

Deep Trade Policy Options for Armenia

The Importance of Services, Trade Facilitation and Standards Liberalization

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Abstract

This paper develops an innovative 21 sector computable general equilibrium model of Armenia to assess the impact on Armenia of a Deep and Comprehensive Free Trade Agreement with the European Union, as well as further regional or multilateral trade policy commitments. The analysis finds that such an agreement with the European Union will likely result in substantial gains to Armenia, but shows that the gains derive from the deep aspects of the agreement. In order of importance, the sources of the gains are: (i) trade facilitation and reduction in border costs; (ii) services liberalization; and (iii) standards harmonization. A

shallow agreement with the European Union that focuses only on preferential tariff liberalization in goods will likely lead to small losses to Armenia primarily due to a loss of productivity from lost varieties of technologies from the rest of the world region in manufactured products. Additional gains can be expected in the long run from an improvement in the investment climate. The authors estimate only small gains from a services agreement with countries of the Commonwealth of Independent States, but significant gains from expanding services liberalization multilaterally.

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I. Introduction

Armenia, along with Ukraine, Georgia and Moldova, is one of four countries to the east of the European Union (EU) that has been targeted by the EU for negotiation of a “Deep and Comprehensive Free Trade Agreement” (DCFTA). Based on the EU-Ukraine ongoing negotiation, we know that a DCFTA between Armenia and the EU will contain numerous chapters and go well beyond tariff liberalization on goods. Notably, a DCFTA would include negotiation of liberalization of business services sectors, and the EU has traditionally placed considerable emphasis on harmonization of standards with the EU, as well improved trade facilitation and lower border costs. Evaluation of these deeper aspects of free trade agreements presents challenges for modelers.

Since the early 1990s, regional trade agreements have surged; 283 are in force and have been notified to the WTO as of February 2010.¹ Given the inclusion of services in modern FTA agreements negotiated with the EU, the US and in some other agreements, economists need to be able to assess the impact of services commitments as part of their advice to governments regarding preferential trade agreements. Since both economic theory and empirical literature have shown that wide availability of business services results in productivity gains to the

¹ http://www.wto.org/english/tratop_e/region_e/region_e.htm. This does not include a significant number that are in force but which have not been notified to the WTO.

manufacturing sector and contributes to its international competitiveness.² Services commitments in regional agreements could lead to substantial productivity improvements. But is there an analogy to trade diversion in goods whereby preferential commitments in services could be immiserating? Moreover, regional agreements with the EU and the US are “deep” involving elements of standards harmonization and trade facilitation, among other chapters. Are developing countries likely to obtain substantially larger gains from a deep agreement with a developed country, rather than a free trade agreement with a developing country? How do the gains of preferential versus global liberalization compare?

Armenia is an example of a country facing regional trade policy choices with both developed and developing countries, as well as multilateral trade policy choices. In addition to being a candidate for a Deep and Comprehensive Free Trade Agreement (DCFTA) with the European Union, it has existing free trade agreements with the countries of the Commonwealth of Independent States (CIS). Moreover, in the context of its international negotiations under the

2 Arnold et al. (2007), Fernandes (2007) and Fernandes and Paunov (2008) have provided econometric estimates of the gains from services liberalization. Marshall (1988) shows that in three regions in the United Kingdom (Birmingham, Leeds and Manchester) almost 80 percent of the services purchased by manufacturers were bought from suppliers within the same region. He cites studies which show that firm performance is enhanced by the local availability of producer services. In developing countries, McKee (1988) argues that the local availability of producer services is very important for the development of leading industrial sectors.

Both the urban economics literature (Vernon, 1960; Chinitz, 1961) and the modern economic geography literature (e.g., Krugman, 1991; Fujita, Krugman and Venables, 1999) have focused on the fact that related economic activity is economically concentrated due to agglomeration externalities (e.g., computer businesses in Silicon Valley, ceramic tiles in Sassuolo, Italy). Evidence comes from a variety of sources. Ciccone and Hall (1996) show that firms operating in economically dense areas are more productive than firms operating in relative isolation. Caballero and Lyons (1992) show that productivity increases in industries when output of its input supplying industries increases. Hummels (1995) shows that most of the richest countries in the world are clustered in relatively small regions of Europe, North America and East Asia, while the poor countries are spread around the rest of the world. He argues this is partly explained by transportation costs for inputs since it is more expensive to buy specialized inputs in countries that are far away for the countries where a large variety of such inputs are located.

Doha Development Agenda, Armenia may be called upon to make further commitments in the business services area.

Policy-makers have expressed considerable demand for analysis of their actual or potential regional agreements. Applied modelers have responded with applied general equilibrium models that focus on goods. So the literature now contains a substantial number of good studies (summarized below) that examine regional agreements in goods. But except of Jensen and Tarr (2010), the literature does not contain any numerical studies of regional arrangements that involve commitments to multinational firms who will undertake foreign direct investment in services. We attempt to fill that gap in this paper. Crucial to the analysis, we incorporate the Dixit-Stiglitz-Ethier mechanism of endogenous productivity gains from additional varieties of imperfectly produced goods and services. Moreover, as a component of the DCFTA, we evaluate the impact on Armenia of establishing a national quality infrastructure that would facilitate Armenian firms that wish to export to the EU to comply with EU voluntary standards, technical regulations in goods and meet EU sanitary and phyto-sanitary requirements. (We refer to this simply as standards harmonization in this paper, although this subject is broader than standards on manufactured goods.) As we explain below, however, we do not recommend that Armenia adopt all EU SPS requirements as requirements for producing for the Armenia or CIS markets; rather a case by case approach would be advisable based on an evaluation of the costs versus benefits.

In this paper we develop a 21 sector small open economy comparative static computable general equilibrium model of Armenia that we believe is appropriate to evaluate the impact of an EU-Armenian DCFTA along with other trade policy options of Armenia. We build on the model of Jensen, Rutherford and Tarr (2008) and Jensen and Tarr (2010), but we decompose the rest of

the world into three regions: the European Union; our CIS region; and the Rest of the World. All foreign regions are sources of foreign direct investment in some of the business services sectors. In addition, and crucially for the results, we evaluate the impact of lowering standards and border costs as a result of the DCFTA with the EU.

We find that a DCFTA with the EU will likely result in substantial gains to Armenia, but we show that the gains derive from the deep aspects of the agreement. We estimate that a shallow free trade agreement with the EU that focuses only on preferential tariff liberalization in goods will likely lead to small losses to Armenia due to traditional trade diversion (tariff losses on displaced imports from the Rest of the World region) and, more importantly, due to a loss of productivity from lost varieties of technologies from the Rest of the World region in manufactured products. We estimate that the gains to Armenia from a DCFTA with the EU derive from further liberalization of barriers in services (by 50 percent of the ad valorem equivalents), harmonization of standards³ and most importantly, from a trade facilitation and a reduction in border costs. Additional gains can be expected in the long run from an improvement in the investment climate. But we calculate slightly smaller gains if Armenians presently capture the rents from the barriers against foreign service-providers.

Preferential liberalization of barriers against CIS services providers could add additional gains, but these gains would be very small. The gains from further integration with the CIS are small for two reasons: first, institutional development through standards harmonization and trade facilitation are not considered part of the scenario, since it is not considered a likely outcome. Although we do consider deeper service commitments on a preferential basis in the CIS,

³ As we discuss in section III below, this does not imply that we recommend that Armenia adopt all technical regulations and sanitary and phyto-sanitary requirements of the European Union.

technology diffusion obtained through trade and FDI with transition and developing countries has been estimated to be much smaller than the technology diffusion obtained through trade and FDI with developed countries.

We find that unilateral liberalization of services and trade barriers on a non-discriminatory basis would yield gains that are about three times the gains from preferential liberalization of goods and services with the EU alone. This policy would assure that Armenia receives goods and services from the least cost supplier and would eliminate any trade diversion costs. Liberal rules of origin in any preferential agreement would help move Armenia toward achieving the gains from unilateral liberalization. Finally, we estimate that a reduction in non-discriminatory regulatory barriers (that is, barriers that raise the costs of Armenians as well as foreign services providers in Armenia) would provide significant additional benefits in Armenia.

