal 6 2012–1, Available at: http://dx.doi.org/10.5018/economics-ejournal.ja.2012-1.
Jensen, J., Rutherford, T.F., Tarr, D.G., 2004. The impact of liberalizing barriers to foreign direct investment in services: The case of Russian accession to the World Trade Organization. World Bank Policy and Research Working Paper 3391. World Bank, Washington, DC. Available at: http://econ.worldbank.org/external/default/main?pagePK=64165259&theSitePK=469372&piPK=64165421&menuPK=64166093&entityID=000012009_20040909153130.
Jensen, J., Rutherford, T.F., Tarr, D.G., 2006. Telecommunications reform within Russia's accession to the WTO. E. Eur. Econ. 44, 25–58.
Jensen, J., Rutherford, T.F., Tarr, D.G., 2007. The impact of liberalizing barriers to foreign direct investment in services: the case of Russian accession to the World Trade Organization. Rev. Dev. Econ. 11, 482–506.
Jensen, J., Rutherford, T.F., Tarr, D.G., 2010. Modeling services liberalization: the case of Tanzania. J. Econ. Int. 25, 644–675.
Kang, J.-S., 2000. Price impact of restrictiveness on maritime transportation services. In: Findlay, C., Tony, W. (Eds), Impediments to Trade in Services: Measurement and Policy Implications. Routledge, London, pp. 189–199.
Kang, J.-S., Findlay, C., 2000. Regulatory reform in the maritime industry. In: Findlay, C., Warren, T. (Eds), Impediments to Trade in Services: Measurement and Policy Implications. Routledge, London, pp. 152–188.
Kimura, F., Ando, M., Fujii, T., 2004a. Estimating the Ad Valorem Equivalent of Barriers to Foreign Direct Investment in the Telecommunications Services Sectors in Russia. World Bank, Washington, DC. Available at: http://www.worldbank.org/trade/russia-wto.

Kimura, F., Ando, M., Fujii, T., 2004b. Estimating the Ad Valorem Equivalent of Barriers to Foreign Direct Investment in the Maritime and Air Transportation Service Sectors in Russia. World Bank, Washington, DC. Available at: http://www.worldbank.org/trade/russia-wto.

Kimura, F., Ando, M., Fujii, T., 2004c. Estimating the Ad Valorem Equivalent of Barriers to Foreign Direct Investment in Financial Services Sectors in Russia. World Bank, Washington, DC. Available at: http://www.worldbank.org/trade/russia-wto.

Keller, W., 2000. Do trade patterns and technology flows affect productivity growth? World Bank Econ. Rev. 14 (1), 17–47.

Konan, D.E., Maskus, K.E., 2006. Quantifying the impact of services liberalization in a developing country. J. Dev. Econ. 81, 142–162.

Levine, R., 2005. Finance and growth: theory and evidence. In: Taylor, J.B., Woodford, M. (Eds), Handbook of Economic Growth, Vol. 1A. North-Holland, Amsterdam, pp. 865–964.

Lejour, A.M., Rojas-Romagosa, H., Verweij, G., 2008. Opening services markets within Europe: Modeling foreign establishments in a CGE framework. Econ. Model. 25, 1022–1039.

Lopez-de-Silanes, F., Markusen, J.R., Rutherford, T., 1994. Complementarity and increasing returns in imported intermediate inputs. J. Dev. Econ. 45, 101–119.

Lumenga-Neso, O., Olarreaga, M., Schiff, M., 2005. On Indirect trade related research and development spillovers. Eur. Econ. Rev. 49, 1785–1798.

Markusen, J.R., 1989. Trade in producer services and in other specialized intermediate inputs. Am. Econ. Rev. 79, 85–95.

Markusen, J.R., 1990. Derationalizing tariffs with specialized intermediate inputs and differentiated final goods. J. Int. Econ. 28, 375–384.

Markusen, J.R., Venables, A., 1998. Multinational firms and the new trade theory. J. Int. Econ. 46, 183–204.

