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Household and Poverty Effects from Russia's Accession to the WTO

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Abstract: In this paper we employ a computable general equilibrium model of the Russian economy to assess the impact of accession to the World Trade Organization (WTO) on income distribution and the poor. We extend our earlier model that estimates the aggregate and sector effects in Russia with a representative consumer to a model that endogenously includes 55,098 Households. We find that virtually all households gain from Russian WTO accession in the medium term, with 99.9 percent of the estimated gains falling with a range from two percent increase in household income to 25 percent. We simulate Russian WTO accession in a constant returns to scale model that shows that the lack of virtually any losers in our model at the micro level is explained by the fact that we incorporate services liberalization and endogenous productivity effects from trade liberalization. These elements have never been incorporated in poverty analysis before and they result in larger estimated gains for the average household. We estimate that the rich will gain slightly less than average as the return on capital does not rise as much as wages. Despite the estimated gains for virtually all households in the medium term, many households may lose in the short term due to the costs of transition. Thus, safety nets are crucial for the poorest members of society during the transition.

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I. Introduction

Among the most important policy changes that Russia may undertake in the near future are those that it will agree to as part of its accession to the World Trade Organization. Policy-makers are concerned with not only the aggregate effects and impact on productive sectors of the economy, but also the impact on the poor and other distributional effects. As a first step in that process, Jensen, Rutherford and Tarr (2004a; 2004b) have estimated the aggregate and sector impacts of WTO accession on Russia. In this paper, we extend that analysis and evaluate the impact of Russian accession to the WTO on the poor and the income and distributional effects more generally throughout the Russian population. We have achieved a methodological breakthrough in the model underlying this paper by integrating the entire 54,000 plus households of the Russian Household Budget Survey (HBS) as agents in our computable general equilibrium model of the Russian economy.[1]

Prior to the paper, computable general equilibrium (CGE) models have not been capable of incorporating large household data sets simultaneously.2 Consequently, a common approach is a two-step (or open loop) approach. In the first step a single representative agent computable general equilibrium model is employed to obtain the estimated price changes from a trade policy change. These price changes are then fed into a micro-simulation household model for predicted household effects.

The two-step approach of a CGE model then a micro-simulation analysis involves an approximation to the true outcome for two important reasons. First, it ignores feedback effects of the change in household behavior on the equilibrium set of prices and quantities. Second, without a Social Accounting Matrix that integrates the households and the productive sectors of the

[1] There have been computable general equilibrium models that have incorporated between one and three thousand households. See, for example, Gørtz, et al. (2000) and Cockburn (2001).

[2] This has been explained by Hertel et al. (2003), Chen and Ravallion (2003) and Reimer (2002).

The pioneering papers on multi-household models in computable general equilibrium models were done by Adelman and Robinson (1978) and Piggott and Whalley (1985). The paper by Harrison, Rutherford, Tarr and Gurgel (2003) is a recent example of this methodology in which the poverty effects of trade policy changes in Brazil are analyzed in a twenty household model, ten rural and ten urban.

economy, there is no consistency imposed between the data in the micro-simulation model and the general equilibrium model.[3] We construct a unified Social Accounting Matrix with the 54,000 plus households of the HBS and the macro data of the Russian economy and simulate Russian WTO accession in this integrated model, thereby avoiding both of the biases above.

The general equilibrium model requires information on how households earn their income from the factors of production in our model. This information is not available in the Russian Household Budget Survey, but is available in the smaller Russian Longitudinal Monitoring Survey (RLMS).[4]. We apply "Small Area Estimation" and "Matching" econometric techniques (developed by authors such as Moriarity and Scheuren, 2003; Rao, 1999; and Elbers, Lanjouw and Lanjouw, 2003) to generate required factor share data. The estimation procedure and results are described in Appendix B.

Our central estimates from our 55,000 household model are summarized in table 1 and figure 1. The gains to Russia, averaged over all households, from WTO accession are 7.3 percent of Russian consumption (or 3.4 percent of GDP) in the medium run.[5] In figure 1, we see that there is a distribution of gains, but virtually all households gain. For the purpose of transparency and ease of interpretation of impacts on the poor as a group, we also construct a ten household version of our model. Gains are rather evenly distributed across income groups, but we find that the poor gain less more than the wealthy because the wage rate of unskilled labor increases more than the rate of return on capital. We also find that rural households gain less than urban households because the wage rate of skilled labor more than the other factors of production and rural households are less endowed with skilled labor than urban households.

We decompose these overall gains into the sources. We estimate that the welfare gains from Russia's tariff reduction are 1.3 percent of consumption (or 0.6 percent of GDP). Improved market access results in gains of 0.7 percent of consumption. The gains from foreign direct investment (FDI) liberalization in services alone are 5.3 percent of the value of Russian consumption. Thus, while improving its offer to foreign services providers within the context of the GATS has been one of the most difficult aspects of Russia's negotiation for WTO accession,

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[3] For example, aggregate earnings of the households from skilled labor, unskilled labor and capital based on the household surveys do not equal to the payments to labor and capital in the general equilibrium model. Predicted impacts from trade liberalization on a household will be based in large measure on the changes in the prices of the factors of production it sells.

[4] The RLMS data are described on the website: http://www.cpc.unc.edu/projects/rlms/rlms_home.html.

[5] These results do not differ significantly from our representative agent model. We estimate in that model that the gains could be as high as 24.3 % of Russian consumption (11.3 % of GDP) in the long run, when the growth effects on the capital stock are incorporated.

our estimates suggest that the most important component of WTO accession for Russia in terms of the welfare gains is liberalization of its barriers against FDI in services sectors.

The ad valorem equivalents of barriers to foreign direct investment in key services sectors in Russia were estimated by Kimura et al. (2004a; 2004b; 2004c). These estimates in turn built on twenty page questionnaires we commissioned from several Russian service sector institutes.[6] Kimura and colleagues then applied the methodology and data in the Findlay and Warren (2000) volume to estimate Russian barriers.

Our principal results for the household effects and for poverty are the following. First, we find that virtually all households gain at least some increase in their income. The gains range from a minimum of about 2.0 percent increase in household income to about 25 percent.[7] The lack of virtually any losers in our model at the micro level is explained by the fact that we incorporate services liberalization and endogenous productivity effects from trade liberalization. These elements have never been incorporated in poverty analysis before (and only recently in our aggregate work) and they result in larger estimated gains for the average household. Thus, even households that are significantly below the average, still manage to gain something. We show that if we had failed to incorporate services liberalization and endogenous productivity effects (as in a constant returns to scale model) in our 55,000 agent model, the distribution of gains would have a mean of 1.4 percent of consumption and we estimate that ten percent of the households would experience losses.

Despite the significant gains we estimate in the medium term and the even larger gains likely in the long term, during a transition period it is possible that many households will lose. Displaced workers will have to find new employment. They will suffer losses from transitional unemployment and will likely incur expenses related to retraining or relocation. Some of the poorest members of the population are ill equipped to handle these transition costs. Thus, despite a likely substantial improvement in the standard of living for almost all Russians after adjustment to a new equilibrium after accession to the WTO, government safety nets are very important to help with the transition and especially for the poorest members of society.

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[6] The questionnaires and papers of Kimura et al. are available at www.worldbank.org/trade/russia-wto.

[7] These are the range of gains for 55,098. There are 54 households with gains less than two percent and 7 households with gains above 25 percent. Thus 99.9 percent of all households have gains that fall in the range of 2 to 25 percent. There are 13 households with estimated losses, i.e., two-hundreths of one percent of the households are estimated to lose.

II. The Model and Data

We employ a computable general equilibrium model of the Russian economy. In this paper we extend our earlier representative agent model of the Russian economy to a model with 55,000 households integrated into a single model. Since we have described the structure of the single representative agent model in Jensen, Rutherford and Tarr (2004a), 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 55,000 households. Given its importance to our results, we begin with some evidence of the importance of liberalization of barriers against foreign direct investment in services and the productivity impacts of liberalization in goods.

Evidence on the Growth Impact of Liberalization of Barriers Against Foreign Direct Investment in Services and on Goods

Services Sector Liberalization. A growing body of evidence and economic theory suggests that the close availability of a diverse set of business services is important for economic growth. The key idea in the literature, dating back to the 1960s is that a diverse set (or higher quality set) of business services allows users to purchase a quality adjusted unit of business services at lower cost.[8] The more recent economic geography literature (e.g., Fujita, Krugman and Venables, 1999) has also focused on the fact that related economic activity is economically concentrated due to agglomeration externalities (e.g., computer businesses in Silicon Valley, ceramic tiles in Sassuolo, Italy). Evidence comes from a variety of sources. Ciccone and Hall (1996) 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 for the countries where a large variety of such inputs are located. Marshall (1988) shows that in three regions in the United Kingdom (Birmingham, Leeds and Manchester) almost 80 percent of the services purchased by manufacturers were bought from suppliers within

[8] As early as the 1960s, the urban and regional economics literature (e.g., Greenfield, 1966; Jacobs, 1969, 1984; Chinitz 1961; Vernon 1960; Stanback, 1979) recognized the importance of non-tradable intermediate goods (primarily producer services produced under conditions of increasing returns to scale) as an important source of agglomeration externalities which account for the formation of cities and industrial complexes, and explanations of the difference in economic performance across regions.

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.