We devote considerable attention to the sensitivity of our results to uncertainty in the parameters. First, to understand the model better, we conduct piecemeal sensitivity of the results, where we isolate the impact of each of the parameters to ascertain which parameters most strongly impact the results. Second, to assess the robustness of the results to parameter uncertainty, we conduct systematic sensitivity analysis, where we execute the model 30,000 times. Each simulation is based on a random draw of all the parameter values; we then present sample distributions and sample confidence intervals of the key variables. Finally, we conduct sensitivity on a range of values of key parameters that determine the productivity impacts in imperfect competition.

An earlier estimate of the gains to Armenia from the DCFTA is Maliszewska *et al.* (2008), known as the CASE study. The CASE study estimates gains to Armenia from the

DCFTA that are about 2.5 times larger than the gains estimated in the present study. We explain in appendix I that the larger estimated gains of the CASE study are due to a combination of two effects: (i) larger assumed distortions in the CASE study; and (ii) different modeling assumptions. The larger the distortions are, the more gains there are from their removal. As we explain in appendix I, the larger distortions in the CASE study partly reflect the fact that our study was based on estimates of distortions in 2010, while the CASE study uses estimates of distortions from 2006 or 2007. Since Armenia has implemented substantial reforms in the interim, the initial distortions in the CASE study are significantly higher. This is the case with border costs. But it is also due, in some cases, to the fact that we had greater data available to us that allowed a more accurate estimate, for example in the services survey and estimates that we conducted. Further, we assume that the benefits of services commitments in a DCFTA are limited to EU investors, while the CASE study assumes those commitments will be extended multilaterally.

The paper is organized as follows. In section II, we provide an overview of the estimation of the ad valorem equivalents of barriers in Armenian services sectors. We provide an overview of the model in section III and a discussion of the data in section IV. The central results are presented in section V and sensitivity results are presented in section VI. Conclusions are presented in section VII. In appendix A, we discuss the trade and tariff data in some detail. We document the calculation of ownership shares by sector and region in appendix B. How we obtained estimates of the Dixit-Stiglitz elasticities in goods is described in appendix C. Our estimation of the reduction in trade or border costs as a result of a DCFTA is presented in appendix D and our estimate of the reduction in standards costs is presented the section E. The estimates and methodology of the ad valorem equivalents of barriers in services is explained in

Modebadze and Eroyants (2010) and our construction of a balanced input-output table for Armenia is explained in appendix G.

II. Estimation of the Tariff Equivalence of the Regulatory Barriers in Services

Estimates of the ad valorem equivalents of the regulatory barriers in services are crucial to the results. In order to make these estimates, we first need to assess the regulatory environment in the services sectors in our model. We commissioned a 112 page survey of the regulatory regimes in key Armenian business services sectors, namely, insurance, banking, fixed line and mobile telecommunications services and air transportation services. We supplemented that information with research by regional experts into the relevant sector.⁴ This questionnaire and research provided us with data and descriptions and assessments of the regulatory environment in these sectors.

Modebadze (2010) then estimated the ad valorem equivalents of barriers to foreign direct investment in fixed line and mobile telecommunications, banking, insurance and maritime transportation services. The process involved converting the answers and data of the questionnaires into an index of restrictiveness in each industry. Modebadze followed the methodology of Kimura, Ando and Fujii (2004a, 2004b, 2004c) to generate these estimates. The methodology involves classification of the possible restrictions into separate categories with unique weights summing to one, where the weights are determined based on the significance of each category. Next, Modebadze assigned a score to each potential restriction, where the score reflects the level of restriction imposed by the economy. Modebadze estimated two indices: an index of “regulatory barriers” (RB index) where the regulatory barriers impose costs on both domestic and multinational firms in a non-discriminatory manner; and an index of discriminatory barriers against multinational service providers, which we call the foreign discriminatory index (FDR index).⁵

This methodology further involves building on the estimates and methodology explained in the volume by C. Findlay and T. Warren (2000), notably papers by Warren (2000), McGuire

⁴ We thank Karine Eroyants and Grigol Modebadze for this research.

⁵ In order to obtain the estimated score for each restriction, the assigned score is multiplied by the corresponding weight. Finally, the estimated scores for all categories are summed to obtain the restrictiveness indices.

and Schuelele (2000) and Kang (2000). For each of these service sectors, the authors evaluated the regulatory environment across many countries. The price of services is then regressed against the regulatory barriers to determine the impact of any of the regulatory barriers on the price of services. Modebadze then assumed that the international regression applies to Armenia in the case that the above mentioned restrictiveness indexes are used. Applying that regression and their assessments of the regulatory environment in Armenia from the questionnaires and other information sources, he estimated the ad valorem impact of a reduction in barriers⁶ both for discriminatory and non-discriminatory barriers. Modebadze then weighted his fixed line and mobile telecommunications estimates by their market shares to obtain her estimate for communications. The results of the estimates of the ad valorem equivalents of the barriers are listed in table 4. Details are provided in Modebadze and Eroyants (2010).

III. Overview of the Model

This paper builds on the algebraic structure of the models of Jensen, Rutherford and Tarr (2007; 2010). Here we provide a general description of the structure described there and provide more details where we depart from that structure. There are 21 sectors in the model shown in table 1. These include six imperfectly competitive business services sectors, two imperfectly competitive goods sectors and thirteen competitive goods and services sectors. Labor and capital are the two primary factors of production. In each imperfectly competitive sector there is sector-specific capital that is unique to production from each region in the model; and there are primary inputs imported by multinational service providers, reflecting specialized management expertise or technology of the firm. The existence of sector specific capital in the imperfectly competitive sectors implies that there are decreasing returns to scale in the use of the mobile factors and supply curves in these sectors slope up. In our central model, we assume that 50 percent of the capital in each of the imperfectly competitive sectors is sector specific. We conduct sensitivity analysis with respect to this share by allowing 25 percent and 75 percent of the capital in each sector to be sector specific.

⁶ Warren estimated quantity impacts and then using elasticity estimates was able to obtain price impacts. The estimates by Modebadze that we employ are for “discriminatory” barriers against foreign direct investment.

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. As in Jensen, Rutherford and Tarr (2010), we disaggregate the rest of the world region into three regions. In this case the three regions are: (1) the European Union; (2) the CIS; and (3) the Rest of the World. 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 Armenia is modeled fully.

Perfectly competitive goods and services sectors

Regardless of sector, all firms minimize the cost of production. In the 13 competitive goods and services sectors, goods or services are produced under constant returns to scale and where price equals marginal costs with zero profits. 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 three possible export regions, based on relative prices the three regions and their constant elasticity of transformation production function for shifting output between the regions.

Goods produced subject to increasing returns to scale

We have two goods in this category in the model: mining and an aggregate manufacturing sector. These goods are differentiated at the firm level. We assume that these 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 Armenia. 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. Domestic 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.

Unlike Jensen, Rutherford and Tarr (2007), but following Jensen, Rutherford and Tarr (2010) all imperfectly competitive domestic firms (both goods and services producers) face a downward sloping demand curve in each of their three 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 markets 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 (2007) model. Balistreri and Markusen (2009) have shown, however, that there should be virtually no role for optimal tariffs to exploit terms of trade effects. The reason is that, unlike perfectly competitive firms, imperfectly competitive firms are pricing such that marginal revenue equals marginal costs on export markets, which is the objective of optimal tariffs.

For simplicity we assume that the composition of fixed and marginal cost is identical in all firms producing under increasing returns to scale (in both goods and services). This assumption in a 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.

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

These sectors are telecommunications, banking services, insurance services, air transportation services, railroad transportation services and pipeline transportation 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 Armenian.⁷ Our model allows for both types of foreign provision of services in these sectors. There are cross border services allowed in this sector and they are provided from abroad at constant costs—this is analogous to competitive provision of goods from abroad. Cross border services, however, are not good substitutes for service providers who have a domestic presence.⁸

Crucial to the results, we allow multinational service firm providers that choose to establish a presence in Armenia in order to compete with Armenian 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.

