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Assessing the Impact of WTO Accession on Belarus: A quantitative evaluation

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Acronyms

CGE	Computable General Equilibrium
CIS	Commonwealth of Independent States
CRTS	Constant Returns to Scale Models
ECU	Eurasian Customs Union
EU	European Union
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GATS	General Agreement on Trade in Services
GDP	Gross Domestic Product
GOST	State Standards System
IRTS	Increasing Return to Scale
MFN	Most Favored Nation
NTBs	Non- Tariff Barriers
OTRI	Overall Trade Restrictiveness Index
ROW	Rest of the World
SAM	Social Accounting Matrix
SPS	Phyto-Sanitary Standards
STRIs	Services Trade Restrictiveness Indices
TBT	Technical Barriers to Trade
UNESCAP	United Nations Social Commission for Asia and the Pacific
WTO	World Trade Organization

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Non-Technical Summary

A. Introduction

As a small and open economy, Belarus' development perspectives are intrinsically linked to its ability to produce and sell goods and services competitively in the global marketplace. While Belarus is an open economy, its trade links are concentrated both in terms of products and markets. Mineral goods –most importantly refined oil and potassium chloride - are the main export product accounting for more than 1/3 of total exports. Non mineral exports, including most importantly machinery, vehicles and transport equipment are mostly exported to Russia and other CIS markets, which account for 74 percent of non-mineral exports while the share of EU countries in Belarus non-mineral exports account for less than 15 percent. Importantly, Belarus has gradually lost market share internationally in many of its major employment generating manufacturing products, including transport equipment (tractors, dump trucks, diesel powered trucks) and machinery. At the same time, rising commodity prices resulted in increasing concentration of Belarus' export bundle in minerals and chemical products, making Belarus more vulnerable to commodity price shocks. With Russia's WTO accession in 2012 competitive pressures on Belarus' major market for non-mineral exports have further intensified. As Belarus is accelerating its own negotiations with the WTO, understanding the challenges and opportunities faced by the country's exporters is critical to putting in place an effective adaptation strategy that will enhance competitiveness and ensure Belarus can take full advantage of more open market access.[1]

The objective of this note is to analyze the economic impacts of Belarus' potential accession to the WTO.[2] The note utilizes a modern computable general equilibrium model of the economy of Belarus[3] to simulate impacts on the economy as a whole and on individual sectors. Importantly, the model incorporates liberalization of and foreign direct investment in business services (in addition to liberalization of trade in goods where major commitments are already binding under the customs union). The model is consistent with both economic theory and the substantial and growing empirical literature that have shown that foreign direct investment and the wide availability of business services results in total factor productivity gains to the manufacturing sector and the economy broadly[4] The results are intended to inform policy decisions with regard to

[1] See World Bank (2012) for a broader discussion of structural reforms and the role of state owned enterprises in the economy of Belarus.

[2] The Working Party on the accession of Belarus to the World Trade Organization was established on October 27, 1993, and held its first meeting in June 1997. The latest meeting of the Working Party was held in May 2005, but bilateral market access negotiations are ongoing. Due to the fact that Belarus is a member of the ECU (with Russia, Kazakhstan and Armenia), Russian accession has resulted in Belarus adopting many of the commitments of Russia to WTO members (such as tariff commitments and limitations on trade distorting subsidies in agriculture), without Belarus obtaining the rights of a member of the WTO. Since 2010, Belarus has reinvigorated its own accession process with WTO members.

[3] At the requests of the Governments of the Russian Federation and Kazakhstan, a similar model was employed to assess the impacts of their WTO accession initiatives. (See Jensen, Rutherford and Tarr (2007) for the Russian Federation; and Jensen and Tarr (2008) for Kazakhstan.) A detailed technical description of the model and utilized data inputs is included in the technical paper.

[4] Focusing on the effects on manufacturing specifically in transition economies, Berulava (2011) finds that liberalization reforms in telecommunications, electric power, railway transport, road transport, and water distribution sectors as well as in banking sector indeed stimulate expansion of export activities of manufacturers. Examining the reform process of the Czech Republic, Arnold, Javorcik, and Mattoo, (2011) find a positive and statistically significant correlation between firm performance in downstream manufacturing and the overall liberalization of services on one hand and the presence of foreign providers of services, and the extent of privatization of services industries on the other. Shepotylo and Vakhitov (2012) found similar results in Ukraine. Zhang, Tang, and Findlay (2010) assess the productivity effects of services trade liberalization on Chinese manufacturing firms. They find that service liberalization and service outsourcing led to a significant increase in total factor productivity of firms located in east China. According

the World Trade Organization (WTO) accession process, and in particular the negotiations of commitments on trade in services, and a broader, accompanying strategy to improve competitiveness and enhance the positive impact of WTO membership while mitigating potential risks.

Specifically, the note presents simulation results of the following scenarios:

- **Impact of adopting reduction in customs union external tariffs consistent with Russia's WTO commitments:** As member of the customs union Belarus is obliged to adopt reductions in the unified external customs union tariff consistent with Russia's commitments to the WTO. This will result in a gradual reduction in the unweighted average tariff from 10 percent in 2012 to 7.8 percent in 2020. These tariff changes will have to be adopted regardless of whether Belarus itself joins the WTO.
- **Impact of Belarus's potential WTO accession:** Aside of the tariff related commitments which are already binding in the context of the customs union, Belarus's own WTO accession would have substantial impacts on the economy as commitments will include areas such as rights of investors in business services, customs regulations, product standards, especially in food and agricultural, trade related intellectual property and trade related investment measures. The impact of the following specific policy changes are estimated: i) improved market access for sectors that have been subject to anti-dumping actions in export markets; ii) reduction of discriminatory barriers against foreign suppliers of services in the Belarussian market; iii) reduction of non-discriminatory barriers in the Belarussian market; and iv) adoption of WTO consistent phyto-sanitary and sanitary standards. The results are presented both for the overall impact of adopting these reforms and for each policy measure separately.

The simulation results suggest that Belarus could reap significant welfare gains not only from tariff reductions but more importantly from full WTO membership. Adopting the reduction in external customs union tariffs, consistent with Russia's WTO commitments is expected to result in aggregate net welfare gains, equal to 1 percent of aggregate consumption (0.5 percent of gross domestic product (GDP). In addition, we estimate that the net welfare gains of WTO accession to Belarus will equal a permanent increase of 8.2 percent of Belarusian consumption (or 4.0 percent of GDP) in the medium term:

- **The most substantial expansion of output occurs in the business services sectors.** All business service sectors are expected to expand as a result of lower barriers to foreign investment and WTO induced liberalization. Four service sectors, insurance, communications, other professional service and rail and other transportation services are expected to register output increases of more than 9 percent. Employment expands the most in insurance, other professional services and other financial services. Overall, the estimated direct welfare gain related to the expansion service sectors following the reduction of discriminatory and non-discriminatory regulatory barriers amounts to 7.2 percent of consumption or 3.5 percent of GDP. Moreover, more competitive business services will also imply indirect benefits through linkages with the manufacturing sector (see next bullet).
- **The manufacturing sector is also expected to expand.** We estimate that most manufacturing sectors will expand slightly in the medium term and more strongly in the long run.[5] The reduction in regulatory barriers in service sectors expected under WTO commitments will bring in additional service varieties and lower costs of using business services. This in turn would lower the cost of doing business and result in a productivity

to Arnold, Javorcik, Lipscomb, and Mattoo, (2012), policy reforms in services sectors played a major role in the transformation of the manufacturing sector in India, allowing greater foreign and domestic competition with greatly improved regulation.

[5] In the long run, the only manufacturing sectors that we estimate will decline are wood and wood products (3.4 percent), machinery and equipment (0.8 percent) and electrical and optical equipment (0.8 percent).

improvement for the manufacturing sector as users of business services. We see that the cost of business services falls in all sectors, with the most significant decreases (by about 14-16 percent) expected in other professional services and insurance. Sectors that most intensely use business services, especially business services that experience the largest decrease in their prices, will see their costs fall the most. In addition, sectors that export will see an improvement of their export prices due to the small real depreciation of the exchange rate; and five sectors will obtain improved market access in export sectors. Due to the combination of these impacts, the four manufacturing sectors that we estimate will expand the most in the long run (percentages output increase in parentheses) are: food, beverages and tobacco (5.1 percent); chemicals (7.1 percent); textiles and textile products (4.2 percent);pulp and paper production (4.5 percent); and leather and leather products (13.7 percent).

- **Agriculture is expected to see small positive impacts.** The results suggest a small increase in the output of agriculture in the medium term of 0.8 percent. In the long run, however, where the economy has time to adjust to a new higher level of capital stock, we estimate that WTO accession will lead to an expansion of the agriculture sector of 6.3 percent. Thus, despite the fact that we incorporate a reduction by 25 percent in the ad valorem equivalent of the non-tariff barriers that protect agriculture, we do not estimate an adverse impact of WTO accession on agriculture. In part this is explained by the fact that we do not assume a reduction of agricultural subsidies as part of the WTO accession scenario. As part of the obligations of the Republic of Belarus in the Eurasian Customs Union (ECU), Belarus must reduce it trade-distorting agricultural subsidies approximately consistent with Russian levels under Russia's WTO commitments--which should be sufficient for Belarus to meet WTO accession requirements. So like with tariffs, the subsidy reduction should not be considered an additional obligation of Belarus due to its WTO accession.

However, despite the expected overall positive impact, the analysis also reveals vulnerabilities in several key sectors. As a result of Russia's tariff reduction under its WTO commitments, Belarus will experience preference erosion in Russian markets. While many sectors would expand in response to the reduction in the external custom union tariff, tariff changes will induce significant output declines in some sectors, most notably in transport equipment (-11 percent); leather and footwear (-7.8 percent); and pulp and paper production (-5.5 percent). In addition to these Customs Union tariff induced contractions, Belarus accession to the WTO would also be expected to adversely affect certain sectors. In the long run, the manufacturing sectors that we estimate will decline are wood and wood products (3.4 percent), machinery and equipment (0.8 percent) and electrical and optical equipment (0.8 percent), with three sectors experiencing contractions larger than 1 percent of output: wood and wood products (-2.7 percent); forestry and related services activities (-3.4 percent); and mining and quarrying except energy (-4.5 percent). This is mainly due to reallocation of labor and capital as increased profitability of the services sectors (and other expanding sectors) induces them to bid up wages and the return on capital which attracts capital and labor away from the rest of the economy.

The following sections present the simulation results in more detail and point to possible policy implications of the findings.

Table S-1. Summary of Impacts of WTO Accession and Complementary Structural Reform Measures in Belarus

		WTO accession-medium term						Complementary Other Policies	
Scenario definition	**Benchmark**	**WTO accession**	**Only Discriminatory Services Barriers (50% reduction)**	**Only non-Discriminatory Services Barriers (25% Reduction)**	**Only improved market access**	**Only reduction in WTO inconsistent SPS barriers**	**WTO accession Steady State**	**Russia's WTO tariff commitments**	**Only non-discriminatory Services Barriers (50% Reduction)**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
50% reduction in discriminatory services barriers for a	No	Yes	Yes	No	No	No	Yes	No	No
25% reduction of non-discriminatory barriers on all se	No	Yes	No	Yes	No	No	Yes	No	No
Increase in the export price for selected sectors	No	Yes	No	No	Yes	No	Yes	No	No
25% reduction in non-tariff barriers in SPS	No	Yes	No	No	No	Yes	Yes	No	No
Steady-state capital stock	No	No	No	No	No	No	Yes	No	No
Implementation of Russia's WTO tariff commitments	No	No	No	No	No	No	No	Yes	No
50% reduction of non-discriminatory barriers on all se	No	No	No	No	No	No	No	No	Yes
State controlled share decreases by 50% in each sector;	No	No	No	No	No	No	No	No	No
Aggregate welfare									
Welfare (EV as % of consumption)		8.2	1.7	5.5	0.1	0.4	16.0	1.1	11.7
Welfare (EV as % of GDP)		4.0	0.8	2.7	0.1	0.2	7.8	0.5	5.8
Government budget									
Tariff revenue (% of GDP)	2.5	2.5	2.5	2.5	2.5	2.5	2.4	1.8	2.5
Tariff revenue		2.2	1.3	0.4	0.1	0.2	2.3	-28.3	-0.1
Aggregate trade									
Real exchange rate		0.5	0.2	0.2	0.0	0.1	0.7	1.2	0.3
Aggregate exports		0.9	1.2	-0.7	0.0	0.1	0.4	1.3	-2.2
Factor Earnings									
Skilled labor		3.9	1.1	2.4	0.0	0.2	7.2	1.0	4.7
Unskilled labor		3.7	0.9	2.4	0.0	0.1	7.0	0.9	4.8
Capital		3.5	1.1	2.1	0.1	0.0	0.6	1.1	4.3
Specific Factors (domestic)		6.4	0.5	5.1	0.1	0.6	11.1	0.3	10.9
Specific Factors (multinationals)		6.6	4.1	1.9	0.1	0.2	10.4	1.3	4.0
Factor adjustments*									
Skilled labor		0.9	0.3	0.7	0.0	0.1	1.3	0.5	1.2
Unskilled labor		0.9	0.2	0.8	0.0	0.1	1.4	0.6	1.4
Capital		1.0	0.3	0.8	0.1	0.2	0.0	0.6	1.6
Capital stock change (steady state only)							6.6		

Source: Authors' estimates.
*Percentage of the factor that must change sectors

B. Impact of Reductions in External Tariffs of the Customs Union

In spite of not yet being WTO member, Belarus will be obliged to adopt the common external customs union tariff, consistent with Russia's commitments to WTO. As part of its WTO accession commitments, the Russian Federation has agreed to substantial tariff reductions to be implemented in phases between 2011 and 2020. As a member of the Belarus- Kazakhstan-Russia Customs Union, Belarus has committed to implement the tariff reductions Russia has agreed as part of Russia's WTO accession commitments. As a result of Russia's commitments to the WTO the (unweighted) average tariff will gradually fall from 10 percent in 2012 to 7.8 percent by the year 2020. Commitments include reductions in the tariffs for manufactured goods from 9.4 percent to 7.2 percent and for agricultural products from 13.3 percent to 11.2 percent. More than one-third of the tariff lines were adjusted immediately after Russia's WTO accession, while the remaining tariff lines will be reduced gradually. By using 2011 as our benchmark equilibrium, we take the initial implementation of the common external tariff of the Customs Union by Belarus in 2010 and 2011 as part of the initial status quo or "benchmark" equilibrium; and we assess the implications for Belarus of the reductions in the common external tariff of the Customs Union after 2011, that is, from 2012 until 2020.

Belarus is expected to gain 1.1 percent of consumption (0.5 percent of GDP) as a result of implementing the tariff reductions agreed by Russia as part of Russia's WTO accession commitments.[6] In column 7 of Table S-1, we show our estimates of the impacts of these tariff changes on Belarus until 2020. The estimated gains of 1.1 percent of consumption are the net impact of two aspects of the tariff reductions by Customs Union members: (i) a gain of 2.0 percent of consumption from improved resource allocation and productivity impacts in Belarus; and (ii) a loss of 0.9 percent of consumption from erosion of tariff preferences in the markets of Russia and Kazakhstan. Although we estimate output expansion for many sectors, we also estimate that the tariff changes will induce significant output declines in several sectors. The most notable sector output declines are: transport equipment, 11 percent; leather and footwear, 7.8 percent; and pulp and paper production, 5.5 percent. The expected output declines emphasize the need for Belarus to improve its international competitiveness as part of comprehensive adaptation strategy. Impacts on the output by sector of implementing Russia's tariff commitments are shown in Table S-2.

Table S-2. Output and Employment Impacts of Key Policy Reforms
(Percentage change from benchmark)

	WTO Accession-Medium Term			WTO accession --Steady State			Russia's WTO tariff commitments			Only non-discriminatory Services Barriers-- 50% Reduction		
		employment			employment			employment			employment	
	output	skilled	unskilled	output	skilled	unskilled	output	skilled	unskilled	output	skilled	unskilled
Business Services												
Trade, repair of motor vehicles, household appliances and personal items	3.9	-3.8	-3.6	8.9	-3.7	-3.5	0.7	0.1	0.3	5.3	-5.8	-5.9
Communication	9.3	5.1	5.4	11.9	4.7	5.0	1.3	1.2	1.3	10.5	7.4	7.3
Insurance	9.7	8.2	8.4	15.4	9.9	10.2	0.7	0.7	0.9	6.0	5.0	5.0
Other financial services	7.3	5.9	6.1	13.0	7.6	7.9	0.8	0.7	0.9	4.7	3.8	3.7
Other professional services (incl R and D)	9.4	7.3	7.5	12.3	7.8	8.0	0.7	0.6	0.8	5.2	4.0	3.9
Water rail transport and transport nec	9.7	4.6	4.8	12.1	3.8	4.0	1.0	0.9	1.0	12.0	8.2	8.1
Air transport	6.7	1.8	2.0	9.4	1.4	1.6	1.0	0.9	1.0	8.6	4.9	4.9
Road transport	7.5	2.5	2.7	10.9	2.8	3.0	1.4	1.2	1.4	8.2	4.5	4.5
Dixit-Stiglitz Goods												
Manufacture of food products , beverages and tobacco	2.5	0.3	0.5	6.1	1.0	1.2	0.7	0.6	0.7	2.4	1.0	0.9
Textiles and textile products	1.6	0.1	0.4	4.2	0.4	0.6	-0.3	-0.4	-0.2	1.6	0.6	0.6
Manufacture of wood and of products of wood	-2.7	-4.1	-3.8	-3.4	-6.4	-6.2	-3.7	-3.8	-3.6	-5.0	-5.8	-5.9
Pulp and paper production. Publishing	1.8	-0.1	0.1	4.5	0.3	0.6	-5.5	-5.6	-5.4	1.1	-0.1	-0.2
Manufacture of coke, refined petroleum and nuclear fuel	1.2	-1.2	-0.9	2.6	-4.1	-3.9	0.6	0.6	0.7	1.6	0.0	-0.1
Chemicals and chemical products	1.5	-0.5	-0.3	7.1	0.7	1.0	2.6	2.6	2.7	-0.4	-1.9	-1.9
Manufacture of rubber and plastic products	-0.2	-2.2	-1.9	1.5	-3.0	-2.8	-1.9	-2.0	-1.8	-2.5	-3.7	-3.8
Manufacture of other non-metallic mineral products	0.5	-1.1	-0.9	1.3	-2.4	-2.2	-1.2	-1.3	-1.1	0.1	-1.0	-1.0
Manufacture of basic metals and fabricated metal products	0.7	-0.9	-0.7	1.8	-2.3	-2.1	-1.0	-1.1	-0.9	-0.7	-1.7	-1.7
Manufacture of machinery and equipment	-0.9	-2.5	-2.2	-0.8	-4.3	-4.1	2.6	2.5	2.7	-2.1	-3.1	-3.1
Manufacture of electrical and optical equipment	-1.0	-2.5	-2.3	-0.8	-4.3	-4.1	-1.1	-1.2	-1.0	-2.3	-3.2	-3.3
Manufacture of transport equipment	-0.7	-2.4	-2.2	1.3	-3.1	-2.9	-11.0	-11.1	-10.9	-2.5	-3.6	-3.7
Manufacturing nec	1.3	-1.1	-0.8	3.2	-1.7	-1.5	-3.2	-3.3	-3.2	0.9	-0.6	-0.7
CRTS Goods and Services												
Agriculture, hunting and related services in these areas	0.8	-0.4	-0.2	6.3	1.2	1.4	-0.4	-0.5	-0.3	3.3	2.5	2.4
Forestry and related service activities	-3.4	-4.1	-3.8	-4.1	-5.7	-5.5	-1.0	-1.1	-0.9	-5.4	-5.7	-5.8
Fishing, fish farming and related services in these areas	0.9	-0.4	-0.1	6.9	1.6	1.9	-8.9	-9.0	-8.8	0.2	-0.6	-0.7
Mining and quarrying of energy minerals	1.6	0.4	0.6	16.8	10.0	10.2	2.5	2.5	2.7	4.0	3.1	3.0
Mining and quarrying except energy	-4.5	-5.6	-5.4	-1.2	-5.4	-5.2	3.7	3.7	3.9	-8.2	-9.0	-9.1
Manufacture of leather , leather products and footwear	3.2	1.6	1.8	13.7	7.8	8.0	-7.8	-7.8	-7.7	3.6	2.6	2.5
Production and distribution of electricity, gas and water	2.2	0.5	0.7	5.5	2.1	2.3	0.1	0.0	0.2	2.2	1.2	1.1
Construction	0.0	-1.4	-1.2	0.3	-3.5	-3.3	0.2	0.1	0.3	0.0	-1.0	-1.0
Hotels and restaurants	-3.1	-3.9	-3.7	-1.3	-3.7	-3.5	3.0	2.9	3.1	-5.1	-5.6	-5.7
Real estate renting and business services	2.1	0.5	0.7	5.7	1.1	1.3	0.9	0.8	1.0	1.5	0.4	0.4
Public services	0.0	-0.1	0.2	0.1	-0.2	0.0	0.0	0.0	0.2	0.1	0.0	0.0
Education	0.6	0.4	0.6	1.4	0.6	0.8	0.1	0.1	0.2	1.0	0.9	0.8
Health care and social services	0.6	0.3	0.6	1.1	0.7	0.9	0.1	0.0	0.1	0.9	0.8	0.8
Community, social and personal services	3.4	2.2	2.4	7.1	4.3	4.5	0.3	0.2	0.3	4.5	3.8	3.7

Source: Author's estimates.

[6] We emphasize that this not an estimate of the impact on Belarus of its initial change in its tariffs in 2010 to implement the common external tariff of the Customs Union.

C. Impact of WTO Accession

WTO accession will have substantial implications for economic policies beyond tariff commitments. As part of accession negotiations, Belarus is expected to schedule commitments in areas such as rights of investors in business services, customs regulations, product standards, especially in food and agricultural, trade related intellectual property and trade related investment measures. These commitments –which unlike tariff commitment are subject to Belarus' own negotiations with WTO member states - will imply wide-ranging reforms in Belarus' regulatory environment.

The negotiations of commitments related to trade in services are particularly important. Unlike trade in goods, trade in services is not impeded by tariff and non-tariff border measures. Most barriers to service trade are national regulatory measures. In Belarus, various regulatory requirements currently prevent market access and foreign investment in key sectors, including financial, telecommunications, professional and transport services (see Box S-1 for an overview of prevailing barriers). As part of the WTO negotiation process Belarus is likely to be expected to address some of the regulatory provisions and practices that may hamper market access. Under the General Agreement on Trade in Services (GATS), WTO members are obliged to progressively liberalize trade in services and ensure that domestic regulatory measures do not create unnecessary barriers to trade in services. Although WTO accession will obligate Belarus to take on liberalization commitments in many of the key business services sectors such as financial services and telecommunications, the GATS is designed to allow flexibility in the negotiation process and specific service commitments may vary substantially both across countries and within countries across different sectors. This offers considerable room for tailoring commitments, but it also offers an opportunity to selectively open up service sectors and lock-in reform under international agreement, especially in those sectors where liberalization promises to generate economic gains. Moreover, even in a liberalized environment, governments retain the ability to address public policy objectives through more market-oriented (e.g. less distorting) regulations, for example prudential regulations in banking and universal service obligations.

The WTO process could therefore provide an important external anchor for structural and regulatory reforms to boost service sector development. Despite some promising growth trends in particular service sectors, most notably ICT, overall the service sector remains small for its level of income, in terms of contribution to GDP (Figure S-1). This is the result of Belarus inherited industrial structure with a large manufacturing sector, but also related to restrictive policy and regulatory frameworks in several service sectors, including financial services, communications and professional services (Figure S-2). There is strong evidence that liberalization and more competition leads to lower prices, better quality and wider choice for consumers. Enabling the provision of services by the private sector, allowing foreign investment and eliminating restrictions that create non-competitive and inefficient market structures can all contribute to more productive service sectors. These direct benefits in terms of improved service sector performance, in turn, work their way through the economic system and help to improve supply conditions for many other producers that rely on service inputs, such as telecommunications, financial and transport services are important inputs for all sectors of the economy.

Box S-1. Service Sector Regulations in Belarus

Like in other countries service sectors in Belarus are subject to a range of regulatory requirements.[7] Licensing, limitations on foreign investment entry, quality and safety requirements, and recognition of qualifications for professionals are examples of regulations typically imposed in service industries. While these requirements are generally intended to achieve legitimate policy objectives, such as consumer protection, financial sector stability, environmental protection, public safety etc., by restricting market entry, operation and hence competition they can pose barriers to the development of these sectors and in particular to cross border trade in services. While the focus of the GATS is naturally on discriminatory regulations that impose different treatment on foreign suppliers, non-discriminatory regulations (e.g. those that apply to all suppliers alike) may also become subject to WTO commitments if they are deemed to pose barriers to trade. The table below summarizes some of the most pertinent regulatory barriers in nine service sectors in Belarus.

Rail Transport	
Non-discriminatory	***Market Structure:*** Railway passenger and cargo transport services are provided by a monopoly state-owned company Belarusian Railways which is under the Ministry of Transport and Communications of the Republic of Belarus. ***Licenses:*** are not issued to private firms, foreign or domestic. ***Investments***: Equity ownership by foreign companies or domestic private companies in rail transport services, either in whole or in part, has not been allowed.
Insurance	
Non-Discriminatory	***Restrictions on services:*** Insurers with over 49 percent private equity participation –foreign or domestic- are prohibited from providing the following insurance services: insurance services to state owned companies; motor vehicle third party liability insurance; work injury and occupational diseases; life, health and personal accident insurance for state employees if compulsory; property insurance for buildings owned by private persons; agricultural insurance for crops and livestock; medical insurance for foreign visitors without insurance; carrier liability for dangerous cargos; and any mandatory insurance service. ***Licensing:*** both foreign and domestic firms face a complicated and costly licensing procedure including a requirement to deposit and hold Euro 5 million in Belarusian banks. ***Other Services:*** Insurance companies (both foreign and domestic) are prohibited from providing other kinds of services, such as banking or securities services. ***Reinsurance:*** Regarding reinsurance, under certain conditions, insurers must make a compulsory cession to the state company Belarusian National Reinsurance Organization (Belarus Re).
Discriminatory	***Quantitative restriction on foreign ownership:*** The share of foreign insurers in the aggregate share capital of insurers domiciled in Belarus may not exceed 30 percent. When this is exceeded, the supervisor will no longer register companies with foreign ownership shares. ***Cross-border insurance supply by foreign insurance companies.*** Belarusians or foreign companies operating in Belarus are not allowed to insure their property from a foreign firm located outside the country; this includes

[7] The provision of many services is characterized by market imperfections, including asymmetric information, externalities and parts of sectors are natural monopolies. This is mainly for three reasons: (1) services are usually intangible and cannot be inspected by consumers before they are bought; (2) services that require specialized distribution networks (e.g., the grid in electricity distribution (but not the production or sale to final consumers), the track-bed in rail transportation or the pipeline in gas distribution (but not the production of sale to final consumers)) are characterized by the prevalence of natural monopolies or oligopolies in parts of the sector; and (3) services tend to be tailored for specific customers and thus contract-enforcing institutions arguably assume greater importance in services. Optimal regulation would attempt to overcome the potential inefficiencies that can arise as a result of these service characteristics without preventing competition or imposing excessive costs on suppliers of services.

	automobile or life insurance services.
Banking Sector	
Non-discriminatory	***Licensing:*** A license for accepting deposits from physical persons can be obtained only after 2 years following registration of the bank, or if the bank has at least 200 percent of the minimum capital requirement. ***Services restrictions*:** Banks are prohibited from offering insurance services.
Discriminatory	***Direct Branching:*** Foreign banks may not enter Belarus as a branch of the foreign headquarters bank. ***Quantitative Restriction on Foreign Ownership:*** The maximum foreign equity participation as a whole banking system (in Belarusian and foreign banks) is regulated by the National Bank so that it may not exceed 50 percent.
Legal Services	
Discriminatory	***Licensing:*** Foreign nationals are prohibited from providing legal services in Belarus. This powerful restraint gives foreign nationals very limited opportunities to engage in legal services in Belarus, and is in violation of some international agreements, including the reciprocity agreement on legal services with Lithuania. ***Direct Branching:*** Foreign law firms are not allowed to enter Belarus as a branch.
Accounting and Auditing Services	
Non-discriminatory	***Licensing:*** To obtain a work permit accountants and auditors must have 3-years of experience and pass a qualification exam administered by the Ministry of Finance.
Discriminatory	***Direct Branching:*** Foreign firms may not enter as a branch of a multinational firm.
Air Transport	
De-Facto Discriminatory	***Airport Services:*** By law transport terminal services, airport services, operation and maintenance of air routes and air traffic control in Belarus are classified as natural monopolies. In practice, these services are provided mainly by state firms. ***Market Entry***: Although there are no legal restrictions on market entry, there are no foreign airlines that provide domestic air services in Belarus. ***Direct Investment*:** The maximum foreign ownership of domestic airline companies would be decided by the regulator of the industry and, in practice, a controlling or blocking stake would likely be retained by the state. Although the legally permitted equity participation of foreign firms is 100 percent, in practice, foreign equity ownership equals zero. This suggests some restrictions in practice.
Non-Discriminatory	*M**arket structure:*** There is a monopoly of state companies.
Discriminatory	***Subsidies***: The Government only subsidizes domestic companies.
Retail Trade	
Non-discriminatory	***Restrictions on large-scale stores:*** The market share of a single retailer is constrained to less than 20 percent. When reaching this limit, the retailer would not be able to expand the business within a given administrative territory. ***Factors affecting investment:*** Acquisition of commercial land is not permitted for either Belarusian or foreign companies. Local authorities in Belarus have special departments to screen investment; all investment projects are scrutinized and assessed. ***Local government requirements:*** The opening hours and the list of products the outlet may sell are usually restricted. ***Statutory government monopolies:*** In Belarus, the government has a monopoly in the distribution of petroleum and petroleum products.
Fixed Line Telephone Services	

Non-discriminatory	***Licensing:*** While there is no restriction on establishment new firms, no new license is being issued. Entering the market by acquiring a stake in Beltelecom or establishing a joint venture in or with Beltelcom will require approval of the President.
	Mobile telephone services
Non-discriminatory	***Interconnection***: Beltelecom has a monopoly for connecting other networks, i.e. wireless carriers and Internet Service Providers can interconnect via Beltelecom only. Direct interconnection agreements between carriers are prohibited. ***Restrictions on certain types of services:*** Private mobile telephone service providers are not permitted to own international gateway. Beltelecom is a monopoly provider of international gateway exchange in Belarus.
Discriminatory de facto	***Equity Restrictions.*** Although Velcom is a wholly owned foreign company, in practice, it appears difficult to enter the market without Beltelecom as a joint venture partner. Beltelecom kept an equity stake in MTS (51 percent) and BeST (Life, 20 percent), despite the fact that MTS operates as a majority owned company in other countries.