Russian commitments to multinational service providers will encourage them to increase foreign direct investment to supply the Russian market. 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. This should lower the cost of doing business and increase productivity of Russian firms using these services.[9]

Productivity Effects from Goods Liberalization. With tariff reduction, Russian businesses will be able to more easily import modern technologies or a greater variety of technologies and this will increase Russian productivity. A larger variety of intermediate inputs allow producers to increase productivity through selection of intermediate inputs that more closely match their production requirements. Support comes from several sources: Cabellero and Lyons (1992) show that productivity increases in industries when output of its input supplying industries increases. Coe, Helpman and Hoffmaister (1997) find that foreign research and development increases domestic total factor productivity and that the positive spillover effect of foreign research and development is stronger the more open the economy is to intermediate inputs. Lumenga-Neso, Olarrearaga and Schiff (2001) find that "trade does matter for the international transmission of knowledge. And the indirect trade-related transmission of knowledge is at least as important as its direct transmission." Finally, Feenstra et al. (1999) show that increased variety of *exports* in a sector increase total factor productivity in most

[9] There have been a number of theoretical papers on the subject of the impact of foreign direct investment liberalization in services, including several by Markusen and various co-authors. Regarding numerical efforts, Markusen, Rutherford and Tarr (2000) developed a stylized model where foreign direct investment is required for entry of new multinational competitors in services, but they did not apply this model to the data of an actual economy. Brown and Stern (2001) and Dee et al. (2003) employ a multi-country numerical model with many of the same features of Markusen, Rutherford and Tarr. Their models contain three sectors, agriculture, manufacturing and services, and are thus also rather stylized. Results in their model depend crucially on capital flows between nations or (in Dee et al., 2003) the loss of rents by multinationals after service sector liberalization, as opposed to microeconomic endogenous productivity effects. 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. For example, see Brown, Deardorff, Fox and Stern (1996).

manufacturing sectors in Taiwan (China) and Korea, and they have some evidence that increased input variety also increases total factor productivity.[10]

Overview of the Model Formulation

Primary factors of production are capital, skilled and unskilled labor. There are five types of capital in the model: (1) mobile capital that can be used in any sector without adjustment costs (46% of total capital); (2) sector-specific capital in the energy sectors, namely ownership of the mineral resources in oil extraction, gas and coalmining (representing 15 percent of total capital); (3) sector specific capital required for expansion of output in imperfectly competitive domestic firms producing either goods or services (representing 32 percent of the capital in the benchmark); (4) sector specific capital required for expansion of output in imperfectly competitive foreign firms producing either goods or services (representing 5 percent of the capital in the benchmark); and (5) ownership of licenses for monopoly rents in services sectors (representing 2 percent of capital in the benchmark). There are 35 sectors listed in table 2. There are three types of sectors: competitive goods and services sectors, imperfectly competitive goods sectors and imperfectly competitive business services sectors. The structure of production is depicted in figure 2. Competitive sectors are modeled as in de Melo and Tarr (1992). For services sectors our work builds on and extends the work of Markusen, Rutherford and Tarr (2000). In Appendix A, we describe the structure of the sectors of the model and the modeling assumptions related to the productive structure of the model.

Households

The major extension over the model of Jensen, Rutherford and Tarr (2004a) is the addition of about 54,000 households to the model. These households are modeled endogenously based on the 55,000 households of the Russian Household Budget Survey (HBS). The HBS, which is representative at the regional level, has very detailed information on the household consumption expenditures, and information about age, gender, education, primary, secondary, and other occupation of each member of the household. It also has derived information about total income of the household as the sum of household expenditures and savings.

[10] Feenstra (1994) has emphasized that the impact of trade liberalization on new or higher quality products is much more important quantitatively than improved resource allocation.

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 5,000 observations and is not representative of the population on the regional level (such as oblast, krai or republic). But is has extensive information on individual and household sources of income: wages and profits from first, second, third jobs; pensions and unemployment benefits; profits and dividends from accumulated assets.

Recent advances in the literature have proposed techniques for combining data from different survey sources. Econometric techniques known as small area estimation (SAE) and Matching have been proposed to produce synthetic datasets that combine survey data with comprehensive census information. We have employed both small area estimation and Matching techniques to generate sources of income data for all 55,000 plus households in the HBS. We describe our procedures in Appendix B. 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 characteristics: age, gender, skilled or unskilled worker, head of the household, primary, secondary, and other occupation, and income.
- Household characteristics: family size, members of the household who work
- Geographic characteristics of the locality: region, type of settlement: urban/rural.

In the SAE procedure, using the RLMS data, we then estimate equations where the independent variables are those listed above and factor shares are the dependent variables. 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.

Data

In tables 3-7 we present some of the basic data in the model. Table 3 is the structure of value added; table 4, structure of exports and imports; and table 5 our estimates of the tariffs and export taxes, ad valorem equivalence of barriers against foreign direct investment is services and our assessment of the gain in the price of exports for selected sectors due to improved treatment in antidumping cases. Data are collected from various sources and from different years, but the

data in table 5 are the key parameters that are known to drive the results in these models. Consequently, these data are rather up to date. To get a sense of the characteristics of the poor versus other households we divide the population into deciles. Tables 6 and 7 are summary data of how these ten aggregate households obtain their factor income and how they spend their income.

Input-output table. The core input-output model is the 1995 table produced by Goskomstat. 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 upon request to the authors.

Tariff and Export Tax data. We estimate the tariff and export tax rates by sector in our model based on the following data and methodology. For the purpose of calculating the tariff and export tax rates, we obtained data on the trade flows from the 2001 Customs Statistics on the External Trade of the Russian Federation («Таможенная Статистика Внешней Торговли Российской Федераций»), a yearly publication from the Russian Customs Committee. Import tariff rates and export taxes at the tariff line level were obtained from official government decrees available online; the data are current as of August 2002.[11]

Tariff Data. In the Russian tariff system most tariff lines are subject to a simple ad valorem tariff while on some tariff lines a "mixed system" applies. For the mixed tariff lines the maximum of the ad valorem and applicable specific tariff applies.[12] For tariff lines where a specific tariff applied, we first calculated the implied collected duty if the specific tariff applied based on the aggregate quantity information available from the Customs Committee data. We then applied the maximum of either the calculated duty from specific tariffs or the calculated duty

[11] The regulations can be found on the web page of the Customs Computer Service: www.tks.ru in the document database (Базы данных → Документы).

[12] An exception is certain footwear products where the tariff is the sum of the ad valorem and specific tariff.

from the legal ad valorem rate to non-CIS imports. Although the Russian tariff system formally contains about 10,000 tariff lines, data are reported on only about 2000 tariff lines. The data in this paper, which were entered manually, are based on a level of aggregation reported by the Customs Committee that yields about 2000 tariff lines.[13]

Goskomstat provides a mapping from the tariff line data of the Customs Committee to the sectors in our input output table. Employing that mapping, we calculated a weighted average tariff rate of all tariff lines that map into a sector in our input output table. We calculated these rates two ways: based on all imports (where the collected tariffs as a percent of all imports is 8.1 percent) and on non-CIS imports (where the collected tariffs as a percent of non-CIS imports is 11.1 percent). 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 5.

Applying these tariff rates across all sectors implies that tariff revenue in our model is about 1.6 percent of GDP in the initial equilibrium. Collected tariffs in Russia are closer to 1.1 percent of GDP.[14] 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 imports and shuttle trade. While we adjust for the CIS trade, we are applying the MFN rates on all imports from the non-CIS. This slightly biases upward the rates we employ relative to collected rates, but the rates we use are lower than the legal MFN rates.

Export Tax Data. Analogous to the import tariff data, the Customs Committee publishes data on export volumes and values. These data were also entered manually at the tariff line level. Unlike the tariff data that are listed by the Customs Committee, it was necessary to consult numerous regulations of the government of Russia to obtain the export taxes. These export taxes are sometimes ad valorem or sometimes the maximum of the ad valorem or specific tax rate.[15]

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[13] We thank Eshref Trushin and Ekaterina Krivonos for their painstaking work on this project.

[14] International Monetary Fund, "Russian Federation: Selected Issues and Statistical Appendix," 2002.

[15] We thank Jan Strelka for painstaking work on the export data, which he compiled into a spreadsheet. He has also documented this work, including his sources for the export tax data.

Barriers to Foreign Direct Investment in Services Sectors.

Kimura, Ando and Fujii (2004a, 2004b, 2004c) have estimated the ad valorem equivalence of barriers to foreign direct investment in several Russian sectors, namely in telecommunications; banking, insurance and securities; and maritime and air transportation services. The work was based on surveys we commissioned from Russian research institutes that specialize in these sectors: 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. [16] These institutes completed 20 page questionnaires that provided us with data and descriptions and assessments of the regulatory environment in these sectors. Subsequently, Kimura, Ando and Fujii reviewed the questionnaires and interviewed staff of the Russian research institutes and then converted the answers and data of the questionnaires into an index of restrictiveness in each industry. Supplementary information from multinational institutes, such as the fact that the duration of the Rostelecom monopoly in the provision of long distance fixed line telecommunications services is one of the major issues in the WTO accession negotations, was also employed. Kimura et al. then applied methodology explained in the volume by C. Findlay and T. Warren (2000). For each of these service sectors, authors in the Findlay and Warren volume evaluated the regulatory environment across many countries; the same regulatory criteria were assessed for all countries in a particular service sector. 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 from the questionnaires, they estimated the ad valorem impact of a reduction in barriers to foreign direct investment in these services sectors.[17]

We arrive at the following estimates of the ad valorem equivalence of barriers to foreign direct investment in key services sectors: telecommunications, 33 percent;[18] banking, insurance

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[16] For the estimates and discussions, we thank Vladimir Klimushin of ZNIIS; Dmitri Grishankov and Irina Shuvalova of ExpertRA; Boris Rybak and Dmitry Manakov of InfoMost; and Tamara Novikova, Juri Ivanov and Vladimir Vasiliev of CNIIMF.

[17] The papers by Kimura et al. as well as the underlying questionnaires are available at www.worldbank.org/trade in the section on Russian WTO accession. The estimates we employ are those of Kimura et al. for discriminatory barriers against foreign direct investment. Kimura et al also estimate the impact of barriers on investment in services that are the sum of discriminatory and non-discriminatory barriers.

Earlier estimates for these sectors, using the same methodology we provided by Zemnitsky (2000) in financial services and telecommunications and by Sokolov in external maritime services. These latter estimates, however, were not informed by questionnaires or interviews with experts in the sectors.