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 Armenia, they will import some of their technology or management expertise. That is, foreign direct investment generally entails importing specialized

⁷ One estimate puts the world-wide cross-border share of trade in services at 41% and the share of trade in services provided by multinational affiliates at 38%. Travel expenditures 20% and compensation to employees working abroad 1% make up the difference. See Brown and Stern (2001, table 1).

⁸ Daniels (1985) found that service providers charge higher prices when the service is provided at a distance.

foreign inputs. Thus, the cost structure of multinationals differs from national only service providers. Multinationals incur costs related to both imported primary inputs and Armenian primary factors, in addition to intermediate factor inputs. Foreign provision of services differs from foreign provision of goods, since the service providers use Armenian 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 Armenian 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).

Trade facilitation and border costs

According to the World Bank Logistics Performance Index of 2010, Armenia ranks 111th in the world out of 155 countries.⁹ This is an improvement from 131st in the world in 2007,¹⁰ but still leaves considerable room for improvement. Given the focus of the EU on institutional development for trade facilitation, a deep and comprehensive free trade agreement with the EU is likely to reduce these costs for exports to the EU. We therefore assume that the costs of exporting to the EU from Armenia will fall and the costs of importing into Armenia from the EU will also fall. Moreover, improved institutional development for trade facilitation is likely to reduce trade facilitation costs for imports from and exports to all regions. If customs is more efficient in processing imports from the EU, these procedures will generally facilitate trade with all regions. For example, if trucks with imports from the EU can pass through Armenian borders more quickly, trucks with imports from other countries are also likely to see reduced delays. Given that the EU will monitor trade with the EU much more carefully, it is possible that not all institutional reforms in trade facilitation will transmit to trade with non-EU countries. So we shall assume that the border costs of exporting to or importing from non-EU countries will fall by a smaller percentage.

⁹ See: <http://info.worldbank.org/etools/tradesurvey/mode1b.asp>.

¹⁰ See <http://siteresources.worldbank.org/INTTLF/Resources/lpireport.pdf>.

To obtain quantitative estimates, we rely on a survey of Armenian firms undertaken for the study by Maliszewska *et al.*, (2008) and data from the Cost of Doing Business study of the World Bank. We estimate that the costs of importing from and exporting to the EU will fall by 2.5 percent of production costs, while the costs of importing into Armenia from non-EU countries will fall by 2.3 percent of production costs and the cost of exporting to non-EU countries from Armenia will fall by 2.2 percent of production costs. Details of the estimation are available in appendix D.

Standards costs

The EU devoted considerable resources to assisting its new member states with standards and, similarly it is allocating resources to this problem for the countries with which it may potentially have a DCFTA. Consequently, we assume these costs will fall as a result of a Deep and Comprehensive Free Trade Agreement. That is, for firms who will sell in the EU, after adaption by the firms and Armenian development of the National Quality Infrastructure, we assume the production costs of selling in the EU by Armenian firms will decline. We rely on a survey by Jakubiak *et al.*, (2006) and adapt it for Armenia. We estimate that the costs of compliance with EU standards as a percentage of production costs will fall for Armenian exports to the EU of agricultural (manufacturing) products from 15.8 (21.6) percent of production to 11.8 (16.2) percent of production. But there are costs of facilities to meet EU standards and in development of the National Quality Infrastructure that we estimate will diminish the cost reduction by about 2 percent. Since the CIS market is predominantly regulated by “GOST” regulations, we do not assume that production costs for Armenian exporters would fall on exports to any market other than the EU. Details are in Appendix E.

An important policy caveat to the above paragraph is that we do not recommend that Armenia adopt all EU technical regulations and sanitary and phyto-sanitary (SPS) measures. On the one hand, facilitating but not compelling voluntary harmonization to standards in goods should be beneficial and is the core of what we estimate. Armenian firms could continue to produce according to Gosstandard (GOST) standards for the CIS market or at home if they choose to do so. On the other hand, requiring Armenian firms to adopt EU technical regulations in goods and especially all SPS requirements will likely impose very high costs. It does not appear that the benefits of these mandatory requirements are justified in all cases without actual

membership in the EU. Experience of the new Eastern Expansion EU members during accession shows that, despite vast accession support from the EU, large parts of their food industry were forced out of business, since the upgrades needed to meet the EC requirements were not commercially feasible. As a result, a more gradual adaptation to EU SPS requirements through choosing to adopt EU SPS requirements on a case by case basis where the benefits exceed the costs seems appropriate.¹¹

Comparative steady state formulation

In this version of our model, we allow the capital stock to adjust to its steady state equilibrium along with all of the model features we employ in our WTO reference case, i.e., we allow for tariff and FDI liberalization with endogenous productivity effects as above. We call this our comparative steady state model. In the comparative static model, we assume that the capital stock is fixed and the rental rate on capital is endogenously determined. In the comparative steady state model, the logic is reversed. We assume that the capital stock is in its initial steady state equilibrium in the benchmark dataset, but that the capital stock will adjust to a new steady state equilibrium based on a fixed rate of return demanded by investors. That is, if the trade policy shock happens to induce and increase in the rate of return on capital so that it exceeds the initial rate of return, investors will invest and expand the capital stock. Expansion of

¹¹ A similar view was expressed in the report of the World Bank (2007, p. 65). It states: Several of the CIS countries have expressed the desire to harmonize their standards with the EU. ...For the CIS countries, even those intending to join the EU, complete harmonization with EU food safety and agricultural health legislations is neither necessary nor, at present, realistic, considering the high costs involved. The new EU members received large-scale financial and technical support from the EU for their accession process. The new EU member states received, over a seven-year period, accumulated SAPARD support for agro-processing and marketing of about 18 percent of their agricultural GDP in 2000, or €357 per person employed in agriculture in 2003, of which the EU paid more than one-third. Under PHARE they also received sizable EC support for their public sector for SPS-related expenses, with accumulated amounts in the range of one-third of the EC support under SAPARD. For non-EU accession countries, implementing the required changes without such support would outstrip public and private capacities. Realistic options are selective convergence or obtaining third-country status to EU accession, each of which has different strategic and resource implications. Selective convergence can mean that selected parts of the relevant legislation and regulations are used as specimens for modernization or for harmonization for purposes of trade in particular products. Third country status—used for livestock and fisheries products—means that a country's regulations, inspection methods, and capabilities are considered equivalent to those of the EC. EU accession, on the other hand, requires full adoption of the *Acquis Communautaire* for domestic production, processing, and marketing. Experience of the new EU members during accession shows that, despite vast accession support from the EU, large parts of their food industry were forced out of business, since the upgrades needed to meet the EC requirements were not commercially feasible. Given the tremendous costs involved, it is therefore not realistic for CIS countries to pursue full adoption of EU standards.

the capital stock drives down the marginal product of capital, i.e., it drives down the rental rate on capital, until the rate of return on capital falls back to the initial level.¹² To analyze trade policy, this comparative steady state approach has been employed by many authors, including Harrison, Rutherford and Tarr (1996, 1997) and Baldwin et al. (1999) and Francois et al. (1996). The approach, however, dates back to the 1970s, when both Hansen and Koopmans (1972) and Dantzig and Manne (1974) used it. The approach ignores the foregone consumption necessary to achieve the higher level of investment and thus, is an upper bound estimate on the long run gains within the framework of the model assumptions.

IV. Data of the Model and Evidence for Key Elasticities

Input-output matrix

The core of the model data consists of an input-output table. No official recent input-output table for Armenia exists, so we produced the table based on data provided by the National Statistical Office of the Republic of Armenia. Our data sources include an unbalanced supply-use table with 16 sectors for the year 2006 and detailed data on GDP for 2007 by types of income, expenditure, and production. The supply-use table contains all the elements we need for the input-output table, but supply deviates significantly from use in most of the sectors. We therefore develop a balancing procedure to arrive at a balanced input-output table. The procedure involves an optimization problem in which the elements of the table are adjusted such that the sum of the squared deviations from the initial values are minimized and subject to a number of side constraints, including supply-use balance. As part of the procedure, we also use detailed GDP data to update the dataset to the year 2007. Finally, we disaggregate two services sectors to get more details on transport, communication and financials sectors. The final table contains 21 sectors. Details of the construction are explained in Appendix G.