Figure S-1. The Services Sector in Belarus

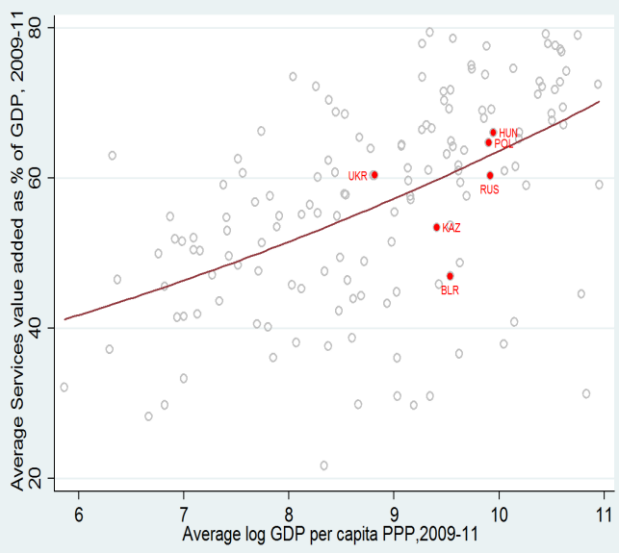
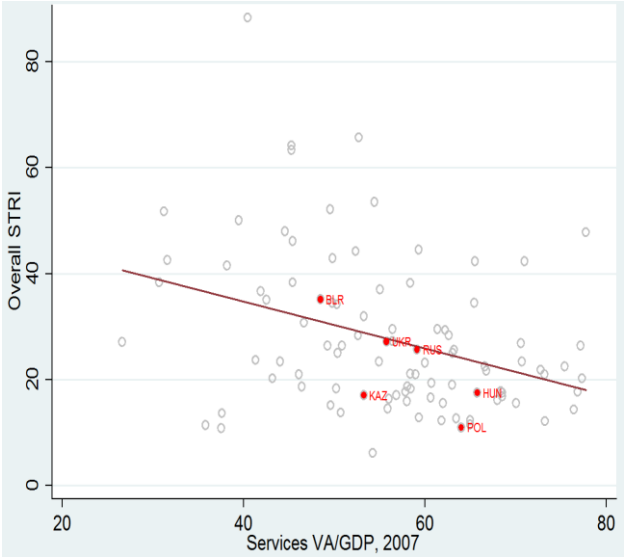


Figure S-2. Restrictions on Services and Share of Services to GDP



Source: Author's calculations from World Bank's Service Trade Restrictiveness Index (STRI) database and WDI. ***Note:*** The STRI measures the prevailing regulatory barriers to trade in services in five major service sectors (Financial Services, Telecommunications, Retail Trade, Transportation, Professional services). The index ranges from 0 (completely open) to 100 (completely closed). The database covers 103 countries that represent all regions and income groups of the world.

Our central WTO scenario estimates the impact of four different types of policy changes:

1. **Improved market access through improved rights in antidumping investigations for WTO members:** Given that WTO members have improved legal rights in antidumping investigations in their export markets, we assume that five Belarusian sectors that have been subject to antidumping actions in export markets receive slightly improved market access. This is implemented as a small exogenous increase in their export price.
2. **Reduction of discriminatory barriers in service sectors:** Given the important role of services negotiations in WTO accession, we assume that discriminatory barriers that

Belarus maintains against **foreign** suppliers of services are reduced by fifty percent of their ad valorem equivalents.

3. **Reduction of non-discriminatory barriers in service sectors:** Given that non-discriminatory barriers against service providers (that is, barriers that impact both Belarusian and foreign services **suppliers**) that limit market access of WTO members fall under the purview of the GATS scheduling negotiations, we assume that non-discriminatory services barriers in services are reduced by 25 percent of their ad valorem equivalents.
4. **Adoption of Phyto-Sanitary standards consistent with WTO requirements:** Ad valorem **equivalents** of WTO inconsistent sanitary and phyto-sanitary barriers in agriculture are reduced by 25 percent.

The WTO scenario does not incorporate further tariff reductions. As pointed out in the previous section, because of Belarus' membership in the Customs Union and Russia's membership in the WTO, tariffs are not subject to negotiations, as Belarus will have to adopt the external customs union tariff which is consistent with Russia commitments to the WTO. WTO accession should not result in any further tariff reductions beyond what Belarus will implement as part of the Customs Union. Nor will Belarus have to reduce trade-distorting agricultural subsidies below what is required as part of its membership in the ECU.

The estimates suggest that in the medium term, WTO accession would increase the welfare (or real income) of Belarusian nationals by 8.2 percent of private consumption per year or 4.0 percent of GDP per year. In our long run model (what we call the steady-state in the table) we allow the capital stock to endogenously adjust to the improved investment climate. In the long run, we estimate that Belarus would gain 16.0 percent of the value of consumption each year, or 7.8 percent of GDP each year. We estimate real wages would increase by about 3.8 percent in the medium term and 7.1 percent in the long term. Slightly less than one percent of the labor force would have to change employment.

The most substantial expansion of output occurs in the business services sectors, especially insurance, communications and professional services that expand by more than nine percent of output. Although there are several manufacturing sectors that slightly contract (most notably wood and wood products and mining and quarrying other than energy), we estimate that most manufacturing sectors will expand slightly (in the medium term and more strongly in the long run. This includes expansions in food products, textiles and textile products, pulp and paper products and chemicals. We estimate a small increase in the output of the agriculture sector of 0.8 percent in the medium term and 6.3 percent in the long term. See Table S-2 for all sector output results from WTO accession in both the in both the medium term and long run.

Among the different policy measures, the reduction of discriminatory and especially non-discriminatory barriers in service sectors is expected to generate the most significant welfare gains. To assess the contributions to the estimated welfare gains of each of our four components of WTO accession of Belarus, we execute four simulations in which we only change the one policy. In columns 2, 3, 4 and 5 of Table 1, we show that the most important contributors to the estimated gains in welfare of Belarus from WTO accession are the reductions of discriminatory and especially non-discriminatory barriers against suppliers of services. The fifty percent reduction in the discriminatory barriers against foreign suppliers of services is estimated to result in a gain of 1.7 percent of consumption per year; and a 25 percent reduction of the ad valorem equivalent of the non-discriminatory barriers that adversely impact both Belarusian and foreign service providers is estimated to lead to a welfare gain of 5.5 percent of consumption per year. The reduction in the barriers against suppliers of services increases profitability for services suppliers in Belarus, thereby inducing new entry by service providers. Belarusian businesses will then have improved access to services in areas like telecommunication, banking, insurance, transportation and other business services. Econometric evidence indicates that additional service suppliers in the business services sectors should lower the cost of doing business and result in a productivity

improvement for users of these goods in manufacturing and throughout the economy, and our model assessments endogenously incorporate these productivity improvements. In comparison, the improved market access (under antidumping provisions) and adoption of phyto-Sanitary standards (SPS) are estimated to generate a combined welfare increase of 0.5 percent of consumption.

To assess which services sector reforms are likely to yield the greatest gains, we assess the impact of policy reforms in eight key business services sectors. We also assess the impact of reduction of the ad valorem equivalents of discriminatory and non-discriminatory barriers separately, at the levels of reduction consistent with our WTO accession scenario: fifty percent of discriminatory barriers and 25 percent for non-discriminatory barriers.[8] Our results are presented in Table S-3. We find that the greatest gains from any single services sector reform come from reduction of non-discriminatory barriers in the rail and other transport sector (2.3 percent of consumption), followed by the trade sector (2.0 percent of consumption). Rail and other transport is the sector with the highest ad valorem equivalent of services barriers in our dataset and also constitutes a substantial 4.1 percent of the aggregate value-added in the economy of Belarus. The trade sector is the largest sector in Belarus, so even though the ad valorem equivalents of the barriers are not high, the costs of the low barriers are high. The greatest gains from reduction of discriminatory barriers are in the "other financial services" sector, which includes banking (1.1 percent of consumption). Despite a zero estimated gain for reduction of foreign discriminatory barriers in insurance, rail transport and air transport, we believe there would be gains from reduction of the barriers against foreigners in these sectors. As explained in the text, the model takes a very conservative approach to estimation of the impacts of reform when the initial foreign share is zero (as in rail and air transport) or where the sector share is very small (as in insurance).

Table S-3. Impact of Individual Sector Services Reform: Discriminatory and Non-Discriminatory Reforms

(Results are percentage change in welfare from the benchmark as a percent of consumption)

	Static Welfare (Percent of Consumption)			Steady-state Welfare (Percent of Consumption)		
	All Services Barriers (50% Discriminatory Reduction and 25% Non-Discriminatory Reduction)	Only Non-Discriminatory Services Barriers (25% Reduction)	Only Discriminatory Services Barriers (50% Reduction)	All Services Barriers (50% Discriminatory Reduction and 25% Non-Discriminatory Reduction)	Only Non-Discriminatory Services Barriers (25% Reduction)	Only Discriminatory Services Barriers (50% Reduction)
All Business Services Sectors	**7.6**	**5.5**	**1.7**	**15.4**	**9.8**	**3.8**
Individual Business Services Sectors						
Trade and selected personal repairs	2.0	2.0	0.0	3.7	3.7	0.0
Communication	0.2	0.1	0.0	0.3	0.2	0.1
Insurance	0.1	0.0	0.0	0.2	0.1	0.1
Other financial services	1.7	0.6	1.1	3.7	1.1	2.4
Other professional services (including R&D)	0.8	0.3	0.4	1.9	0.6	1.1
Rail, water and other transport (not air or road)	2.3	2.3	0.0	3.7	3.7	0.0
Air transport	0.01	0.01	0.00	0.02	0.02	0.00
Road transport	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' estimates.

[8] We believe that these percentage reductions in the ad valorem equivalents of the services barriers are conservative estimates of the average reductions likely to be achieved, but the cuts may be more or less is any particular sector. But these estimated gains in particular sectors could be seen as the expected gains from reform in the individual sector of these cuts, independent of WTO commitments.

D. Policy Implication

The WTO accession process offers an important opportunity to Belarus to promote regulatory reforms, especially in service sectors, which would boost productivity and competitiveness. Unlike in the trade for goods where liberalization is focused primarily on the removal of tariff and non-tariff barriers, service liberalization implies the creation of a competitive and non-discriminatory regulatory environment. As part of its WTO negotiation and adaptation strategy, the government will need to review the existing regulatory environment in those service sectors subject which will likely be subject to WTO commitments. Deregulating services is a complex task that needs to carefully balance the potential benefits of more open markets with other legitimate policy objectives. Steps to deregulate therefore need to be accompanied by efforts to establish sound and independent regulatory and supervisory infrastructures.[9] Targeted liberalization measures to remove barriers to competition and open up markets could contribute to higher productivity, lower cost and broader access to services. The analysis in this paper indicates that particular consideration should be given to the elimination of non-discriminatory barriers. The results suggest that such reforms would substantially increase the productivity and competitiveness of the economy of Belarus, resulting in substantial increases in the incomes of the citizens of Belarus. Increasing the performance of service sectors matters not only because the service sector itself remains small in terms of value added and exports, but also because services are critical inputs for many other sectors. Enabling the competitive provision of financial, transport, logistical, communication and other business services is an important pillar of an overall strategy to strengthen competitiveness, especially of the tradable sector. Given the deep forward linkages services have with the rest of the economy, efficiency improvements in intermediate commercial services are innately linked to the competitiveness of other sectors of the economy.

[9] Marel (2012) and Shepard and Marel (2013) find that after deregulation in a particular services sector, the ability to successfully export services depends on how well domestic (regulatory) institutions govern these deregulated markets in terms of private sector development.

Main Report

A. Introduction and Summary of Key Results

1. The Working Party on the accession of Belarus to the WTO was established on October 27, 1993, and held its first meeting in June 1997. The latest meeting of the Working Party was held in May 2005, but bilateral market access negotiations are ongoing. Due to the fact that Belarus is a member of the ECU (with Russia and Kazakhstan), the accession of Russia to the WTO has provided added impetus to Belarus to accede to the WTO. Russian accession has resulted in Belarus adopting many of the commitments of Russia to WTO members (such as tariff commitments and limitations on trade distorting subsidies in agriculture), without obtaining the rights of a member of the WTO. Possibly motivated by this fact, since 2010, there has been substantial work between the WTO members and the Government of Belarus.[10]

2. Despite the obligations of the Government of Belarus under the Customs Union, WTO accession is expected to have substantial impacts on the economy as commitments or reform will include areas such as rights of investors in business services, customs regulations, product standards, especially in food and agricultural, trade related intellectual property and trade related investment measures. The Government of Belarus has requested this quantitative assessment of the consequences of WTO accession in Belarus that would attempt to assess the overall impact of these changes.

3. We develop and modern, innovative computable general equilibrium model of the economy of Belarus to undertake this assessment. Crucially, the model is constructed to be consistent with both economic theory and the substantial and growing empirical literature that have shown that foreign direct investment and the wide availability of business services results in total factor productivity gains to the manufacturing sector and the economy broadly.[11]

4. We find that WTO accession would be expected to increase the welfare (or real income) of Belarusian nationals by 8.2 percent of private consumption per year.[12] Our decomposition analysis finds that it is the reduction of barriers against suppliers of services that is the most important contributor to the gains in welfare of Belarus. A fifty percent reduction in the discriminatory barriers against foreign suppliers of services is estimated to result in a gain of 1.7 percent of consumption; and a 25 percent reduction of the ad valorem equivalent of the non-discriminatory barriers that adversely impact both Belarusian and foreign service providers is estimated to lead to a welfare gain of 5.5 percent of consumption per year.

5. Further decomposition of our WTO scenario into impacts of individual services sector reforms shows that the greatest gains from any single services sector reform comes from reduction

[10] An updated Factual Summary by the WTO Secretariat on the status of the accession of Belarus to the WTO was circulated in November 2012. In March 2013, a set of follow-up questions and answers by the Government of Belarus were circulated by the WTO Secretariat. For a list of documents available on WTO accession by the WTO Secretariat see http://www.wto.org/english/thewto_e/acc_e/a1_belarus_e.htm.

[11] For the theoretical literature, see, for example, Markusen (1989) and Francois (1990). See Francois and Hoekman (2010) for a survey of more than a dozen empirical studies that support this finding. Support comes from a variety of sources including studies that use firm level data, such as Arnold et al. (2011) for the Czech Republic, Fernandes and Paunov (2012) for Chile, Arnold et al. (2012) for India, and Shepotylo and Vakhitov (2012) for Ukraine. Examples of studies that use cross country growth regressions are Fernandes (2009) for the Transition economies and Mattoo *et al*. (2006).

[12] Our calculations based on the national accounts data for 2011 of Belstat show private consumption at 47.1 percent of GDP, with a statistical discrepancy in the GDP components of 2.6 percent. In our model, we must eliminate statistical discrepancies and we have private consumption at 49.0 percent of GDP. For the Belstat data, see: http://belstat.gov.by/en/ofitsialnaya-statistika/otrasli-statistiki/natsionalnye-scheta/osnovnye-pokazateli-za-period-s-__-po-____gody_2/gross-domestic-product-by-use-of-incomes-method.

of non-discriminatory barriers in the in the rail and other transport sector (2.3 percent of consumption), followed by the trade sector (2.0 percent of consumption). The greatest gains from reduction of discriminatory barriers is in the "other financial services" sector, which includes banking (1.1 percent of consumption).

6. We also identify and quantify where two potential complementary structural reforms can significantly contribute to the growth and competitiveness of the economy of Belarus. We call these reforms complementary because they are mostly independent of WTO accession and we model them independently. In particular, we find that a more aggressive fifty percent reduction in the ad valorem equivalents of the non-discriminatory barriers against services providers than what may be required by WTO accession could have an even more substantial impact on the productivity, competitiveness and output of the Belarusian economy than WTO accession; we estimate a gain of 11.7 percent of consumption from a fifty percent reduction in the ad valorem equivalents of these barriers. And based on data on the relative productiveness of various sectors in Belarus by type of ownership, we find that institutional reforms that would lead to over time to a fifty percent reduction in the state sector share of the economy in favor of the private sector would lead to a large dramatic increase in the productivity, competitiveness and output of the economy of Belarus. We estimate that the welfare of Belarus would increase by 36.2 percent of consumption per year under our central modeling assumptions of privatization. By increasing the productivity and competitiveness of Belarusian firms, we find both of these complementary reforms would lead to a reduction of imports, contrary to WTO accession. We hope that by identifying these complementary reforms to WTO accession, we may be able to assist the Government in its efforts to use the WTO accession process as a vehicle to make the economy more competitive.

7. We conduct extensive sensitivity analysis of both our WTO accession and privatization scenarios, with respect to modeling assumptions and parameter values. Although there is a large variance in the estimated gains from privatization depending on the modeling assumptions, the estimated gains from privatization are always very large.

8. Finally, we also assess the impact on Belarus of its implementation of Russia's WTO tariff commitments as part of its Customs Union membership commitments. We exclude tariff reduction from the WTO accession scenario for Belarus, since Belarus has agreed to reduce tariffs as part of its Customs Union membership and intends to accede to the WTO at the level of Russia's tariff commitments. To be clear, we do *not* assess the impact on Belarus of its initial implementation of the common external tariff in 2010. Rather, we quantify the impact of the lowering of the common external tariff of the Customs Union. This has benefits and costs for Belarus: benefits from better resource allocation in Belarus where production will be better aligned with world prices, and better access to internationally competitive goods and technologies; costs from an erosion of tariff preferences for Belarusian exporters in the markets of Russia and Kazakhstan. On balance, we assess gains to Belarus from the lowering of the common external tariff.

9. In Section 2, we provide an overview of the model and a brief literature review. The key data are explained in Section 3. Results for WTO accession are explained in Section 4. The complementary reforms of non-discriminatory reform of services and privatization are discussed in Sections 6 and 7, respectively. We conduct sensitivity analysis in Section 8 and offer conclusions in Section 9.

B. Overview of the Model

Literature Review and General Model Features

10. Given that commitments to foreign investors in services are a key aspect of WTO accession negotiations, as well as modern Free Trade Agreements (FTAs), there have also been

several papers in recent years that examine foreign director investment (FDI) in services.[13] Markusen, Rutherford and Tarr (2005) introduced a stylized CGE model with FDI in services and Dixit-Stiglitz endogenous productivity effects. These key features were developed into a full CGE models and used to analyze WTO accession of Russia by Jensen *et al*. (2007) and Rutherford and Tarr (2008; 2010) and in Kazakhstan by Jensen and Tarr (2008).[14] Given the importance of preferential commitments to foreign investors in services, the model was extended to incorporate preferential commitments to foreign investors in services and applied to Kenya by Balistreri and Tarr (2011) and Armenia by Jensen and Tarr (2012). This paper builds on the algebraic structure of these latter two models, but extends it to incorporate productivity increases from Privatization.

11. Here we provide a general description of the structure. A mathematical description of the model is included as Appendix 7. There are 35 sectors in the model shown in Table 4. Figure 1 depicts the structure of production in a representative sector. Primary factors include skilled and unskilled labor; mobile capital; 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.

12. There are three categories of firms in the model: (1) perfectly competitive goods and services sectors; (2) imperfectly competitive goods sectors; and (3) imperfectly competitive services sectors with foreign direct investment. The cost, production and pricing structures in the three categories differ widely. The model is a small open economy model in which we disaggregate the ROW region into four regions: (1) the European Union; (2) Russia-Kazakhstan; (3) the rest of the Commonwealth of Independent States (CIS) plus Georgia; and (3) the Rest of the World (ROW). In the imperfectly competitive sectors, this requires introducing different firm types with distinct cost structures for each region. We retain the small open economy model framework, so only Belarus is modeled fully.

Perfectly Competitive Goods and Services Sectors

13. Regardless of sector, all firms minimize the cost of production. In the fourteen *competitive goods and services sectors*, goods or services are produced under constant returns to scale and where price equals marginal costs with zero profits. This includes agriculture, mining and several services sectors such as public services, health and education. In these sectors, products are differentiated by country of origin, i.e., we employ the Armington assumption. All goods producing firms (including imperfectly competitive firms) can sell on the domestic market or export. Firms optimize their output decision between exports and domestic sales based on relative prices and their constant elasticity of transformation production function. Having chosen how much to allocate between exports and domestic sales, firms also optimize their output decision between exports to the four possible export regions, based on relative prices the four regions and their constant elasticity of transformation production function for shifting output between the regions.

[13] A more complete survey of the literature may be found in Tarr (2013) or Francois and Hoekman (2010).

[14] Earlier efforts to include services in CGE models of trade were Dee et al. (2003), Konan and Maskus (2006), and Brown and Stern (2001). Konan and Maskus had an interesting application in Tunisia, but did not incorporate FDI in services or productivity impacts for additional services providers. Brown and Stern (2001) and Dee et al. (2003) employ multi-country numerical models with many of the same features of Markusen, Rutherford and Tarr. Their models, however, contain only 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. For example, they estimate that Japan will lose from multilateral liberalization of barriers to FDI service providers because Japan is a capital exporting nation. In Dee et al., (2003) welfare results depend largely on rent capture. The productivity effect from the impact of service sector liberalization on product variety is not mentioned in the results of Brown and Stern and are interpreted as of little relevance in Dee et al.

Goods Produced Subject to Increasing Returns to Scale

14. Goods in these thirteen sectors (and IRTS services) are differentiated at the firm level. Each firm produces a unique variety that is differentiated in the demand functions of users of the goods. Users of the differentiated goods have an elasticity of substitution for the different varieties that is known as the Dixit-Stiglitz elasticity of substitution. Larger values of this elasticity imply the goods are closer substitutes. We assume that manufactured goods may be produced domestically or imported for firms in any region in the model. Firms in these industries set prices such that marginal cost (which is constant) equals marginal revenue; and there is free entry, which drives profits to zero. For domestic firms, costs are defined by observed primary factor and intermediate inputs to that sector in the base year data. Foreigners produce the goods abroad at constant marginal cost but incur a fixed cost of operating in Belarus. 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. Firms set prices using the Chamberlinian large group monopolistic competition assumption within a Dixit-Stiglitz framework, which results in constant markups over marginal cost for both foreign firms and domestic firms.

15. In the models of Russian WTO accession of Jensen, Rutherford and Tarr (2007) and Rutherford and Tarr (2008), domestic firms faced a perfectly elastic demand curve on export markets and they exported at marginal costs. In this model, all imperfectly competitive domestic firms (both goods and services producers) face a downward sloping demand curve in each of their four export markets. Consistent with firm level product differentiation, we assume that the elasticity of demand in each of the export markets is the Dixit-Stiglitz elasticity of demand. Firms then set marginal revenue equal to marginal costs in each of the three export markets; then the export market contribute to the quasi-rents of the firm and affect the entry and exit decisions of firms. Introducing downward sloping demand curves into the model means that there are possible terms of trade affects to consider in this model that were not present in the Jensen, Rutherford and Tarr model.[15]

16. 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 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.

17. The number of varieties affects the productivity of the use of imperfectly competitive goods based on 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.

Service Sectors that are produced under Increasing Returns to Scale and Imperfect Competition

18. These eight services sectors are telecommunications; insurance; banking and other financial services; air transport; road transport; rail and other transportation services; other professional services; and trade, including wholesale and retail services. In these 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, both multinational and Belarusian.[16] Our model allows for both types of foreign service provision in these sectors. There are cross border services

[15] Balistreri and Markusen (2009) show that since Chamberlinian firms consider the impact of their own actions on the group price, the role for optimal tariffs is significantly reduced.

[16] One estimate puts the world-wide cross-border share of trade in services at 41 percent and the share of trade in services provided by multinational affiliates at 38 percent. Travel expenditures 20 percent and compensation to employees working abroad 1 percent make up the difference. See Brown and Stern (2001, Table 4).

allowed in these sectors and they are provided from abroad at constant costs—this is analogous to competitive provision of goods from abroad. The elasticity of substitution for services from firms with a domestic presence (either foreign or domestic) is three in our central scenario. Cross border services, however, are not as good substitutes; the elasticity of substitution between cross border services and services provided by firms with a domestic presence is 1.5.[17]

19. Crucial to the results, we allow multinational service firm providers to establish a presence in Belarus in order to compete with Belarusian firms directly. As in the goods sectors, services that are produced subject to increasing returns to scale are differentiated at the firm level. Firms in these industries set prices such that marginal cost (which is constant) equals marginal revenue; and there is free entry, which drives profits to zero. We assume firm level product differentiation and employ the Chamberlinian large group monopolistic competition assumption within a Dixit-Stiglitz framework. Given our assumption on the composition of fixed and variable costs, we have constant markups over marginal cost for both foreign firms and domestic firms, i.e., no rationalization impacts.

20. For domestic firms, costs are defined by observed primary factors and intermediate inputs to that sector in the base year data. When multinationals service providers decide to establish a domestic presence in Belarus, they will import some of their technology or management expertise. That is, foreign direct investment generally entails importing specialized foreign inputs. Thus, the cost structure of multinationals differs from national only service providers. Multinationals incur costs related to both imported primary inputs and Belarusian primary factors, in addition to intermediate factor inputs. Foreign provision of services differs from foreign provision of goods, since the service providers use Belarusian 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 Belarusian labor and capital only. These services are characterized by firm-level product differentiation. For multinational firms, the barriers to foreign direct investment affect their profitability and entry. Reduction in the constraints on foreign direct investment 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).

Productivity Increase from Privatization

21. In the Privatization scenario, we implement a labor productivity increase based on data discussed below. In this scenario, we assume that skilled and unskilled labor (but not other factors of production) become more productive in sectors according to the estimates we have for the predicted increase in labor productivity. A formal characterization is provided in Appendix 7, following equation 10.

C. Key Data

Ad Valorem Equivalence of Barriers to Foreign Direct Investment in Services Sectors

22. Several of the business services sectors are crucial inputs into the manufacturing sector and efficient, competitive business services sectors are key to the development of a Belarusian economy that can compete in the increasingly integrated global marketplace. Estimates of the ad valorem equivalents of the barriers to FDI in services are important to the results. Consequently, to obtain a good picture of the regulatory regimes Irina Kolesnikova conducted extensive interviews

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

of government regulatory agencies and industry associations[18] in the relevant sectors and utilized official government reports, academic studies and a 160 page survey of the regulatory regimes in the key business services sectors in Belarus. We focus on insurance, banking, fixed line and mobile telecommunications services, air transportation, road transportation, and rail, water and other transportation services, professional services (we base the estimates on legal, accounting and auditing services) and retail services.