[18] Kimura et al. estimated that the price 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

and securities, 36 percent; maritime services, 95 percent; and air transportation services, 90 percent. In the case of maritime and air transportation services, we assume that the barrier will only be cut by 15 percentage points, since pressure from the Working Party in these sectors is not strong. These estimates are summarized in table 5.

Share of Expatriate Labor Employed by Multinational Service providers.

The impact of liberalization of barriers to foreign direct investment 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. If multinationals use mostly Russian labor, their expansion is likely to increase the demand for Russian labor in these sectors.[19] We obtained estimates of the share of expatriate labor or specialized technology not available to Russian firms that is used by multinational service providers in Russia from the Russian research institutes mentioned above. 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 percent plus or minus 2 percent; financial services, 3 percent, plus or minus 2 percent; maritime transportation, 3 percent, plus or minus 2 percent; and air transportation, 12.5 percent, plus or minus 2.5 percent.

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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 which 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:
$sx + (1-s)*0 = .10$. That is, $x= .10/s$ Our data indicate that $s = .15$, then $x = .67$ or 67%.

Barriers to foreign direct investment, however, have an indirect effect on the price of Russian telecommunications services. Consequently, $sx + (1-s)*y = .10$ may be more appropriate, where y is the amount by which 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 foreign direct investment 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. But if we take $y=.05$, 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.

[19] See Markusen, Rutherford and Tarr (2000) for a detailed explanation on why FDI may be a partial equilibrium substitute for domestic labor but a general equilibrium complement.

III. Results

In Jensen, Rutherford and Tarr (2004a) we explain in some detail what are the principal changes to be expected in Russia from WTO accession. Briefly: (1) several sectors can expect to receive higher prices on their exports as a result of improved treatment in antidumping cases in foreign markets. The amounts of the increase and the sectors are listed in table 5; (2) we assume that tariffs will be reduced by fifty percent across the board from the levels indicated in table 5; and (3) we assume there will be a decrease in the barriers to foreign direct investment in key service sectors. The estimated ad valorem equivalent of the barriers to foreign direct investment and the amount by which we assume they will be reduced is also listed in table 5. Our WTO accession scenario involves the change in all three sets of these parameters in our model. Then we evaluate the changes between the initial equilibrium in our model and the new equilibrium where in the new equilibrium the barriers against imported goods and foreign direct investment are lower and there is improved market access for the sectors indicated in table 5.

We have simulated the impact of WTO accession in three versions of our model: (1) a model with all **55 thousand** households from the HBS all represented as agents; (2) a model with a **single representative agent**; and (3) a model with **ten representative** households, where households are aggregated into representative households according to per capita income from the poorest to the richest (within each decile, we separate rural and urban households and report results separately). We also simulate Russian WTO accession in a constant returns to scale (CRTS) model with 55 thousand households, i.e., the CRTS model excludes endogenous productivity effects and liberalization of barriers to foreign direct investment. Finally, we execute three simulations in our 55 thousand household model to decompose the importance of: (1) improved market access; (2) reduction of tariff barriers; and (3) reduction of barriers against foreign direct investment in services.

Results in the Full 55,000 Household Model

Aggregate results are summarized in table 1 and the distribution of gains across households is summarized in figures 1 and 3-6. Using our central model, which includes 55,000 households, foreign direct investment liberalization in services and endogenous productivity effects, the average gain across all households is 7.3 percent of household income. As figure 1 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 percent.[20] As is evident from the figure, we estimate that virtually all households will gain after an adjustment period. In figure 3, we show that the distributions of gains are comparable for the poorest 25 percent of the population, although the mean of the gains becomes slightly larger as the populations become poorer.

From table 6, we see that the main difference in the source of factor income between rich and poor households is that the rich obtain a larger share of factor income from capital and the poor obtain a larger share from unskilled labor. Skilled labor is more evenly distributed across income deciles, reflecting that fact that government employees such as researchers and teachers often receive very low wages, and that retirees living only a pension are often retired skilled workers.[21] On the other hand, rural households systematically have less education and are therefore classified as less skilled than urban workers in the same income group.

As shown in table 1, the wage rate of skilled labor increases by 5.5 percent, the wage rate of unskilled labor increases by 3.8 percent and the return on capital increases by 1.7 percent. 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 imperfectively competitive sectors that are subject to increased competition from imports or from foreign direct investment will see a reduction in the value of their returns (negative impact). Returns to mobile capital increase by over six percent, even faster than returns to skilled labor because the economy shifts resources into the capital intensive sectors metallurgy, chemicals, gas and away from more labor intensive sectors light industry, construction materials, and the food industry. But, the return on sector specific capital in all imperfectively 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 in greater than in the contracting sectors. As a result, the wage of skilled labor rises faster than the wage rate of unskilled labor.[22]

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[20] In order not to distort the figure, we exclude 53 households with estimated gains less than two percent and seven households with gains exceeding 25 percent.

We calculate the aggregate change in equivalent variation in multiple household models by a weighted average of the individual equivalent variations, weighted by the consumption level of the household.

[21] Individuals are classified as skilled if he or she has any education post-high school.We defined skills at individual level, determined labor and capital shares individually, and then aggregated factor shares within the household.

[22] The data do not allow us to distinguish capital holdings at the household level between the various types of capital. Thus, all households are assumed to hold the five kinds of capital in our model in equal proportions. Households that depend disproportionately on specific capital that falls in return would be expected to lose.

Results in the Ten Household Model

In order to ascertain broad patterns and the impact of WTO accession on the poor, we have constructed a ten household model. The distributional consequences on the poor are more transparent in this model. The results from our ten household model are displayed in table 9. We see that all ten representative households gain significantly, but in column one the richest household gains slightly less in percentage terms than the wealthy. This is because the return on capital increases less than the wage rate of unskilled labor. The rich depend more on earnings from capital than the rest of the population, so the impact on their income is affected more by the relatively lower increase in the returns to capital.[23]

We hold expenditures of the government constant in our model and require that any change in government revenue be offset by either a tax on households for a decline in government revenue or a transfer to households if a surplus appears. In the case of WTO accession of Russia, government revenue increases despite a loss of about 33 percent of the tariff revenue of the government. This is because collected tariff revenue in Russia is only about 1.6 percent of GDP. Although tariff revenue falls to about 0.9 percent of GDP, the economy grows as a result of WTO accession. We estimate that, since the economy expands from WTO accession, the other indirect taxes of the government more than offset the loss of tariff revenue. Consequently, we estimate that the government will have a surplus of revenue relative to its initial expenditures.

Given that there is a government surplus to be distributed to households, we examine two distribution schemes. In column one of table 1, results from our central model are displayed. In this version of our model, the surplus is distributed to all households in proportion to their income. Then each household will gain 1.5 percent of its income from this transfer. Proportional government transfers imply larger absolute transfers to wealthier households. On equity grounds, many would prefer a distribution scheme that is more progressive. Consequently, we also assess the impact of fixed and equal absolute transfers to all households and present those results in column 2 of table 1. Absolute transfers are progressive and will result in the poor doing significantly better than the richer households.

[23] Changes in factor income as a percent of consumption will be larger than the percentage change in factor income due to the net positive transfers of income away from households in Russia. That is define T as the net transfers the household incurs on non-consumption expenditures, such as net transfers between the household and the government, savings, and transfers to foreigners other than to acquire foreign goods in the model period (intuitively to pay for debt or for capital flight). Let C= Consumption and FI= factor income. Then FI= C + T. Due to the large current account surplus in the Russian economy, consistency between the macro balances and the household data in construction of the Social Accounting Matrix implies that T is positive. That is FI-C= T>0. Household factor income must be larger than consumption to allow for the transfer of capital to foreigners as well as to pay for investment. Then an x percent change in factor income will be greater than an x percent change in consumption.

In determining the consequences of trade policy changes, it has been shown in many applications that how households earn their income is much more important than how the households spend their income.[24] We find the same result here. In our ten household model, we show that virtually all the change in income for any of the ten representative households is due to changes in the income sources, that is, changes in the prices of factors of production and transfers. The effects on the welfare of the ten households due to price changes varies from 0.3 percent to –0.3 percent. On the other hand, the effects on the welfare of the ten households due to factor income changes varies from 8.1 percent to 6.4 percent. In the 55,000 household model, there are households for which the prices of goods are more important, but these households are not common.

For comparison purposes, we evaluate Russian WTO accession in a "constant returns to scale" (CRTS) model. This CRTS model does not include some key elements of WTO accession. In particular, it excludes foreign direct investment liberalization in services and endogenous productivity effects in goods or services. The results show that it is crucially important to include endogenous productivity effects and foreign direct liberalization in services. The aggregate gains in our central model are 7.3 percent of consumption, but are 1.4 percent of consumption with the CRTS model (see table 1, columns 1 and 6). Table 9 displays similar results from our ten household model

In figure 4, we show the distribution of gains across all households based on the CRTS model. With average gains across all households of 1.4 percent of consumption in the CRTS model, the distribution of gains across all households contains ten percent of households with losses (compared with one-tenth of one percent in our central model). For easier comparison of the two models, in figure 5 we also superimpose the distribution of gains in our central model with the distribution of gains in the CRTS model. It is evident that ignoring foreign direct investment liberalization and endogenous productivity effects will seriously distort the assessed impact and the impression that there are many losers from WTO accession than would be expected when the full effects of WTO accession are incorporated in the model.

[24] See, for example, Harrison, Rutherford and Tarr (2003) and the papers in the Conference on Poverty and the International Economy available at www.worldbank.org/trade.