¹² The rate of return on investment in our model is the rental rate on capital divided by the cost of a unit of the capital good.

Trade data by regional partner and sector

To obtain the shares of imports and exports from the different regions of our model, we used trade data published by the National Statistical Service of the Republic of Armenia¹³. The data is for the year 2007 and shows exports and imports by country and commodity.

The regions of our model are Armenia, the European Union, the CIS, and the Rest of the World. For the European Union, we took the 27 member countries as of 2007. For the CIS, we include Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Rest of the World is the residual.

The data is reported according to the Harmonized System (HS) classification at the two digit level. We mapped the HS-commodities into the sectors of our model. The exact mapping and results for both exports and imports are reported in Appendix A.

Tariff data—Collected rates at the tariff line level

We received data on collected import duties (tariffs) and import values at the four digit tariff line level (again using the Harmonized System classification) from the Armenian Customs Authority. The collected tariff rates for the sectors in our model are obtained by first aggregating the four digit tariff line level tariff collections and import values to the sectors of our model. The ratio of tariff collections to import values for each sector of our model is then calculated to give estimates of the collected tariff rates, which in turn are incorporated into our dataset. The tariff rates are shown in table 4 of appendix A. Applying these tariff rates across all sectors implies that tariff revenue in the revised database is about 1% of GDP, which is consistent with collected revenues in Armenia.¹⁴

Given that Armenia participates in preferential trade areas with the other CIS member states, it was necessary to make further adjustments. That is, since, in principle, tariff rates should be zero within these preferential trade areas, we set tariff collections on imports from CIS countries at zero. We then increased the tariff rates for the other regions in our model so that the overall weighted average collected tariff rate is unchanged at the tariff line level. We used the trade flow data, disaggregated by regions and sectors of our model to weight the tariff rates. This

¹³ http://www.armstat.am/file/article/ft_2nish_07_14.pdf

¹⁴ For the year 2008, aggregate data from Armenia show that tariff collections are 1% of GDP.

adjustment has the impact of raising the collected tariff rates for the regions in our model where positive tariff rates apply. The resulting adjusted tariff rates are also reported in table 4 of appendix A.

Share of market captured by multinational service providers

It was necessary to calculate the market share of multinational firms in the services sectors by region of the model. Take the banking sector as an example. We need to know the share of the market captured by Armenian, EU, CIS and Rest of the World firms, where the countries in the regions are defined in table 1. This entailed acquiring a list of all banks operating in Armenia along with their market share, and, when the bank is owned by multiple parties, allocating the ownership across the regions of our model. The database www.armbanks.am was sufficient for this task in most cases, but websites of the banks had to be consulted to allocate ownership shares in several cases. The results, by region and sector, are presented in appendix B.

Share of expatriate labor employed by multinational service providers

The impact of liberalization of barriers to foreign direct investment in business services sectors on the demand for labor in these sectors will depend on the share of expatriate labor used by multinational firms. Despite the fact that multinationals use Armenian labor less intensively than their Armenian competitors, if multinationals use mostly Armenian labor, their expansion is likely to increase the demand for Armenian labor in these sectors.¹⁵ As estimates of the share of expatriate labor or specialized technology not available to Armenian firms that is used by multinational service providers in Armenia, we used estimates from other studies in these sectors.¹⁶ We have found that multinational service providers use mostly local primary factor inputs and only small amounts of expatriate labor or specialized technology. Our estimated share of foreign inputs used by multinationals in Armenia is presented in the table on sensitivity analysis.

¹⁵ See Markusen, Rutherford and Tarr (2005) for a detailed explanation on why FDI may be a partial equilibrium substitute for domestic labor but a general equilibrium complement.

¹⁶ See Jensen, Rutherford and Tarr (2007) for Russia and Jensen and Tarr (2008) for Kazakhstan. Theory would suggest that small countries may have a greater need to expatriate labor compared with large countries.

Estimates of the Dixit-Stiglitz elasticities of substitution for 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. Christian Broda, Joshua Greenfield and David Weinstein (2006) estimated Dixit-Stiglitz product variety elasticities of substitution at the 3 digit level in 73 countries. Among the 73 countries, there were no CIS countries, but Lithuania is in their sample. As a former Soviet Union economy with a population about the size of Armenia, we choose Lithuania as our proxy. We explain in appendix C, 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 C1. For the manufacturing sector, we get a trade weighted elasticity of 8.

Elasticities of varieties with respect to price--evidence on the role of trade and FDI in increasing total factor productivity through technology transfer as a function of research and development intensity of the trading partner

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.¹⁷ 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

¹⁷ Trade or services liberalization may increase growth indirectly through its positive impact on the development of institutions (see Rodrik, Subramanian 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.

(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. We summarize this literature in appendix H. 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. Due to lack of data for Armenia, the classification is defined by the share of R&D expenditures in total sales, based on U.S. data. For low R&D intensive sectors, we assume that the elasticity of firms with respect to price is the same for the CIS region as for the EU, but the elasticity is only one-third of Rest of the World

elasticity (trade with the CIS or EU regions misses out on trade with China or the U.S.). For medium and high R&D intensive sectors, we assume that trade and FDI with the CIS region is only one-eighth as valuable as trade with the Rest of the World (as discussed above), while trade with the EU is two-thirds as valuable as trade with the Rest of the World. Finally, we allow the elasticity of the Rest of the World to vary 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 6b.¹⁸

To determine the impact of this parameter on the results, we conduct three types of sensitivity analysis on these parameters: systematic sensitivity analysis, piecemeal sensitivity analysis and a third where we simulate the model 100 times. When we conduct sensitivity analysis, we scale all the elasticities from 0.5 times their central values to 1.5 times their central values.

V. Results for Deep Liberalization: Central Elasticity Case

We execute several scenarios to assess the impacts of Armenia's broad trade policy options, where liberalization of services is featured in all scenarios. First, we consider the impact of Armenia entering into a Deep and Comprehensive Free Trade Agreement (DCFTA) with the European Union. Second, we evaluate the impact of deepening the CIS free trade agreement by adding preferential liberalization of services in the CIS; third, we evaluate combining a DCFTA with the EU with preferential liberalization of services with the CIS; fourth, in the scenario we call "unilateral," we combine the impact of a DCFTA with the EU, preferential liberalization of services with the CIS, and unilateral liberalization of tariffs and services with the rest of the world; finally, we add the impact of reducing geographically non-discriminatory services barriers in Armenia to the unilateral scenario. We discuss the results for each of these broad policy options in turn.

¹⁸ On the other hand, table 6a shows that the CIS has a larger share of the market than the EU in most services sectors. This will have the effect of yielding larger gains for liberalization with respect to the CIS.

Impact of the DCFTA with the EU

Aggregate Effects. A DCFTA with the EU is a complex agreement that will contain numerous chapters. Overall, we assess that the agreement will result in gains to Armenia of 1.4 percent of consumption in the medium term and 1.8 percent of consumption in the long run. We focus on five of the most important impacts that impact on trade and real incomes and assess their impacts separately to determine the source of these gains. These are: (i) preferential reduction in the of barriers in services with the EU that reduced the ad valorem equivalents of the barriers by 50 percent; (ii) a reduction in border costs; which will reduce border costs for trade with the EU most strongly, but will also reduce border costs with third countries, including the CIS; (iii) a reduction in standards costs of trading with the EU; (iv) elimination of tariff barriers against the EU; and (v) the impact on the investment climate from the four above mentioned impacts. We analyze each of these components in turn.

Services Liberalization. We estimate that the impact of preferential liberalization of services with EU will result in a welfare gain to Armenia of 0.4 percent of Armenian consumption (measured by Hicks an equivalent variation). In this scenario we assume that Armenian discriminatory barriers against EU multinational service providers are reduced by 50 percent in all sectors except airline services. In airline services, we assume that barriers are reduced by 25 percent due to the fact that several barriers in airlines will not be affected by a DCFTA.¹⁹ The gains from preferential services liberalization are smaller than we have observed in other applications, such as in Russia (Jensen, Rutherford and Tarr, 2007), Kazakhstan (Jensen and Tarr, 2008), Tanzania (Jensen, Rutherford and Tarr, 2010) and Kenya (Balistreri, Rutherford and Tarr, 2009). There are two reasons for this. First, the estimated discriminatory ad valorem equivalents of the barriers against multinational providers of services in Armenia are a lot lower than we have observed in these other applications (see table 4). Second, the liberalization is preferential, so there are lost services varieties from all regions other than the EU. The loss in varieties from other regions results in a loss of productivity and ultimately welfare. .