23. As a first step in the process, the methodology involved converting the answers and data of the questionnaires and interviews into two indices of restrictiveness in each industry: a non-discriminatory index and a discriminatory index. The literature refers to these indices as Services Trade Restrictiveness Indices (STRIs). Some restrictions only apply to foreign firms, such as maximum foreign equity shares in firms in a sector or licensing restrictions that apply to foreigners only. These kinds of restrictions as the basis of the discriminatory STRIs. Other restrictions apply to domestic as well as foreign firms regardless of their national origin. Examples include: blocking entry of all firms to a sector (e.g., reserving the sector for state firms); prohibitions on banks from selling insurance; limitations on the size of retail businesses, their market share in a region or their hours of operation. These kinds of restrictions are the basis of our non-discriminatory STRIs. Since WTO accession involves commitments regarding both discriminatory and non-discriminatory barriers, we estimate the ad valorem equivalents of both types of barriers and simulate reductions in both types of barriers as part of WTO accession.[19]

24. Our methodology builds on a series of studies supported by the Australian Productivity Commission. First, these authors calculated STRIs in several business services sectors. This included studies by McGuire, Schuele and Smith (2000), McGuire and Schuele (2000), Kalirajan (2000) and Nguyen-Hong (2000). STRIs were calculated and, crucially, ad valorem equivalents were aso estimated (usually in separate studies). Since we need to use the regressions of the Australian authors for the ad valorem equivalents estimates, we first score the regulatory barriers indices consistent with the STRI methodology employed by the Australian authors. Details of the scoring and calculations for both discriminatory and non-discriminatory STRIs in Belarus for the ten services sectors mentioned above may be found in Kolesnikova (2014a).

25. The second step in the methodology involves converting the STRIs into ad valorem equivalents. We rely on econometric estimates by Warren (2000) in telecommunications (for both fixed line and mobile), Kalirajan et al., (2000) in financial services (for both banking and insurance), Kang (2000) in transportation services (for all four transportation sectors), Nguyen-Hong (2000) in professional services (for both accounting and auditing, and legal services) and Kalirajan (2000) for retail distribution services. Except for Warren, in all studies the authors regressed a measure of the price or costs of services against their STRIs and other relevant variables in a cross-country regression at a point in time to determine the impact of the regulatory barriers on the price of services.[20] Through these regressions, the authors estimated the ad valorem equivalents of the regulatory barriers in the countries of their sample.

[18] The interviews included the following Ministries of the Republic of Belarus: the National Bank, several departments of the Ministry of Transport and Communications, Ministry of Trade, Ministry of the Economy, Ministry of Finance, Ministry of Communications and "Informatization." Firms and associations interviewed in Belarus included: Beltelecom, Association of Belarusian Banks, Belarusian Association of Insurers, Belarusian Association of Accountants and Auditors, Belarusian Association of Accountants, Belarusian Association of International Road Carriers, VELCOM, Belarusian Union of Lawyers, law firm of Stepanovski, Papakul and Partners, Economic Journal (Ekonomicheskaya Gazeta).

[19] The WTO Guidelines Scheduling Services Commitments notes that non-discriminatory measures that limit market access of WTO members fall under the purview of the GATS scheduling negotiations. In particular, World Trade Organization (2001, p.4) states:"all measures falling under any of the categories listed in Article XVI:2 must be scheduled, whether or not such measures are discriminatory."

[20]Warren estimated quantity impacts and then, using elasticity estimates and a measure of the quantity of telephone subscribers in each country, was able to obtain price impacts and ad valorem equivalents.

26. Take banking services as an example. Kalirajan et al., (2000) use the net interest margin of banks as their performance variable. From their estimation, the ad valorem equivalent (in percentage terms) of the STRI in banking services may be calculated from the following relationship:

(1)

$$100*(NIM_i - NIM_{i0})/NIM_{i0} = 100*(NIM_i/NIM_{i0} - 1) = 100*(e^{0.73*STRI_i} - 1),$$

where NIM_i is the net interest margin in banking in country i, NIM_{i0} is the net interest margin when all restrictions in banking are removed in country i, and $STRI_i$ is the services trade restrictiveness index in banking in country i. In equation 1, the denominator is a price measure without any restrictions. In our model, and in Table 4, we convert the ad valorem equivalents with the unrestricted price in the denominator (as estimated by Kolesnikova, 2014a) to an ad valorem equivalent (AVE) with the domestic price with restrictions in the denominator.[21] The conversion implies that our AVEs have a maximum of 100 percent.

Share of the Output of the Sector produced by Multinational Service providers

27. The impact of liberalization of barriers to foreign direct investment in business services sectors on the demand for labor in these sectors will depend on the share of the output of the sector sold by multinationals. Given that we have five regions in the model: Belarus, Russia plus Kazakhstan, Rest of the CIS plus Georgia, European Union and the ROW, we need ownership shares for each of the regions of our model for all eight of the sectors of our model with foreign direct investment. The results of our calculations are in Table 6. Details of the calculations may be found in Kolesnikova (2014b).

28. A brief summary of the sources is as follows. In air transportation, Kolesnikov used data from official websites on flights of non-Belarusian airlines, aircraft types and their seating capacity, and data of Belstat on passenger turnover. In road transport, Belstat revenue data were used along with expert opinion of "BAMAP," the Association of International Road Carriers of Belarus. In rail transportation, Belarusian railways hold a monopoly on passenger and cargo traffic. In telecommunications, data were obtained from publications of the Ministry of Communications and Information of Belarus as well as Belstat. In banking, data from Bankscope was accessed. In addition, the National Bank of Belarus provided data on the assets of banks, owners-shareholders of the bank and the percent of the bank owned by each owner-shareholder. The market share of each bank was defined based on the bank's assets as a share of total bank assets in Belarus. In insurance, we had a list of the insurance companies in Belarus from Axco. Kolesnikova used insurance premia data from the Ministry of Finance of Belarus and data on the foreign ownership share of companies from the Belarusian Association of Insurers to calculate the ownerhip shares, based on shares of insurance premia. In legal services, data were obtained from the National Statistical Committee of Belarus (Belstat) for the total foreign share, and decomposed into the regions of our model based on expert interviews (law firm of Stepanovski, Papakul & Partners, and the Union of Lawyers of the Republic of Belarus) and data from the Registry of the Ministry of Justice of the Republic of Belarus. In accounting and auditing, Kolesnikova used experts' interviews (from the Ministry of Finance: Department of Control and Audit, the General Directorate of Regulation of Accounting and Auditing; and the Belarusian Association of Accountants and Auditors) and data from the Register of the Ministry of Justice of the Republic of

[21] In particular, let AVE = ad valorem equivalent with the unrestricted world price as the base, or denominator; let D=domestic price before reform, and W = unrestricted world price. We have

(2) (D-W)/W = AVE = (D/W) - 1, where we take the AVE from Kolesnikova (2014a), but for exposition purposes we take AVE as a ratio, not percentage. Rearranging (2) , we have

(3) W/D = 1/[AVE+1].

Multiplying (2) by W/D and using (3), we have

(4) (D-W)/D = AVE*W/D = AVE /[AVE+1].

Belarus. Finally, in retailing, the total foreign share was obtained from Belstat data, but we were unable to obtain data on the decomposition of the foreign share among the foreign regions of our model.

Social Accounting Matrix

Going from the Input-Output Table to our Social Accounting Matrix

29. The backbone of the CGE model is the Social Accounting Matrix (SAM).[22] The primary data sources were data from the Belarussian National Accounts[23] and the Input-Output (IO) tables for 2011 at basic and consumer prices. These are produced by the National Statistical Committee of the Republic of Belarus (Belstat).[24] Other data sources are discussed below. We provide an overview of the construction of the SAM here, and a full and detailed description in Appendix 4.

30. While most of the data are taken from the IO tables, some values are available only in the National Accounts. These include the current account balance (adjusted by net lending), data on factor income of the government and households, compensation of employees from abroad as well as savings of the representative household and of the government.[25] Despite the fact that the IO table was balanced, due to the acquisition of data from multiple data sources to expand the IO table into a Social Accounting Matrix, initially our SAM for Belarus was not balanced. It was necessary to assure a balance between supply and demand; income and expenditure for all agents; and sector revenues with payments. To obtain these balances, as balancing items we used transfers from abroad to the government and transfers from the representative household to the government.[26]

31. Tax rates on exports, consumption, investment and government are calculated using the IO table and a matrix of taxes and subsidies on products available from Belstat. We report the former two in Table 4, but suppress reporting of the latter two since, given fixed investment and government spending in our model, they cannot impact the results.[27] Additional detailed information on trade and transport margins as well as on imports (separately for intermediate, private, public and investment demand) were also provided to the World Bank by Belstat as supplementary data to the IO table.

Regarding factors of production, the initial IO table includes only labor and capital. To be able to distinguish between skilled and unskilled labor according to the level of education, we disaggregate labor remuneration in the SAM, while holding total labor remuneration constant. We obtained data on the number of employees by education level and economic activity for 2012[28] that we use to calculate the shares of skilled and unskilled labor in total employment by sector. We assume that employees with post-secondary education and a second group referred to as possessing "professional technical" education represent skilled workers. We aggregated the rest to unskilled labor (secondary special education, general secondary and basic education). For labor remuneration, we assume the wage rate in agriculture for all unskilled labor. For skilled workers, we take the average wage across all sectors for workers with "professional technical" education and apply this to this class of workers in each sector, and the wage in manufacturing for workers

[22] Pyatt and Round (1985).
[23] National Statistical Committee of the Republic of Belarus (2013).
[24] The IO table was provided to the World Bank for this project by Belstat and is not publicly available. We would like to express our deep gratitude for the excellent support and cooperation provided to this project by Belstat for these data and for several other datasets that are not publicly available.
[25] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.
[26] Transfers from the representative household to the government usually consist of current taxes on income or wealth, as well as of payments for property income and social contributions, social benefits other than social transfers in kind. For further documentation, including discussion of some additional minor adjustments, see Appendix 4.
[27] Negative values represent subsidies.
[28] National Statistical Committee of the Republic of Belarus (2012b).

with post-secondary education.[29] The process gives us total remuneration to skilled and unskilled workers, which we use to calculate the shares of total labor compensation to the skilled and unskilled categories. The resulting disaggregated value-added shares for labor as well as value-added shares for capital are shown in Table 5.

32. As shown in Table 4, the final SAM includes 35 sectors. However, the initial IO table includes only 30 sectors with highly aggregated services. In order to be able to examine the effects of services trade liberalization as a part of WTO accession, we decompose some services. We employ additional data on value-added for subsectors provided to the World Bank by Belstat. In particular, we disaggregate three of the services sectors of the initial IO table. The sector mapping and the shares of value-added of the aggregate sectors are as follows. Transport and communications is: communication, 20 percent; air transport, 1percent; road transport, 27 percent; and rail, water and other transport, 52 percent. Financial activities is: insurance, 3 percent; other financial services 97 percent. Real estate, renting and business services to consumers is: Real estate, renting and business services to consumers, 61 percent; other professional services, 39 percent. In the disaggregation, we assume that IO shares of the subsectors are identical to the aggregate sector.

Export and Import Data by Sector with Decomposition of Rest of the World

33. Using the IO tables for 2011 as a base for the SAM, we only have data on imports and exports with the ROW. These trade flows are illustrated in Table 6. However, as different trade regimes apply to different trade partners of Belarus, we decompose the ROW into four regions with three of them being the most important trading partners of the country: CIS and Georgia, ECU, the European Union (EU) and the ROW (see Table 4). We classify commodity trade within the CU as well as with the CIS countries (including Georgia) as free trade according to the plurilateral and bilateral regional trade agreements. Most Favored Nation (MFN) status is applied to the EU and ROW.[30]

34. Regarding trade flows by region of our model, we hold the total trade flows from the IO table constant and calculate import and export shares by region and sector of our model using trade data supplied to us by Belstat in the 2007 version of the Harmonized System (HS). As the National Statistical Committee of the Republic of Belarus classifies the trade flows by the main economic activity[31] of the company that exports or imports, not by a particular HS product group, we had to aggregate the data to the sectors of our model. We used a few tables of concordance (between HS 2007 and HS 1996 as well as between HS 1996 and ISIC Rev. 3/NACE Rev. 1). Concerning services trade, we calculate regional trade shares using the data provided to us by Belstat in the special national classification, which is not harmonized with any international classification. Mapping the categories of the Belarusian national classification to the sectors of the model allows us to calculate the import and export shares for the abovementioned regions. The resulting trade flows by trading partner are presented in Table 5.

Dixit-Stiglitz Elasticities

35. It was necessary for us to obtain estimates of the Dixit-Stiglitz product variety elasticities of substitution for the imperfectly competitive sectors in our model. In fact, since we do not have rationalization gains in our model, results will differ from a competitive model only to the extent that there is a Dixit-Stiglitz variety externality. Thus, we based our classification of goods sectors into perfectly competitive or imperfectly competitive based on the Dixit-Stiglitz elasticity values.

[29] National Statistical Committee of the Republic of Belarus (2012a), p. 229.
[30] Detailed description of the existing trade regimes can be found at http://www.mfa.gov.by/en/foreign_trade/trade_regime/
[31] The main economic activities (also included in the IO table) are classified according to the Belarusian "General State Classificatory of Economic Activities" (OKED Rev.1) which is based on NACE Rev 1 and ISIC Rev.3.

High Dixit-Stiglitz values means the results will be very close to perfectly competitive, and we classified the sector as perfectly competitive.

36. Based on data for the years 1994-2003, Christian Broda, Joshua Greenfield and David Weinstein (2006) estimated Dixit-Stiglitz product variety elasticities of substitution at the 3 digit level in 73 countries. Belarus was not one of the countries in their dataset. Among the 73 countries, there were three Transition countries bordering Belarus (Latvia, Lithuania and Poland), plus four other Transition countries in Central Europe: Croatia, Hungary, Slovakia and Slovenia. As a country that was also one of the Republics of the former Soviet Union, we chose Lithuania as the closest proxy for Belarus. We explain in Appendix 1 how we mapped the 3 digit elasticities for 130 goods sectors estimated by Broda et al. into the sectors of our model. The mapping and resulting elasticities by relevant sector in our model are shown in Table A1.

Antidumping Actions against Belarus and Export Price Increase

37. In antidumping and countervailing duty actions, WTO members are guaranteed an injury determination in which the antidumping duty will not be applied if it is found that the domestic industry was not injured by the imports. Non-WTO members are not assured of an injury hearing. Consequently, Belarus may expect some small improved market access as a result of WTO membership to the extent that antidumping has been an issue in certain sectors.

38. Based on a global database maintained at the World Bank, in Appendix 2 we list the antidumping and countervailing duty actions against Belarus and estimate price increases by sector for Belarus as a result of WTO membership. We list the country that initiated the case against exports from Belarus, the product exported by Belarus and the date the case was initiated. The expected price increases by sector as a result of WTO accession are listed in Table 4. We expect only modest price increases for Belarus in several sectors, in part due to our assessment that the injury determination does not typically prevent the imposition of the antidumping duty. The database is described in Bown (2014).

Estimated Labor Productivity by Type of Ownership and Productivity Increases

39. In this section we describe how we estimated the increase in labor productivity by sector of the Belarusian economy as a result of shifting some of the ownership from state firms to the private sector. We regard this estimate as a long run estimate obtained as a result of creating an institutional environment for growth of the private sector. This could include conversion of state owned companies to private companies; but the private sector is likely to grow faster and create private sector jobs in an institutional environment that is more favorable to it.

40. In preparation for the World Bank Country Economic Memorandum for Belarus (see World Bank, 2012), Belstat provided data to the World Bank on value-added and employment by six aggregate sectors and by three classes of ownership: (i) state owned enterprises, (ii) mixed ownership and (iii) private companies. Data are available from 2004 to 2010 inclusive. We use these data to calculate labor productivity by sector and class of ownership by dividing value-added in the sector and class of ownership by employment in the corresponding sector and class of ownership. We then calculate the weighted average labor productivity in each of the six sectors in the year 2010, using the share of value-added in the sector as the weights of the three labor productivities.

41. In our counterfactual scenarios, we assume that in each of our six aggregate sectors, the state share is decreased by 50 percent and the private sector share increases by an identical amount. Then we calculate the predicted weighted average labor productivity in the counterfactual, assuming unchanged labor productivities of the separate classes of ownership. Taking the ratio of the new productivity index to the productivity index using the 2010 data, we calculate the percentage increase in productivity by sector from the increase in the private sector share of the economy. We map each of the 35 sectors in our model to one of the six aggregate sectors (the

mapping is shown in Table 4). In the counterfactual scenario, we assume that labor productivity increases by the percentages we have calculated. The productivity increases that we assume for each sector in our privatization scenario are listed in Table 4. Details of the methodology, including the data and calculations, are provided in Appendix 3.

42. As shown in Table 4, we map 16 of our sectors to the aggregate "Industry" sector. Based on Belstat data, we calculate a zero productivity increase for the Industry sector, and thus, a zero productivity increase in 16 of our sectors.[32] As explained in World Bank (2012), however, the state industry sector, especially the refinery sector, receives oil at less than market prices. This is an implicit subsidy, but it is not accounted for by Belstat. In general, value-added should be adjusted for taxes or subsidies. Had we adjusted for this implicit subsidy, the state companies in the Industry sector would have lower value-added and labor productivity, and we would have estimated a productivity increase from privatization. Our estimates of the productivity increase of privatization should be considered conservative (or biased down) to the extent that we failed to account for the subsidy from state firms receiving energy products at below market prices.

Non-Tariff Measures and their Ad Valorem Equivalents (AVEs)

43. Traditional command and control non-tariff barriers to trade, such as quotas and bans on imports, have largely been eliminated. Research based on a new multi-agency task force database has shown, however, that regulatory measures, especially sanitary and SPS measures have become a very important barrier to trade.[33] In the CIS, experts have identified the State Standards system (GOST) inherited from the Soviet Union as a major obstacle to an effectively functioning SPS system that is not a barrier to trade. For example, the Asian Development Bank (2013, p.11) has noted that in the CIS countries "*The most significant technical barriers to adherence to SPS principles, apart from being a trade barriers itself, is the GOST system."* Countries have the right and the obligation to protect their nationals from unsafe or unhealthy products and the right to protect their environment and livestock against introduction and spread of pests and diseases. What WTO principles require is that technical regulations or SPS requirements should be adopted with minimum trade distorting implications, should be science based and should not discriminate against imports. Under the GOST system, however, while safety is mandatory and ensuring safety is consistent with WTO principles, quality is also mandatory and that is inconsistent with WTO principles. The GOST quality regulations that are unrelated to safety are NTBs. Safety regulations that are not supported by scientific evidence as posing risks are also NTBs under the WTO SPS agreement. Further, in many instances these regulations are discriminatory against imports (such as duplicative required inspections not required of domestic production), and therefore are in contravention of WTO principles. The GOST system served an important function under the centrally planned system of the Soviet Union and performed well in some areas. But it is ill suited to a market economy and conversion to international standards is part of the transition process to a market economy.[34]

44. Nonetheless, as the UNIDO-STDF report (van der Meer, 2010) and the World Bank (2007) have noted, there are important costly and difficult issues in the transition from GOST to international SPS standards. The costly transition suggests a phased case by case approach to the

[32] There is some ambiguity of where to map the two mining sectors. We mapped them to the Industry sector. In view of the fact that there is a zero productivity increase for the Industry sector from privatization, this is a conservative choice in that it will lead to a lower estimated benefit from privatization.
[33] See, for example, Cadot and Gourdon (2012).
[34] "There are over 20,000 [SPS] standards, which is too many for smooth implementation. The prescriptive and mandatory nature of the standards can stifle product innovation. The system is inflexible to respond to consumer demand and new health risks. Implementation is difficult and costly because of overlapping mandates. Inspectorates have much discretionary power and there is generally weak rule of law" (van der Meer, 2010, p. 6).

adoption on international standards, based on assessments of health risks, costs, benefits and trade opportunities.[35]

45. The accession of the Russian Federation and several other CIS countries to the WTO (and the possible accession of Kazakhstan, and the commitment of the Russian Federation and these countries to adhere to the WTO SPS and Technical Barriers to Trade (TBT) agreements, however, imply that markets that accept GOST standards are declining. As part of their WTO accession agreements, both Russia and the other CIS countries that have acceded to the WTO have agreed to move toward international SPS standards. Further, the EU-Russia "Partnership for Modernization" has listed harmonization of Russia's technical regulations and standards with the EU as a priority for cooperation[36] and the associated program of assistance is aimed at aligning Russian standards with EU norms and regulations.[37] It is important to begin a process of adoption of international standards for the CIS countries. Accession to the WTO should accelerate this process as Belarus will be obligated to accept the WTO SPS and TBT agreements.

46. Our estimates of the AVEs of NTMs are based on the estimates of Kee *et al*., (2008; 2009), which in turn are based on the theoretical developments of Anderson and Neary (1996; 2003). Kee *et al*. estimate the AVEs of NTMs for 105 countries, including Belarus at the 6 digit level, and aggregate these to provide estimates for all of manufacturing and agriculture for the 105 countries, including Belarus. The estimates are available on the World Bank website.[38]

47. The measure we use from Kee *et al*. is the uniform tariff equivalent that generates the same level of import value for the country in a given year.[39] Kee *et al*. provide estimates based on both applied and MFN tariffs; the measure we use is based on applied tariffs, which take into account bilateral trade preferences. Specifically, we use the values for the Overall Trade Restrictiveness Index (OTRI) and for the Tariff-only (OTRI_T) at the aggregated level of agriculture or manufacturing. The OTRI measures the uniform tariff equivalent of the country's tariff and NTMs that would generate the same level of import value for the country in a given year. The OTRI_T focuses only on tariffs of each country.

In the case of agriculture in Belarus, calculating the difference between OTRI (which is 21.77 percent) and OTRI_T (which is 4.04 percent) gives us an AVE for NTBs in agriculture for Belarus of 17.7 percent. This value of 17.7 percent is reported in Table 4 as the benchmark ad valorem equivalent of the non-tariff barriers in agriculture in Belarus. In the case of manufacturing, the estimate from Kee et al., of the ad valorem equivalent is less than 3 percent. Moreover, while the UNESCAP (2008) report shows that many of the SPS issues also apply to TBT on industrial goods, the difficulty of converting to international standards is greater with SPS measures. Further, reports are that the transition to international standards appears to be proceeding much more rapidly in industrial goods.[40] Consequently, we do not assess that WTO accession will result in a reduction of non-tariff barriers in manufactured goods.

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[35] See Hoekman, Jensen and Tarr (2014) for more details on the phased transition to the adoption of international standards.

36 See http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/er/114747.pdf.

37 The European Commission (2013) notes that under the Partnership for Modernization program there are projects to align 19 technical product and horizontal standards by the end of 2013. A draft agreement between Rosstandart and European standards bodies CEN and CENELEC was to be signed in 2013 and an EU-Russian industry task force was formed to pursue approximation of technical regulations and use of international standards.

38 The dataset is available at
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:22574446~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

39 Specifically, we take the difference between the Overall Trade Restrictiveness Index (OTRI) and for the Tariff-only OTRI (OTRI_T), which gives us the AVE of the NTMs.

[40] According to representative of Government of Tajikistan during its WTO accession negotiations, "the CIS Agreement envisaged the harmonization of the new GOST requirements with international, regional and

Tariff Changes in Belarus as a Result of Russia's WTO Commitments

48. We explain the scenario in the results section. Here we only discuss the tariff data.

49. Shepotylo and Tarr (2013) have calculated Russian tariffs for all years from 2001 to 2020, based on actual tariffs in Russia from 2001 to 2011 and have projected tariff rates forward from 2012 to 2020 based on Russia's WTO commitments to lower tariffs. They have calculated tariffs at the 10-digit level, where they have calculated the ad valorem equivalents (AVEs) for mixed and specific tariffs at the 10-digit level. Thus, the Shepotylo and Tarr dataset is available as fully ad valorem dataset. Our calculations are a trade-weighted aggregation of the Shepotylo and Tarr ad valorem tariff rates, aggregated to the sectors of our model. We take the tariff rates for 2020 as our counterfactual tariff rates since this is when all commitments are scheduled to be implemented. The results for the benchmark (2011) and the counterfactual (2020) for the sectors of our model are reported in Table 4. Details of our calculations are reported in Appendix 6.

D. Results of WTO Accession

50. In our general WTO scenario, we assume that: (i) discriminatory barriers against foreign suppliers of services are reduced by fifty percent of their ad valorem equivalents, as indicated in Table 4; (ii) non-discriminatory services barriers in services are reduced by 25 percent of their ad valorem equivalents as indicated in Table 4 under the column "after WTO; (iii) five sectors subject to antidumping actions in export markets receive slightly improved market access. This is implemented as an exogenous increase in their export price as shown in Table 4; and (iv) the ad valorem equivalent of barriers in agriculture are reduced by 25 percent. We first discuss (and present in Table 11) 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 as 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.

51. First we discuss the comparative static results, called medium-term in Table 11. The comparative static model assumes a time period long enough for the economy to adjust to the new equilibrium, but not long enough for the aggregate capital stock to adjust. The existing labor and capital moves between economic activities, but the aggregate capital stock is fixed. In the sensitivity analysis, we 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.

Aggregate Impacts—Medium Term

52. **We estimate that the welfare gains to Belarus will equal 8.2 percent of Belarusian consumption (or 4.0 percent of GDP) in the medium term.** This is not a one-time gain; rather, we estimate that these are estimated gains that are recurring each year. That is, the real value of output should be higher each year by an amount that would increase welfare by 8.2 percent of consumption.[41] Returns to skilled labor, unskilled labor and capital are estimated to increase by

leading national standards….The level of such harmonization had reached 45 per cent by 2010." See WTO (2012, para. 203).

[41] To take an example, suppose that real income without WTO accession would be 100 in year 1; 105 in year 2; 109 in year 3; 113 in year 4; and 120 in year 5. (Later years are not shown in the example.) Then if there is an 8.2 percent increase in welfare due to WTO accession, and we take real income changes to approximate welfare changes, then real income in the five years with WTO accession would be: 108.2 in year 1; 113.6 in year 2; 117.9 in year 3; 122.3 in year 4; and 129.8 in year 5.

about one percent. Aggregate exports are estimated to increase by 1.4 percent, which leads to a small depreciation of the real exchange rate. We assume that the total amount of labor in both the skilled and unskilled labor categories does not change;[42] but labor will shift between sectors as a result of changed incentives between the sectors. We estimate that the percentage of labor that will have to move to another sector to obtain employment is three-tenths of one percent for both unskilled and skilled labor.

53. These impacts derive from four key effects: (1) improved access to the markets to non-CIS countries in selected products; (2) Belarusian reduction on non-tariff barriers in agriculture; (3) liberalization of barriers against foreign services suppliers and (4) liberalization of non-discriminatory barriers against all services suppliers. We execute four scenarios that allow us to understand the relative impact of these various elements and the mechanisms through which they operate.

Impact of Improved Market Access

54. In the column labeled "only improved market access" of Table 11, we present the results of a scenario in which we allow for improved market access (according to the terms of trade improvements of Table 4), but we do not reduce non-tariff barriers in agriculture or barriers to services suppliers. **We estimate that the impact of improved market access at 0.1 percent of consumption.**[43] Gains derive from improved prices for exports in the five sectors. But also a higher value for exports allows Belarus 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 constant return to scale model.

Impact of Reduced Barriers in Agriculture.

55. The results for this scenario are presented in the column labeled "only reduction in WTO inconsistent SPS barriers" of Table 11. We reduce the ad valorem equivalents of the barriers by 25 percent, but there is no liberalization of the barriers against suppliers of services or improved market access. **The estimated welfare gains to the economy are 0.4 percent of consumption or 0.2 percent of GDP.**

56. The gains to the economy come about for two reasons. The reduction in the barriers will lead to improved domestic resource allocation since the non-tariff barrier reduction will induce Belarus to shift production to sectors where production is valued more highly based on world market prices. This is the fundamental effect from trade liberalization in constant returns to scale models (CRTS). In addition, the resources spent on producing to standards that are not risk based will be saved; this is known as rent capture.

Impact of Liberalization of Discriminatory Barriers against Foreign Suppliers of Services

57. In this scenario, labeled "only discriminatory services barriers" in Table 11, we reduce the discriminatory tax on foreign suppliers of services in Belarus (as shown in Table 4), but there is no reduction in non-tariff barriers in agriculture and no improved market access. We assume that the services of each imperfectly competitive services (and goods) firm are differentiated in some way from all the others, i.e., each firm produces its own unique variety. The reduction in the discriminatory barrier on foreign suppliers of services increases profitability for foreign provision of services in Belarus, thereby inducing new entry by foreign service providers until zero profits are restored. Although there is a loss of domestic service varieties due to increased foreign competition, there is a net increase in varieties. Belarusian businesses will then have wider access to services 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

[42] This assumes that the level of unemployment is determined by structural factors in the economy that are not impacted by the policy scenario.