IV. Conclusions and Extensions

Conclusions

These results stand in contrast to what one might expect from a model with so many households.[25] It is commonly presumed that although trade liberalization may benefit the average consumer and even the poor, there are almost certainly some households that lose. But previous micro-simulation analysis has relied on representative agent CGE models where these gains from trade reform are much are less than we have estimated here. This is because these models have not incorporated the impact of liberalization of barriers against foreign direct investment in services sectors or endogenous productivity effects from the ability to import new or diverse technologies. We have shown that the distribution of gains across the 55,000 households would be dramatically different if we had not accounted for these effects. Rutherford and Tarr (2002) have shown, however, that gains of this size that we have estimated are not large when compared to the welfare equivalent of the growth effects predicted by cross-country growth regressions.

We estimate that the richest households will gain somewhat less than the rest of the population, since the overall return on capital does not rise as much as wages. Nonetheless, the rich on average are expected to gain from accession to the WTO.

During a transition period it is possible that many more households will lose. There will be unskilled workers who will be displaced and who will have to find new employment. They will suffer losses from transitional unemployment and will likely incur expenses related to retraining or relocation. Thus, despite a likely substantial improvement in the standard of living for almost all Russians after adjustment to a new equilibrium after accession to the WTO, government safety nets are very important to help with the transition and especially for the poorest members of society who can ill afford a harsh transition..

Extensions

It would be useful to assess the extent of the bias in the typical micro-simulation approach done in two steps compared with an integrated approach. As we mentoned, there could be a bias from ignoring feedback effects from quantity changes in the micro-simulation model on the prices in the representative agent model, and from not reconciling the data between the

[25] Chen and Ravallion, for example, find many losers at the household level in their micro-simulation approach. Their estimates for China are based on the paper by Ianchovichina and Martin (2003), who estimated an average gain to China of about one % of GDP. As Chen and Ravallion note, that inclusion of productivity effects in the model would result in larger estimated gains and would alter the conclusions at the household level.

household model and the representative agent general equilibrium model. Our preliminary results in this area indicate that the bias from ignoring feedback effects is very small—prices in the representative agent model and the 55,000 agent model are close. On the other hand, data reconciliation does have a significant impact on the wage rate of unskilled labor. Either in the 55,000 household model or the representative agent model, data reconciliation results in a significant difference in the estimated change in the wage rate of unskilled labor as a result of Russian WTO accession, compared with our representative agent model without data reconciliation with the data from the household budget survey. Since changes in the wage rate of unskilled labor is very important in assessing the impact of policy changes on the poor, ignoring data reconciliation in a two step approach can lead to significant inaccurate assessments of the impact of the policy change on many of the poor households in the micro-simulation model. In future work, we intend to examine these issues in more detail.

Table 1: Impact of WTO Accession in 55,000 Household Model on Economy-Wide Variables in Russia: Policy Results and Decomposition of Effects
(results are percentage change from initial equilibrium)

	Benchmark	WTO accession	WTO accession (equal Ruble transfers) a/	Improved market access only	Tariff reform only	Reform of FDI barriers only	CRTS Model
		(1)	(2)	(3)	(4)	(5)	(6)
Aggregate welfare							
Welfare (EV as % of consumption)		7.3	7.3	0.7	1.3	5.3	1.4
Welfare (EV as % of GDP)		3.4	3.4	0.3	0.6	2.5	0.7
Government budget							
Tariff revenue (% of GDP)	1.4	0.9	0.9	1.4	0.8	1.4	0.9
Tariff revenue (% change)		-32.9	-32.9	8.8	-38.1	11.4	-42.1
Aggregate trade							
Real exchange rate (% change)		2.7	2.7	-0.5	2.1	1.2	0.4
Aggregate exports (% change)		14.5	14.5	2.3	8.1	3.7	7.4
Returns to mobile factors							
Unskilled Labor (% change)		3.8	3.8	0.1	0.5	3.2	0.7
Skilled Labor (% change)		5.5	5.5	0.6	1.7	3.0	1.8
Capital (% change)		1.7	1.7	-0.5	1.1	1.1	1.4
Percent of Factors that must adjust							
Unskilled labor		1.3	1.2	0.3	1.3	0.3	1.0
Skilled labor		1.2	1.2	0.4	0.5	0.6	0.6
Capital		0.9	0.9	0.5	0.2	0.5	0.6

Source: Authors' estimates.

a/ Government revenue surplus is distributed in equal ruble amounts in the results of column 2. In all other columns, government revenue surplus is distributed proportional to income.

Table 2. List of Sectors

1. Sectors where foreign direct investment from new multinational services providers is possible	
RLW	Railway transportation
TRK	Truck transportation
PIP	Pipelines transportation
MAR	Maritime transportation
AIR	Air transportation
TRO	Other transportation
TMS	Telecommunications
SCS	Science & science servicing
SSM	Public health & sports & social security
ECM	Education & culture & art
FIN	Financial services
2. Sectors where new foreign firms may provide new goods from abroad	
FME	Ferrous metallurgy
NFM	Non-ferrous metallurgy
CHM	Chemical & oil-chemical industry
MWO	Mechanical engineering & metal-working
TPP	Timber & woodworking & pulp & paper industry
CNM	Construction materials industry
CLO	Light industry
FOO	Food industry
OTH	Other industries
3. Competitive sectors subject to constant returns to scale	
ADM	Administration & public associations
AGF	Agriculture & forestry
COA	Coalmining
PSM	Communal & consumer services
CON	Construction
ELE	Electric industry
GAS	Gas
GEO	Geology & hydrometeorology
OLE	Oil extraction
OLP	Oil processing
OFU	Other fuel industries
OIN	Other goods-producing sectors
PST	Post
CAT	Public catering
TRD	Trade

Table 3. Structure of Value Added in Russia *

		VA	VA%	UNSK%	SKL%	CAP%
ELE	Electric industry	48	4	8	78	14
OLE	Oil extraction	39	3	0	12	87
OLP	Oil processing	10	1	3	80	17
GAS	Gas	12	1	1	10	89
COA	Coalmining	15	1	2	52	47
OFU	Other fuel industries	0	0	36	25	39
FME	Ferrous metallurgy	26	2	8	78	14
NFM	Non-ferrous metallurgy	31	2	10	72	18
CHM	Chemical & oil-chemical industry	24	2	17	66	18
MWO	Mechanical engineering & metal-working	71	5	27	63	11
TPP	Timber & woodworking & pulp & paper industry	19	1	15	76	9
CNM	Construction materials industry	21	2	17	69	14
CLO	Light industry	9	1	61	33	6
FOO	Food industry	45	3	15	69	16
OTH	Other industries	9	1	20	75	5
CON	Construction	116	9	9	86	5
AGF	Agriculture & forestry	103	8	57	40	3
RLW	Railway transportation	45	3	10	83	7
TRK	Truck transportation	20	1	8	91	1
PIP	Pipelines transportation	49	4	7	37	57
MAR	Maritime transportation	4	0	12	78	9
AIR	Air transportation	8	1	13	84	3
TRO	Other transportation	14	1	8	81	11
TMS	Telecommunications	16	1	14	74	12
PST	Post	4	0	13	69	18
TRD	Trade	309	23	22	59	20
CAT	Public catering	2	0	18	81	1
OIN	Other goods-producing sectors	11	1	22	77	1
PSM	Communal & consumer services	76	6	18	71	12
SSM	Public health & sports & social security	42	3	40	50	10
ECM	Education & culture & art	54	4	52	38	10
SCS	Science & science servicing	11	1	32	58	10
GEO	Geology & hydrometeorology	3	0	41	49	10
FIN	Financial services	21	2	10	84	6
ADM	Administration & public associations	65	5	22	78	1

VA: Value added net of tax

VA%: Sectoral value added as a percent of aggregate value added

UNSK%: Unskilled labor share of sector value added, in percentage form

SKL%: Skilled labor share of sector value added, in percentage form

CAP%: Capital share of sector value added, in percentage form

* Factor shares are a reconciliation between the input-output table and the household survey data.

Table 4: Structure of Exports and Imports

	EXP	EXP%	EXPIN%	IMP	IMP%	IMPIN%
Electric industry	2	0	1	0	0	0
Oil extraction	73	18	70	3	1	8
Oil processing	23	6	18	4	1	7
Gas	62	15	26	0	0	1
Coalmining	5	1	10	2	0	5
Other fuel industries	0	0	3	0	0	0
Ferrous metallurgy	40	10	37	12	4	18
Non-ferrous metallurgy	69	17	55	6	2	16
Chemical & oil-chemical industry	35	8	33	22	7	29
Mechanical engineering & metal-working	39	9	17	84	27	36
Timber & woodworking & pulp & paper industry	21	5	31	7	2	17
Construction materials industry	1	0	2	4	1	8
Light industry	4	1	13	51	17	69
Food industry	12	3	6	64	21	30
Other industries	2	0	5	4	1	13
Construction	0	0	0	8	2	3
Agriculture & forestry	2	0	1	8	3	4
Railway transportation	1	0	1	1	0	1
Truck transportation	1	0	1	2	1	4
Pipelines transportation	0	0	0	2	1	2
Maritime transportation	6	1	56	6	2	52
Air transportation	8	2	39	1	0	8
Other transportation	1	0	3	1	0	2
Telecommunications	1	0	5	3	1	11
Post	0	0	9	0	0	4
Trade	2	1	1	7	2	2
Public catering	0	0	2	0	0	1
Other goods-producing sectors	0	0	0	3	1	16
Communal & consumer services	0	0	0	0	0	0
Public health & sports & social security	0	0	0	0	0	0
Education & culture & art	0	0	0	1	0	1
Science & science servicing	1	0	6	1	0	5
Geology & hydrometeorology	0	0	0	0	0	0
Financial services	1	0	2	1	0	3
Administration & public associations	0	0	0	0	0	0

EXP: Value of exports

EXP%: Sector exports as a percentage of aggregate exports

EXPIN%: Sector exports as a percentage of domestic output

IMP: Value of imports

IMP%: Sector imports as a percentage of aggregate imports

IMPIN%: Sector imports as a percentage of domestic demand

Table 5. 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 & oil-chemical industry	7.1	1.6	1.5		
Mechanical engineering & metal-working	7.2	0.0	0.0		
Timber & woodworking & pulp & 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 & forestry	8.2	0.6	0.0		
Other goods-producing sectors	0.0	0.0	0.5		
Telecommunications				33.0	0.0
Science & 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: Authors' estimates

Table 6. Factor Income Shares by Income Decile and for Rural Households within each Decile

	All Households			Rural Households		
	Skilled a/	Unskilled b/	Capital c/	Skilled	Unskilled	Capital
Decile 1	0.57	0.41	0.02	0.51	0.46	0.03
Decile 2	0.58	0.38	0.04	0.51	0.43	0.06
Decile 3	0.62	0.32	0.05	0.52	0.40	0.07
Decile 4	0.63	0.30	0.07	0.54	0.37	0.09
Decile 5	0.62	0.27	0.10	0.54	0.35	0.12
Decile 6	0.61	0.25	0.14	0.49	0.35	0.15
Decile 7	0.61	0.21	0.18	0.50	0.33	0.16
Decile 8	0.62	0.17	0.21	0.48	0.31	0.21
Decile 9	0.55	0.16	0.29	0.47	0.28	0.25
Decile 10	0.47	0.11	0.42	0.40	0.23	0.37

a/ Share of factor income of the aggregate household that comes from skilled labor.
b/ Share of factor income of the aggregate household that comes from unskilled labor.
c/ Share of factor income of the aggregate household that comes from capital.