EU Tariff Liberalization. In this scenario, we assess the impacts of preferentially removing tariffs on imports of goods imported from the EU, with no other policy changes. We

¹⁹ For example, airline services can only be provided within the framework of an international agreement. This is not likely be changed by a DCFTA.

find this will lead to a loss of welfare for Armenia equal to -0.08 percent of consumption. Although the welfare loss is not large, it deserves explanation. There are two primary explanations--loss of tariff revenue of displaced imports from the Rest of the World and loss of manufactured good varieties from the Rest of the World. .

The EU has a minority share in manufactured and agricultural goods imports in Armenia. For manufactured goods, 45 percent of imports come from the Rest of the World region, while only 30 percent is from the EU. In agriculture, only 6 percent of imports originate in the EU, while 45 percent originate in the Rest of the World. Preferential tariff liberalization with respect to the EU results in a displacement of Rest of the World imports and a loss of tariff revenue on those imports.

To isolate the tariff loss impact from the productivity impact, we executed the preferential tariff liberalization scenario in model with perfect competition and constant returns to scale model in all goods sectors. In this scenario, there are no productivity impacts from additional varieties of goods. We find that there is a very small welfare loss for preferential reduction of barriers against EU imports equal to -0.001 percent of consumption. Thus, the tariff loss on rest of world imports is enough to offset any welfare gains from additional imports from the EU region, but the tariff loss is not sufficient to give significantly negative welfare impacts.

The difference between the welfare loss of -0.001 in the perfectly competitive case and the welfare loss of -0.08 in the full model must be due to loss of varieties from regions other than the EU. That is, preferential liberalization of tariffs against the EU induces additional varieties from the EU, but loss of varieties from the Rest of the World, CIS and Armenia. Given the large share of the Rest of the World in manufacturing imports of Armenia, the number of varieties lost from this region is relatively large.

Improved Trade Facilitation, including reduced border costs. In this scenario, called “border costs” in the table, we evaluate the impact of improved trade facilitation in Armenia as a result of the DCFTA with the EU. We assume that the costs of importing from or exporting to the EU declines by 2.5 percent of total production costs and the costs of non-EU trade fall by 2.3 or 2.2 percent of total production costs. (See appendix D for an elaboration of the methodology.) We evaluate the welfare gain from improved trade facilitation at 1.0 percent of consumption.

That is, this scenario suggests that the largest source of gains from the DCFTA with the EU is due to its impact on lowering the costs of trade transport on both imports and exports on both EU and non-EU trade.

Harmonization with EU Standards. In this scenario, labeled EU standards, we evaluate the impact of harmonization with EU standards as part of the DCFTA. As we explain in appendix E, we assess that the costs of meeting EU standards for Armenian exporters will fall by 25 percent for agricultural and manufacturing exports to the EU (from 15.8 of production costs to 11.8 percent of production costs in agriculture and from 21.6 percent of production costs to 16.2 percent of production costs in the case of manufacturing). On the other hand, there are adjustment costs of adapting to the new standards that we assess raise the costs of production by 2 percentage points. This cost reduction applies only to Armenian firms exporting to the EU and only on the agriculture and manufacturing sectors.

We assess that Armenia will gain 0.1 percent of consumption as a result of the harmonization of standards. The gains in standards are considerably less than from trade facilitation. This is due to the fact that the standards costs reduction is limited to exports to the EU on a subset of all exports, whereas trade facilitation cost reduction is assumed to apply to all products, on both imports and exports and there is some cost reduction for all trade partners.

EU DCFTA Steady-State. As discussed above, we assess the potentially positive impact of the DCFTA on the investment climate by executing a “steady-state” scenario. In this scenario, the capital stock adjusts to its long run equilibrium in response to an increase in the real return on capital. We estimate that the welfare gain will increase to 1.8 percent of consumption in this scenario. This is a modest increase over the comparative static result, but not striking. It reflects that the real return on capital increases only modestly in the comparative static scenario.

Similarly, in the scenario “unilateral steady state” and the scenario “unilateral and domestic steady state” we estimate approximately a 30 percent increase in the welfare gain in the steady state scenario relative to the comparative static scenario. Again, this reflects a modest increase in the rate of return on capital in the comparative static scenario.

Small gains from preferential liberalization of services with the CIS region

In the case of preferential liberalization of services barriers with the CIS region (to reduce the ad valorem equivalent by 50 percent), the gains are smaller—0.10 percent of consumption. The agreement with the EU includes tariff reduction, while tariff free access in the CIS region is considered part of the status quo; so the appropriate scenario for comparison of the relative gains for Armenia is the scenario labeled EU Discriminatory Services. The gains for Armenia of an agreement with the EU are four times greater than the gains from an agreement with the CIS region.

Why are the gains larger for the agreement with the EU? As we discussed above, trade with and FDI from large technologically advanced regions can be expected to lead to technology diffusion that increases total factor productivity. Although trade and FDI from small developing countries can contribute to technology diffusion, it has been estimated to do so to a significantly lesser extent, at least for research and development intensive sectors. The elasticity of the number of varieties (firms) with respect to price is the parameter in our model that captures that effect, and the values we have chosen are in table 6B.²⁰ Table 21 shows that we estimate that the number of varieties from the EU substantially increases in air transportation, banking and insurance as a result of preferential liberalization with the EU, while table 18 shows that the estimated expansion of varieties from the CIS region is much more modest (except in insurance) in response to preferential liberalization with respect to the CIS region. We show in the sensitivity analysis below that this elasticity of supply parameter is very important for the results: preferential agreements in services are more likely to be beneficial the higher the supply elasticities of the partner country's services suppliers and the lower the supply elasticities of the excluded countries services suppliers.

²⁰ The elasticity of supply corresponds to the share of the sector's costs that are due to a specific factor of production. In all of the imperfectly competitive sectors, we assume there are four specific factors: one for each region in the model. Then, as industry output expands, the price of the specific factor necessary for production of that variety increases, thereby increasing the cost of production of firms. Since the cost of production of firms increases as the industry supply increases, the supply curve of each region will slope up in each of these sectors. And higher cost shares of the specific factor will lead to less elastic supply curves in that sector.

Combining the CIS FTA with a DCFTA with Europe-- more substantial gains

In tables 7 and 8, in the column labeled “EU-CIS FTA,” we show our estimates for the impacts of agreeing to a FTA with both the EU and the CIS region. The estimated gains are approximately the sum of the separate agreements. This shows that Armenia can augment the gains it may realize from an agreement with the EU, by adding a preferential services agreement with its CIS partners.

Harrison, Rutherford and Tarr (2002) found that, for Chile, the gains from combining free trade agreements would be more than additive. Harrison, Rutherford, Tarr and Gurgel (2004) found similar results for Brazil. That is, the gains of the two agreements combined exceeded the gains of the two separate agreements. The reason is that if Chile, for example, agreed to a free trade agreement with the U.S., then competition from the U.S. would greatly reduce the trade diversion associated with an agreement with neighboring developing countries. But there are the possibilities of trade diversion with the rest of the world region, so the gains from combined agreements are not necessarily greater than the gains from the separate agreements.

Non-discriminatory liberalization of services and tariff barriers would result in about a three-fold increase in the gains compared with preferential liberalization of goods and services with the EU alone. With non-discriminatory liberalization, Armenians would be able to access goods and services from the least cost supplier in the world. This would eliminate all trade diversion losses and result in the maximum number of new foreign varieties for productivity improvement from trade and FDI liberalization. Consequently, the gains, which are equal to 1.1 percent of consumption, are much larger in this case than in the comparable case of preferential liberalization with the EU (between 0.4 and 0.3 percent of consumption for service and goods liberalization alone) or the CIS alone. The larger gains from the agreement with the EU come from trade facilitation cost reduction, not from services liberalization. Over 85 percent of the gains from unilateral liberalization come from liberalization of services rather than tariff liberalization.