[43] Due to rounding, the percent of consumption and GDP are shown as the same.

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 Belarus from liberalization of discriminatory barriers to foreign suppliers of services in Belarus are about 1.7 percent of the value of Belarusian consumption.**

Impact of Liberalization of Non-Discriminatory Barriers against Suppliers of Services

58. **N**on-discriminatory barriers against service providers that limit market access of WTO members fall under the purview of the GATS scheduling negotiations (World Trade Organization, 2001, p.4). We assume, however, that the WTO Working Group of the accession of the Republic of Belarus will negotiate more aggressively against discriminatory barriers. Consequently, we assume only a 25 percent reduction in the non-discriminatory barriers against services providers. In this scenario, we assume no change in the discriminatory barriers against foreign service providers, and there is no reduction in non-tariff barriers in agriculture and no improved market access for exporters from Belarus. The reduction of barriers against both Belarusian and foreign service suppliers increases their profitability and induces entry of both until zero profits is restored. **We estimate that the gains to Belarus from liberalization of non-discriminatory barriers to suppliers of services in Belarus are 5.5 percent of consumption or 2.7 percent of GDP.**

59. One might question why the gains from reform of non-discriminatory barriers are so much larger than the gains from reduction of discriminatory barriers against foreign firms. The results are explained by the fact that the Belarusian services sectors are dominated by Belarusian firms. In Table 6, we show that the foreign share of the transportation sectors is less than two percent in rail, road and air transportation services, and the foreign share is a maximum of 35 percent in any of the eight sectors. When reforms are executed on a small base, even if the supply elasticity is high, the output response and welfare gains usually will not be quantitatively large. For the reduction of non-discriminatory barriers in services, the reforms apply to domestic firms as well; so the reforms are applied on 100 percent of the sector.

Sector Results

Business Services Sectors.

60. The most substantial expansion of output occurs in the business services sectors. We estimate they will all expand output, with four sectors registering output increases of more than 9 percent. The reason is as follows. As a result of a reduction in the barriers to suppliers of services in these sectors, we estimate that there will be an expansion in the number of services firms (both foreign and domestic) who locate in Belarus to provide business services from within Belarus. In Table 14, we report the estimated change in the weighted average number of firms. In the WTO accession scenarios, we estimate an increase in the number of firms in all business services sectors and the expansion in the medium terms exceeds ten percent in four of the eight services sectors. Note that since foreign owned firms that are resident in Belarus employ Belarusian labor and are part of Belarusian GDP, we include the output of foreign firms located in Belarus as part of the output of the sector.

61. As shown in Table 12, employment expands the most in insurance, other professional services and other financial services. Given that the total amount of skilled and unskilled labor is fixed (no change in total unemployment), labor must be bid away from other sectors. Consequently, we see a reduction of employment in some sectors. The total amount of labor that must change jobs is less than one percent, as shown in Table 11.

Manufacturing Sectors

62. Although there are several sectors that slightly contract, we estimate that most manufacturing sectors will expand slightly in the medium term and more strongly in the long run.[44] The primary explanation for the expansion is that WTO accession will bring in additional service varieties in the business services sectors and that should lower the cost of doing business and result in a productivity improvement for the manufacturing sector as users of business services. In Table 14, we report the quality adjusted price[45] change by sector. We see that it falls in all business services sectors, and falls the most (by about 14-16 percent) in other professional services and insurance. Sectors which use business services most intensely, especially the business services that fall considerably in price, will see their costs fall the most and this will contribute to output increases. In addition, sectors that export will see an improvement of their export prices in terms of Belarusian rubles due to the small real depreciation of the exchange rate; and five sectors will obtain improved market access in export sectors. Chemicals, textiles and textile products, metals and fabricated metal products, and non-metallic mineral products are four of the sectors that obtain improved market access and these are expanding sectors.

63. We estimate a slight contraction of several sectors, with three sectors experiencing contractions larger than one percent of output: wood and wood products (-2.7 percent); forestry and related services activities (-3.4 percent); and mining and quarrying except energy (-4.5 percent). The reason that some sectors contract is that the increased profitability of the services sectors (and the other expanding sectors) induces them to bid capital and labor away from the rest of the economy. We estimate that real returns to skilled labor, unskilled labor and capital increase between 3.5 and 3.9 percent. The increased costs of labor and capital induces a slight decline in several sectors.

64. It may be surprising that in our WTO reform scenario we don't see more sectors declining. The explanation is as follows. Tariff reductions are usually associated with trade reforms, and tariff reductions lead to a reallocation of resources between sectors that often lead to some declining sectors. However, we do not incorporate tariff reductions as part of the WTO accession scenario. (If we had included tariff reductions, the estimated welfare gains would have been larger.) The reason tariff reductions are not part of the WTO accession scenario is that as part of the Belarus- Kazakhstan-Russia Customs Union, Belarus has committed to implement the tariff reductions Russia has agreed as part of Russia's WTO accession commitments; and Belarus hopes to accede to the WTO with the same tariff commitments as Russia. So WTO accession should not result in any further tariff reductions beyond what Belarus will implement as part of the Customs Union. We evaluate the impacts of Belarus implementing the tariff reductions agreed by Russia in a separate scenario that is independent of the WTO accession scenario.

Agriculture—Small Positive Impacts

65. In Table 12, we report a small increase in the output of agriculture in the medium term of 0.8 percent. In the long run, however, where the economy has time to adjust to a new higher level of capital stock, we estimate that WTO accession will lead to an expansion of the agriculture sector of 6.3 percent. Thus, despite the fact that we incorporate a reduction by 25 percent in the ad valorem equivalent of the non-tariff barriers that protect agriculture, which subjects agriculture to increased competition, we do not estimate an adverse impact of WTO accession on agriculture.

66. Some may be surprised that the estimated impacts on agriculture in Belarus are not substantially negative, since many fear that the WTO limitations on trade distorting subsidies will have a substantially negative impact on agricultural output. In our modeling of the impacts of WTO accession on Belarus, however, we assume no reduction in agricultural subsidies. There are

[44] The only exceptions in the long run is industry are that manufacture of wood and wood products, and mining other than energy both decline, by 0.1 and 0.2 percent, respectively.
[45] This is the Dixit-Stiglitz price index for the sector that takes into account the varieties.

three reasons for this assumption. First, as part of the obligations of the Republic of Belarus in the Belarus-Kazakhstan-Russia Customs Union, Belarus must reduce it agricultural subsidies approximately consistent with Russian levels under Russia's WTO commitments. So like with tariffs, Belarus would have to reduce its subsidies as part of its Customs Union obligations and this should not be considered a marginal commitment of Belarus under its WTO accession. Second, WTO only limits trade distorting subsides, what the WTO calls "amber box" subsidies, and permits without constraint a wide range of subsidies that are not considered trade distorting (called "green box" subsidies)[46]. We have been informed by the Ministry of Agriculture of Belarus that amber box subsidies have already been reduced to nine percent of agricultural value-added. As a practical matter, this is below what is known as the *de minimus* level for industrialized countries.[47] Subsidies below the *de minimus* level are permitted by the WTO; and third, the Ministry of Agriculture informed us they are looking for further ways to switch from amber box to green box subsidies. Green box subsidies include a large list of permissible subsidies under the WTO and research has shown that green box subsidies are better than the trade distorting amber box subsidies for agricultural productivity.

E. Impact of Reductions in the Common External Tariff of the Customs Union

Defining the Scenario: Increased Competition from Imports in Belarus and Preference Erosion in the Russia-Kazakhstan Markets

67. As a member of the Belarus-Kazakhstan-Russia Customs Union, Belarus will be called upon to change its tariffs due to Russia's WTO commitments. Russia has made tariff commitments that will be phased in over a period of eight years from 2012 to 2020. In our tariff scenario, we assess the impact on Belarus of the tariff reductions it will implement due to Russia's WTO commitments. In 2011 the common external tariff of the Customs Union was applied in both Belarus and Russia; and it was the last year that the tariffs of Russia and Belarus were not impacted by Russia's WTO accession commitments. Consequently, we use the trade weighted tariff rates for 2011 as our benchmark tariff rates. In order to capture the full impact of Russia's WTO commitments, we use the projected tariff rates of the Customs Union for 2020 as our counterfactual tariff rates.

68. To be clear, we are not assessing the impact on Belarus of the initial change in its tariffs in 2010 to implement the common external tariff of the Customs Union.[48] By using 2011 as our benchmark equilibrium, we take the initial implementation of the common external tariff of the Customs Union by Belarus in 2010 and 2011 as part of the initial status quo or "benchmark" equilibrium; and we assess the implications for Belarus of the reductions in the common external tariff of the Customs Union after 2011, that is, from 2012 until 2020.

69. CIS countries and Georgia have negotiated a network of bilateral and plurilateral agreements under which goods are supposed to flow tariff free among these countries. Consequently, we assume these tariff rates apply only to the European Union and the ROW in our model. In the counterfactual scenario, there will be two types of changes as a result of the tariff reductions of the Customs Union. First, the industry and agriculture sectors in Belarus will have less import protection as Belarus implements the lowering of the common external tariff against

[46] Green box subsidies include subsidies for agricultural research and development, pest control, general and specialist training, extension and advisory services, inspection services for health and sanitary reasons, infrastructure services and crop insurance subsidies for natural disasters.

[47] The *de minimus* amount for developing countries is ten present product specific and ten percent overall or roughly 20 percent. In the WTO accession negotiations, however, many Transition countries have been required to take the more stringent obligations on *de minimus* subsidies of industrialized countries.

[48] In the case of Kazakhstan, the tariff changes along to implement the common external tariff of the Customs Union were shown to have a negative impact. See World Bank (2012a).

imports. Second, Belarus will suffer preference erosion in the Russia and Kazakhstan markets; that is, the tariff umbrella in Russian and Kazakhstani markets will be lower. Then exporters from Belarus will suffer a decline in the export prices they will be able to receive in these markets. In a world of homogeneous goods, the price decline in Russia and Kazakhstan would equal the decline in the tariff. Based on this theory, to capture preference erosion, in our counterfactual tariff scenario, we assume that the export price received by exporters from Belarus in the Russia-Kazakhstan region of our model falls by the percentage decline in the tariff. The cuts by sector in the tariff reduction scenario are shown in Table 4.

Results of Reductions in the Tariffs of the Customs Union

70. The impact of reducing the common external tariff of the Customs Union on Belarus is an increase in welfare of 1.1 percent of consumption or 0.5 percent of GDP. This is a combination of the two impacts mentioned above, which have opposite effects on the welfare of Belarus.

Reduced Tariffs in Belarus—Gains of 2.0 Percent of Consumption

71. Reducing tariffs results in increased import competition in Belarus, which results in estimated gains. We execute a scenario with tariff reduction, but without preference erosion in the Russia-Kazakhstan markets. We estimate the welfare gains to Belarus would be equal to 2.0 percent of consumption. These gains come about from two impacts. First, tariff reduction in Belarus will lead to improved domestic resource allocation since tariff reduction will induce Belarus to shift production to sectors where production is valued more highly based on world market prices. This is the fundamental effect from trade liberalization in CRTS models. In addition, 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 Belarusian 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. The additional varieties in the imperfectly competitive sectors of Belarus results in a productivity improvement for users of these goods through the Dixit-Stiglitz-Ethier effect.

Preference Erosion on Exports to Russia and Kazakhstan—Losses of 0.9 Percent of Consumption.

72. The welfare gains of improved resource allocation and productivity increases in Belarus from increased import competition are reduced, however, by preference erosion in the Russia-Kazakhstan markets. Given that we estimate that the estimated welfare gains to Belarus without (with) preference erosion taken into consideration are equal to 2.0 (1.1) percent of consumption, this indicates that preference erosion in Russia and Kazakhstan from implementation of the WTO tariff reduction commitments of Russia will cost Belarus 0.9 percent of consumption per year. Moreover, as shown in table 8, the tariff reductions are estimated to lead to a 28 percent reduction in tariff revenues or a reduction of about 0.7 percent of the GDP of Belarus. This highlights the need for the address alternate efficient methods of collecting tariff revenues.

F. Impact of Reduction of Non-Discriminatory Services Barriers

73. In the WTO accession scenario, we assumed a 25 percent reduction in the non-discriminatory barriers against services providers in Belarus, but a fifty percent reduction in discriminatory barriers on multinational services providers on the assumption that the WTO members would negotiate more aggressively on non-discriminatory barriers. In this scenario, labeled “only non-discriminatory services barriers,” we assume that the Republic of Belarus takes a more aggressive fifty percent reduction in the ad valorem equivalent of the non-discriminatory barriers on domestic and multinational service providers in Belarus. But there is no reduction in the discriminatory tax on multinationals in the services sectors in this scenario. **At 11.7 percent of the value of Belarusian consumption (or 5.8 percent of GDP), the gains from the**

liberalization of non-discriminatory regulatory barriers in services are larger than the other reforms considered to this point. This estimate could be compared to the estimate above of a gain of 5.5 percent on consumption from a 25 percent reduction in non-discriminatory services barriers, which we executed as part of the WTO accession scenario. The reduction in the regulatory barriers on the provision of services in Belarus reduces the cost of providing services in Belarus for both Belarusian and multinational service providers. This increases profitability for the provision of services in Belarus, thereby inducing new entry by both domestic and multinational service providers until zero profits are restored. Consequently, there is an increase in new varieties of services. Belarusian businesses will then have improved access to services 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. In addition, we assume that there are real resource costs of the barriers which are freed through the liberalization. The very powerful impact of the reduction of non-discriminatory barriers in services in Belarus is explained by the fact that the Belarusian services sectors are dominated by Belarusian firms. For the reduction of non-discriminatory barriers in services, the reforms apply to Belarusian and foreign firms as well; so the reforms are applied on 100 percent of the sector.

G. Impacts of Business Services Reforms in Individual Sectors

74. As part of our WTO accession decomposition analysis, we have estimated the impact of reform of discriminatory or non-discriminatory reforms in all business services sectors. Regulators and policy-analysts, however, would likely want to know where reform is likely to yield the greatest gains. To provide insight into this question, we assess the impact of reduction to barriers to suppliers of services in each of our eight business services sectors. We also assess the impact of reduction of the ad valorem equivalents of discriminatory and non-discriminatory barriers separately, at the levels of reduction consistent with our WTO accession scenario: fifty percent of discriminatory barriers and 25 percent for non-discriminatory barriers. Our results are presented in Table 12.

75. The estimated gains by sector are largely explained by three sets of parameters: (i) the ad valorem equivalents of the barriers (see Table 4); (ii) the share of the sector in the economy (see Table 5); and (iii) for the discriminatory barriers, the share of foreign firms in the sector (see Table 6). Our discussion of particular sectors should clarify the issues.

76. The sector where we estimate the largest estimated gains from reduction of barriers to services providers is the rail and other transport sector (not air or road). We estimate gains of 2.3 percent of consumption from a 25 percent reduction of the ad valorem equivalents of the non-discriminatory barriers to services providers. Rail and other transport is the sector with the highest ad valorem equivalent of services barriers in our dataset. The non-discriminatory (discriminatory) barriers are 47.5 (42.5) percent as a percent of the domestic price.[49] In addition, rail and other transport constitute a substantial 4.1 percent of the aggregate value-added in the economy of Belarus. Consequently, we estimate that reduction of the non-discriminatory barriers in this sector would yield very substantial gains.

77. On the other hand, we do not estimate gains from the reduction of discriminatory barriers in the rail and other transport sector (not air or road) because the data indicate that there are no foreign suppliers of these services in Belarus in our initial equilibrium. Our estimate of no gains from the reduction of non-discriminatory barriers in the rail and other transport sector should be considered a very conservative lower bound estimate, since our model assumes that if there is no foreign presence in the benchmark equilibrium, there will never be any foreign supply.[50] It is

[49] This is 90.5 (73.9) percent as a percentage of estimated undistorted prices.

[50] In order to model foreign service supply in response to a reduction in barriers when there is no foreign presence initially, we would need data on how much of a price increase would be necessary to start foreign entry. Those data are not available.

possible that with a large reduction in the ad valorem equivalents of barriers in a sector, that foreign entry would be induced and gains would accrue to Belarus. Consequently, we should not read this result as indicating there are no gains possible form reform of discriminatory barriers.

78. With estimated gains of 1.1 percent of consumption from reduction of **discriminatory** services barriers, we estimate that the largest gains from reduction of **discriminatory** services barriers is in the "other financial services" sector, which includes banking. There are two explanations for this. The other financial services sector has 5.0 percent of value-added of the economy, making it the fourth largest sector of the economy measured by value-added. Crucially, it is the business services sector with the highest foreign share of the sector: the foreign share is 35 percent of the sector. So reductions in barriers have a more powerful impact on foreigners who have demonstrated their interest in the sector.

79. The largest sector in Belarus, measured by value-added, is the trade sector, with 16.5 percent of the value-added of the economy. At 6.3 percent, the ad valorem equivalents of the non-discriminatory barriers are low; and we did not find any discriminatory barriers. Nonetheless, since the sector is so large, we estimate substantial gains (of 2.0 percent of consumption) from a 25 percent reduction in the ad valorem equivalents of the low non-discriminatory barriers. The opposite is true for air transport. Since the sector constitutes only 0.1 percent of total value added, the estimated welfare gains form reform are relatively small. Recall, however, that these are estimated gains that are repeated every year and represent substantial cumulative income. It is only by comparison with the estimated gains from other sectors that they are small.

H. Sensitivity Analysis

80. 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.

Model Assumptions

Long Run--Comparative Steady State Results of WTO Accession

81. In a long run analysis, we should allow for the fact that WTO accession could improve the investment climate in Belarus. In this scenario, we employ our comparative steady state model. The principal feature is that we allow for the fact that accession to the WTO could increase the rate of return on investment. This 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. **With our comparative steady state model, we estimate that the gains to Belarus from WTO accession are 16.0 percent of consumption (7.8 percent of GDP).** This is about twice 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 Belarus in the comparative static model by 3.5 percent. 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 6.6 percent 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. We typically argue that this type of model produces 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, Rutherford and Tarr (2002) have shown that a fully dynamic model which incorporates productivity effects like those in our present model, and which takes into account foregone consumption from investment decisions, could produce estimated welfare gains that are larger than these comparative steady state results.

Rent Capture.

82. In our central scenario we have assumed that there are real resource losses from the barriers in services and in agriculture. Firms must expend resources to comply with the regulations or expend resources in rent seeking to obtain licenses. Then the ad valorem equivalents of the barriers are a real resource cost, and WTO accession frees resources that were used to capture the rents so they become available for productive activities. We also consider, however, the alternate, where there is no loss of capital and labor in wasteful license seeking activities and the like, either because licenses are allocated without real resource costs or because the rents are captured by domestic agents. Under this assumption, the estimated gains from WTO accession fall to 4.9 percent of consumption (as shown in Table 15), which reflects a large share of rents (or losses from dissipated rents) in the economy of Belarus. The estimated gains from privatization are unchanged with respect to the rent capture assumption, however, since we do not assume a gain in rents in the central scenario.

Perfect Competition and CRTS Model

83. We also executed our central WTO scenario in a perfect competition, CRTS version of our model. As we show in Table 15, without the Dixit-Stiglitz structure that provides the possibility of productivity gains, the welfare gains from WTO accession are reduced to 3.0 percent of consumption (we allow rent capture of the barriers in services in the CRTS scenario and most of the gains are from rent capture). The estimated gains fall since with perfect competition and constant returns to scale, the model excludes the productivity gains from additional varieties of services and goods. The evidence we cited above, however, indicates that there are productivity effects from additional suppliers of services, so the model with imperfect competition is the better one.

Piecemeal Sensitivity Analysis

84. Our piecemeal sensitivity analysis in Table 16 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. Two sets of parameters stand out as having a strong impact on the results.

85. The elasticity of substitution between firm varieties in imperfectly competitive services sectors, $\sigma(q_i, q_j)$ has a very strong impact in both the WTO and Privatization scenarios. At the low end of the elasticity range (2.5 in all services sectors), the estimated gains are 10.9 per cent of consumption from WTO accession and 47.1 percent from Privatization. Unlike most other elasticities, a lower value of $\sigma(q_i,q_j)$ increases the welfare gains because lower values of this elasticity imply that varieties are less close to each other; so additional varieties are worth more. Since the policy shocks in goods are much less, the elasticity variation in goods has a smaller impact, but its impact is nonetheless significant.

86. The elasticity of substitution between value-added and business services, σ(va, bs), also has a strong impact. At its upper value of 1.75 in the WTO accession scenario (1.70 in the Privatization scenario), the estimated gains increase to 10.6 percent of consumption in the WTO accession scenario and 44.6.percent of consumption in the Privatization scenario. The better firms are able to substitute business services for labor and capital, the more the economy will gain from the reforms that reduce the quality adjusted price of business services.

87. Other elasticities in the model follow the Le Chatelier principle, i.e., larger elasticities typically lead to larger welfare gains in response to welfare improving reforms, as the economy can adapt more readily. For example, a larger elasticity of firm supply means that more firms will enter when profits are available, that results in more varieties and productivity increases. The results appear rather robust to the other elasticities in the model. That is, the results are within plus or minus ten percent of the central estimate for these parameter values for the WTO accession and privatization scenarios. (The final two rows, for rent capture and constant returns to scale, are results for model assumptions, not parameter values, and these were discussed above.)

I. Conclusions

88. We developed a modern, innovative computable general equilibrium model of the economy of Belarus to undertake an assessment of WTO accession and key complementary reforms. We find that WTO accession would be expected to increase the welfare (or real income) of Belarusian nationals by 8.2 percent of consumption per year. Our decomposition analysis finds that it is the reduction of barriers against suppliers of services that is the most important contributor to the gains in welfare of Belarus, especially a 25 percent reduction of the ad valorem equivalent of the non-discriminatory barriers that adversely impact both Belarusian and foreign service providers. Further decomposition of our WTO scenario into impacts of individual services sector reforms shows that the greatest gains from any single services sector reform comes from reduction of non-discriminatory barriers in the in the rail and other transport sector (not air or road), followed by the trade sector. The greatest gains from reduction of discriminatory barriers is in the "other financial services" sector, which includes banking.

89. We find that deeper more aggressive reduction of non-discriminatory barriers against services providers (fifty percent) could have an ever more substantial impact on the productivity, competitiveness and output of the Belarusian economy; we estimate a gain of 11.7 percent of consumption per year. And based on data on the relative productiveness of various sectors in Belarus, we find that partial privatization would lead to a large dramatic increase in the productivity, competitiveness and output of the economy of Belarus, yielding gains of 36.2 percent of consumption per year under our central modeling assumptions. We conduct extensive sensitivity analysis of both our WTO accession and privatization scenarios, with respect to modeling assumptions and parameter values. Although there is a large variance in the estimated gains from privatization, depending on the modeling assumptions, the gains are always very large and dramatic. .By increasing the productivity and competitiveness of Belarusian firms, we find both of these complementary structural reforms would lead to a reduction of imports, contrary to WTO accession. We hope that by identifying these complementary reforms to WTO accession, we may be able to assist the Government in its efforts to use the WTO accession process as a vehicle to make the economy more competitive.

Statistical Tables

Table 1. List of Sectors, Regions and Factors of Production

		Corresponding Aggregate Sector	Regions
Business Services			
TRD	Trade, repair of motor vehicles, household appliances and personal items	TDC	Belarus
CMN	Communication	TCM	Commonwealth of independent States and Georgia
ISR	Insurance	OSR	Customs Union (Russia, Kazakhstan)
OFN	Other financial services	OSR	EU
OPS	Other professional services (incl R and D)	OSR	Rest of the World
WRT	Rail, water and other transport	TCM	
ATP	Air transport	TCM	**Primary Factors of Production**
ROT	Road tran port	TCM	Compensation of unskilled employees
			Compensation of skilled employees
IRTS Goods (also called Dixit-Stiglitz Goods)			Capital -- Gross operation surplus, mixed income
FPR	Manufacture of food products , beverages and tobacco	IND	
TEX	Textiles and textile products	IND	**Aggregate Sectors for Productivity Calculation**
LUM	Manufacture of wood and of products of wood	IND	AGF = Agriculture, Forestry and Fishing
PPP	Pulp and paper production and Publishing	IND	CST = Construction
P_C	Manufacture of coke, refined petroleum and nuclear fuel	IND	IND = Industry
CHM	Chemicals and chemical products	IND	TDC = Trade and Catering
RUB	Manufacture of rubber and plastic products	IND	TCM = Transport and Communications
NMM	Manufacture of other non-metallic mineral products	IND	OSR = Other Services
MET	Manufacture of basic metals and fabricated metal products	IND	
OME	Manufacture of machinery and equipment	IND	
EOE	Manufacture of electrical and optical equipment	IND	
OTN	Manufacture of transport equipment	IND	
OMF	Other manufacturing	IND	
CRTS Goods and Services			
AGR	Agriculture, hunting and related services in these areas	AGF	
FRS	Forestry and related service activities	AGF	
FSH	Fishing, fish farming and related services in these areas	AGF	
ENM	Mining and quarrying of energy minerals	IND	
OMN	Mining and quarrying except energy	IND	
LEA	Manufacture of leather , leather products and footwear	IND	
UTL	Production and distribution of electricity, gas and water	IND	
CNS	Construction	CST	
H_R	Hotels and restaurants	OSR	
RRB	Real estate renting and business services	OSR	
PUB	Public services	OSR	
EDU	Education	OSR	
HSS	Health care and social services	OSR	
CSP	Community, social and personal services	OSR	

Source: Authors' aggregation based on data in National Statistical Committee of the Republic of Belarus (2012a; 2012b), the Input-Output table for 2011 as well as trade and labor productivity data supplied by Belstat.

Table 2. Sector Value-Added

(In percent, unless otherwise indicated)

	Labor			Total	
	Skilled Labor	Un-skilled Labor	Capital	TBYR (Trillions BYR)	Percent of Total
Business Services					
Trade, repair of motor vehicles, household appliances and personal items	16.6	11.3	72.1	43.3	16.5
Communication	24.2	23.1	52.8	4.3	1.6
Insurance	21.8	5.7	72.5	0.4	0.2
Other financial services	21.8	5.7	72.5	13.1	5.0
Other professional services (incl R and D)	39.5	15.3	45.2	6.8	2.6
Rail, water and other transport	24.2	23.1	52.8	10.9	4.1
Air transport	24.2	23.1	52.8	0.2	0.1
Road transport	24.2	23.1	52.8	5.6	2.1
Dixit-Stiglitz Goods					
Manufacture of food products , beverages and tobacco	23.5	18.7	57.8	11.8	4.5
Textiles and textile products	31.1	20.0	48.9	4.5	1.7
Manufacture of wood and of products of wood	29.3	29.1	41.6	2.0	0.7
Pulp and paper production and Publishing	33.5	18.2	48.3	2.0	0.8
Manufacture of coke, refined petroleum and nuclear fuel	11.4	4.2	84.4	4.6	1.8
Chemicals and chemical products	12.6	7.0	80.4	18.5	7.0
Manufacture of rubber and plastic products	27.2	20.1	52.7	3.2	1.2
Manufacture of other non-metallic mineral products	29.5	25.5	45.0	4.2	1.6
Manufacture of basic metals and fabricated metal products	26.2	18.5	55.3	6.8	2.6
Manufacture of machinery and equipment	32.0	24.3	43.7	9.3	3.5
Manufacture of electrical and optical equipment	31.3	22.4	46.3	4.3	1.7
Manufacture of transport equipment	19.9	20.8	59.3	6.5	2.5
Other Manufacturing	26.6	21.2	52.2	2.8	1.1
CRTS Goods and Services					
Agriculture, hunting and related services in these areas	16.8	22.8	60.5	22.3	8.5
Forestry and related service activities	40.9	44.4	14.7	1.4	0.5
Fishing, fish farming and related services in these areas	19.7	16.9	63.4	0.1	0.1
Mining and quarrying of energy minerals	10.2	8.6	81.2	2.6	1.0
Mining and quarrying except energy	26.3	22.1	51.6	0.7	0.3
Manufacture of leather , leather products and footwear	22.1	15.2	62.7	1.2	0.4
Production and distribution of electricity, gas and water	41.7	39.0	19.2	5.1	1.9
Construction	39.0	25.9	35.0	19.2	7.3
Hotels and restaurants	42.8	32.9	24.3	2.2	0.8
Real estate renting and business services	39.5	15.3	45.2	10.8	4.1
Public services	79.7	17.5	2.8	8.9	3.4
Education	66.6	25.5	8.0	11.2	4.3
Health care and social services	38.8	58.8	2.4	7.2	2.7
Community, social and personal services	44.3	34.1	21.6	5.0	1.9

Source: Authors' calculations based on data in National Statistical Committee of the Republic of Belarus (2012a; 2012b) (Belstat) and the *IO* table for 2011 supplied by Belstat.