Table 7. Shares of Consumption Expenditure on Goods and Services, by Income Decile (Rural versus Total)

		Decile 1		Decile 5		Decile 10	
		total	rural	total	rural	total	rural
Electric industry	ELE	0.8	0.7	0.5	0.4	0.3	0.3
Oil processing	OLP	0.4	0.4	0.8	0.8	1.7	1.3
Gas	GAS	0.9	1.2	0.4	0.6	0.1	0.2
Coalmining	COA	0.5	0.9	0.3	1.0	0.0	0.2
Chemical & oil-chemical industry	CHM	3.3	2.7	2.5	1.7	1.5	1.2
Mechanical engineering & metal-working	MWO	1.3	1.3	3.2	3.9	15.3	16.9
Timber & woodworking & pulp & paper industry	TPP	0.9	0.7	1.2	0.9	3.0	2.0
Construction materials industry	CNM	0.3	0.4	0.4	0.5	1.0	1.2
Light industry	CLO	13.9	12.7	14.8	12.1	16.5	11.4
Food industry	FOO	38.8	29.9	38.6	24.6	26.6	18.6
Other industries	OTH	0.3	0.2	0.5	0.3	0.9	0.4
Construction	CON	0.3	0.0	0.0	0.0	1.7	1.1
Agriculture & forestry	AGF	24.3	38.3	19.0	42.2	8.8	30.3
Railway transportation	RLW	0.3	0.2	0.6	0.3	0.7	0.4
Truck transportation	TRK	1.4	2.2	0.9	1.6	1.2	3.0
Air transportation	AIR	0.1	0.0	0.7	0.2	4.4	2.0
Other transportation	TRO	1.0	0.5	1.2	0.4	0.8	0.3
Telecommunications	TMS	0.9	0.6	1.2	0.6	1.2	0.7
Post	PST	0.2	0.1	0.3	0.2	0.2	0.3
Public catering	CAT	0.8	0.8	1.5	0.8	2.3	1.4
Other goods-producing sectors	OIN	0.3	0.3	0.5	0.3	0.8	0.5
Communal & consumer services (market)	PSM	5.1	2.0	6.6	2.5	4.9	2.2
Public health & sports & social security (market)	SSM	0.9	0.7	1.2	0.7	2.5	0.7
Education & culture & art (market)	ECM	0.5	0.3	0.9	0.7	1.3	1.2
Financial services	FIN	0.8	0.5	0.8	0.6	1.1	0.7
Administration & public associations (market)	ADM	1.7	2.5	1.5	2.2	1.1	1.5

Source: Russian Household Budget Survey for 2000 and authors' calculations.

Table 8: Impact of WTO Accession on Russian industry and labor by sector in 55,000 Household Model
(percentage change in variable)

Sectors	Abbreviation	WTO Accession				
		output	exports	imports	skilled employment	unskilled employment
Electric industry	ELE	1.6	-1.2	8.0	0.7	0.7
Oil extraction	OLE	2.8	3.4	2.7	-0.1	-0.1
Oil processing	OLP	1.8	5.4	7.4	1.3	1.3
Gas	GAS	3.8	10.3	42.0	17.8	17.8
Coalmining	COA	5.1	11.7	8.5	4.2	4.2
Other fuel industries	OFU	1.0	30.1	4.7	0.2	0.2
Ferrous metallurgy	FME	13.2	30.4	7.2	11.8	11.8
Non-ferrous metallurgy	NFM	27.9	40.6	36.1	26.5	26.5
Chemical & oil-chemical industry	CHM	8.7	26.3	9.3	6.4	6.4
Mechanical engineering & metal-working	MWO	-13.3	-10.7	21.3	-15.2	-15.2
Timber & woodworking & pulp & paper industry	TPP	-4.0	4.0	34.6	-6.1	-6.1
Construction materials industry	CNM	-6.5	-1.3	73.9	-8.2	-8.2
Light industry	CLO	-8.9	1.6	7.9	-11.2	-11.2
Food industry	FOO	-12.8	-5.7	37.3	-14.5	-14.5
Other industries	OTH	-5.3	1.4	45.1	-7.6	-7.6
Construction	CON	0.2	0.9	-0.1	-1.6	-1.6
Agriculture & forestry	AGF	-1.9	-2.0	9.6	-3.7	-3.7
Railway transportation	RLW	0.3	-4.4	223.4	-0.6	-0.6
Truck transportation	TRK	7.8	7.3	41.9	6.1	6.1
Pipelines transportation	PIP	-4.5		150.5	-4.5	-4.5
Maritime transportation	MAR	2.4	7.4	-3.9	-1.7	-1.7
Air transportation	AIR	-1.7	1.4	24.0	-5.8	-5.8
Other transportation	TRO	3.3	1.0	104.9	1.7	1.7
Telecommunications	TMS	6.3	10.2	47.5	5.0	5.0
Post	PST	3.0	4.2	2.2	-0.8	-0.8
Trade	TRD	6.1	2.8	8.1	3.5	3.5
Public catering	CAT	5.7	17.0	-0.8	1.3	1.3
Other goods-producing sectors	OIN	-1.7	3.4	28.7	-3.8	-3.8
Communal & consumer services (market)	PSM	2.1	-2.2	4.7	0.8	0.8
Public health & sports & social security (mar	SSM	0.6	1.2	0.3	-1.7	-1.7
Education & culture & art (market)	ECM	0.4	-1.6	1.6	-1.8	-1.8
Science & science servicing (market)	SCS	-11.0	-1.7	148.7	-13.5	-13.5
Geology & hydrometeorology	GEO	0.1			-3.1	-3.1
Financial services	FIN	7.9	16.4	53.0	5.0	5.0
Administration & public associations (market)	ADM	0.5			-8.2	-8.2

Source: Authors' estimates

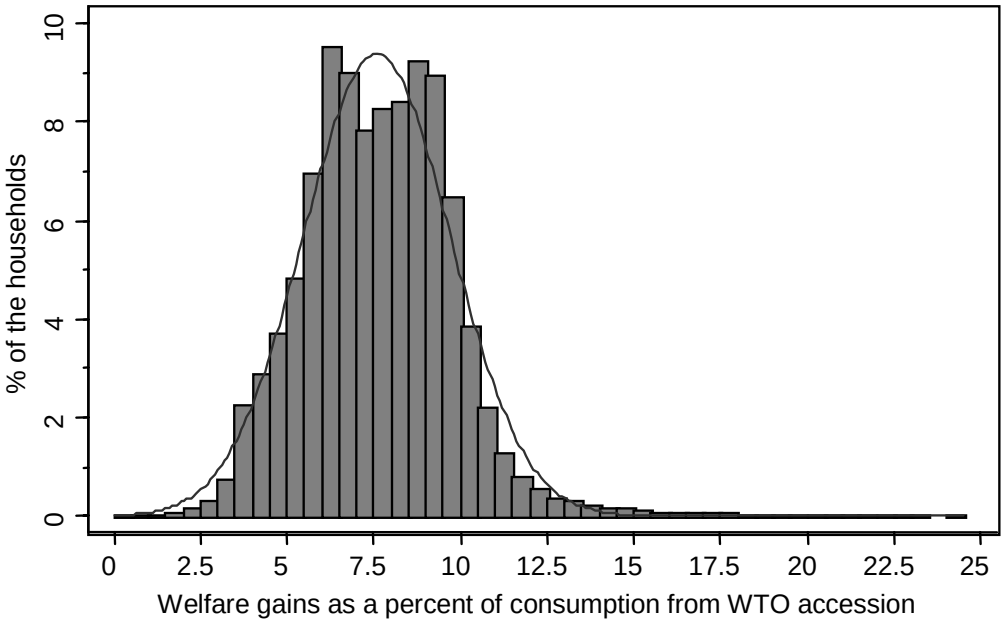
Table 9: The Impact of WTO Accession on Ten Representative Russian Households, from Poorest to Richest
(welfare change as a percent of consumption)