Additional gains would be derived from reduction in the barriers that domestic as well as foreign firms face

If inefficient regulatory barriers that do not discriminate against foreign firms were also reduced by 50 percent, additional gains of 0.4 percent of consumption would be realized. This is a relatively low additional gain in comparison with some earlier work (Balestreri, Rutherford and Tarr, 2009; Jensen, Rutherford and Tarr, 2010). It reflects a relatively efficient legal framework for domestic services in Armenia.

Sector impacts

In table 9, we present results for the percentage change in output by sector for four scenarios: an FTA with the EU; and FTA with the CIS region; and FTA with the EU and the CIS region combined; and unilateral liberalization. Details of what is included in these scenarios are explained in table 7.

In general we see an expansion of the output of the business services sectors, as the removal of discriminatory barriers induces more foreign direct investment. Multinational firms in the business services sectors who locate in Armenia have their output defined as part of Armenian industry output. Preferential reduction of barriers against one region, generally reduces the number of firms from the other three regions in the model, but on balance the output of the sector expands. To see what happens to EU firms, versus Armenian and other firms, it is necessary to view the tables that report the change in the number of firms by scenario.

Given that we assume that total employment and the capital stock are fixed in the medium term, if labor expands in some sectors, it must contract in other sectors. Given the expansion in several sectors, we must have declines in others in the medium term. What is striking about the output results is how small the output declines are. In other applications, we have observed significant output declines in some sectors in the unilateral liberalization scenario. This is because we assume zero tariffs in our unilateral reform scenario. The mild output declines reflect the low level of tariff protection in Armenia in the benchmark equilibrium. In our

unilateral liberalization scenario, we do observe output declines in agriculture and manufacturing of 1.6 percent, as these are the only sectors that are protected by tariffs in the initial data.

Outside of business services, the sectors that expand depend on the scenario. In our unilateral liberalization scenario, we estimate that the hotel and restaurant sector, other transport services and wholesale and retail trade, and post and courier services are the sectors that will expand the greatest. These sectors are relatively intensive users of business services, such as transportation and banking services. Regulatory reforms will decrease the price and allow for quality improvements in these business services, which permits the using sectors to operate more cheaply and offer better quality services.

With the EC DCFTA, we estimate that wholesale and retail trade and mining and quarrying would be the main sectors that expand outside of business services. The expansion of business services is less strong than in unilateral liberalization, so intensive users of business services, like hotels and restaurants, gain less.

VI. Sensitivity Analysis

In this section we assess the impact of parameter values and key modeling assumptions on the results. Through our “piecemeal sensitivity analysis” we will determine the most important parameters for the results, and we will assess how important for the results are rent capture or additional varieties from reform in services sectors under increasing returns to scale. In the piecemeal sensitivity analysis, we change the value of a single parameter while holding the values of all other parameters unchanged at our central elasticity values. We present piecemeal sensitivity analysis of the two most relevant policy scenarios. In table 22, we examine the prospective free trade agreement with the EU and in table 23 we examine the agreement with the CIS region.

Given uncertainty of parameter values and the rent capture assumption, point estimates of the results may be viewed with skepticism. In our “systematic sensitivity analysis,” we execute 30,000 simulations. In each simulation, we allow the computer to randomly select the values of all parameters, subject to the specified probability distributions of the parameters. Through the

systematic sensitivity analysis we will be able to assess how robust the results are and obtain confidence intervals of the results.

Rent capture assumption

In the row labeled θ_r we retain the increasing returns to scale assumption in the services sectors and selected goods sectors, but allow initial rent capture in the services sectors to be either zero (central value) or 100 percent (upper value). The welfare gain with no rent capture is 1.44 percent of consumption but falls to 1.37 percent of consumption with initial rent capture. The fall is modest in relation to the overall gains, due to the fact that border costs, not service sector gains dominate the welfare results.

In the case of an agreement with the CIS region, the gains fall even more dramatically in percentage terms, from a welfare gain of 0.10 percent of consumption to 0.01 percent of consumption in our central elasticity case.

Impact of constant returns to scale—Possible negative welfare effects

In the row labeled “ θ_r –CRTS model,” we assume constant returns to scale in all sectors; this eliminates the Dixit-Stiglitz externality from additional varieties. We allow initial rent capture in the services sectors to be either zero (central value) or 100 percent (upper value). We see that without the Dixit-Stiglitz variety externality, the gains from an agreement with the EU fall dramatically and are estimated to be negative with the CIS region (-0.03 percent of consumption) in the case of initial rent capture. With no initial rent capture, the gains for the EU agreement would be approximately 0.73 percent of consumption and would fall to 0.67 with initial rent capture. In the case of an agreement with the CIS region, the gains are 0.06 with no initial rent capture and are -0.03 with initial rent capture.

Piecemeal sensitivity analysis

Three parameters stand out as having a strong impact on the results. The elasticity of substitution between firm varieties in imperfectly competitive goods and services sectors, $\sigma(q_i, q_j)$ has a very strong impact. Following from the Le Chatelier principle, larger elasticities typically lead to larger welfare gains in response to welfare improving reforms, as the economy can adapt more readily. This holds for the elasticities in the EU DCFTA scenario. Unlike other

elasticities, however, a lower value of $\sigma(q_i, q_j)$ can increase the welfare gains. This holds for the lower value of this elasticity in goods and services and the upper value in goods. This is because lower values of this elasticity imply that varieties are less close to each other, so additional varieties are worth more. In the case of goods in the EU DCFTA and in the case of the CIS piecemeal sensitivity, lower values of this parameter increase the estimated welfare gains. The elasticity of substitution between value-added and business services, $\sigma(va, bs)$, also has a strong impact. 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. Finally, for the agreement with the EU, a strong impact comes from changes in the value of ε_{EU} , the elasticity of EU multinational service firm supply with respect to the price of EU services in Armenia. Larger values of this parameter mean that tariff preferences that open opportunities for EU service firms to provide new varieties, will not be so quickly choked by the increased cost of the specific factor required for EU firm expansion. Similarly, for the agreement with the CIS region, ε_{AFR} , the elasticity of CIS multinational service firm supply with respect to the price of CIS services in Armenia has a strong impact. We conduct more detailed sensitivity analysis on this parameter below.

Systematic sensitivity analysis

In the systematic sensitivity analysis, we execute the model 30,000 times and harvest the results for desired variables. In each individual simulation, we allow the computer to select values of all the parameters in the model (the parameters in table 22), based on the specified probability density functions (pdfs) of the parameters. We assume uniform probability density functions, with upper and lower values of the pdfs given by the upper and lower values in the piecemeal sensitivity analysis table. We include initial rent capture in the systematic sensitivity analysis, with the rent capture parameter allowed to take values between zero and one with a uniform pdf.

The welfare results for a deep and comprehensive free trade agreement with the EU are depicted in figure 1. A 95 percent confidence interval for the gain in equivalent variation as a percent of consumption is: 1.01 percent to 1.84 percent. There are no simulations with negative estimated welfare changes.

In figures 2 and 3, we show “box and whisker” diagrams for the sample distribution of the percentage change in output by sector. Sectors are on the horizontal axis and the percentage change in output is shown on the vertical axis. The bars in the box are the means of the distributions. Fifty percent confidence intervals are depicted by the boxes, while the vertical lines show 95 percent confidence intervals.

The means of the systematic sensitivity results show a similar pattern to the point estimates regarding the expansion of the services sectors. The business services sectors, mining and quarrying and wholesale and retail trade sectors are the sectors that we estimate will expand. While the confidence intervals are rather tight for most sectors (95 percent confidence intervals for the significantly expanding sectors are virtually all positive), they reveal a large range of uncertainty for hotels and restaurants.