Table 3. Trade Flows

	Import			Exports		
	TBYR	% of Total	% of Supply	TBYR	% of Total	% of Output
Business Services						
Trade, repair of motor vehicles, household appliances and personal items	0.1	0.1	0.2	0.4	0.2	0.3
Communication	1.2	0.5	20.7	3.5	1.7	51.2
Insurance	0.0	0.0	5.4	0.0	0.0	1.4
Other financial services	0.9	0.4	5.4	0.2	0.1	1.4
Other professional services (incl R and D)	1.2	0.5	13.4	1.5	0.7	19.9
Rail, water and other transport	3.0	1.3	20.7	9.0	4.4	40.8
Air transport	0.1	0.0	20.7	0.2	0.1	40.8
Road transport	1.5	0.6	20.7	4.6	2.2	40.8
Dixit-Stiglitz Goods						
Manufacture of food products , beverages and tobacco	12.5	5.3	17.5	16.2	7.9	27.8
Textiles and textile products	3.4	1.4	24.0	4.7	2.3	46.9
Manufacture of wood and of products of wood	1.0	0.4	22.2	1.9	0.9	44.3
Pulp and paper production. Publishing	3.1	1.3	32.5	1.1	0.5	19.6
Manufacture of coke, refined petroleum and nuclear fuel	21.2	9.0	54.5	61.0	29.7	83.9
Chemicals and chemical products	19.0	8.1	62.9	34.8	17.0	105.3
Manufacture of rubber and plastic products	5.0	2.1	41.1	6.1	3.0	51.0
Manufacture of other non-metallic mineral products	2.5	1.1	13.4	2.4	1.1	16.7
Manufacture of basic metals and fabricated metal products	24.1	10.2	49.9	9.3	4.5	41.0
Manufacture of machinery and equipment	18.2	7.7	51.2	14.0	6.8	53.2
Manufacture of electrical and optical equipment	12.8	5.4	58.3	5.6	2.7	48.1
Manufacture of transport equipment	16.9	7.2	69.8	16.7	8.1	92.7
Manufacturing nec.	1.4	0.6	15.3	3.0	1.5	39.4
CRTS Goods and Services						
Agriculture, hunting and related services in these areas	4.1	1.7	6.7	1.4	0.7	2.5
Forestry and related service activities	0.0	0.0	0.7	0.6	0.3	29.4
Fishing, fish farming and related services in these areas	0.1	0.1	32.5	0.0	0.0	3.8
Mining and quarrying of energy minerals	70.7	30.0	85.9	0.1	0.0	1.8
Mining and quarrying except energy	1.8	0.8	61.1	0.5	0.3	36.0
Manufacture of leather , leather products and footwear	2.1	0.9	34.6	0.8	0.4	27.5
Production and distribution of electricity, gas and water	1.9	0.8	6.9	0.1	0.0	0.3
Construction	1.9	0.8	3.3	1.2	0.6	2.1
Hotels and restaurants	1.5	0.6	40.1	1.7	0.8	43.1
Real estate renting and business services	1.9	0.8	13.4	2.4	1.2	16.6
Public services	0.0	0.0	0.2	0.2	0.1	1.6
Education	0.0	0.0	0.3	0.2	0.1	1.2
Health care and social services	0.0	0.0	0.0	0.1	0.0	0.6
Community, social and personal services	0.1	0.0	1.2	0.0	0.0	0.5

Source: Authors' calculations based on data of the National Statistical Committee of the Republic of Belarus (Belstat): *IO* table for 2011 at basic and consumer prices.

Table 4. Distortions in the Benchmark (BenchM) and Counterfactual (After) Scenarios

(In percentage)*

	Tariff (EU and ROW Only)		Nontariff Barriers		Export Price Increase	Export Tax	Con-sumption Tax	Privatization Productivity Increase	Services Regulatory Barriers				
									Non-discriminatory- All Firms			Discriminatory-Foreign Firms Only	
	Bench-mark	After	Bench-mark	After	After	Bench-mark	Bench-mark	After	Bench-mark	After WTO	After Com-plementary	Bench-mark	After WTO
Business Services													
Trade, repair of motor vehicles, household appliances and personal items						2.9	17.9	1.4	6.3	4.7	3.1		
Communication						0.6	-10.3		5.3	4.0	2.6	2.3	1.1
Insurance								51.8	19.7	14.7	9.8	33.3	16.7
Other financial services								51.8	7.9	5.9	3.9	14.2	7.1
Other professional services (incl R and D)						1.8	-20.1	51.8	11.1	8.3	5.5	19.8	9.9
Rail, water and other transport						0.6	-10.3	1.3	47.5	35.6	23.8	42.5	21.2
Air transport						0.6	-10.3	1.3	12.6	9.5	6.3	25.3	12.6
Road transport						0.6	-10.3	1.3					
Dixit-Stiglitz Goods													
Manufacture of food products , beverages and tobacco	14.2	12.6				6.5	11.9						
Textiles and textile products	11.2	8.0			0.5	4.1	15.2						
Manufacture of wood and of products of wood	13.4	7.0				3.9	11.4						
Pulp and paper production. Publishing	11.4	5.2				4.3	18.5						
Manufacture of coke, refined petroleum and nuclear fuel	5.0	5.0				6.2	26.2						
Chemicals and chemical products	7.2	4.6			0.5	3.4	6.3						
Manufacture of rubber and plastic products	13.0	6.5			1.0	3.5	14.1						
Manufacture of other non-metallic mineral products	13.3	9.6			1.0	3.7	18.4						
Manufacture of basic metals and fabricated metal products	11.4	7.1			1.5	3.5	21.7						
Manufacture of machinery and equipment	3.1	2.5				3.6	15.1						
Manufacture of electrical and optical equipment	5.3	2.5				3.5	19.8						
Manufacture of transport equipment	17.6	9.0				4.7	8.6						
Manufacturing nec	16.2	10.3				3.4	14.4						
CRTS Goods and Services													
Agriculture, hunting and related services in these areas	6.2	3.8	17.7	13.3		3.9	2.9	7.0					
Forestry and related service activities	5.4	5.2				3.3	18.8	7.0					
Fishing, fish farming and related services in these areas	10.0	3.1				3.9	18.4	7.0					
Mining and quarrying of energy minerals	0.0	0.0				46.3	3.2						
Mining and quarrying except energy	4.9	4.8				4.7							
Manufacture of leather , leather products and footwear	8.0	4.6				3.6	14.8						
Production and distribution of electricity, gas and water						3.3	0.9						
Construction						0.4	0.4	1.2					
Hotels and restaurants						0.8	11.1	1.4					
Real estate renting and business services						1.8	-20.1	51.8					
Public services								51.8					
Education						0.2	0.2	51.8					
Health care and social services							0.0	51.8					
Community, social and personal services						1.9	-2.8	51.8					

Source: Kolesnikova (2014a) for the services regulatory barriers (converted to percentage of domestic prices); Shepotylo and Tarr (2014) for tariff changes and Comtrade data for 2011 trade weights. Kee et al (2009) for non-tariff barrier estimates and GTAP data for aggregation; Appendix 2 for export price increases. Export and consumption taxes and subsidies from the IO table for 2011. ***** A blank in a cell in the table implies zero distortion.

Table 5. Trade Flows by Trading Partner

(In Percentage)*

	Imports				Exports			
	Rest of CIS and Georgia	Customs Union (Russia and Kazakhstan)	EU	ROW	Rest of CIS and Georgia	Customs Union (Russia & Kazakhstan)	EU	ROW
Business Services								
Trade and selected personal repair (see Table 1)	30	36	32	1	16	38	7	39
Communication	8	56	27	8	6	67	21	6
Insurance	0	47	48	4	0	13	65	22
Other financial services	0	19	62	19	2	25	47	26
Other professional services (incl R and D)	7	37	29	27	2	32	30	36
Rail, water and other transport	9	16	54	21	2	60	16	22
Air transport	12	30	44	14	11	28	43	19
Road transport	3	32	61	4	1	40	49	11
Dixit-Stiglitz Goods								
Manufacture of food products , beverages and tobacco	17	23	30	30	6	85	5	4
Textiles and textile products	4	29	31	37	8	77	13	2
Manufacture of wood and of products of wood	17	42	33	8	14	34	51	1
Pulp and paper production. Publishing	11	39	42	8	9	81	7	3
Manufacture of coke, refined petroleum and nuclear fuel	0	99	1	0	25	1	70	4
Chemicals and chemical products	5	33	41	21	4	9	40	46
Manufacture of rubber and plastic products	5	38	40	18	13	73	5	9
Manufacture of other non-metallic mineral products	13	35	35	16	13	74	11	1
Manufacture of basic metals and fabricated metal products	13	63	16	8	4	46	34	16
Manufacture of machinery and equipment	4	19	57	21	13	75	5	7
Manufacture of electrical and optical equipment	2	26	32	40	5	75	15	5
Manufacture of transport equipment	4	14	22	59	9	84	2	6
Other Manufacturing	4	51	20	24	12	62	11	15
CRTS Goods and Services								
Agriculture, hunting and related services in these areas	13	6	32	48	1	77	21	0
Forestry and related service activities	5	23	46	26	1	1	96	2
Fishing, fish farming and related services in these areas	0	6	5	89		82	18	
Mining and quarrying of energy minerals	8	81	0	11	0	0	100	0
Mining and quarrying except energy	22	48	7	23	4	60	35	1
Manufacture of leather , leather products and footwear	4	50	7	38	4	80	12	3
Production and distribution of electricity, gas and water	48	52					100	
Construction	2	10	20	67	5	47	14	34
Hotels and restaurants	10	52	22	16	4	69	17	10
Real estate renting and business services	4	62	22	11	18	45	26	11
Public services	5	23	61	11	2	6	72	20
Education	5	40	45	10	41	10	2	47
Health care and social services	14	21	50	15	30	58	3	9
Community, social and personal services	6	33	5	57	1	18	3	78

Source: Trade data supplied to the World Bank by the National Statistical Committee of the Republic of Belarus (Belstat) for 2011.

*A bank in a cell in the table implies zero trade share rounded to the nearest percent.

Table 6. Market Shares in Sectors with FDI
(In Percentage)*

	Belarus	Rest of CIS and Georgia	CU(Russia and Kazakhstan)	EU	ROW
Business Services					
Trade, repair of motor vehicles, household appliances and personal items	82.0	1.0	9.0	7.0	1.0
Communication	77.0		7.0	13.0	3.0
Insurance	85.0	1.0	9.0	5.0	
Other financial services	65.0	1.0	25.0		9.0
Other professional services (incl R and D)	95.0		1.0	3.0	1.0
Rail, water and other transport	100.0				
Air transport	100.0				
Road transport	98.0		1.0		1.0

Source: Kolesnikova (2014b).
*****All shares are rounded to the nearest whole percent. A blank in a cell in the table implies zero market share after rounding.

Table 7. Estimates of: (1) Elasticities of Supply of Firms With Respect To Price in Belarus by Sector and Trading Partner; And (2) Dixit-Stiglitz Elasticities of Substitution for Varieties

	R&D Intensity R&D Expenditures Divided By Sales (Times 1000) for the US*	Elasticity of Supply Estimates					Dixit-Stiglitz Elasticities of Substitution for Varieties****
		Belarus	Other CIS+ Georgia	Russia-Kazakhstan	EU	ROW	
Services							
Communications	52-High	2.5	2.5	13.4	13.4	20	3.0
Insurance	4-Low	3.3	3.3	3.3	6.6	10	3.0
Banking and other financial services	4-Low	3.3	3.3	6.6	6.6	10	3.0
Other professional services	116-High	2.5	2.5	13.4	13.4	20	3.0
Air transport**	Medium	1.9	1.9	3.3	10	15	3.0
Road transport	Low	3.3	3.3	3.3	3.3	10	3.0
Rail and water transport**	Medium	1.9	1.9	10	10	15	3.0
Trade	Low	1.9	1.9	3.3	10	15	3.0
Manufacturing							
Food, beverages and tobacco	14-Low	3.3	3.3	3.3	3.3	3.3	5.3
Textiles and apparel	13-Low	3.3	3.3	3.3	3.3	3.3	6.1
Wood and wood products	0-17-Low	3.3	3.3	3.3	3.3	3.3	2.2
Pulp, paper and Publishing	0-17-Low	3.3	3.3	3.3	3.3	3.3	2.5
Petroleum, coke, and nuclear fuel	2-Low	3.3	3.3	3.3	3.3	3.3	4.0
Chemicals	34-Medium	3.3	3.3	6.6	6.6	6.6	2.7
Rubber and plastic products	0-17-Low	3.3	3.3	3.3	3.3	3.3	5.6
Non-metallic mineral products	0-17-Low	3.3	3.3	3.3	3.3	3.3	3.4
Metals and metal products	33-Medium	3.3	6.6	6.6	6.6	6.6	3.5
Machinery and equipment	33-Medium	3.3	3.3	3.3	6.6	6.6	8.0
Electrical and optical equipment	33-Medium	3.3	3.3	3.3	6.6	6.6	6.1
Transport equipment	33-Medium	3.3	3.3	6.6	6.6	6.6	2.4
Other manufacturing	33-Medium	3.3	3.3	3.3	6.6	6.6	3.8

Source: R&D and sales data from National Science Foundation, Division of Science Resources Statistics, *Survey of Industrial Research and Development: 2005, Data Tables*. Available at: http://www.nsf.gov/statistics/nsf10319/content.cfm?pub_id=3750&id=3 A7. See Appendix 5 for details of the calculations.

*Based on average R&D expenditures for the years 2004 and 2005. The average for all US industries was 36.

**We evaluate transportation as a medium R&D sector since three sectors dominate R&D expenditures of US multinationals operating abroad. These are transportation, chemicals and computers and electronics. Moreover, about two-thirds of all R&D expenditures of foreign multinationals operating in the US was performed in the same three sectors. See "U.S. and International Research and Development: Funds and Technology Linkages," at 'http://www.nsf.gov/statistics/seind04/c4/c4s5.htm.

***Metals and machines is a proxy for transport equipment, electrical and optical equipment, other manufacturing and metals and minerals. Machinery is used for metals and machines, all equipment products and other manufacturing; we used plastics, rubber, mineral and wood products for non-metallic products, wood products, pulp, paper and publishing, and plastics and rubber products.

****Calculations based on Broda, Greenfield and Weinstin (1996) for goods and Broda and Weinstein (2004) for services.

Table 8. Summary of Impacts of WTO Accession and Complementary Structura Reform Measures

(Results are percentage change from initial equilibrium, unless otherwise indicated)

		WTO Accession Medium Term						Complimentary Other Policies		
Scenario definition	Benchmark	WTO Accession	Only Discriminatory Services Barriers (50% Reduction)	Only Non-Discriminatory Services Barriers (25% Reduction)	Only Improved Market Access	Only Reduction in WTO Inconsistent SPS Barriers	WTO Accession Steady State	Russia's WTO Tariff Commitments	Only Non-Discriminatory Services Barriers (50% Reduction)	Privatization Impact
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
50% reduction in discriminatory services barriers for all services firms	No	Yes	Yes	No	No	No	Yes	No	No	No
25% reduction of non-discriminatory barriers on all services firms	No	Yes	No	Yes	No	No	Yes	No	No	No
Increase in the export price for selected sectors	No	Yes	No	No	Yes	No	Yes	No	No	No
25% reduction in non-tariff barriers in SPS	No	Yes	No	No	No	Yes	Yes	No	No	No
Steady-state capital stock	No	No	No	No	No	No	Yes	No	No	No
Implementation of Russia's WTO tariff commitments	No	No	No	No	No	No	No	Yes	No	No
50% reduction of non-discriminatory barriers on all services firms	No	No	No	No	No	No	No	No	Yes	No
State controlled share decreases by 50% in each sector; private sector increases	No	No	No	No	No	No	No	No	No	Yes
Aggregate welfare										
Welfare (EV as % of consumption)		8.2	1.7	5.5	0.1	0.4	16.0	1.1	11.7	36.2
Welfare (EV as % of GDP)		4.0	0.8	2.7	0.1	0.2	7.8	0.5	5.8	17.7
Government budget										
Tariff revenue (% of GDP)	2.5	2.5	2.5	2.5	2.5	2.5	2.4	1.8	2.5	2.5
Tariff revenue		2.2	1.3	0.4	0.1	0.2	2.3	-28.3	-0.1	-15.5
Aggregate trade										
Real exchange rate		0.5	0.2	0.2	0.0	0.1	0.7	1.2	0.3	2.9
Aggregate exports		0.9	1.2	-0.7	0.0	0.1	0.4	1.3	-2.2	-20.0
Factor Earnings										
Skilled labor		3.9	1.1	2.4	0.0	0.2	7.2	1.0	4.7	7.9
Unskilled labor		3.7	0.9	2.4	0.0	0.1	7.0	0.9	4.8	7.7
Capital		3.5	1.1	2.1	0.1	0.0	0.6	1.1	4.3	18.3
Specific Factors (domestic)		6.4	0.5	5.1	0.1	0.6	11.1	0.3	10.9	1.4
Specific Factors (multinationals)		6.6	4.1	1.9	0.1	0.2	10.4	1.3	4.0	14.0
Factor adjustments*										
Skilled labor		0.9	0.3	0.7	0.0	0.1	1.3	0.5	1.2	10.0
Unskilled labor		0.9	0.2	0.8	0.0	0.1	1.4	0.6	1.4	7.9
Capital		1.0	0.3	0.8	0.1	0.2	0.0	0.6	1.6	6.5
Capital stock change (steady state only)							6.6			

Source: Authors' estimates.

*Percentage of the factor that must change sectors.

Table 9. Output and Employment Impacts of Key Policy Reforms
(Results are percentage change from benchmark)

	WTO Accession-Medium Term			WTO Accession Steady State			Russia's WTO Tariff Commitments			Only non-discriminatory Services Barriers-- 50% Reduction			Privatization Impact		
		Employment			Employment			Employment			Employment			Employment	
	Output	Skilled	Un-skilled	Output	Skilled	Un-skilled	Output	Skilled	Un-skilled	Output	Skilled	Un-skilled	Output	Skilled	Un-skilled
Business Services															
Trade, repair of motor vehicles, household appliances and personal items	3.9	-3.8	-3.6	8.9	-3.7	-3.5	0.7	0.1	0.3	5.3	-5.8	-5.9	11.4	1.8	2.1
Communication	9.3	5.1	5.4	11.9	4.7	5.0	1.3	1.2	1.3	10.5	7.4	7.3	25.4	15.9	16.2
Insurance	9.7	8.2	8.4	15.4	9.9	10.2	0.7	0.7	0.9	6.0	5.0	5.0	54.1	17.9	18.2
Other financial services	7.3	5.9	6.1	13.0	7.6	7.9	0.8	0.7	0.9	4.7	3.8	3.7	57.4	20.5	20.7
Other professional services (incl R and D)	9.4	7.3	7.5	12.3	7.8	8.0	0.7	0.6	0.8	5.2	4.0	3.9	104.4	27.7	27.9
Water rail transport and transport nec	9.7	4.6	4.8	12.1	3.8	4.0	1.0	0.9	1.0	12.0	8.2	8.1	15.5	3.4	3.6
Air transport	6.7	1.8	2.0	9.4	1.4	1.6	1.0	0.9	1.0	8.6	4.9	4.9	15.4	3.5	3.7
Road transport	7.5	2.5	2.7	10.9	2.8	3.0	1.4	1.2	1.4	8.2	4.5	4.5	24.3	11.3	11.6
Dixit-Stiglitz Goods															
Manufacture of food products , beverages and tobacco	2.5	0.3	0.5	6.1	1.0	1.2	0.7	0.6	0.7	2.4	1.0	0.9	9.2	6.7	6.9
Textiles and textile products	1.6	0.1	0.4	4.2	0.4	0.6	-0.3	-0.4	-0.2	1.6	0.6	0.6	7.0	5.9	6.1
Manufacture of wood and of products of wood	-2.7	-4.1	-3.8	-3.4	-6.4	-6.2	-3.7	-3.8	-3.6	-5.0	-5.8	-5.9	4.3	3.0	3.2
Pulp and paper production. Publishing	1.8	-0.1	0.1	4.5	0.3	0.6	-5.5	-5.6	-5.4	1.1	-0.1	-0.2	14.7	11.9	12.1
Manufacture of coke, refined petroleum and nuclear fuel	1.2	-1.2	-0.9	2.6	-4.1	-3.9	0.6	0.6	0.7	1.6	0.0	-0.1	1.9	1.5	1.7
Chemicals and chemical products	1.5	-0.5	-0.3	7.1	0.7	1.0	2.6	2.6	2.7	-0.4	-1.9	-1.9	-6.5	-5.9	-5.7
Manufacture of rubber and plastic products	-0.2	-2.2	-1.9	1.5	-3.0	-2.8	-1.9	-2.0	-1.8	-2.5	-3.7	-3.8	0.3	-1.9	-1.6
Manufacture of other non-metallic mineral products	0.5	-1.1	-0.9	1.3	-2.4	-2.2	-1.2	-1.3	-1.1	0.1	-1.0	-1.0	3.5	1.6	1.9
Manufacture of basic metals and fabricated metal products	0.7	-0.9	-0.7	1.8	-2.3	-2.1	-1.0	-1.1	-0.9	-0.7	-1.7	-1.7	0.4	-0.3	-0.1
Manufacture of machinery and equipment	-0.9	-2.5	-2.2	-0.8	-4.3	-4.1	2.6	2.5	2.7	-2.1	-3.1	-3.1	-0.4	-2.0	-1.8
Manufacture of electrical and optical equipment	-1.0	-2.5	-2.3	-0.8	-4.3	-4.1	-1.1	-1.2	-1.0	-2.3	-3.2	-3.3	0.9	-0.6	-0.4
Manufacture of transport equipment	-0.7	-2.4	-2.2	1.3	-3.1	-2.9	-11.0	-11.1	-10.9	-2.5	-3.6	-3.7	-2.7	-3.5	-3.3
Manufacturing nec	1.3	-1.1	-0.8	3.2	-1.7	-1.5	-3.2	-3.3	-3.2	0.9	-0.6	-0.7	9.6	5.4	5.7
CRTS Goods and Services															
Agriculture, hunting and related services in these areas	0.8	-0.4	-0.2	6.3	1.2	1.4	-0.4	-0.5	-0.3	3.3	2.5	2.4	13.3	13.2	13.4
Forestry and related service activities	-3.4	-4.1	-3.8	-4.1	-5.7	-5.5	-1.0	-1.1	-0.9	-5.4	-5.7	-5.8	13.8	7.1	7.4
Fishing, fish farming and related services in these areas	0.9	-0.4	-0.1	6.9	1.6	1.9	-8.9	-9.0	-8.8	0.2	-0.6	-0.7	8.0	8.3	8.5
Mining and quarrying of energy minerals	1.6	0.4	0.6	16.8	10.0	10.2	2.5	2.5	2.7	4.0	3.1	3.0	-15.8	-12.0	-11.8
Mining and quarrying except energy	-4.5	-5.6	-5.4	-1.2	-5.4	-5.2	3.7	3.7	3.9	-8.2	-9.0	-9.1	-13.5	-11.8	-11.6
Manufacture of leather , leather products and footwear	3.2	1.6	1.8	13.7	7.8	8.0	-7.8	-7.8	-7.7	3.6	2.6	2.5	7.0	8.5	8.8
Production and distribution of electricity, gas and water	2.2	0.5	0.7	5.5	2.1	2.3	0.1	0.0	0.2	2.2	1.2	1.1	14.6	11.2	11.5
Construction	0.0	-1.4	-1.2	0.3	-3.5	-3.3	0.2	0.1	0.3	0.0	-1.0	-1.0	1.0	-0.5	-0.3
Hotels and restaurants	-3.1	-3.9	-3.7	-1.3	-3.7	-3.5	3.0	2.9	3.1	-5.1	-5.6	-5.7	12.1	11.0	11.2
Real estate renting and business services	2.1	0.5	0.7	5.7	1.1	1.3	0.9	0.8	1.0	1.5	0.4	0.4	190.4	102.8	103.3
Public services	0.0	-0.1	0.2	0.1	-0.2	0.0	0.0	0.0	0.2	0.1	0.0	0.0	17.9	-41.8	-41.7
Education	0.6	0.4	0.6	1.4	0.6	0.8	0.1	0.1	0.2	1.0	0.9	0.8	25.9	-35.0	-34.8
Health care and social services	0.6	0.3	0.6	1.1	0.7	0.9	0.1	0.0	0.1	0.9	0.8	0.8	14.3	-43.7	-43.6
Community, social and personal services	3.4	2.2	2.4	7.1	4.3	4.5	0.3	0.2	0.3	4.5	3.8	3.7	44.8	-15.9	-15.7

Source: Authors estimates.

Table 10. Export and Import Impacts of Key Policy Reforms

(Results are percentage change from benchmark)

	WTO Accession-Medium Term		WTO Accession -- Steady State		Russia's WTO Tariff Commitments		Only Non-Discriminatory Services Barriers--50% Reduction		Privatization Impact	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Business Services										
Trade, repair of motor vehicles, household appliances & personal items	13.1	5.6	17.2	14.5	3.0	1.5	23.8	7.0	8.0	30.4
Communication	8.2	-0.6	8.0	2.3	2.7	0.6	10.4	0.7	17.9	5.9
Insurance	1.3	11.9	4.1	15.7	3.2	0.0	34.7	-8.4	109.6	-15.3
Other financial services	-4.5	12.8	-1.6	16.3	3.2	0.0	6.8	6.5	99.6	-12.2
Other professional services (incl R and D)	0.4	-7.3	-1.4	-3.6	2.5	0.5	11.8	0.2	177.7	-48.7
Water rail transport and transport nec	38.5	15.4	37.3	10.8	2.3	1.0	71.0	-26.7	18.0	11.3
Air transport	13.5	-2.0	12.8	2.9	2.3	1.0	20.9	-5.2	17.7	11.6
Road transport	9.2	0.6	10.3	4.4	3.1	0.4	7.8	2.9	37.5	-0.8
Dixit-Stiglitz Goods										
Manufacture of food products , beverages & tobacco	-1.6	8.2	-1.7	15.1	4.8	3.5	-5.0	13.5	-8.1	37.6
Textiles and textile products	-1.5	8.3	-2.0	15.2	6.4	8.2	-3.1	12.2	-5.1	31.0
Manufacture of wood and of products of wood	-4.6	7.4	-6.0	11.8	-1.0	10.0	-8.7	11.4	7.3	11.2
Pulp and paper production. Publishing	2.2	3.7	5.3	6.6	-0.2	8.6	0.8	5.1	16.7	19.0
Manufacture of coke, refined petroleum and nuclear fuel	1.5	3.6	2.7	7.6	1.9	1.3	1.5	4.3	3.0	19.3
Chemicals and chemical products	1.7	2.9	7.2	6.5	4.6	1.9	-0.1	3.7	-3.9	15.6
Manufacture of rubber and plastic products	-0.9	2.0	0.2	3.9	10.9	9.4	-3.2	2.1	0.1	8.9
Manufacture of other non-metallic mineral products	0.9	2.7	1.6	4.4	3.0	8.4	-0.1	4.2	4.9	10.2
Manufacture of basic metals and fabricated metal products	1.2	1.8	2.8	3.4	4.3	0.9	0.5	1.7	2.8	9.6
Manufacture of machinery and equipment	-0.6	2.1	-0.7	4.0	6.9	0.0	-2.0	2.9	0.5	8.7
Manufacture of electrical and optical equipment	-0.9	2.4	-0.9	4.3	9.1	5.5	-2.5	2.9	0.1	14.3
Manufacture of transport equipment	-0.3	2.7	2.2	5.0	-5.3	4.0	-2.6	3.6	-0.5	13.3
Manufacturing nec	0.9	7.1	2.1	12.7	4.5	23.2	-0.7	12.2	7.6	27.8
CRTS Goods and Services										
Agriculture, hunting and related services in these areas	-2.9	21.5	5.4	24.9	-4.4	6.5	-4.3	12.8	3.9	31.8
Forestry and related service activities	-10.7	12.7	-16.2	23.6	1.4	-1.5	-15.9	17.3	23.3	6.7
Fishing, fish farming and related services in these areas	-3.9	7.4	4.7	11.0	-24.2	16.1	-8.0	10.5	-3.6	29.5
Mining and quarrying of energy minerals	159.9	2.3	346.1	4.2	38.2	1.6	280.9	2.5	120.3	9.3
Mining and quarrying except energy	-7.1	3.1	-2.8	4.8	7.1	0.5	-12.9	3.3	-19.0	9.5
Manufacture of leather , leather products and footwear	2.8	7.3	17.9	11.9	-15.5	3.5	1.9	10.9	0.1	31.4
Production and distribution of electricity, gas and water	1.2	4.2	3.7	8.8	2.0	0.5	-0.3	5.4	17.6	18.3
Construction	-1.7	3.0	-1.7	3.8	4.7	-2.0	-3.9	4.8	1.7	6.3
Hotels and restaurants	-8.4	12.9	-9.1	23.2	6.0	-0.4	-13.5	19.2	5.1	44.2
Real estate renting and business services	-3.9	12.3	-0.3	16.7	3.4	0.1	-9.2	18.9	744.3	-68.5
Public services	-8.7	11.0	-15.5	20.8	2.8	-0.4	-11.6	14.3	662.5	-84.9
Education	-7.8	11.2	-13.2	20.4	3.5	-1.0	-10.7	15.2	633.8	-80.5
Health care and social services	-7.0	9.9	-12.8	19.1	3.1	-0.6	-10.0	13.8	465.1	-77.0
Community, social and personal services	-1.7	9.8	-1.0	17.7	3.3	-0.5	-4.2	14.7	352.6	-52.2

Source: Authors' estimates.