Household types a/	WTO accession (1)	WTO accession (equal Ruble transfers) b/ (2)	Improved market access only (3)	Tariff reform only (4)	Reform of FDI barriers only (5)	CRTS Model (6)
Decile 1 (0-10%) - overall	7.8	9.0	0.9	1.0	5.8	1.1
- rural	7.2	8.5	0.8	0.8	5.6	0.9
- urban	8.5	9.5	1.0	1.3	6.1	1.3
Decile 2 (11-20%) - overall	7.7	8.4	0.9	1.1	5.7	1.1
- rural	6.9	7.6	0.8	0.8	5.3	0.9
- urban	8.3	9.0	1.0	1.3	6.0	1.3
Decile 3 (21-30%) - overall	7.9	8.3	0.9	1.2	5.7	1.3
- rural	6.8	7.3	0.8	0.8	5.2	0.9
- urban	8.4	8.8	1.0	1.4	5.9	1.4
Decile 4 (31-40%) - overall	7.9	8.1	0.9	1.2	5.7	1.3
- rural	6.8	7.1	0.8	0.8	5.2	1.0
- urban	8.3	8.6	1.0	1.4	5.8	1.4
Decile 5 (41-50%) - overall	7.8	8.0	0.9	1.2	5.6	1.3
- rural	6.6	6.8	0.7	0.8	5.0	1.0
- urban	8.2	8.4	0.9	1.4	5.8	1.4
Decile 6 (51-60%) - overall	7.6	7.7	0.8	1.3	5.5	1.4
- rural	6.3	6.4	0.6	0.8	4.9	0.9
- urban	8.1	8.2	0.9	1.4	5.7	1.5
Decile 7 (61-70%) - overall	7.6	7.6	0.8	1.3	5.5	1.4
- rural	6.4	6.4	0.6	0.8	4.9	1.0
- urban	7.9	7.9	0.8	1.4	5.6	1.5
Decile 8 (71-80%) - overall	7.6	7.5	0.8	1.4	5.4	1.5
- rural	6.2	6.1	0.6	0.8	4.7	1.0
- urban	7.9	7.9	0.8	1.5	5.5	1.7
Decile 9 (81-90%) - overall	7.2	7.1	0.6	1.3	5.3	1.5
- rural	6.2	6.0	0.5	0.8	4.9	1.0
- urban	7.4	7.2	0.6	1.4	5.3	1.5
Decile 10 (91-100%) - overall	6.7	6.4	0.4	1.3	5.0	1.5
- rural	5.6	5.3	0.3	0.9	4.4	1.0
- urban	6.8	6.4	0.4	1.3	5.0	1.5

a/ Ten percent of the households in the Household Budget Survey are in each decile. Decile (10) contains the poorest (richest) households on a per capita basis.
b/ Government revenue surplus is distributed in equal ruble amounts in the results of column 2. In all other columns, government revenue surplus is distributed proportional to income.

Source: Authors' estimates.

Figure 1. Distribution of estimated welfare gains from Russian WTO accession.
55100 sampled households



Graph is truncated. 13 observations with negative gains and 7 observations with gains above 25% are not shown.

Figure 2: Production and Allocation of Output

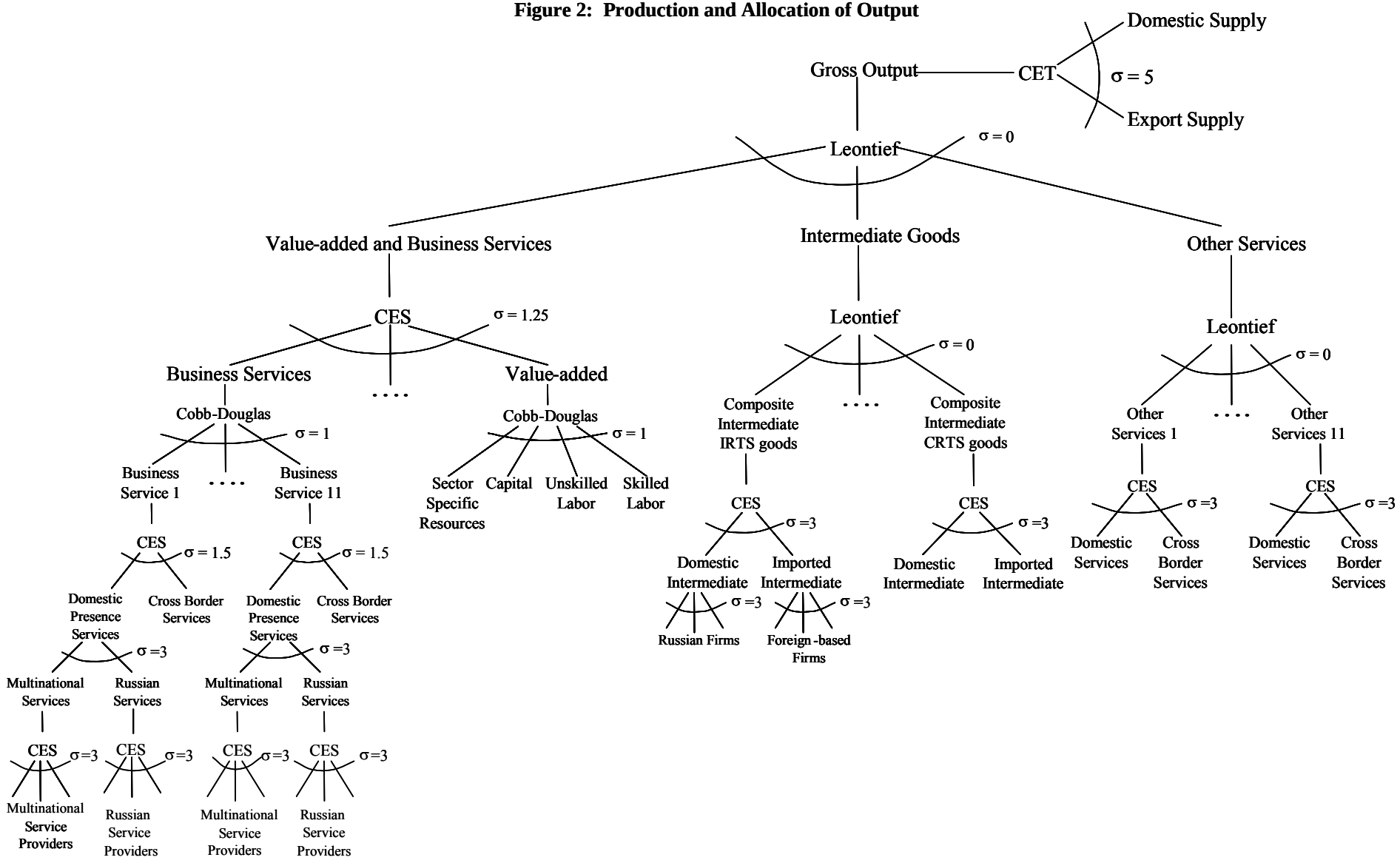
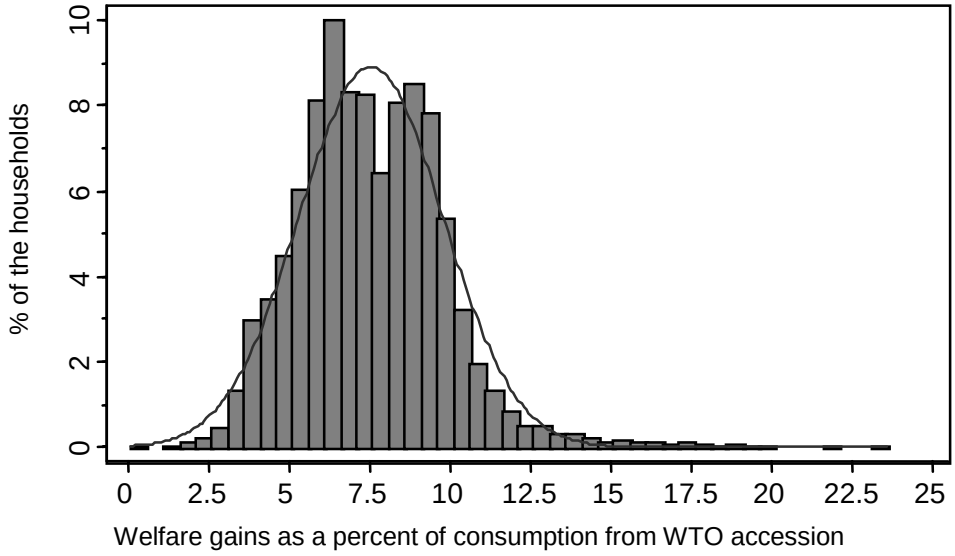
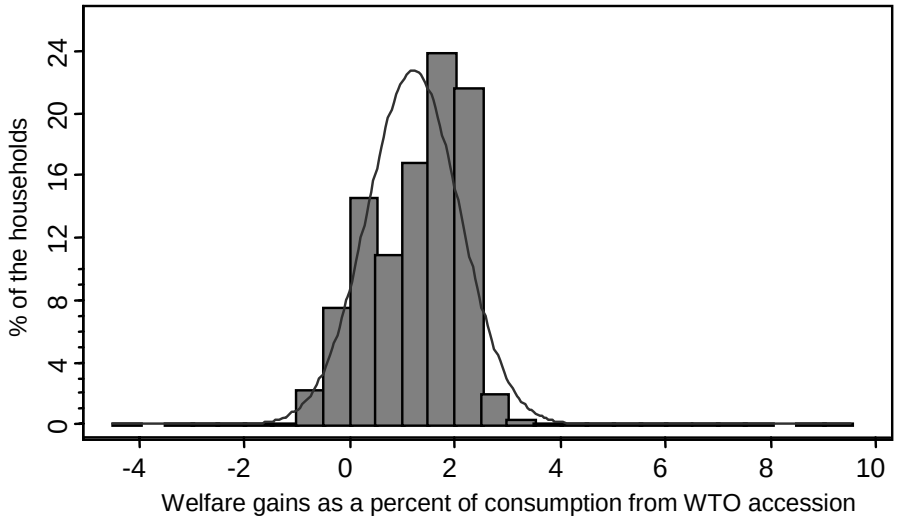


Figure 3. Distribution of estimated welfare gains from Russian WTO accession.
13775 of the poorest households.