The results for preferential reduction of barriers with CIS partners on welfare, output and labor are shown in figures 4-6. The welfare results for preferential reduction of barriers in services with the CIS region, depicted in figure 6, are impacted significantly by the fact that we allow the rent capture parameter to vary between 0 and 1. The median result is between the two extreme values in the piecemeal sensitivity table for rent capture. Losses can occur when the share of rent capture in services by Armenian nationals is high. A 95 percent confidence interval for equivalent variation as a percent of consumption is: 0.003 to 0.147. There is a negative value for equivalent variation in 576 simulations.

Regarding output impacts of a services agreement with the CIS, results appear rather robust within a 95 percent confidence interval with the exception of air transport and telecommunications. The sensitivity analysis reveals that we cannot have a great deal of confidence in the sign of the impacts for air transportation.

VII. Conclusions

In this paper we have developed an innovative small open economy computable general equilibrium model of the Armenian economy that is capable of assessing the impact of a deep and comprehensive free trade agreement with the European Union. In addition to preferential tariff liberalization, we have examined preferential liberalization of barriers against multinational

service providers, harmonization of Armenian standards with EU standards and reduction of trade and border costs. We have also assessed the impact of preferential liberalization of services with the CIS region and compared all results with wider non-discriminatory liberalization. We find that Armenia would lose from a shallow free trade agreement with the EU, that is, a free trade agreement that preferentially liberalizes good alone. This is due primarily to a loss of productivity from excluded varieties of manufactured products from the non-EU regions. But Armenia would gain substantially from a DCFTA with the EU, due to inclusion of services liberalization, reduction of trade and border costs and harmonization of standards.

Armenia would obtain only small gains from a preferential reduction of barriers in services with the CIS region in our central elasticity case. Gains from liberalization with the EU region are considerably larger because of the larger amount of technology diffusion associated with trade and FDI with large industrialized countries, captured in our model as a relatively large increase in the number of varieties. Non-discriminatory liberalization of goods and services, however, will produce gains about three times larger than preferential liberalization of goods and services with the EU alone.

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Table 1 -- List of Sectors, Factors and Regions in the Armenia Model

Business Services	Other goods and services
Telecommunication	Agriculture, hunting, forestry and fishing
Insurance	Electricity, gas and water supply
Banking	Construction
Air transport	Wholesale, retail trade and repair
Transport via pipelines	Hotels and restaurants
Railway transport	Road transport
	Auxiliary transport activities
Dixit-Stiglitz Goods	Post and courier activities
Mining and quarrying	Real estate and professional services
Manufacturing	Public administration and defence
	Education
Regions	Health and social work
Armenia	Other social and personal services
EU: The 27 members of the European Union	
CIS+Georgia: Azerbaijan, Belarus, Georgia,	
Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan,	
Turkmenistan, Ukraine, Uzbekistan	Factors of Production
Rest of the World: All other countries	Labor, capital

Table 2 -- Sectoral value-added (% , unless otherwise indicated)

	Capital (%)	Labor (%)	GDP	
			bnDram	% of total
Business Services				
Transport via railways	46.0	54.0	12.0	0.4
Transport via pipelines	46.0	54.0	7.3	0.2
Air transport	46.0	54.0	42.0	1.4
Telecommunications	46.0	54.0	90.1	2.9
Insurance	66.3	33.7	0.9	0.0
Banking	66.3	33.7	70.9	2.4
Dixit-Stiglitz Goods				
Mining and quarrying	47.9	52.1	51.6	1.7
Manufacturing	46.9	53.1	332.8	10.9
Other goods and services				
Agriculture, hunting, forestry and fishing	75.6	24.4	575.2	19.2
Electricity, gas and water supply	38.5	61.5	122.7	4.1
Construction	56.0	44.0	865.5	29.0
Wholesale and retail trade and repair	61.6	38.4	363.0	12.0
Hotels and restaurants	25.2	74.8	10.6	0.3
Other land transport	46.0	54.0	36.1	1.2
Auxiliary transport activities	46.0	54.0	14.2	0.5
Post and courier activities	46.0	54.0	1.0	0.0
Real estate and professional services	85.7	14.3	107.2	3.5
Public administration and defence	7.6	92.4	90.7	3.0
Education	23.1	76.9	98.5	3.3
Health and social work	56.0	44.0	89.6	3.0
Other social and personal services	43.1	56.9	34.3	1.0

Table 3 -- Trade Flows

	Imports			Exports		
	bnDram	% of total	% of supply	bnDram	% of total	% of output
Business Services						
Transport via railways	5.9	0.5	27.4	3.1	0.7	16.5
Transport via pipelines	3.6	0.3	27.4	1.9	0.4	16.5
Air transport	20.9	1.9	27.4	11.0	2.5	16.5
Telecommunications	44.7	4.1	27.4	23.5	5.4	16.5
Insurance	0.1	0.0	12.7	0.1	0.0	9.5
Banking	11.2	1.0	12.7	8.0	1.9	9.5
Dixit-Stiglitz Goods						
Mining and quarrying	70.4	6.4	63.5	50.5	11.7	57.3
Manufacturing	823.0	74.6	54.6	254.6	58.8	39.0
Other goods and services						
Agriculture, hunting, forestry and fishing	42.7	3.9	5.0	6.2	1.4	0.8
Electricity, gas and water supply	4.3	0.4	2.5	7.4	1.7	4.3
Construction	1.4	0.1	0.1	4.0	0.9	0.3
Wholesale and retail trade and repair						
Hotels and restaurants	16.2	1.5	42.6	7.8	1.8	26.3
Other land transport	17.9	1.6	27.4	9.4	2.2	16.5
Auxiliary transport activities	7.1	0.6	27.4	3.7	0.9	16.5
Post and courier activities	0.5	0.0	27.4	0.3	0.1	16.5
Real estate and professional services	8.7	0.8	6.3	20.1	4.6	13.5
Public administration and defence	6.8	0.6	4.2	3.9	0.9	2.5
Education	10.7	1.0	9.0	9.8	2.3	8.3
Health and social work	2.7	0.2	2.1	5.0	1.2	3.8
Other social and personal services	3.6	0.3	5.7	2.4	0.6	4.6

Table 4 -- Benchmark Distortions (%)

	Output tax	Tariff	Border costs		Standards for EU exports	Regulatory barriers	
			Imports	Exports		All firms	Foreign firms
Business Services							
Transport via railways	2.5					20.0	
Transport via pipelines	2.5					40.0	
Air transport	2.5						106.8
Telecommunications	2.5					1.7	0.3
Insurance	0.7					9.6	15.8
Banking	0.7					1.5	5.6
Dixit-Stiglitz Goods							
Mining and quarrying	2.4		9.1	8.9			
Manufacturing	1.5	4.3	9.1	8.9	21.6		
Other goods and services							
Agriculture, hunting, forestry and fishing	0.7	10.1	9.1	8.9	15.8		
Electricity, gas and water supply	0.8						
Construction	0.3						
Wholesale and retail trade and repair	1.2						
Hotels and restaurants	4.5						
Other land transport	2.1						
Auxiliary transport activities	2.1						
Post and courier activities	2.1						
Real estate and professional services	1.9						
Public administration and defence	0.5						
Education	0.1						
Health and social work	0.3						
Other social and personal services	6.3						

Table 5 -- Trade Flows by Trading Partner (%)

	Imports			Exports		
	European Union	CIS	Rest of the World	European Union	CIS	Rest of the World
Business Services						
Transport via railways	0	100	0	0	100	0
Transport via pipelines	0	100	0	0	100	0
Air transport	30	30	41	30	30	41
Telecommunications	6	39	55	6	39	55
Insurance	30	57	14	30	57	14
Banking	21	49	30	21	49	30
Dixit-Stiglitz Goods						
Mining and quarrying	28	62	9	42	23	35
Manufacturing	30	25	45	33	31	36
Other goods and services						
Agriculture, hunting, forestry and fishing	6	49	45	13	83	4
Electricity, gas and water supply	0	0	100	0	0	100
Construction	0	0	100	0	0	100
Wholesale and retail trade and repair	0	0	100	0	0	100
Hotels and restaurants	0	0	100	0	0	100
Other land transport	0	0	100	0	0	100
Auxiliary transport activities	0	0	100	0	0	100
Post and courier activities	0	0	100	0	0	100
Real estate and professional services	0	0	100	0	0	100
Public administration and defence	0	0	100	0	0	100
Education	0	0	100	0	0	100
Health and social work	0	0	100	0	0	100
Other social and personal services	0	0	100	0	0	100

Source: Authors' estimates.