Table 11. Number of Firms and Price* Impacts of Key Policy Reforms (Results are percentage change from benchmark)

	WTO Accession-Medium Term		WTO Accession -- Steady State		Russia's WTO Tariff Commitments		Only Non-Discriminatory Services Barriers--50% Reduction		Privatization Impact	
	Price	No. of Firms	Price	No. of Firms	Price	No. of Firms	Price	No. of Firms	Price	No. of Firms
Business Services										
Trade, repair of motor vehicles, household appliances and personal items	-6.2	4.3	-10.6	8.0	-0.2	0.6	-12.9	6.7	-29.5	9.7
Communication	-7.0	9.6	-10.7	12.0	0.0	1.1	-10.8	11.7	-34.5	21.8
Insurance	-16.2	16.8	-20.3	21.5	-0.1	0.5	-14.3	12.3	-42.3	36.4
Other financial services	-9.6	10.2	-13.9	14.6	-0.2	0.5	-8.5	6.7	-44.1	38.8
Other professional services (incl R and D)	-13.6	13.5	-16.9	16.4	0.1	0.6	-9.6	9.6	-54.5	81.8
Water rail transport and transport nec	-9.9	20.7	-12.3	21.6	0.2	0.8	-18.3	36.5	-29.7	14.3
Air transport	-4.9	8.7	-7.5	10.0	0.2	0.8	-10.1	13.1	-29.6	14.3
Road transport	-4.0	6.7	-7.0	8.8	0.0	1.2	-7.4	6.8	-32.7	23.5
Dixit-Stiglitz Good										
Manufacture of food products , beverages and tobacco	-1.8	3.0	-4.7	6.7	-0.2	0.9	-5.3	3.7	-26.1	11.7
Textiles and textile products	-2.0	2.6	-4.9	5.5	-0.7	1.2	-5.8	3.3	-26.6	9.7
Manufacture of wood and of products of wood	-1.0	-1.1	-3.9	-1.1	-0.8	-1.4	-4.1	-2.3	-28.7	4.3
Pulp and paper production. Publishing	-2.7	1.9	-6.4	4.3	-1.7	-1.0	-6.4	2.0	-30.3	12.7
Manufacture of coke, refined petroleum and nuclear fuel	-2.1	1.5	-5.2	3.1	0.4	0.5	-6.0	1.9	-27.3	4.1
Chemicals and chemical products	-2.7	1.4	-6.8	5.3	-1.6	1.8	-6.7	0.6	-28.8	-0.5
Manufacture of rubber and plastic products	-1.6	0.2	-4.6	1.7	-2.6	0.9	-5.2	-1.2	-26.8	1.6
Manufacture of other non-metallic mineral products	-2.0	0.7	-5.1	1.5	-0.5	0.0	-5.6	0.6	-27.6	3.6
Manufacture of basic metals and fabricated metal products	-2.2	0.8	-5.5	1.8	-1.0	-0.1	-6.1	0.2	-27.7	2.7
Manufacture of machinery and equipment	-1.8	0.0	-4.7	0.5	-0.1	1.1	-5.5	-0.4	-27.0	1.5
Manufacture of electrical and optical equipment	-1.9	0.3	-4.8	1.1	-1.9	1.3	-5.6	0.0	-27.2	4.8
Manufacture of transport equipment	-2.7	0.5	-6.5	2.3	-7.7	-3.5	-6.7	0.1	-29.7	2.7
Manufacturing nec	-2.4	1.8	-5.7	3.9	-1.7	0.4	-6.2	2.1	-28.3	10.2
CRTS Goods and Services										
Agriculture, hunting and related services in these areas	-1.2		-4.7		-0.1		-3.8		-25.1	
Forestry and related service activities	1.1		0.0		0.1		-1.6		-28.4	
Fishing, fish farming and related services in these areas	-1.1		-4.5		-2.1		-4.5		-25.6	
Mining and quarrying of energy minerals	-1.9		-5.0		0.5		-5.7		-27.1	
Mining and quarrying except energy	-1.4		-4.4		0.2		-4.9		-26.4	
Manufacture of leather , leather products and footwear	-2.2		-5.7		-0.2		-6.1		-26.6	
Production and distribution of electricity, gas and water	-1.4		-4.1		0.4		-4.9		-27.0	
Construction	-1.2		-4.0		-0.3		-4.5		-26.7	
Hotels and restaurants	-0.3		-2.5		0.0		-3.3		-25.3	
Real estate renting and business services	-0.1		-3.0		0.2		-2.7		-50.0	
Public services	0.6		-0.3		0.1		-2.4		-55.3	
Education	0.5		-0.7		0.0		-2.4		-53.6	
Health care and social services	0.3		-0.9		0.1		-2.7		-51.1	
Community, social and personal services	-0.4		-2.6		0.1		-3.4		-44.8	

Source: Authors' estimates.

Table 12. Impact of Individual Sector Services Reform: Discriminatory and Non-Discriminatory Reforms

(Results are percentage change in welfare from the benchmark as a percent of consumption)

	Static Welfare (Percent of Consumption)			Steady-state Welfare (Percent of Consumption)		
	All Services Barriers (50% Discriminatory Reduction and 25% Non-Discriminatory Reduction)	Only Non-Discriminatory Services Barriers (25% Reduction)	Only Discriminatory Services Barriers (50% Reduction)	All Services Barriers (50% Discriminatory Reduction and 25% Non-Discriminatory Reduction)	Only Non-Discriminatory Services Barriers (25% Reduction)	Only Discriminatory Services Barriers (50% Reduction)
All Business Services Sectors	**7.6**	**5.5**	**1.7**	**15.4**	**9.8**	**3.8**
Individual Business Services Sectors						
Trade and selected personal repairs	2.0	2.0	0.0	3.7	3.7	0.0
Communication	0.2	0.1	0.0	0.3	0.2	0.1
Insurance	0.1	0.0	0.0	0.2	0.1	0.1
Other financial services	1.7	0.6	1.1	3.7	1.1	2.4
Other professional services (including R&D)	0.8	0.3	0.4	1.9	0.6	1.1
Rail, water and other transport (not air or road)	2.3	2.3	0.0	3.7	3.7	0.0
Air transport	0.01	0.01	0.00	0.02	0.02	0.00
Road transport	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' estimates

Table 13. Piecemeal Sensitivity Analysis from WTO Accession and Privatization
(Results are percentage change from benchmark)

	Parameter Value			% EV WTO (Medium Term)			% EV Privatization		
	Lower	Central	Upper	Lower	Central	Upper	Lower	Central	Upper
σ(va, bs)**	0.75	1.25	1.75	6.6	8.2	10.6	31.8	36.2	44.6
$\sigma(q_i, q_j)$ – services sectors	2.50	3.00	4.00	10.9	8.2	6.3	47.1	36.2	30.9
$\sigma(q_i, q_j)$ – goods sectors*	x0.75	x1	x1.5	8.9	8.2	7.6	39.0	36.2	33.3
σ(D, M)	2.00	4.00	6.00	7.8	8.2	8.5	36.2	36.2	36.3
σ(L, K)	0.50	1.00	1.50	8.2	8.2	8.2	33.0	36.2	37.8
$\sigma(A_1,\ldots A_n)$	0.00	0.00	0.25	8.2	8.2	8.3	36.2	36.2	36.0
σ(D, E)	3.00	4.00	5.00	7.9	8.2	8.5	38.2	36.2	32.7
ε(Belarus)*	x0.75	x1	x1.5	7.7	8.2	8.8	34.8	36.2	38.1
ε(CIS)*	x0.75	x1	x1.5	8.2	8.2	8.2	36.1	36.2	36.3
ε(CU)*	x0.75	x1	x1.5	7.9	8.2	8.6	35.6	36.2	37.3
ε(EU)*	x0.75	x1	x1.5	7.9	8.2	8.7	35.4	36.2	38.1
ε(ROW)*	x0.75	x1	x1.5	7.8	8.2	8.8	35.3	36.2	38.2
θr	0.00	0.00	1.00	8.2	8.2	4.9	36.2	36.2	36.2
CRTS	0.00	0.00	1.00	8.2	8.2	3.0	36.2	36.2	21.7

Source: Authors' estimates.

*Note: See table 7 for the sets of elasiticity values for σ(qi, qj) and all ε elasticity values. For these elasticities, we scale the entire set of elasticities by the number indicated in the table. We placed a lower bound on sigma(qi,qj)--Goods of 2.0 to avoid numerical instability

**Note: In the "Privatization Upper" sensitivity run an upper bound of 1.70 was placed on sigma(va, bs) to avoid numerical instability.

Key:

$\sigma(q_i, q_j)$: Elasticity of substitution between firm varieties in imperfectly competitive sectors

σ(va, bs): Elasticity of substitution between value-added and business services

σ(D, M): Elasticity of substitution between domestic and imported varieties

σ(L, K): Elasticity of substitution between primary factors of production in value added

$\sigma(A_1,\ldots A_n)$: Elasticity of substitution in intermediate production between composite Armington aggregate goods

σ(D, E): Elasticity of transformation (domestic output versus exports)

ε(Belarus): Elasticity of national service firm supply with respect to price of output

ε(CU): Elasticity of Russia-Kazakhstan service firm supply with respect to price of output in Belarus

ε(EU): Elasticity of EU service firm supply with respect to price of output in Belarus

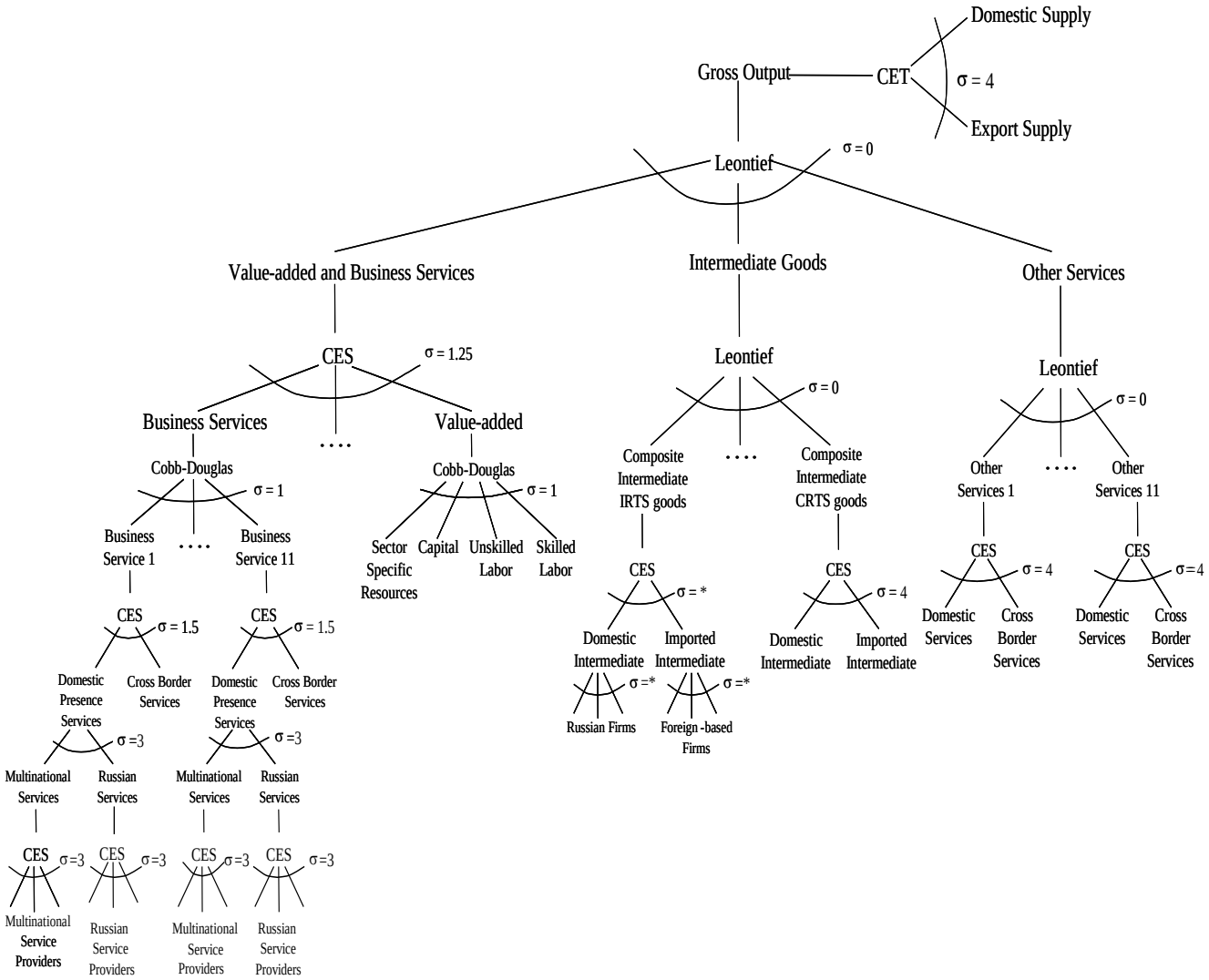
ε(CIS): Elasticity of CIS service firm supply with respect to price of output in Belarus

ε(ROW): Elasticity of Rest of World service firm supply with respect to price of output in Belarus

θ_r: Share of rents in services sectors captured by domestic agents

CRTS: Constant Returns to Scale, perfect competition

Figure 1. Production and Allocation of Output



*****Note: Elasticities of substitution in imperfectly competitive sectors (Dixit-Stiglitz elasticities) vary by sector and are listed in Table 7.

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Appendices

Appendix 1: Estimates of the Dixit-Stiglitz Elasticities of Substitution for Belarusian Imperfectly Competitive Goods

It was necessary for us to obtain estimates of the Dixit-Stiglitz product variety elasticities of substitution for the imperfectly competitive sectors in our model. In fact, since we do not have rationalization gains in our model, results will differ from a competitive model only to the extent that there is a Dixit-Stiglitz variety externality. Thus, we based our classification of goods sectors into perfectly competitive or imperfectly competitive based on the Dixit-Stiglitz elasticity values. High Dixit-Stiglitz values means the results will be very close to perfectly competitive, and we classified the sector as perfectly competitive.

Based on data for the years 1994-2003, Christian Broda, Joshua Greenfield and David Weinstein (2006) estimated Dixit-Stiglitz product variety elasticities of substitution at the 3 digit level in 73 countries. Belarus was not one of the countries for which Broda et al., estimated the elasticities. Among the 73 countries, there were three Transition countries bordering Belarus (Latvia, Lithuania and Poland), plus four other Transition countries in Central Europe: Croatia, Hungary, Slovakia and Slovenia. As a country that was also one of the Republics of the former Soviet Union, we chose Lithuania as the closest proxy for Belarus.

Broda et al., estimate 3 digit elasticities for 130 goods sectors, but there are 20 goods sectors in our model (plus 15 services sectors). We assumed that six sectors are perfectly competitive in structure or have high Dixit-Stiglitz elasticities of substitution, so classified these sectors as perfectly competitive.[51] For the remaining 14 sectors, it was necessary to map the sectors estimated by Broda et al. into the sectors of our model. In Table A1 of this appendix, we show the mapping for these sectors. (These elasticities are not relevant in our model for perfectly competitive sectors.)

Since there are often multiple sectors from Broda et al. mapped into a single sector in our model, it was necessary to determine a method of weighting the Broda et al. elasticities. There are reasons to use both export shares as well as import shares. A larger share of a subcategory in imports reflects more imports, and more likely there are more varieties of imports. So weighting by the import share of a subcategory is better than an unweighted measure. Domestic varieties are also important. Since we do not have production data for the subcategories, we use export shares as a proxy for domestic production by subcategory. Analogously, weighting subcategories by export shares is better than unweighted categories. Since both import shares and export shares are useful in the weighting, we take one half the shares of both exports and imports as the weights. The resulting elasticities are reported in Table A1. Except for leather and footwear, all the sectors have weighted average Dixit-Stiglitz elasticities that are sufficiently low that we classify them as Dixit-Stiglitz goods. Leather and footwear was classified as perfectly competitive.

Broda, Christian, Joshua Greenfield and David Weinstein (2006), "From Groudnuts to Globalization: A Structural Estimate of Trade and Growth," National Bureau of Economic Research Working Paper 12512. Available at: http://faculty.chicagobooth.edu/christian.broda/website/research/unrestricted/TradeElasticities/TradeElasticities.html.

[51] These sectors are: agriculture, forestry, fishing, the two mining sectors and production of electricity, gas and water,

Table A1. Estimated Elasticities of Substitution for Varieties in Belarusian Imperfectly Competitive Goods Sectors

Sector in our Model	Matching HS-3 Code from Broda et al estimates	weighted elasticity of substitution
Food, Beverages & tobacco	160-240	5.25
Wood and Wood Products	441-470	2.20
Paper, pulp and publishing	480,481,482	2.52
Petroleum, Coke and Nuclear	270, 271	3.96
Chemicals	280-382	2.68
Manufacture of rubber and plastic products	390-401	5.58
Manufacture of other non-metallic mineral products	680-702	3.37
Manufacture of basic metals and fabricated metal products	720-831	3.52
Manufacture of machinery and equipment	840-848	7.95
Manufacture of electrical and optical equipment	850-854	6.08
Manufacture of transport equipment	860-890	2.35
Other manufacturing	900-961	3.75
Textile and apparel	500-631	6.07
Leather and footwear*	410,411, 420, 430, 640, 650, 660, 670	39.05

*Leather and footwear was classified as perfectly competitive, given its high elasticity value.
Source: Authors' calculations based on estimates from Broda, Greenfield and Weinstein (2006).

Appendix 2: Antidumping Cases Initiated Against Belarus and Estimated Export Price Increase from Improved Legal Rights of WTO membership

In antidumping and countervailing duty actions, WTO members are guaranteed an injury determination in which the antidumping duty will not be applied if it is found that the domestic industry was not injured by the imports. Non-WTO members are not assured of an injury hearing. Consequently, Belarus may expect some small improved market access as a result of WTO membership to the extent that antidumping has been an issue in certain sectors. In this appendix, we list the antidumping and countervailing actions against Belarus and estimate price increases by sector for Belarus as a result of WTO membership.

Chad Bown of the World Bank research department maintains a database of antidumping and countervailing duty actions in the world.[52] The latest version of the database is explained in Bown (2014). Based on this database, we list below, all antidumping and countervailing duty cases initiated against Belarus by the EU, Russia, Ukraine, Poland, Latvia, Lithuania, China or the US. We have found only antidumping cases against Belarus; there are no countervailing duty cases against Belarus in the database of these countries. We list the country that initiated the case, the product exported by Belarus and the date the case was initiated. We summarize the data for the sectors of our model and indicate our estimated export price increases as follows:[53]

(i) Manufacture of basic metals and fabricated metals (MET). There were three cases by the EU against pipes and tubes from Belarus in the past 7 years. We assume a 1.5 percent export price increase as a result of WTO accession.

(ii) Non-metallic mineral products (NMM). In 2011, Ukraine initiated cases against float glass and also corrugated cement-asbestos; Lithuania and Latvia initiated antidumping cases against cement from Belarus in 2000 and 2001, respectively. We assume a 1 percent export price increase from WTO accession.

(iii) Rubber and plastic products (RUB). There was a case by Ukraine against rubber tires for motor vehicles from Belarus in 2010. We assume a 1 percent export price increase from WTO accession.

(iv) Textiles and textile products (TEX). There were two cases by the EU against fibers and yarn, the most recent of which was 2004; and there were two cases by Poland in 1999 against synthetic fibers of polyester from Belarus. We assume a 0.5 percent export price increase from WTO accession.

(v) Chemicals and chemical products (CHM). The EU initiated four cases in this sector (potassium chloride in 1990, ammonium nitrate in 1992 and ammonium nitrate and urea in 1999 and urea in 2000). We assume a 0.5 percent export price increase from WTO accession.

[52] The data are available at the following link: http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTPROGRAMS/EXTTRADERESEARCH/0,,contentMDK:22561572~menuPK:544860~pagePK:64168182~piPK:64168060~theSitePK:544849,00.html

[53] We assume no remaining impact from the antidumping case on uranium from Belarus in the US in 1991 and lime from Belarus in Lithuania in 2000.

Appendix 3: Labor Productivity in 2010 and Estimated Change in Labor Productivity from Shifting from State to Private Ownership

In this appendix, we explain how we calculate the productivity changes in the economy for a shift of ownership from the state sector to the private sector. We explain the eight steps in the calculations as they correspond to the data in Table A2

1 and 2. Data on Value Added and Employment

We base our calculations on a dataset we obtained from Belstat on value-added and labor employment for six aggregate sectors, where value-added and employment are broken down into three classes of ownership: (state, mixed and private). The data are available for the years 2004 to 2010. We base our productivity index on the year 2010 and report the value-added and employment data for the six sectors and by class of ownership in the first two sections of Table A2.

3 Labor Productivity by Sector and Class of Ownership

We divide value added from Section 1 of the table by employment from Section 2. The results are in Section 3 of Table A2.

4 and 5. Index of Productivity and Value-Added Shares by Sector

Based on the above data, we calculate the weighted average labor productivity in each of the six sectors in the year 2010, using the share of value-added in the sector as the weights**.** The share of value-added calculations are in Section 4 of Table A3 and the weighted average productivity measures of each sector are in Section 5 of Table A2. Formally, the process is as follows.

In general, with data for multiple years, we have the following as the weighted average labor productivity by sector in year t.

$A_{i,t} = \alpha s_{i,t} PS_{i,t} + \alpha m_{i,t} PM_{i,t} + \alpha p_{i,t} PP_{i,t}$ t=2004,…, 2010, i=1,…6 (our six sectors)

Where $\alpha s_{i,t}$ is the share of value added captured by state owned firms in sector i in year t; $\alpha m_{i,t}$ is the share of value added captured by mixed firms in sector i in year t; and $\alpha p_{i,t}$ is the share of value added captured by private firms in sector i in year t; and $PS_{i,t}$ is labor productivity of state owned firms in sector i in year t; $PM_{i,t}$ is labor productivity of mixed owned firms in sector i in year t; and $PP_{i,t}$ is labor productivity of private firms in sector i in year t. As our benchmark parameter, for each sector, we take the most recent year $A_{i,2010}$.

6 and 7. Value-Added Shares and Weighted Average Productivity in the Counterfactual Scenario.

We wish to assess the impact of an increase of the private share of the economy with a decrease in the share of the economy that is state owned. In our counterfactual scenarios, we assume that in each of our six aggregate sectors, the state share is decreased by 50 percent and the private sector share increases by an identical amount. The results are in Section 6 of Table A2. Using these hypothetical shares, we then calculate weighted average labor productivity by sector and show these results in Section 7 of Table A2. Formally, using the above notation, A^*_{it} is our new hypothetical weighted average labor productivity measure, assuming the change in ownership shares as mentioned above.

$$A*_{i,2010} = \alpha s_{i,2010} PS_{i,2010} * 0.5 + \alpha m_{i,2010} PM_{i,2010} + (\alpha p_{i,2010} + .5\ \alpha s_{i,2010}) PP_{i,2010}$$

8. Percentage Change in Weighted Average Labor Productivity by Sector

We calculate the ratio of the weighted average labor productivity by sector in the counterfactual to the analogous index in 2010 and convert this into the percentage increase in productivity by sector. That is, we calculate the following.

$[(A*_{i,2010}/A_{i,2010}) - 1] * 100$ i=1,…6 (i=our six aggregate sectors in Table A3).

The results are reported in section 8 of Table A3.

9 Mapping of our Six Aggregate Sectors to the Sectors of Our Model.

The final step is to map the six aggregate sectors to the 35 sectors of our model. That mapping is defined in Table 1 of the main text. In the counterfactual of our central privatization scenario, we assume that skilled and unskilled labor productivity increases by the percentages shown in Table A3 for the sectors of our model that correspond to these aggregate sectors.

Table A3. Calculation of the Change in Labor Productivity from Shifting from State to Private Ownership in Belarus, based on 2010 data.

	National economy	Agriculture and forestry	Construction	Industry	Trade and catering	Transport and communications	Other services
1. Value Added (billions of Belarusian 2010 rubles)							
State	51638	2501	4227	9143	2190	9111	24467
Mixed	27572	1268	5547	15926	872	3298	660
Private	65578	10670	8131	14933	14446	3234	14165
		14438.1	17905.0	40002.4	17507.5	15642.8	39292.0
2. Employment (in thousands of employees in 2010)							
State	1933	141	94	252	64	189	1192
Mixed	691	63	108	365	47	41	68
Private	1309	200	163	412	336	64	135
3. Labor Productivity in 2010							
State	26.72	17.70	44.92	36.22	34.00	48.33	20.53
Mixed	39.90	20.28	51.22	43.66	18.71	80.84	9.70
Private	50.09	53.29	49.82	36.26	43.03	50.76	105.24
4. Value Added Shares (2010)							
State		0.173	0.236	0.229	0.125	0.582	0.623
Mixed		**0.088**	**0.310**	**0.398**	**0.050**	**0.211**	**0.017**
Private		0.739	0.454	0.373	0.825	0.207	0.361
5. Weighted Average Labor Productivity in 2010							
State		3.07	10.60	8.28	4.25	28.15	12.78
Mixed		1.78	15.87	17.38	0.93	17.05	0.16
Private		39.38	22.63	13.54	35.51	10.49	37.94
Total		44.23	49.10	39.20	40.69	55.69	50.88
6. Value Added Shares (Counterfactual Scenario)							
State		0.087	0.118	0.114	0.063	0.291	0.311
Mixed		0.088	0.310	0.398	0.050	0.211	0.017
Private		0.826	0.572	0.488	0.888	0.498	0.672
7. Weighted Average Labor Productivity (Counterfactual Scenario)							
State		1.53	5.30	4.14	2.13	14.08	6.39
Mixed		1.78	15.87	17.38	0.93	17.05	0.16
Private		44.00	28.51	17.68	38.20	25.28	70.70
Total		47.31	49.68	39.20	41.26	56.40	77.26
8. Percentage Change in Labor Productivity in Counterfactual Scenario							
		7.0%	1.2%	0.0%	1.4%	1.3%	51.8%

Source: Authors'calculations based on value-added and employment data supplied to the World Bank by Belstat. See World Bank (2012) for further details on the data.

Appendix 4: Construction of a Social Accounting Matrix (SAM) and Benchmark Calibration for Belarus for 2011

1. The Original Matrix:

The file explains our constructed SAM together with raw data. The SAM and the data are in the file "SAM_Belarus_2.xlsx", the final SAM can be found in the spreadsheet "SAM2011". Data sources are described in Section 3.3 of the main text.

1.A. Activity columns:

1.A.1. Intermediate Demand (Activity Column<a>/Commodity Row <b>):

Intermediate demand is reported in user prices, that are basic prices (given in spreadsheet "IO_basic_Цены осн") plus trade and transport margins in consumer prices (given separately in spreadsheets "trade_margins_Торг наценки" and "transp_margins_Трансп наценки", however, according to the description of the Belstat methodology these margins are already built in to the gross output of each sector).

Total trade and transport margins are added to intermediate demand of trade *<a22>* for trade *<b22>* and transport *<a24>* for transport *<b24>* (accordingly, total margins are added to output of trade and transport as explained in *1.B.1.*).