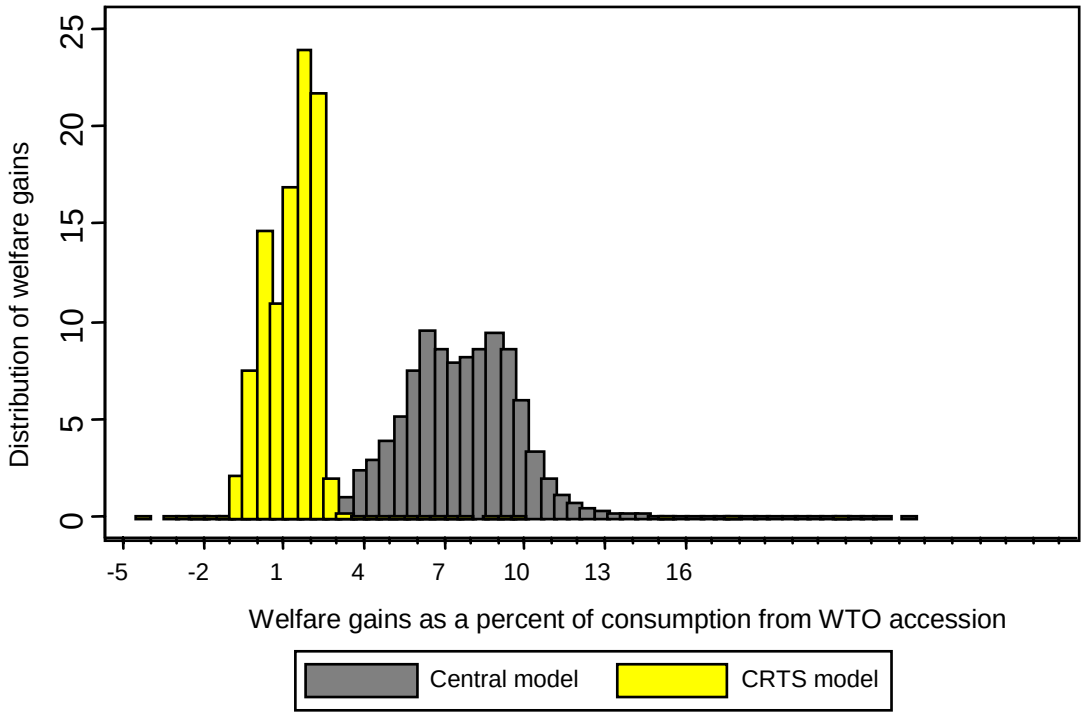
Graph is truncated. 3 observations with negative gains and 3 observations with gains above 25% are not shown.

Figure 4. Distribution of estimated welfare gains from Russian WTO accession.
Constant return to scale. 55100 sampled households



Graph is truncated. 10 observations with gains below -5% and 5 observations with gains above 10% are not shown

Figure 5. Distributions of estimated welfare gains from Russian WTO accession.
Central and CRTS models comparison. 55100 households sampled.



Observations in a range from - 5 % to 25 % are shown.

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Appendix A: Structure and Modeling Assumptions Regarding Sectors of the Model

Competitive Sectors. One category of sectors is those in which goods and services that are produced under constant returns to scale and where price equals marginal costs. This includes agriculture, forestry and construction. It also includes certain public services, like education and post office facilities, and key mineral industries.[26] In these sectors, domestic firms face competition from foreign producers where we assume that the quality of goods produced domestically and by foreign firms are differentiated in the demand functions of Russian consumers and firms. This is known as the Armington assumption. All Russian goods producing firms (including imperfectly competitive firms) can sell on the domestic market or export, but there are quality differences between the domestic and export goods.[27]

Imperfectly Competitive Goods. A second category of sectors is those goods that are produced under increasing returns to scale and imperfect competition, such as ferrous metals, non-ferrous metals and chemicals. There are both foreign and domestic firms competing to supply these products in the Russian market. Foreign firms supply the Russian market with production facilities abroad, but, due to fixed costs required to sell in Russia, the number of foreign firms that sell in the Russian market depends on profitability in the Russian market, which in turn depends on the tariff rate. Tariff liberalization will typically lead to productivity gains because when more varieties are available, buyers can obtain varieties that more closely fit their demands and needs.[28]

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[26] To reflect the use of exhaustible resources, we assume capital is sector specific in oil, gas and coal. This implies there are decreasing returns to scale in the variable factors, skilled and unskilled labor, in these three sectors. 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.

[27] Russian firms substitution possibilities are represented by a constant elasticity of transformation production possibility frontier.

[28] The efficiency gains associated with an increased number of varieties accrue to both consumers and firms using these goods as intermediate inputs.

Goods produced subject to increasing returns to scale are differentiated at the firm level; firms in these industries set prices such that marginal cost equals marginal revenue; and there is free entry, which drives profits to zero. We assume that there is a fixed cost with constant marginal costs. We employ the standard Chamberlinian large group monopolistic competition assumption, which results in constant markups over marginal cost.

Aggregate productivity is affected by the number of varieties using the standard Dixit-Stiglitz formulation. The effective cost function for users of goods produced subject to increasing returns to scale declines in the total number of firms in the industry.

For simplicity we assume that the composition of fixed and marginal cost is identical in all increasing returns to scale sectors. This implies that the ratio of fixed to marginal cost is a constant. This assumption in a standard 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.

Business Services Sectors. The third category of sectors is services sectors that are produced in Russia under increasing returns to scale and imperfect competition, such as telecommunications, financial services, most business services and transportation services. 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. But a large share of business services are provided by service providers with a domestic presence.[29] Our model allows for both types of 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.[30]

There are two types of service firms in these sectors that have a domestic presence in Russia: Russian firms and multinational firms. There are multinational service firm providers that choose to establish a presence in Russia in order to compete with Russian firms directly in the Russian market. Multinational service providers will import some of their technology or management expertise when they decide to establish a domestic presence in Russia. Thus, their cost structure differs from Russian service providers. They incur costs related to both imported **inputs** and Russian primary factors, in addition to intermediate factor inputs. Domestic service providers do not import foreign technology or management expertise. Hence, domestic service firms incur primary factor costs related to Russian labor and capital only. These services are characterized by firm-level product differentiation. Restrictions on foreign direct investment, right of establishment, the movement of business personnel, and lack of intellectual property protection and contract enforcement have major, direct impacts on multinational firms providing services to the market.

We assume that manufactured goods are either produced domestically or imported, and the cost structure of domestic firms is defined by observed primary factor and intermediate inputs to that sector in the base year data. The cif 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.

Finally, models of this type are often criticized for the lack of heterogeneity among firms. We allow for a sector specific factor in for each firm type (foreign or domestic). This assumption will produce firm heterogeneity represented by a continuous upward sloping supply curve for each firm type in response to a price increase. The elasticity of firm supply can be derived from the share of capital that is sector specific and the elasticity of substitution between the specific factor and the mobile primary factors of production.

[29] One estimate puts the world-wide 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).

[30] Empirical work has traditionally treated producer services as non-traded. See Kravis and Lipsey (1988). Daniels (1985) found that service providers charge higher prices when the service is provided at a distance.

We think of firms as multinational even if the foreign firm forms a joint venture with a Russian company. Joint ventures will typically involve some foreign management techniques or technology—that is what the foreign partner brings to the joint venture, while the Russian partner brings knowledge of the local institutions. What is important for our model is that the multinational bring in specialized imported inputs that result in a different production structure or method of delivery of the service compared to Russian firms. Russian firms operate without foreign primary inputs and are primarily or wholly Russian owned so that they are not subject to discriminatory taxes against multinationals. The fact that multinationals can include Russian companies as joint venture partners has important implications for interpreting the results of our model regarding the change in the market shares of the multinationals versus Russian firms.

The number of multinational and Russian firms that are present in the Russian market depends on profitability in the Russian market. For multinational firms, the barriers to foreign direct investment affects the profitability. Reduction in the constraints on foreign direct investment 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.[31]

Modeling Assumptions

Goods produced subject to increasing returns to scale are differentiated at the firm level; firms in these industries set prices such that marginal cost equals marginal revenue; and there is free entry, which drives profits to zero. We employ the standard Chamberlinian large group monopolistic competition assumption, which results in constant markups over marginal cost.

Aggregate productivity is affected by the number of varieties using the standard Dixit-Stiglitz formulation. The effective cost function for users of goods produced subject to increasing returns to scale declines in the total number of firms in the industry. For simplicity we assume that the composition of fixed and marginal cost is identical in all increasing returns to scale sectors. This implies that the ratio of fixed to marginal cost is a constant. This assumption in a standard 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.

[31] We assume that the structure of both the marginal and fixed costs of services firms are identical, so that as was the case in goods production, output per firm is fixed and there are no rationalization gains. For multinational service providers, both the fixed and variable costs of service supply are assumed to be a convex combination of the domestic supply price in the same sector and the cost of imported inputs.

We assume that manufactured goods are either produced domestically or imported, and the cost structure of domestic firms is defined by observed primary factor and intermediate inputs to that sector in the base year data. The cif 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 assume that in the service sector characterized by increasing returns to scale, there are two types of firms providing services to the Russian economy: (i) Russian firms, who employ primary factors and intermediate inputs and (ii) multinational firms who provide services using imported **inputs** (FDI and foreign expertise) together with primary factors and intermediate inputs.

We assume that the structure of both the marginal and fixed costs of services firms are identical, so that as was the case in goods production, output per firm is fixed and there are no rationalization gains. For multinational service providers, both the fixed and variable costs of service supply are assumed to be a convex combination of the domestic supply price in the same sector and the cost of imported inputs.

Appendix B: Estimation on Factor Income Shares for the Household Budget Survey of Russia.

Experience with trade policy models that examine household impacts has shown that the impact on household income is most strongly affected by changes in wages and payments to other factors of production. Thus, it is crucial in an assessment of the impact of WTO accession on Russian household welfare to determine the sources of household income. There are three input factors in the numerical general equilibrium model: unskilled labor, skilled labor, and capital. Trade policy changes will differ across industries and industries use factors in different proportions. Therefore, returns to input factors will also be affected differently. If for example as a result of WTO accession the wage rate of unskilled workers will increase because of expansion of the sectors that are unskilled labor intensive, then the households that earn a larger proportion of their income from unskilled labor will benefit more. In addition, given the concerns about regional impacts of WTO accession, we seek estimates of factor shares that differ according to the region of Russia.