Markusen, J.R., Venables, A.J., 2000. The general theory of endowment, intra-industry, and multinational trade,. J. Int. Econ. 52, 209–234.

Markusen, J.R., Rutherford, T., Tarr, D., 2005. Trade and direct investment in producer services and the domestic market for expertise. Can. J. Econ. 38, 758–777.

Markusen, J.R., Rutherford, T.F., Tarr, D.G., 2000. Foreign direct investment in services and the domestic market for expertise. World Bank Policy and Research Working Paper 2413. World Bank, Washington, DC.

Marshall, J.N., 1988. Services and Uneven Development. Oxford University Press, London.

Matoo, A., Rathindran, R., Subramanian, A., 2006. Measuring services trade liberalization and its impact on economic growth: An illustration. J. Econ. Int. 21, 64–98.

Matusz, Steven J, Tarr, D.G., 2000. Adjusting to trade policy reform. In: Krueger, A. (Ed.), Economic Policy Reform. University of Chicago Press, Chicago, IL, pp. 365–399.

McGuire, G., Schuele, M., 2000. Restrictiveness of international trade in banking services. In: Findlay, C., Warren, T. (Eds), Impediments to Trade in Services: Measurement and Policy Implications. Routledge, London, pp. 215–229.

McKee, D.L., 1988. Growth, Development, and the Service Economy in the Third World. Praeger, New York.

Moriarity, C., Scheuren, F., 2003. A note on Rubin's statistical matching using file concatenation with adjusted weights and multiple imputations. J. Bus. Econ. Stat. 21, 65–73.

Piggott, John, Whalley, J., 1985. UK Tax Policy and Applied General Equilibrium Analysis. Cambridge University Press, New York.

Rao, J.N.K., 1999. Some recent advances in model-based small area estimation. Surv. Method. 25, 175–186.

Robinson, S., Wang, Z., Martin, W., 2002. Capturing the implications of services trade liberalization. Econ. Syst. Res. 14, 3–33.

Rodrik, D., Subramanian, A., Trebbi, F., 2004. Institutions rule: the primacy of institutions over geography and integration in economic development. J. Econ. Growth 9, 131–165.

Romer, P., 1994. New goods, old theory and the welfare costs of trade restrictions. J. Dev. Econ. 43, 5–38.

Romer, P.M., 1990. Endogenous technological change. J. Polit. Econ. 98, 71–102.

Rutherford, T.F., 1999. Applied general equilibrium modeling with MPSGE as a GAMS subsystem: An overview of the modeling framework and syntax. Comput. Econ. 14, 1–46.