1.A.2. Factor Remuneration (Activity Column <a>/Factor Row <c>):

Data on factor remuneration per activity is taken from the IO table at basic prices (spreadsheet "IO_basic_Цены осн").

1.A.3. Taxes and Subsidies (Activity Column <a>/Government <e>):

For each activity, taxes on production are taken from the IO table at basic prices (spreadsheet "IO_basic_Цены осн"). The information is reported in row *<e01>*. Taxes and subsidies (negative values) on commodities per activity are given in the IO table at basic prices (spreadsheet "IO_basic_Цены осн") and reported in row *<e02>* of the SAM. There are subsidies on commodities (concerning intermediate consumption) in the following four sectors: agriculture (a01), mining and quarrying of energy materials (a04), pulp, paper production and publishing (a10), production and distribution of electricity, gas and water (a20).

Sum per Activity: The sum for each activity column equals the total industry output per activity in the IO table at basic prices. The sum over all activities equals to the total output at economy-wide level.

1.B. Commodity columns

1.B.1. Total supply (Commodity Column<b>/Activity Row <a>):

Under the assumption that each sector produces only one principal good, total supply per activity and commodity is given by the total industry output at basic prices in spreadsheet "Resources-Ресурсы".
In addition to industry output, total trade and transport margins are also added to the rows of trade *<a22>* and transport *<a24>*. Margins are taken from the spreadsheets "trade_margins_Торг наценки" and "transp_margins_Трансп наценки".

1.B.2. Taxes/Subsidies on Commodities (Commodity Column <b> /Government Row <e>):

Data on taxes and subsidies (negative values) per commodity is calculated in spreadsheet "tax-subsidy". It is the difference between total tax payments and tax payments for intermediate consumption (the last ones are described in 1.A.3. - row *<e02>*). There are subsidies on

commodities in the following four sectors: transport (b24), real estate and business services (b29), health care and social services (b29), community, social and personal services (b30).

1.B.3. Imports (Commodity Column<b>/Rest-of-the-World Row <h>):

Data on imports per commodity is taken from the IO table at basic prices (given in spreadsheet "Resources-Ресурсы").

1.C. Factor columns

1.C.1. Household factor income (Factor Column<c>/Household Row <d>):

Data on factor income of households ('Gross operating surplus, mixed income' and 'Compensation of employees') is taken from the National Accounts for Belarus for 2011[54] (available in the spreadsheet "income distribution"). The values are adjusted as, in contrast to the IO table, the initial values in National Accounts are rounded up to one decimal in billions.

1.C.2. Government factor income (Factor Column<c>/Government Row <e>):

Data on 'Gross operating *surplus*, mixed income' of the government is taken from the National Accounts for Belarus for 2011 (see sheet "income distribution").[55]

1.D. Household column

1.D.1. Household consumption (Household Column<d>/Commodity Rows <b>):

Household demand is given in consumer prices, taken from the IO table at consumer prices (spreadsheet "IO_cons_Цены пок"). Some adjustments are made for SAM calibration:

- In contrast to the rest of the data, private consumption of b22-b24 (trade, hotel and restaurants, transport and communication) is given with three decimals. These values are rounded up to get a balanced SAM.
- For mining and quarrying of energy minerals (b04) we could not move the negative changes in inventories as described in 2.B. because it caused a negative indirect tax on intermediates over -200 percent after reducing the intermediate demand. That is why we reduce the household consumption in b04 and savings of households (column <d>7/row <f>).
- For manufacture of leather, leather products and footwear (b08) we initially observe positive changes in inventories, but tax payments of 13982 (see cell AK12 in the spreadsheet "tax-subsidy") are higher than the positive changes of inventories of 10778. It caused a negative indirect tax over -400 percent. That is why we move these changes in inventories just like for b04 to the household account (we increased household consumption and indirect tax payments and adjusted the savings of the household (column <d>7/row <f>)).

1.D.2. Transfers to government (Household Column<d>/Government Row <e>):

Usually transfers from households to government consist of current taxes on income, wealth etc. as well as of payments for property income and social contributions, social benefits other than social transfers in kind and other current transfers (see spreadsheet "income distribution").[56] In the SAM

[54] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.
[55] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.
[56] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.

this figure is received as a balancing item: total household income (sum over household row <d>) minus aggregate household consumption (1.D.1) minus household savings (1.D.3).

1.D.3. Household savings (Household Column<d>/Savings-investment Row <f>):

Data on (gross) household savings is taken from the National Accounts for Belarus for 2011 (spreadsheet "income distribution").[57] However, private savings are adjusted by negative and positive changes in inventories in b04 and b08 (see 1.D.1.).

1.E. Government column

1.E.1. Government consumption (Government Column<e>/Commodity Rows <b>):

Government demand is given in consumer prices, taken from the IO table at consumer prices (spreadsheet "IO_cons_Цены пок").

1.E.2. Transfers to households (Government Column<e>/Household Row <d>):

Transfers from government to households consist of payments due to property income as well as social contributions, social benefits other than social transfers in kind and other current transfers. However, it is not possible to calculate these from National Accounts for Belarus as there is no detailed balance with payers and beneficiaries. That is why we assume that there is no such a transfer (there is a single net government-household transfer described in 1.D.2).

1.E.3. Government savings (Government Column<e>/Savings-investment Row <f>):

Data on (gross) government savings is taken from the National Accounts for Belarus (spreadsheet "income distribution").[58]

1.F. Savings-investment column

1.F.1. Savings-investment demand (Savings-investment Column<f>/Commodity Rows <b>):

Savings-investment demand is given in consumer prices, given by the IO table (spreadsheet "IO_cons_Цены пок").

1.F.2. Balance between 'Savings-investment' and 'Changes in inventories' (Savings-investment Column<f>/Changes in inventories Rows <g>):

The link between "Savings-investment" and "Changes in inventories" is a balancing item (in the model the both accounts will be aggregated, here we report them separately to identify negative changes in inventories as depreciation). It is equal to the sum of changes in inventories (column <f>).

1.G. Changes in inventories column

1.G.1. Changes in inventories demand (Changes in inventories Column<g>/Commodity Rows <b>):

Changes in inventories demand is given in consumer prices, given by the IO table (spreadsheet "IO_cons_Цены пок"). For b04 and b08 these values are adjusted to zero as described in 1.D.1. In addition, the values for agriculture (b01) and mining and quarrying (b05) are rounded up as these were reported with three decimals.

[57] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.
[58] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.

1.H. Rest of the world column

1.H.1. Exports (Rest of the World Column<h>/Commodity Rows <b>):

Exports by commodity are given in consumer prices, given by the IO table (spreadsheet "IO_cons_Цены пок").

1.H.2. Compensation of employees (Rest of the World Column<h>/Factor Rows <c>):

Compensation of employees from the Rest of the World is taken from the National Accounts for Belarus.[59]

1.H.4. Transfers to government (Rest of the World Column<h>/Government Row <e>):

This figure is the last balancing item between the government row <e> and column <e> – the transfers between the government and abroad.

1.H.5. Current exter`nal balance (Rest of the World Column<h>/Savings-investment Row <f>):

The current external balance is taken from the National Accounts for Belarus.[60] This value is adjust by statistical discrepancy (net lending) of 5 538,5 reported in the capital account.

2. Modifications and Adjustments:

The following modifications are executed in 'sam1.gms'

2.A. Exports:

The original SAM reports exports by commodity in the commodity accounts, whereas the standard general equilibrium framework considers them as part of output by activities. Therefore, exports are eliminated from commodity accounts and moved to the activity account that produces the respective commodity as principal good. Accordingly, original total supply of each activity account has to be reduced to domestic output (by subtracting exports).

As the "tax-subsidy" sheet also reports taxes on exports of commodities, these taxes on products are also moved from the commodity accounts to the corresponding activity accounts (and added to output of this activity). Similarly, the trade and transportation margins on exports are also moved to the respective activity accounts.

Additional adjustment: re-exports are reported for mining and quarrying of energy minerals (b04) and for manufacture of transport equipment (b18) (see imports_2011.xls, cells AK8 and AK22). That caused a negative output after calculating domestic output for domestic market. That is why we adjusted the trade flows by these reexports, so they are not included any more.

2.B. Negative changes in inventory:

For some commodities the SAM reports negative changes in inventories. To avoid this we shift them as additional costs to the activity account, which means we interpret negative changes in inventories as net depreciation of the activity that produces the respective commodity. This also requires adjustment of intermediate demand of the activity for the respective commodity (reducing total costs to their initial levels), as well as moving the corresponding taxes/subsidies on commodities from commodity to activity accounts. The exceptions are the changes made for (b04) and (b08) described in 1.D.1.

[59] National Statistical Committee of the Republic of Belarus (2013), pp. 274-276.
[60] National Statistical Committee of the Republic of Belarus (2013), p. 276.

2.C. Negative operating profits

Negative operating profits (returns to capital) as reported in the original SAM for "financial intermediation services indirectly measured" (a31) are not possible in a general equilibrium framework. Hence, we use the following adjustment procedure: The negative operating profit as well as intermediate demand of this activity (there is only one entry for *'Financial intermediation' <b25>*) is allocated across all other sectors according to the weight of operating profits of a given sector in economy-wide operating profits. Then, activity *<a31>* and commodity *<b31>* are eliminated from the SAM.

2.D. Revenue from import tariffs for intermediate demand

The "tax-subsidy" sheet reports all revenue from taxes on products, including revenue from import tariffs. Hence, for imports used in intermediate consumption, also the basic SAM reports revenue from import tariffs in the activity accounts. To report all revenue from import tariffs in the commodity accounts, we first calculate tariff revenue from imports to intermediate demand using additional import data (file imports_2011.xlsx and weighted import tariffs), and then move it to the commodity accounts.

2.E. Current account

The current account balance of 15808327 m BYR (1.H.5.) is moved to the government account. We increase the initial savings of the government by this current account balance and create a balancing item as a transfer from the government to abroad which is always constant.

3. Disaggregation of Labor and Services:

3.A. Disaggregation of services

Three services sectors (transport and communications (a24), financial activities (a25) and real estate, renting and business services (a26)) are disaggregated according to the shares of value-added in the sector of IO table (see Table A3.1). The shares of subsectors are calculated using additional data provided by the Belstat. Disaggregation is done in file services_disaggr_ejb.gms and details on decomposition are provided in Table A4.1.

Table A4.1.

Aggregate sectors (basic SAM)		Disaggregate sectors		shares
a24	Transport and communications	a24_w	Water, rail transport and transport nec	0,520
		a24_a	Air transport	0,011
		a24_r	Road transport	0,265
		a24_c	Communication	0,205
a25	Financial activities	a25_i	Insurance	0,031
		a25_f	Other financial services	0,969
a26	Real estate, renting and business services to consumers	a26_r	Real estate, renting and business service	0,614
		a26_ps	Other professional services (incl. R&D)	0,386

Source: Authors' estimates

3.B. Disaggregation of labor

We disaggregate labor into skilled and unskilled according to the level of education. Using data on the number of employees by education level and economic activity for 2012[61] we calculate the shares of skilled and unskilled labor in the total employment by sector. Hereby we assume that employees with post-secondary education and a second group referred to as possessing "professional technical" education represent skilled workers whereas the rest is aggregated to unskilled labor (secondary special education, general secondary and basic education). To calculate the shares of labor remuneration by sector and skill level we assume the wage rate in agriculture (1331.2 thousand BYR) for unskilled labor, the average wage across all sectors (1899.8 thousand BYR) for workers with professional technical education and the wage in manufacturing (2093.4 thousand BYR) for workers with post-secondary education.[62] Calculations can be found in the file Labor_Shares_by_Skill1.xlsx and the resulting shares of labor remuneration (applied in the file datainput1.gms for disaggregation) are illustrated in A4.2.

Table A4.2.

Sector		unskilled	skilled
AGR	a01	0,576	0,424
FRS	a02	0,521	0,479
FSH	a03	0,462	0,538
ENM	a04	0,457	0,543
OMN	a05	0,457	0,543
FPR	a06	0,443	0,557
TEX	a07	0,391	0,609
LEA	a08	0,407	0,593
LUM	a09	0,498	0,502
PPP	a10	0,353	0,647
P_C	a11	0,267	0,733
CHM	a12	0,359	0,641
RUB	a13	0,425	0,575
NMM	a14	0,464	0,536
MET	a15	0,414	0,586
OME	a16	0,432	0,568
EOE	a17	0,418	0,582
OTN	a18	0,510	0,490
OMF	a19	0,443	0,557
UTL	a20	0,483	0,517
CNS	a21	0,399	0,601
TRD	a22	0,404	0,596
H_R	a23	0,435	0,565
TRC	a24	0,488	0,512
FIN	a25	0,206	0,794
OBS	a26	0,280	0,720
PUB	a27	0,180	0,820
EDU	a28	0,277	0,723
HSS	a29	0,603	0,397
CSP	a30	0,435	0,565

Source: Authors' estimates

[61] National Statistical Committee of the Republic of Belarus (2012).
[62] National Statistical Committee of the Republic of Belarus (2012a), p. 229.

Additional Data Used For Modeling

- Imports_2011.xlsx – detailed matrix of imports including imports for intermediate consumption.
- Margins_exp_2011.xlsx – trade and transport margins for exports – taken from SAM_Belarus_2.xlsx, spreadsheets "transp_margins_Трансп наценки" and "trade_margins_Торг наценки".
- Tariffs_1_2011.xlsx and tariffs_1_2020 – trade weighted tariff rates calculated for the sectors of the model (using the trade weighted tariffs for 2011 and for 2020).
- Taxes&subsidies_2011.xlsx – detailed matrix of tax and subsidy payments.
- Tradeshares_IO.xlsx – shares for disaggregation of trade flows by regions (CU, CIS, EU and ROW) – calculated using the Belstat trade data for 2011.

Appendix 5: The Elasticity of Varieties with Respect to Price

Grossman and Helpman (1991) have developed models of economic growth that have highlighted the role of trade in a greater variety of intermediate goods as a vehicle for technological spillovers that allow less developed countries to close the technological gap with industrialized countries. Similarly, Romer (1994) has argued that 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.[63] 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 percent 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. In business services, because of the high cost of using distant suppliers, the close availability of a diverse set of business services may be even more important for growth than in goods. The evidence for this was cited in the introduction section.

Beginning with the path-breaking work of Coe and Helpman (1995), a rich literature now exists that has empirically investigated the transmission of knowledge through the purchase of imported intermediate goods and through foreign direct investment. Coe and Helpman found that OECD countries benefit from foreign research and development (R&D); that they benefit more from trading with countries that have a larger stock of R&D, and that 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; that is, foreign R&D is more important for small countries. Coe, Helpman, and Hoffmaister (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 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 U.S. are the largest, since the U.S. stock of R&D is the highest and it is the most important trading partner for many developing countries. A one percent increase in the R&D stock of the U.S. raises total factor productivity for all 77 developing countries in their sample by 0.03 percent. By comparison, a one percent increase in the R&D stock of Japan, Germany, France or the U.K. raises total factor productivity only between 0.004 percent and 0.008 percent. Crucially, they find that countries that trade more with the U.S., such as the Latin American countries, get more productivity spillover increases from the U.S. R&D stocks. And 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 et al., (2002) 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 U.K. embody some U.S. technology due to U.K. imports from the U.S. Since the data show that OECD countries have the vast majority of R&D stocks,[64] it implies that it is important for

[63] Trade or services liberalization may increase growth indirectly through its positive impact on the development of institutions (see Rodrik, Subramananian and Trebbi, 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.

[64] Coe, Helpman and Hoffmaister (1997) calculate that 96 percent of the world's R&D expenditures took place in industrial countries in 1990 and this number stood at 94.5 percent in 19995.

small developing countries to trade with large technologically rich countries, such as the U.S. and the EU, at least indirectly.

Regarding the impact of FDI on the productivity of firms, the results depend on intra-industry versus inter-industry impacts. Since FDI in the same industry may bring spillovers, but has an adverse competitive or market share impact, the literature has found mixed results on the productivity of firms in the same industry that receives the FDI. But several papers have found significant productivity spillovers from FDI in both upstream (supplying) industries (e.g., Javorcik, 2004; Blalock and Gertler, 2008; and Javorcik and Spatareanu, 2008) and downstream (using) industries (e.g., Wang, 2010; Jabbour and Mucchielli, 2007; and Harris and Robinson, 2004).

Schiff and Wang (2006) estimate the relative importance for technology diffusion to developing countries of trade with industrialized versus developing countries. They note that technology from the industrialized countries may indirectly diffuse to a developing country through trade with another developing country, if the other developing country has traded with industrialized countries. They conclude that trade with industrialized countries has a stronger impact on productivity in developing countries and that spillovers from developing country trade occurs with more of a lag. They find that the elasticity of productivity (TFP) with respect to current trade with all industrialized countries is 0.16, but only 0.01 for current trade with all developing countries. That is, trade with the industrialized countries in 16 times better for productivity spillovers. In addition, since trade may be expected to have an impact on productivity with a lag, Schiff and Wang estimate the impact of lagged trade with developing countries. They find that the productivity spillovers from current trade with industrialized countries are only about 1.5 times greater than the productivity spillovers from lagged trade with developing countries.[65] Moreover, Schiff et al. (2002) show that developing country trade with technologically advanced countries is very important in technology intensive sectors, but trade with developing countries can be important for productivity spillovers in less technologically complex products in which developing countries have comparative advantage. So on low R&D products like footwear and textiles and apparel, trade with China and Indonesia could be as important for technology diffusion as trade with the EU and the US.

In summary, this literature shows that the purchase of intermediate inputs and FDI from industrialized countries is an important mechanism for the transmission of R&D and productivity growth in developing countries. For small developing countries, trading with large technologically advanced countries is crucial for TFP growth. But for products in which developing countries have a comparative advantage, developing country trade may be important for spillovers.

In our model, the parameter that reflects the ability of a region to increase total factor productivity through the transmission of new technologies is the elasticity of varieties with respect to the price. Schiff *et al*., (2002, Table 1) have shown that for R&D intensive sectors, trade with industrialized countries contributes significantly to total factor productivity in developing countries, but trade with developing countries does not. Averaging over the industries in Schiff *et al*.,(2002, Table 3) yields that trade with industrialized countries in R&D intensive products is about eight times more valuable for developing country TFP increases. On the other hand, for sectors that are low in R&D intensity, their results suggest that for technology diffusion trade with developing countries can be as important as trade with industrialized countries.

Based on these considerations, we first classify the increasing returns to scale sectors of our model into low, medium and high technology sectors. The classification is defined by the share of R&D expenditures in total sales, based on U.S. data and we use this information to set the elasticities of firm supply in each region by sector. The greater the elasticity of firm supply in a sector the more varieties will be received in response to a price increase with respect to that country. In manufacturing, for low R&D intensive sectors, we assume that the elasticity of firms with respect

[65] Schiff and Wang do not compare lagged industrialized trade to lagged developing country trade, which may bias the results against the relative benefits of industrialized trade.

to price is the same in all regions, at 3.3. For medium and high R&D intensive sectors, we assume that the elasiticty of supply in Belarus, the CIS+Georgia and Russia-Kazakhstan is 3.3, but it is 6.6 in the EU and the ROW. In chemicals and metals, where Russia is internationally competitive, we increase the elasticity of supply to the same as the EU (and also in transport equipment for Russia, since Russia has a substantial and developing auto sector). In business services, we generally follow this pattern, but we allow the elasticity of the EU and the ROW to vary more depending on the R&D intensity of the sector, where we allow for more technology diffusion in more R&D intensive sectors. The results of these assumptions are in table 7. We conduct sensitivity analysis on these parameters, to determine the impact of this parameter on the results.

Appendix 6: Aggregation of Common External Tariffs of Belarus-Kazakhstan-Russia Customs Union to the Products of the Belarus CGE Model

As a member of the Belarus-Kazakhstan-Russia Customs Union, Belarus will be called upon to change its tariffs due to Russia's WTO commitments. Russia has made tariff commitments that will be phased in over a period of eight years from 2012 to 2020. In our tariff scenario, we assess the impact on Belarus of the tariff reductions it will implement due to Russia's WTO commitments. We use the trade weighted tariff rates for 2011 as our benchmark tariff rates. In 2011, the common external tariff of the Customs Union was applied in both Belarus and Russia; and it was the last year that the tariffs in Russia were not impacted by its WTO accession commitments. Based on the projected tariff rates of the Customs Union due to Russia's WTO accession tariff commitments, we use the projected tariff rates of the Customs Union for 2020 as our counterfactual tariff rates.

To be clear, we are not assessing the impact on Belarus of its initial change in its tariffs in 2010 to implement the common external tariff of the Customs Union. By using 2011 as our benchmark equilibrium, we take the implementation of the common external tariff of the Customs Union by Belarus as part of the initial status quo or "benchmark" equilibrium; and we assess the implications for Belarus of the reductions in the common external tariff of the Customs Union.

Shepotylo and Tarr (2013) have calculated Russian tariffs for all years from 2001 to 2011 based on actual tariffs in Russia and project tariff rates forward from 2012 to 2020 based on Russia's WTO commitments to lower tariffs. They have calculated tariffs at the 10-digit level, where they have calculated the ad valorem equivalents (AVEs) for mixed and specific tariffs at the 10-digit level. Thus, the Shepotylo and Tarr dataset is available as a fully ad valorem dataset. Our calculations are a trade-weighted aggregation of the Shepotylo and Tarr ad valorem tariff rates, aggregated to the sectors of our model.

The aggregation was done in two steps. First, Shepotylo and Tarr provided us with a trade-weighted aggregation of the 10-digit ad valorem rates, aggregated to the 6-digit level of the Harmonized System, version 2007. We then aggregated from the 6-digit level of HS 2007 to the sectors of our model, using a number of correspondence tables. As there is no direct correspondence between HS 2007 and ISIC Rev. 3/NACE Rev. 1 (which constitute the base classifications for the data used in the model), we constructed a new correspondence using the following sources:

- The correspondence table between HS 2007 and HS 1996 available at http://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1.
- The correspondence table between HS 1996 (6-digit) and ISIC Rev.3 (4-digit) available also at http://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1.[66]
- Correspondence between the sectors of our model and ISIC Rev. 3/NACE Rev.1. shown in Table A6.1.

[66] 49 available 6-digit tariff lines are not mapped according to the correspondence tables. These were mapped by hand to the 2-digit of NACE Rev. 1 classification and are listed in the Table 3.

Table A6.1. Correspondence Between the Sectors of the Model and NACE Rev. 1/ISIC Rev. 3

Sectors of the model		NACE Rev. 1	ISIC Rev. 3
AGR	Agriculture, hunting and related services in these areas	01	011-015
FRS	Forestry and related service activities	02	020
FSH	Fishing, fish farming and related services in these areas	05	050
ENM	Mining and quarrying of energy minerals	10,11,12	101-120
OMN	Mining and quarrying except energy	13,14	131-142
FPR	Manufacture of food products , beverages and tobacco	15,16	151-160
TEX	Textiles and textile products	17,18	171-182
LEA	Manufacture of leather , leather products and footwear	19	191-192
LUM	Manufacture of wood and of products of wood	20	201-202
PPP	Pulp and paper production. Publishing	21,22	210-223
P_C	Manufacture of coke, refined petroleum and nuclear fuel	23	231-233
CHM	Chemicals and chemical products	24	241-243
RUB	Manufacture of rubber and plastic products	25	251-252
NMM	Manufacture of other non-metallic mineral products	26	261-269
MET	Manufacture of basic metals and fabricated metal products	27,28	271-289
OME	Manufacture of machinery and equipment	29	291-293
EOE	Manufacture of electrical and optical equipment	30,31,32,33	300-333
OTN	Manufacture of transport equipment	34,35	341-359
OMF	manufacturing nec	36,37	361-372
UTL	Production and distribution of electricity, gas and water	40,41	401-410
CNS	Construction	45	451-455
TRD	Trade, repair of motor vehicles, household appliances and personal items	50,51,52	501-526
H_R	Hotels and restaurants	55	551-552
TRC	Transport and communications	60,61,62,63,64	601-642
FIN	financial activities	65,66,67	651-672
OBS	Real estate, renting and business services to consumers	70,71,72,73,74	701-749
PUB	Public services	75	751-753
EDU	Education	80	801-809
HSS	Health care and social services	85	851-853
CSP	Community, social and personal services	90,91,92,93	900-930

Source: UN Comtrade

For calculation of trade weighted import tariffs we use the data on Belarussian imports (in HS 2007 6-digit level) from UN Comtrade for 2011. Therefore, to have only duty paid imports as weights we subtract the value of imports under free trade from total imports. The free trade regime exists between Belarus and the following trade partners: Russia, Kazakhstan, Armenia, Azerbaijan, Kyrgyzstan, Moldova, Tajikistan, Uzbekistan, Turkmenistan, Georgia and Ukraine.

The aggregation procedure consists of the following steps:

(i) **Calculation of Total Import Tariff Payments at the 6-Digit Level**

We calculate the total value of import tariff payments by multiplying the 6-digit tariff rate by total imports (excluding imports from the CIS and Georgia). Let HS denote the set of all 6-digit tariff lines of HS 2007. There is a different number of tariff lines available for 2011 (4336) and 2020 (4684). That is why let HS_t be the set of 6-digit tariff lines available for $t = 2011, 2020$. So, the total value of import tariff payments ($tarp_{HS_t}$) is:

$$tarp_{HS_t} = tar_{HS_t} \cdot Im_{HS_t} \qquad \forall\, HS, t\,,$$

where tar_{HS_t} denotes the tariff rate and Im_{HS_t} is the value of imports on the 6-digit level of HS 2007.

(ii) **Aggregation of Import Tariff Payments to the 2-Digit Level of ISIC Rev. 3/NACE Rev.1**

Let n define the set of all 2-digit groups of ISIC Rev. 3/NACE Rev. 1. Then for any element of n, we aggregate these total import tariff payments–simply summing up the values for HS 2007 6-digit groups which belong to the one 2-digit group of ISIC/NACE (according to the aforementioned correspondence tables). So, the aggregate tariff payment (TP_{nt}) is:

$$TP_{nt} = \sum_{HS_t \in n} tarp_{HS_t} \qquad \forall\, n, t$$

(iii) **Aggregation of imports to the 2-digit level of ISIC Rev. 3/NACE Rev. 1.**

In the same way we aggregate the value of imports (AIm_{nt}) for each element of n:

$$AIm_{nt} = \sum_{HS_t \in n} Im_{HS_t} \qquad \forall\, n, t$$

(iv) **Calculation of the trade weighted tariff rates for the sectors of the model.**

Let s denote the set of 19 sectors of the model presented in Table A6.2.[67] For each s we calculate the trade weighted import tariff ($tarf_{st}$) by dividing the value of total import tariff payments by the value of imports which are both aggregated to the sectors of our model (according to Table A6.1):

$$tarf_{st} = \sum_{nt \in s} TP_{nt} \Big/ \sum_{nt \in s} AIm_{nt} \qquad \forall\, s, t$$

The resulting tariff rates are illustrated in Table A6.2.

[67] In addition to the production sectors of set s our model includes services listed in Table F1. However, there are no tariffs on services what reduces the number of elements of set s to 19.

Table A6.2. Trade Weighted Tariff Rates For the Sectors of Our Model

Sectors	of the model	2011	2020
AGR	Agriculture, hunting and related services in these areas	6,2	3,8
FRS	Forestry and related service activities	5,4	5,2
FSH	Fishing, fish farming and related services in these areas	10,0	3,1
ENM	Mining and quarrying of energy minerals	0,0	0,0
OMN	Mining and quarrying except energy	4,9	4,8
FPR	Manufacture of food products , beverages and tobacco	14,2	12,6
TEX	Textiles and textile products	11,2	8,0
LEA	Manufacture of leather , leather products and footwear	8,0	4,6
LUM	Manufacture of wood and of products of wood	13,4	7,0
PPP	Pulp and paper production. Publishing	11,4	5,2
P_C	Manufacture of coke, refined petroleum and nuclear fuel	5,0	5,0
CHM	Chemicals and chemical products	7,2	4,6
RUB	Manufacture of rubber and plastic products	13,0	6,5
NMM	Manufacture of other non-metallic mineral products	13,3	9,6
MET	Manufacture of basic metals and fabricated metal products	11,4	7,1
OME	Manufacture of machinery and equipment	3,1	2,5
EOE	Manufacture of electrical and optical equipment	5,3	2,5
OTN	Manufacture of transport equipment	17,6	9,0
OMF	Manufacturing nec	16,2	10,3

Source: Authors' calculations.