To calculate factor income shares in the model, two datasets have been used: the Household Budget Survey (HBS) and the Russian Longitude Monitoring Survey (RLMS). The HBS has 55,000 household observations and is representative at the regional level. In order for us to assess household impacts at the regional level we will have to employ the HBS. The HBS has very detailed information on the household consumption expenditures, and information about age, gender, education, primary, secondary, and other occupation of each member of the household. It also has derived information about total income of the household as the sum of household expenditures and savings.

The major shortcoming of the HBS for our purposes is that we do not have information from it on the sources of income of the households. For sources of household income, we must turn to the RLMS. The RMLS has less than 5,000 observations and is not representative of the population on the regional level (such as oblast, krai or republic). But is has extensive information on individual and household sources of income: wages and profits from first, second, third jobs; pensions and unemployment benefits; profits and dividends from accumulated assets. In this note, we explain how we combine information from the two surveys to generate factor shares for the households in the HBS.

Recent advances in the literature have proposed techniques for combining data from different data sources. Econometric techniques as small area estimation (SAE) and matching have been proposed to produce synthetic datasets that combine survey data with comprehensive census

information. For a literature review on different SAE model see Rao (1999). Properties of small area statistics are also discussed in Nordbotten (1999). A useful application is by Elbers, Lanjouw, and Lanjouw (2003), who applied the small area estimation technique to study the effect of policy changes on welfare measures for Ecuador. They show that their estimated welfare measures are reliable (small variance of the estimator) for populations as small as 15,000 households. An alternative to SAE is the matching technique based on propensity scores. Matching is discussed in Moriarity and Scheuren (2003)

Mapping the Data.

First, we chose characteristics of the two datasets that are common to both and which we expect influence factor shares of income. These characteristics, which can be found in both the HBS and the RLMS, are:

- Personal characteristics: age, gender (1-male, 2-female), skilled (0-unskilled, 1-skilled), head of the household (1-headhh), primary, secondary, and other occupation, and income.
- Household characteristics: family size, members of the household who work
- Geographic characteristics of the locality: region, type of settlement: urban/rural.
- Household income

A full explanation of the variables and summary statistics are provided in Table 1. Some variables are directly comparable between the two datasets. This includes data on personal and household characteristics such as age, gender, composition of the household. But there are differences between the datasets in geographical representation, reported occupation, and the income of households. These differences can be explained by the differences in sampling and indirectly to the differences in survey designs. For example, in order to reduce the costs of face-to-face interviews, geographically inaccessible regions are underrepresented in the RLMS dataset. In particular, the geographically biggest East Siberia and Far East region is underrepresented in the RLMS sample[32].

In order to make some of the variables comparable between the surveys, we transformed the raw data in some cases. For example, there is only one question on education in the HBS: what is your level of education? The RLMS, on the other hand, has a number of questions on education, such as the level of education, the number of years studied, whether the individual

[32] RLMS sampling procedure is discussed at http://www.cpc.unc.edu/projects/rlms/project/sampling.html

received a diploma or not, and whether the individual attended professional courses while working or not. Therefore, it was necessary to combine the various educational measures in the RMLS into one summary measure in order to produce a comparable variable.

In addition, the questions that are posed in the two surveys regarding primary, secondary and other occupation of household members are not identical in the two surveys. Thus, there may be some differences in responses across the surveys due to the framing of the questions.

Factor income shares: RLMS

The RLMS contains data on both households and individuals, and both sets of information were employed. The individual (adult) survey has the information on individual income sources and contains around 10,500 observations. The household survey has around 4,500 households. Each individual respondent can be traced to a particular household in the household survey, making it possible to merge these two datasets. We used individual surveys to calculate income from primary and secondary place of employment, pensions, unemployment benefits and from additional (self-employed) work, such as selling goods in a market, doing construction or repair work and providing transportation services in one's personal vehicle. From the household surveys we obtained information on household characteristics.

First, we classified all individuals according to their primary, secondary, and other occupation to make it comparable with the HBS data. If a person had a primary job then she was classified as a worker or entrepreneur based on her answer whether she is an entrepreneur or worker on the primary job. If a person did not have a primary job but received pension or unemployment benefit then she was classified as a pensioner or unemployed. A person who had no primary or secondary job and was not a pensioner or unemployed was defined to be outside of the labor force. The classification according to the secondary occupation was done analogously. A person was considered as a worker or entrepreneur if she had second job and classified herself as a worker or entrepreneur. A small number of individuals (194 out of 128,500) were both workers and entrepreneurs based on this classification system, but whether they were workers or entrepreneurs in their primary or secondary jog was also recorded. A person was considered as a working pensioner if she had primary job and also received a pension.

Total individual income can be broken down into primary, secondary, and other sources of income according to occupation. For example, if a person is a pensioner who continues to work then her primary occupation is worker and secondary occupation is pensioner. Her primary source of income is wages, bonuses, profits from primary place of work in the last 30 days (variables

i9wagelm and **i9goodsv**). > **i9wagelm** Her secondary source of income is pension in the last 30 days (variable **i9ampens**) and she has no other source of income.

To separate wages from profits and bonuses, we applied the following procedure. If the person is a co-owner of the company, some of her income could be attributed to payments to capital. Also, if a person reported not only wages but also profits and bonuses then part of it could be attributed to the capital. To account for this, we subtracted implied wages from the primary, secondary and other income. Implied wages were calculated as average wage rates depending on skills and location times the number of hours worked that is reported in the survey. Then we can write the following:

$$\textbf{labor income}_i = \textbf{hours}_i * \textbf{wage rate}_i(\textbf{skilled, region}), \qquad (1)$$

where i is primary, secondary, or other occupation

$hours_i$ number of hours worked at i

$wage\ rate_i$(skilled, region) is the average wage rate for occupation i depending on skill status of the worker and region of employment.

The remaining income is attributed to capital earnings.

$$\textbf{capital income}_i = \textbf{income from occupation}_i - \textbf{labor income}_i, \qquad (2)$$

If hours worked in the primary company owned by the individual are not reported, we assumed that she worked 160 hours (4 x 40 hour working week) minus the time worked in other places. Also, if the person was a pensioner or unemployed we assumed that all her income was labor income because these sources of income are deferred compensation to workers.

Imputation of individual income for HBS.

The HBS has data on total household income and individual characteristics such as age, education, gender, primary, secondary and other occupation. To exploit individual information to predict factor income shares we have to break down household income into incomes of household members.

Based on the RLMS individual and household income data, we calculated average income shares of household members as a function of the composition of the household (Table 2). We defined the head of the household as a person who has a source of income from primary,

secondary, or other occupation and is listed first in the household member list (has the lowest id number). We applied the numbers from Table 2 to calculate individual incomes using the equation 3:

indinc=hhinc*ind_share, **(3)**

where indinc is individual income, hhinc is total household income less non-working related benefits[33], ind_share is the share of household income attributed to this individual, which depends on whether the individual in the head of household and the number of people in the household (see Table 2).

Calculation of factor income shares for HBS.

As the last step, we break down imputed individual incomes into three parts: skilled labor income, unskilled labor income and capital income for each individual in the HBS survey. The person is considered a skilled worker if her educational level goes beyond high school education.[34] Then, we calculate household factor shares as weighted averages of individual income shares.[35]

Based on the data in the RMLS survey, we run a logit regression of individual labor share on common characteristics for RLMS individuals and use the estimates to predict labor shares for HBS individuals:

$$lshare_i = \frac{\exp(X_i\beta)}{1+\exp(X_i\beta)} + \varepsilon_i \qquad (4)$$

where X is a vector of personal characteristics and β is a vector of coefficients.

The choice of a functional form was motivated by the fact that labor share is always positive and bounded between 0 and 1.Also, the relationship between labor share of income and the explanatory variables is potentially highly non-linear. Finally, we are restricted to the set of explanatory variables that are common for both surveys. To improve the power of prediction we

[33] Household income is defined as household expenditures plus savings minus transfers. Transfers are the sum of housing benefits, gifts, and other non-work related benefits. Also, if no household members had work related source of income then the whole household income was considered as transfers.

[34] Person is a skilled worker if she has technical or higher education.

[35] Weights equal to the ratio of individual income to the household income.

divide individuals in quintiles according to individual income and run regression (4) separately for each quintile[36]. The results of the regressions by individual income quintiles are presented in Table 3.

Based on the results of Table 3, we estimate the individual factor shares for the HBS sample. With the estimated factor shares for individuals in the HBS, we calculate household factor shares as a weighted average. The imputed factor shares by household income deciles in the HBS are presented in Table 4. It also contains the RLMS sample statistics to compare the results. The differences in skilled labor share are mainly due to the higher proportion of skilled workers in RLMS sample. On the other hand, both surveys agree well on the capital income shares.

As a check on our estimates, we employed a subgroup matching approach to compute factor shares. All workers were divided into subgroups according to the following categories: region, rural/urban, skilled/unskilled, primary occupation, individual income quintile. Then we calculated average labor share for each subgroup using RLMS data and applied it to HBS individuals in the same subcategory:

$$avg\_lshare_i = \frac{\sum_k lshare_{ik}}{K},$$

where K is the number of RLMS people in the subcategory i.

The results of imputation of factor shares by household income deciles using the subgroup matching approach are presented in Table 5. The results are remarkably close to the regression results. The main difference is that the unskilled labor share is slightly higher and capital's share is slightly lower with the regression approach. We employ the results from the regression approach in our model.

[36] We did not run regression for the first quintile but rather assumed that labor share is 1 for all individuals because there are no observations with labor share different from 1 in the RLMS.

Literature

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