Rutherford, T.F., 1995. Extensions of GAMS for complementarity problems arising in applied economics. J. Econ. Dynam. Contr. 19, 1299–1324.
Rutherford, T.F., Tarr, D.G., 1998. Trade liberalization and endogenous growth in a small open economy. World Bank Policy and Research Working Paper 1970. World Bank, Washington, DC.
Rutherford, T.F., Tarr, D.G., 2002. Trade liberalization, product variety and growth in a small open economy: a quantitative assessment. J. Int. Econ. 56, pp. 247–272.
Rutherford, T.F., Tarr, D., 2003. Regional trading arrangements for Chile: Do the results differ with a dynamic model? Integrat. Trade 7, 117–139.
Rutherford, T.F., Tarr, D.G., 2008. Poverty effects of Russia's WTO accession: Modeling "real households" with endogenous productivity effects. J. Int. Econ. 75, 131–150.
Rutherford, T.F., Tarr, D.G., 2010. Regional impacts of liberalization of barriers against foreign direct investment in services, the case of Russia's accession to the WTO. Rev. Int. Econ. 18, 30–46.
Rutherford, T.F., Tarr, D.G., Shepotylo, O., 2005. Poverty effects of Russia's WTO accession: Modeling "real" households and endogenous productivity effects. World Bank Policy and Research Working Paper 3473. World Bank, Washington, DC.
Rutherford, T.F., Tarr, D.G., Shepotylo, O., 2006. The Impact on Russia of WTO accession and The Doha Agenda: the importance of liberalization of barriers against foreign direct investment in services for growth and poverty reduction. Reprinted in: Winters, L. A. (ed.), 2007. The WTO and Poverty and Inequality: An Elgar Reference Collection. Cheltenham: Edgar Elgar. In: Hertel, T., Winters, L.A. (Eds), Putting Development Back into the Doha Agenda: Poverty Impacts of a WTO Agreement. Palgrave McMillan and the World Bank, New York.
Sachs, J.D., Warner, A., 1995. Economic reform and the process of global integration. In: Brainard, W.C., Perry, G.L. (Eds), Brookings Papers on Economic Activity. Brookings Institution, Washington, DC, pp. 1–117.
Schiff, M., Wang, Y., 2006. North–south and south–south trade related technology diffusion: An industry level analysis of direct and indirect effects. Can. J. Econ. 39, 831–844.
Schott, P., 2004. Across-product versus within-product specialization in international trade. Q. J. Econ. 119, 647–678.
Shepotylo, O., Tarr, D.G., 2008. Specific tariffs, tariff simplification and the structure of import tariffs in Russia: 2001-2005. E. Eur. Econ. 46, 49–58.
Shepotylo, O., Vakitov, V., 2012. Impact of services liberalization on productivity of manufacturing firms: Evidence from the Ukrainian firm-level data. World Bank Policy and Research Working Paper 5944. World Bank, Washington, DC.
Stibora, J., de Vaal, A., 1995. Services and Services Trade: A Theoretical Inquiry. Tinbergen Institute, Amsterdam.
Tarr, D.G. (Ed.), 2006. Trade Policy and WTO Accession for Development in Russia and the CIS: A Handbook (in Russian). Ves Mir, Moscow.
Tarr, D.G., 2007. Russian accession to the WTO: An assessment. Eurasian Geography and Economics 48, 306–319.
Tarr, D.G., 2010a. The economic impact of export restraints on Russian gas and raw timber. In: The Economic Impact of Export Restrictions on Raw Materials. OECD, Paris, pp. 131–154.
Tarr, D.G., 2010b. The crucial role for competition in the Russian gas market: implications for Russia and Europe. IAEE Energy Forum, Fourth Quarter, 31–35.
Tarr, D.G., Thomson, P., 2004. The merits of dual pricing of Russian natural gas,. World Econ. 27, 1173–1194.
Tarr, D.G., Volchkova, N., 2010. Foreign economic policy at a crossroads. In: Aslund, A., Guriev, S., Kutchins, A. (Eds), Russia After the Global Economic Crisis. Peterson Institute for International Economics and Center for Strategic and International Studies, Washington, DC, pp. 200–222.
Tarr, D.G., Volchkova, N., 2012. Foreign trade and direct investment, patterns and policy issues. In: Alexeev, M.V., Weber, S. (Eds), Handbook of the Russian Economy. Oxford University Press, Oxford forthcoming.
Triplett, J.E., Bosworth, B.P., 2004. Productivity in the US Services Sector: New Sources of Economic Growth. Brookings Institution, Washington, DC.

Tybout, J., Westbrook, D., 1995. Trade liberalization and the dimensions of efficiency change in Mexican manufacturing industries. J. Int. Econ. 39, 53–78.
UN Conference on Trade and Development, Division on Transnational Corporations and Investment 1995. World Investment Report 1995, New York: United Nations.
Vernon, R., 1960. Metropolis 1985. Harvard University Press, Cambridge, MA.
Walmsley, T.L., Winters, L.A., 2005. Relaxing the restrictions on the temporary movement of natural persons: A simulation analysis. J. Econ. Integrat. 20, 688–726.
Warren, T., 2000. The impact on output of impediments to trade and investment in telecommunications services. In: Findlay, C., Warren, T. (Eds), Impediments to Trade in Services: Measurement and Policy Implications. Routledge, London, pp. 93–108.
Winters, L.A., McCulloch, N., McKay, A., 2004. Trade liberalization and poverty: The evidence so far. J. Econ. Lit. 42, 72–115.