Table A6.3. Mapping by Hand for 6-Digit Groups Unmapped in the Correspondence Tables

HS 2007	ISICRev.3	
050290	01	Agriculture, hunting and related service activities
050400	01	
050510	01	
050590	01	
051000	15	Manufacture of food products and beverages
051199	15	
180200	01	Agriculture, hunting and related service activities
230210	15	Manufacture of food products and beverages
230230	15	
230240	15	
230250	15	
230310	15	
230320	15	
230700	15	
230800	15	
240130	16	Manufacture of tobacco products
261900	27	Manufacture of basic metals
262029	36	Manufacture of furniture; manufacturing n.e.c.
262040	36	
262099	36	
380400	10	Mining of coal and lignite; extraction of peat
391510	25	Manufacture of rubber and plastics products
391520	25	
391530	25	
391590	25	
400400	25	
401220	25	
411520	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
440130	20	Manufacture of wood and of products of wood and cork, except furniture
470710	21	Manufacture of paper and paper products
470720	21	
470730	21	
470790	21	
510320	17	Manufacture of textiles
520210	17	
520291	17	
520299	17	
550510	17	
550520	17	
711292	28	Manufacture of fabricated metal products, except machinery and equipment
720429	27	Manufacture of basic metals
720441	27	
720449	27	
740400	28	Manufacture of fabricated metal products, except machinery and equipment
750300	27	Manufacture of basic metals
760200	27	
800200	37	Recycling
854810	37	
890800	35	Manufacture of other transport equipment

Source: Authors' calculations.

Appendix 7: Mathematical Structure of the Belarus Model with Multiple FDI and Trade Partners

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This document presents the algebraic formulation of a general-equilibrium numeric-simulation model of the Belarus economy. The model is currently under development by the authors. This model largely follows the structure of our earlier work on developing countries [e.g., Balistreri et al. (2009)].

The model includes 35 goods and services, which are purchased by households, firms, and the government. Let the goods and services be indexed by $g \in G$. Divide these goods and services into the following three categories that define their treatment in the model formulation: $(a.)$ Business Services, characterized by monopolistic competition and foreign direct investment (FDI), indexed by $i \in I \subset G$; $(b.)$ Dixit-Stiglitz manufacturing sectors, characterized by monopolistic competition, indexed by $j \in J \subset G$; and $(c.)$ Constant Returns To Scale (CRTS) goods indexed by $k \in K \subset G$. In the current aggregation there are 8 elements in I, 13 elements in J, and 14 elements in K. Goods and services are also classified by their associated region, indexed by $r \in R$, where there are 5 regions. The current formulation includes Belarus or the domestic region (BEL), the Commonwealth of Independent States and Georgia (CIS), the Customs Union—Russia and Kazakhstan (CU), the European Union (EU), and the rest-of-world region (ROW), such that $R = \{BEL, CIS, CU, EU, ROW\}$. The accounts track the incomes the representative houshold in Belarus decomposed by the primary mobile factors of

production Unskilled Labor (USK), Skilled Labor (SK), and Capital (CAP) [$f \in F = \{USK, SK, CAP\}$] as well as sector-specific inputs for the increasing returns sectors.

Table 1 summarizes the equilibrium conditions and associated variables. The non-linear system (of 1,330 equations and variables) is formulated in GAMS/MPSGE and solved using the PATH algorithm. We proceed with a description and algebraic representation of each of the conditions itemized in Table 1.

1 Dual representation of technologies and preferences

Technologies and preferences are represented in the Belarus model through value functions that embed the optimizing behavior of agents. Generally, any linearly-homogeneous transformation of inputs into outputs is fully characterized by a unit-cost (or expenditure) function. Setting the output price equal to optimized unit cost yields the equilibrium condition for the activity level of the transformation. That is, a competitive constant-returns activity will increase up to the point that marginal benefit (unit revenue) equals marginal cost. In the case of the Belarus model not all transformations are constant returns, so there are exceptions. In general, however, we will use the convention of setting unit revenues (left-hand side) equal to unit cost (right-hand side) and associating this equilibrium condition with a transformation activity level.

Agents in Belarus wishing to purchase a particular good or service g face an aggregate price PA^g. In constructing the aggregate prices, we will rely on the following notation for the component prices:

PD^g Price of domestic output ($\forall g \in G$),

PM_r^g Price of cross-border imports from region r of Business Services and CRTS goods ($\forall g \in (I \cup K)$),

P_r^g Dixit-Stiglitz price index on region-r varieties ($\forall g \in (I \cup J)$).

Table A7. General Equilibrium Conditions

Equilibrium Condition	(Equation)		Associated Variable	Dimensions
Dual representation of preferences and technologies:				
Armington unit-cost functions	(1)	$\forall i \in I$	A^g : Armington Activity	G
	(2)	$\forall j \in J$		
	(3)	$\forall k \in K$		
Dixit-Stiglitz price indexes	(4)	$\forall g \in (I \cup J)$	Q_r^g : D-S Activity by region	$(I+J) \times R$
Zero Profits for Dixit-Stiglitz firms	(5)	$\forall g \in (I \cup J)$	N_r^g : Number of Firms	$(I+J) \times R$
Dixit-Stiglitz composite input prices	(6)	$\forall g \in (I \cup J)$ and $r = D$	Z_r^g : IRTS resource use	$(I+J) \times R$
	(7)	$\forall j \in J$ and $r \neq D$		
	(8)	$\forall i \in I$ and $r \neq D$		
Input-output technologies	(10)	$\forall g \in G$	Y^g: Production level	G
Constant elasticity of transformation	(11)	$\forall k \in K$	X^g: Index on CET activity	G
	(12)	$\forall g \in (I \cup J)$	(No Export Coefficients for $g \in (I \cup J)$)	
Exports	(13)	$\forall k \in K$ and $r \neq D$	EX_r^g: Exports	$G \times (R-1)$
	(14)	$\forall g \in (I \cup J)$ and $r \neq D$		
Imports	(15)	$\forall g \in G$ and $r \neq D$	IM_r^g: Imports (net of FDI-firm imports)	$G \times (R-1)$
Unit expenditure function	(16)		U: Household utility index	1
Unit cost of public purchase	(17)		PUB: Government Activity	1
Unit cost of investment	(18)		INV: Investment Activity	1
Market clearance conditions:				
Composite goods and services	(19)	$\forall g \in G$	PA^g : Composite price indexes	G
D-S composites	(21)	$\forall g \in (I \cup J)$ and $r \neq D$	P_r^g: Prices of D-S composites	$(I+J) \times R$
	(22)	$\forall g \in (I \cup J)$ and $r = D$		
Markets for IRTS composite input	(23)	$\forall g \in (I+J)$	PMC^g: Composite input prices	$(I+J) \times R$
Markets for domestic output	(24)	$\forall k \in K$	PD^g: Domestic output prices	G
	(25)	$\forall i \in I$		
	(26)	$\forall j \in J$		
Markets for export output	(27)	$\forall k \in K$ and $r \neq D$	PX_r^k: Export output prices	$K \times (R-1)$
Markets for gross output	(28)	$\forall g \in G$	PY^g: Output prices	G
Markets for imports	(29)	$\forall i \in I$ and $r \neq D$	PM_r^g: Import prices	$G \times (R-1)$
	(30)	$\forall j \in J$ and $r \neq D$		
	(31)	$\forall k \in K$ and $r \neq D$		
Factor markets	(32)	$\forall f \in F$	PF_f: Factor prices	F
IRTS specific factors	(33)	$\forall g \in (I \cup J)$	PZ_r^g: Sector-specific capital price	$(I+J) \times R$
Fixed real investment	(34)		$PINV$: Unit cost of investment	1
Fixed real public spending	(35)		PG: Unit cost of public good	1
Nominal utility equals Income	(36)		PC: Unit expenditure index	1
Balance of payments	(37)		PFX: Price of foreign exchange	1
Income balance:				
Domestic agent income	(38)		RA_h: Household Income	1
Government budget	(39)		$GOVT$: Government spending	1
Foreign Entrepreneur	(40)		FE: External agent income	1
Auxiliary Conditions:				
Fixed real public spending	(41)		T: Index on direct taxes	1
Total Dimensions:		$6G + 6[(I+J) \times R] + 3[G \times (R-1)] + [K \times (R-1)] + F + 11 =$		1,330

Assuming a Constant Elasticity of Substitution (CES) aggregation of the components we equate the prices to the CES unit-cost functions:

$$PA^i = \left(\sum_r (P_r^i)^{1-\sigma_F^i} + \sum_r \phi_r^i (PM_r^i)^{1-\sigma_F^i}\right)^{1/(1-\sigma_F^i)} \quad (1)$$

$$PA^j = \left(\sum_r (P_r^j)^{1-\sigma_F^j}\right)^{1/(1-\sigma_F^j)} \quad (2)$$

$$PA^k = \left(\phi_D^k (PD^k)^{1-\sigma_{DM}^k} + \sum_r \phi_r^k (PM_r^k)^{1-\sigma_{DM}^k}\right)^{1/(1-\sigma_{DM}^k)}, \quad (3)$$

where $\sigma_F^g \forall g \in (I \cup J)$ is the Dixit-Stiglitz elasticity of substitution and σ_{DM}^k is the Armington elasticity of substitution on CRTS goods. The arguments of these functions are the component prices. The ϕ parameters are CES distribution parameters that indicate scale and weighting of the arguments. These are calibrated to the Belarusn social accounts such that the accounts are replicated in the benchmark equilibrium.

For the IRTS sectors we have the Dixit-Stiglitz price indexes. These are functions of the number of varieties, firm-level costs, and the optimal markup. Assuming each firm is small relative to the size of the market the demand elasticity for a firm's variety is σ_F^g and the optimal markup over marginal cost is given by $1/(1-\frac{1}{\sigma_F^g})$. Let marginal cost equal $PMC_r^g \ \forall g \in (I \cup J)$, which is the price of a composite input to the Dixit-Stiglitz firms associated with region-r, and let the number of varieties by region equal $N_r^g \ \forall g \in (I \cup J)$. The price indexes for the Dixit-Stiglitz goods are thus given by

$$P_r^g = \left[N_r^g \left(\frac{PMC_r^g}{1-\frac{1}{\sigma_F^g}}\right)^{1-\sigma_F^g}\right]^{1/(1-\sigma_F^g)} \qquad \forall g \in (I \cup J). \quad (4)$$

In equilibrium, the number of varieties by region adjusts such that we have zero profits. Denote the Dixit-Stiglitz composite activity level associated with equation (4) by $Q_r^g \ \forall g \in (I \cup J)$. Given the Dixit-Stiglitz aggregation of varieties each firm produces a quantity

$Q_r^g(N_r^g)^{\sigma_F^g/(1-\sigma_F^g)}$. Assuming that fixed and variable costs are satisfied using the same input technology, and a firm-level fixed cost of f_r^g (in composite input units), we have the zero profit condition

$$f_r^g - \frac{Q_r^g(N_r^g)^{\sigma_F^g/(1-\sigma_F^g)}}{\sigma_F^g - 1} = 0 \quad \forall g \in (I \cup J). \tag{5}$$

The technologies for producing the composite inputs for use in the Dixit-Stiglitz sectors depend on the type of sector. For all of the sectors there is a sector-specific capital input from the respective source region. Let $PZ_r^g \; \forall g \in (I \cup J)$ be the price of this sector-specific capital input. Domestic firms (producing goods or services) use domestic inputs, so the unit cost function is given by

$$PMC_r^g = \left[\theta_{Zr}^g (PZ_r^g)^{1-\epsilon_r^g} + \theta_{Dr}^g (PD^g)^{1-\epsilon_r^g}\right]^{1/(1-\epsilon_r^g)}, \quad \text{for} \quad r = D; \tag{6}$$

where ϵ_r^g is the elasticity of substitution between the sector-specific capital input and other inputs, and the θ's are the CES distribution parameters. Imports of Dixit-Stiglitz goods embody the gross of tariff imported inputs:

$$PMC_r^j = \left[\theta_{Zr}^j (PZ_r^j)^{1-\epsilon_r^j} + \theta_{Mr}^j (PM_r^j)^{1-\epsilon_r^j}\right]^{1/(1-\epsilon_r^j)}, \quad \text{for} \quad r \neq D. \tag{7}$$

FDI firms, on the other hand, use domestic inputs as well as a specialized imported service from the sources region. The price of the specialized imports equals the price of foreign exchange (denoted PFX) times one plus the tariff rate (denoted t_{ir}^{imp}). The unit cost for FDI firms is thus given by the following:

$$PMC_r^i = \left[\theta_{Zr}^i (PZ_r^i)^{1-\epsilon_r^i} + (\theta_{Dr}^i PD^i + \theta_{Mr}^i (1 + t_{ir}^{imp}) PFX)^{1-\epsilon_r^i}\right]^{1/(1-\epsilon_r^i)}, \quad \text{for} \quad r \neq D \tag{8}$$

For the CRTS sectors and upstream of the IRTS technologies, we have domestic production in accordance with the input output data. Denote the price of this output PY^s, for $s \in G$. The technology includes an upstream Cobb-Douglas value-added nest which then combines business services and ultimately then this composite combines with other intermediates in fixed proportions. Let PF_f indicate the price of primary factor of production $f \in F$ and let P_s^{vas} be the value-added business-services composite price for sector s. The composite of business services and value added is the CES aggregate of two Cobb-Douglas aggregates as follows:

$$P_s^{vas} = \left[\left(\prod_i \gamma_i^s [(1+t_{is}^{int}) PA_i]^{\alpha_i^s} \right)^{1-\sigma_{vas}} + \left(\prod_f \gamma_f^s [(1+t_{fs}) PF_f^{\alpha_f^s}] \right)^{1-\sigma_{vas}} \right]^{1/(1-\sigma_{vas})}, \quad (9)$$

where t_{gs}^{int} is the tax in sector s on purchases of good g and t_{fs} is the factor tax. The substitution elasticity between value added and the business services composite is given by σ_{vas}. With P_s^{vas} established, the top-level Leontief unit cost function for sector s is given by

$$PY^s = \beta_{vas}^s P_s^{vas} + \sum_{g \neq I} \beta_g^s (1+t_{gs}^{int}) PA^g, \quad (10)$$

where the α, β, and γ are share and scale parameters determined in the calibration to the input-output accounts. In the privatization scenarios explored in the Belarus model the γ_f^s parameters can be manipulated to represent pure productivity increases. For example, if the productivity of skilled labor increased by 10% in sector s we would simply multiply γ_{SK}^s by 1.1 raised to the power α_{SK}^s.

For the CRTS sectors a constant elasticity of transformation (CET) activity splits domestic output (with a unit value PY^k) into goods destine for domestic versus the region-specific export markets. Let the export price (for goods destine for region $r \neq D$)

be PX_r^k then the CET technology is given by

$$\left[\gamma_D^k (PD^k)^{1+\sigma_\tau} + \sum_{r \neq D} \gamma_r^k (PX_r^k)^{1+\sigma_\tau}\right]^{1/(1+\sigma_\tau)} = PY^k, \tag{11}$$

where σ_τ indicates the elasticity of transformation and the γ are the CET distribution parameters. In the case of IRTS sectors, we assume that domestic firms use domestic output to produce Dixit-Stiglitz varieties. Thus the CET technology collapses without export coefficients $[\gamma_r^g = 0 \; \forall g \in (I \cup J)]$:

$$PD^g = PY^g \quad \forall g \in (I \cup J). \tag{12}$$

For CRTS sectors the export commodity is traded for foreign exchange at a fixed rate. Let *PFX* equal the price of foreign exchange, and with a choice of units such that all gross of tax unit export prices are one at the benchmark, we have the following specification for the CRTS export activities:

$$PFX = (1 + t_k^{exp}) PX_r^k \quad \text{for} \quad r \neq D, \tag{13}$$

where t_g^{exp} is the export tax. For the IRTS sectors, domestic firms export the firm-level good where foreign agents are assumed to behave according to Dixit-Stiglitz preferences that are the same as domestic agents. Domestic IRTS firms face an export demand elasticity for their variety of σ_F^g and thus price their exports using the optimal markup. In aggregate the IRTS export activities by region are characterized by

$$EX_r^g = \xi_r^g \left[\left(1 - \frac{1}{\sigma_F^g}\right) \frac{PFX}{(1 + t_k^{exp}) PMC_D^g}\right]^{\sigma_F^g} \quad \forall g \in (I \cup J) \text{ and } r \neq D. \tag{14}$$

Cross-border imports are purchased at the price of foreign exchange times one plus

the tariff rate, which sets up the arbitrage condition for each import activity;

$$PM_r^g = (1 + t_{gr}^{imp})PFX \quad \text{for} \quad r \neq D. \tag{15}$$

Final demand includes three categories: household demand, government demand, and investment. The representative agents for each household h are assumed to have identical Cobb-Douglas preferences over the aggregated goods and services. The preferences are specified via a unit expenditure function associated with an economy-wide utility index (U). Let PC be the true-cost-of-living index indicated by the following unit expenditure function:

$$PC = \prod_g [(1 + t_g^{cons})PA^g]^{\mu_C^g}, \tag{16}$$

where the μ are value shares. The government faces a Leontief price index, PG, for government purchases:

$$PG = \sum_g \mu_G^g (1 + t_g^{gov})PA^g. \tag{17}$$

Similarly the price of investment, $PINV$ is a Leontief aggregation of commodity purchases:

$$PINV = \sum_g \mu_{INV}^g (1 + t_g^{inv})PA^g. \tag{18}$$

Equations (1) through (18) define all of the transformation technologies for the model. Next we turn to a specification of the market clearance conditions for each price.

2 Market clearance conditions

For each good or service there is a market, and, for any non-zero equilibrium price, supply will equal demand. We will use the convention of equating supply, on the left-hand side, to demand, on the right-hand side. The unit-value functions presented above are

quite useful in deriving the appropriate compensated demand functions, by the envelope theorem (Shephard's Lemma).

Supply of the composite goods and services, trading at PA^g, is given by the activity level, A^g, and demand is derived from each production or final demand activity that uses the good or service. The market clearance condition is given by

$$A^g = \sum_s h_{gs}(Y^s, \boldsymbol{p}) + \mu_C^g U \frac{PC}{(1+t_g^{cons})PA^g} + \mu_G^g PUB + \mu_{INV}^g INV, \tag{19}$$

where $h_{gs}(Y^s, \boldsymbol{p})$ are the conditional input demands (as a function of output and the price vector. These are found by taking the partial derivative of the unit cost function for sector s with respect to the gross of tax price of input g. For inputs that are not business services input demands are proportional to output: $h_{gs}(Y^s, \boldsymbol{p}) = \beta_g^s Y^s \quad \forall g \in (J \cup K)$. The input demands for business services are, however, more complex:

$$h_{is}(Y^s, \boldsymbol{p}) = \alpha_i^s \beta_{vas}^s Y^s \left(\frac{P_s^{srv}}{(1+t_{is}^{int})PA_i} \right) \left(\frac{P_s^{vas}}{P_s^{srv}} \right)^{\sigma_{vas}} \tag{20}$$

where P_s^{srv} is the composite price of business services inputs: $P_s^{srv} = \prod_i \gamma_i^s [(1+t_{is}^{int})PA_i]^{\alpha_i^s}$.

For the IRTS sectors we have market clearance for the Dixit-Stiglitz regional composites:

$$Q_r^g = A^g \left(\frac{PA^g}{P_r^g} \right)^{\sigma_F^g} \forall g \in (I \cup J), \quad \text{for} \quad r \neq D; \tag{21}$$

and for domestic firms we include demand for the Dixit-Stiglitz exports

$$Q_D^g = A^g \left(\frac{PA^g}{P_D^g} \right)^{\sigma_F^g} + \sum_r EX_r^g \quad \forall g \in (I \cup J). \tag{22}$$

The IRTS composite input (trading at PMC_r^g) is supplied by an activity, denoted $Z_r^g \; \forall g \in$

$(I \cup J)$, and is demanded by the firms:

$$Z_r^g = f_r^g N_r^g + Q_r^g (N_r^g)^{1/(1-\sigma_F^g)} \quad \forall g \in (I \cup J). \tag{23}$$

To derive (23) recall that firm-level output is $Q_r^g (N_r^g)^{\sigma_F^g/(1-\sigma_F^g)}$ so the use of the input across all firms is $Q_r^g (N_r^g)^{1/(1-\sigma_F^g)}$ plus the total input use on fixed costs, $f_r^g N_r^g$.

Market clearance for the domestic output of CRTS sectors depends on supply from the CET activity and demand from the Armington activity:

$$\gamma_D^k X^k \left(\frac{PD^k}{PY^k} \right)^{\sigma_\tau} = \phi_D^k A^k \left(\frac{PA^k}{PD^k} \right)^{\sigma_{DM}^k}. \tag{24}$$

For IRTS sectors, supply is simply given by the CET activity (as there are no export coefficients in the CET technology for IRTS sectors). Output is then demanded by either the domestic or FDI firms. The market clearance conditions are given by

$$X^i = \theta_{DD}^i Z_D^i \left(\frac{PMC_D^i}{PD^i} \right)^{\epsilon_D^i} + \sum_{r \neq D} \theta_{Dr}^i Z_r^i \left(\frac{PMC_r^i}{\theta_{Dr}^i PD^i + \theta_{Mr}^i (1 + t_{ir}^{imp}) PFX} \right)^{\epsilon_r^i} \tag{25}$$

for the service sectors, and

$$X^j = \theta_{DD}^j Z_D^j \left(\frac{PMC_D^j}{PD^j} \right)^{\epsilon_D^j} \tag{26}$$

for the Dixit-Stiglitz goods sectors.

Market clearance for exports of CRTS output is given by the CET supply function and demand is given by the export activity level (export demand is perfectly elastic):

$$\gamma_r^k X^k \left(\frac{PX_r^k}{PY^k} \right)^{\sigma_\tau} = EX_r^k, \quad \text{for} \quad r \neq D. \tag{27}$$

Reconciling gross output with the CET activities, we have market clearance for the commodities that trade at PY^g:

$$Y^g = X^g. \tag{28}$$

Import supply is perfectly elastic and import demand is derived from the Armington activities or embodied in the foreign Dixit-Stiglitz firm's inputs. For $r \neq D$, we have the following:

$$IM_r^i = \phi_r^i A^i \left(\frac{PA^i}{PM_r^i}\right)^{\sigma_F^i} \tag{29}$$

$$IM_r^j = \theta_{Mr}^j Z_r^j \left(\frac{PMC_r^j}{PM_r^j}\right)^{\epsilon_r^j} \tag{30}$$

$$IM_r^k = \phi_r^k A^k \left(\frac{PA^k}{PM_r^k}\right)^{\sigma_{DM}^k}. \tag{31}$$

Factor markets clear, where factor supply is given by the exogenous endowments to households, denoted $\overline{S}_f$, and input demands are derived from the cost functions:

$$\overline{S}_f = \sum_s \alpha_f^s \beta_{vas}^s Y^s \left(\frac{P_s^{va}}{(1+t_{fs})PF_f}\right) \left(\frac{P_s^{vas}}{P_s^{va}}\right)^{\sigma_{vas}}, \tag{32}$$

where P_s^{va} is the composite value-added price: $P_s^{va} = \prod_f \gamma_f^s [(1+t_{fs})PF_f]^{\alpha_f^s}$. In addition, we have the market for the specific factor used in the IRTS sectors. Denoting the regional endowments of the specific factors $\overline{SF}_r^g \ \forall g \in (I \cup J)$, we have:

$$\overline{SF}_r^g = \theta_{Zr}^g Z_r^g \left(\frac{PMC_r^g}{PZ_r^g}\right)^{\epsilon_r^g} \quad \forall g \in (I \cup J). \tag{33}$$

Real investment equals real savings by households:

$$INV = \overline{sav}. \tag{34}$$

Real government purchases equal the nominal government budget scaled by the government price index:

$$PUB = \frac{GOVT}{PG}. \tag{35}$$

Household utility (U) equals nominal income across households scaled by the true-cost-of-living index. That is, we represent an aggregate activity U, which supplies *utils* to the households. For the representative agent of household type h denote nominal income RA. The market clearance condition for *utils* is thus

$$U = \frac{RA}{PC}. \tag{36}$$

The final market clearance condition reconciles the balance of payments. The supply of foreign exchange includes its generation in the export activities and net borrowing from the rest of the world (net capital account surpluses). The real capital account surplus is held fixed at the exogenous benchmark observation, denoted $\overline{ftrn}$. Foreign exchange is demanded for direct import purchases as well as the payments to foreign agents for their contribution to production.

$$\begin{aligned} \sum_{r\neq D}\sum_{g} EX_r^g + \overline{ftrn} &= \sum_{r\neq D}\sum_{g} IM_r^g \\ &+ \sum_{r\neq D}\sum_{i} \theta_{Mr}^i Z_r^i \left(\frac{PMC_r^i}{\theta_{Dr}^i PD^i + \theta_{Mr}^i (1+t_{ir}^{imp}) PFX}\right)^{\epsilon_r^i} \\ &+ \frac{FE}{PFX}, \end{aligned} \tag{37}$$

where FE equals the nominal claims that the foreign entrepreneurs have on specific factor rents in the Dixit-Stiglitz manufacturing sectors.

3 Income Balance Conditions

The representative agent (household) earns income from factor endowments, but disposable income nets out savings and a direct tax transfer to the government. Real savings is held fixed (by the coefficient $\overline{sav}_h$). We also hold fixed the real level of government spending, but this requires an adjustment in direct taxes on households. Removal of tariffs, for example, impact the government budget and the shortfall is made up for by an endogenous increase in the direct taxes on households. We use the auxiliary variable T to scale the direct taxes appropriately. In addition, the household is assumed to hold any benchmark net international capital flows. The household's budget is given by

$$\begin{aligned} RA &= \sum_f PF_f \overline{S}_f \\ &+ \sum_g PZ^g_{BEL} \overline{SF}^g_{BEL} \\ &- \overline{sav} PINV \\ &- \overline{dtax} PG \times T \\ &+ \overline{ftrn} PFX \end{aligned} \tag{38}$$

The government budget is given by net direct and indirect taxes on domestic and international transactions. The full nominal government budget is

$$\begin{aligned} GOVT &= \overline{dtax}_h PG \times T \\ &+ \sum_g t^{cons}_g PA^g \mu^g_C U \frac{PC}{(1+t^{cons}_g) PA^g} \end{aligned}$$

$$
\begin{aligned}
&+ \sum_g t_g^{inv} PA^g \mu_{INV}^g INV \\
&+ \sum_g t_g^{gov} PA^g \mu_G^g PUB \\
&+ \sum_s \sum_i t_{is}^{int} PA_i \alpha_i^s \beta_{vas}^s Y^s \left(\frac{P_s^{srv}}{(1+t_{is}^{int}) PA_i} \right) \left(\frac{P_s^{vas}}{P_s^{srv}} \right)^{\sigma_{vas}} \\
&+ \sum_s \sum_j t_{js}^{int} PA_j \beta_j^s Y^s \\
&+ \sum_s \sum_k t_{ks}^{int} PA_k \beta_k^s Y^s \\
&+ \sum_s \sum_f t_{fs} PF_f \alpha_f^s \beta_{vas}^s Y^s \left(\frac{P_s^{va}}{(1+t_{fs}) PF_f} \right) \left(\frac{P_s^{vas}}{P_s^{va}} \right)^{\sigma_{vas}} \\
&+ \sum_{r \neq D} \sum_g t_{gr}^{imp} (PFX) IM_r^g \\
&+ \sum_{r \neq D} \sum_i t_{ir}^{imp} (PFX) \theta_{Mr}^i Z_r^i \left(\frac{PMC_r^i}{\theta_{Dr}^i PD^i + \theta_{Mr}^i (1+t_{ir}^{imp}) PFX} \right)^{\epsilon_r^i} \\
&+ \sum_{r \neq D} \sum_i t_i^{exp} \frac{PMC_{BEL}^i}{1 - \frac{1}{\sigma_F^i}} EX_r^i \\
&+ \sum_{r \neq D} \sum_j t_j^{exp} \frac{PMC_{BEL}^j}{1 - \frac{1}{\sigma_F^j}} EX_r^j \\
&+ \sum_{r \neq D} \sum_k t_k^{exp} PX_r^k EX_r^k
\end{aligned} \tag{39}
$$

Again, the index T is adjusted endogenously to hold the real level of public spending fixed. In addition to the household and government agents we need an agent representing the foreign entrepreneurs who own the specific factors associated with cross-border Dixit-Stiglitz traded goods. The foreign entrepreneur's nominal income is FE, which is spent on foreign exchange:

$$
FE = \sum_{r \neq D} \sum_g PZ_r^g \overline{SF}_r^g \tag{40}
$$

4 Auxiliary Condition

In addition to the three sets of standard conditions presented above, we need to close the model with an auxiliary condition such that the real size of the government is held fixed. To do this we need to determine the index which scales direct taxes on households. Associated with the variable T is the following condition:

$$PUB = \overline{pub}. \tag{41}$$