Table 6A -- Market Shares in Sectors with FDI (%)

	Armenia	European Union	CIS	Rest of the World
Business Services				
Transport via railways	0	0	100	0
Transport via pipelines	0	0	100	0
Air transport	70	9	9	12
Telecommunications	0	6	39	55
Insurance	31	20	39	10
Banking	26	16	36	22

Source: See Appendix

Table 6B -- Estimates of supply elasticity of firms with respect to price

	Armenia	European Union	CIS	Rest of the World
Business Services				
Transport via railways	2	10	2	15
Transport via pipelines	2	10	2	15
Air transport	2	10	2	15
Telecommunications	3	13	3	20
Insurance	3	3	3	10
Banking	3	3	3	10
Dixit-Stiglitz Goods				
Mining and quarrying	3	3	3	10
Manufacturing	2	10	2	15

Source: See Appendix

Table 7: Summary of Results—no initial capture of rents in services by Armenians
(results are percentage change from initial equilibrium, unless otherwise indicated)

Scenario definition	Benchmark	EU					EU FTA		
		EU FTA	Discriminatory Services	EU Tariffs	Border Costs	EU Standards	Steady-state	CIS FTA	EU-CIS FTA
Reduction of discriminatory barriers on EU services firms	No	Yes	Yes	No	No	No	Yes	No	Yes
Reduction of discriminatory barriers on CIS services firms	No	No	No	No	No	No	No	Yes	Yes
Reduction of discriminatory barriers on ROW services firms	No	No	No	No	No	No	No	No	No
Reduction of regulatory barriers for all services firms	No	No	No	No	No	No	No	No	No
Removal of tariffs on EU sourced goods	No	Yes	No	Yes	No	No	Yes	No	Yes
Removal of tariffs on ROW sourced goods	No	No	No	No	No	No	No	No	No
Reduction in border costs	No	Yes	No	No	Yes	No	Yes	No	Yes
Reduction in standards for EU exports	No	Yes	No	No	No	Yes	Yes	No	Yes
Steady-state capital stock	No	No	No	No	No	No	Yes	No	No
Aggregate welfare									
Welfare (EV as % of consumption)		1.4	0.4	-0.1	1.0	0.1	1.8	0.1	1.5
Welfare (EV as % of GDP)		1.0	0.3	-0.1	0.7	0.1	1.2	0.1	1.1
Government budget									
Tariff revenue (% of GDP)	1.0	0.6	1.0	0.5	1.0	1.0	0.6	1.0	0.6
Tariff revenue		-40.9	0.3	-44.2	5.0	0.7	-40.4	0.1	-40.8
Aggregate trade									
Real exchange rate		0.6	0.2	0.5	0.2	-0.3	0.9	0.1	0.6
Aggregate exports		13.9	-0.1	2.5	9.3	1.8	15.1	0.2	14.2
Factor Earnings									
Capital		2.0	0.4	0.5	0.8	0.2	1.0	0.1	2.0
Labor		2.0	0.5	0.4	0.9	0.1	2.9	0.1	2.0
Factor adjustments									
Capital		0.4	0.1	0.2	0.1	0.2		0.0	0.4
Labor		0.4	0.2	0.2	0.1	0.1	0.6	0.0	0.4
Capital stock and investment							1.9		

Source: Authors' estimates.

Table 7: Summary of Results—no initial capture of rents in services by Armenians -- continued
(results are percentage change from initial equilibrium, unless otherwise indicated)

Scenario definition	Unilateral	Unilateral		Unilateral Steady-state	Unilateral & Domestic	Unilateral & Domestic Steady-state
		Discriminatory Services	Unilateral Tariffs			
Reduction of discriminatory barriers on EU services firms	Yes	Yes	No	Yes	Yes	Yes
Reduction of discriminatory barriers on CIS services firms	Yes	Yes	No	Yes	Yes	Yes
Reduction of discriminatory barriers on ROW services firms	Yes	Yes	No	Yes	Yes	Yes
Reduction of regulatory barriers for all services firms	No	No	No	No	Yes	Yes
Removal of tariffs on EU sourced goods	Yes	No	Yes	Yes	Yes	Yes
Removal of tariffs on ROW sourced goods	Yes	No	Yes	Yes	Yes	Yes
Reduction in border costs	No	No	No	No	No	No
Reduction in standards for EU exports	No	No	No	No	No	No
Steady-state capital stock	No	No	No	Yes	No	Yes
Aggregate welfare						
Welfare (EV as % of consumption)	1.1	0.9	0.1	1.4	1.4	1.8
Welfare (EV as % of GDP)	0.8	0.7	0.1	1.0	1.0	1.3
Government budget						
Tariff revenue (% of GDP)		1.0				
Tariff revenue	-100.0	0.8	-100.0	-100.0	-100.0	-100.0
Aggregate trade						
Real exchange rate	2.0	0.5	1.4	2.3	2.2	2.5
Aggregate exports	7.0	0.1	6.9	8.2	7.6	8.9
Factor Earnings						
Capital	2.3	1.0	1.3	1.3	2.6	1.6
Labor	2.3	1.0	1.3	3.3	2.6	3.7
Factor adjustments						
Capital	0.8	0.2	0.6	0.2	0.8	0.2
Labor	0.8	0.3	0.5	0.9	0.8	0.9
Capital stock and investment						
				1.9		2.1

Source: Authors' estimates.

Table 8: Summary of Results, initial capture of rents in services by Armenians
(results are percentage change from initial equilibrium, unless otherwise indicated)

Scenario definition	Benchmark	EU					EU FTA		
		EU FTA	Discriminatory Services	EU Tariffs	Border Costs	EU Standards	Steady-state	CIS FTA	EU-CIS FTA
Reduction of discriminatory barriers on EU services firms	No	Yes	Yes	No	No	No	Yes	No	Yes
Reduction of discriminatory barriers on CIS services firms	No	No	No	No	No	No	No	Yes	Yes
Reduction of discriminatory barriers on ROW services firms	No	No	No	No	No	No	No	No	No
Reduction of regulatory barriers for all services firms	No	No	No	No	No	No	No	No	No
Removal of tariffs on EU sourced goods	No	Yes	No	Yes	No	No	Yes	No	Yes
Removal of tariffs on ROW sourced goods	No	No	No	No	No	No	No	No	No
Reduction in border costs	No	Yes	No	No	Yes	No	Yes	No	Yes
Reduction in standards for EU exports	No	Yes	No	No	No	Yes	Yes	No	Yes
Steady-state capital stock	No	No	No	No	No	No	Yes	No	No
Aggregate welfare									
Welfare (EV as % of consumption)		1.4	0.3	-0.1	1.0	0.1	1.7	0.0	1.4
Welfare (EV as % of GDP)		1.0	0.2	-0.1	0.7	0.1	1.2	0.0	1.0
Government budget									
Tariff revenue (% of GDP)	1.0	0.6	1.0	0.5	1.0	1.0	0.6	1.0	0.6
Tariff revenue		-40.9	0.3	-44.2	5.0	0.7	-40.5	0.0	-40.9
Aggregate trade									
Real exchange rate		0.6	0.2	0.5	0.2	-0.3	0.9	0.1	0.6
Aggregate exports		13.9	-0.1	2.5	9.3	1.8	15.0	0.2	14.1
Factor Earnings									
Capital		2.0	0.4	0.5	0.8	0.2	1.0	0.1	2.0
Labor		2.0	0.5	0.4	0.9	0.1	2.9	0.1	2.1
Factor adjustments									
Capital		0.4	0.1	0.2	0.1	0.2		0.0	0.4
Labor		0.5	0.2	0.2	0.1	0.1	0.6	0.1	0.5
Capital stock and investment							1.8		

Source: Authors' estimates.

Table 8: Summary of Results, initial capture of rents in services by Armenians -- continued

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

Scenario definition	Unilateral	Unilateral Discriminatory Services	Unilateral Tariffs	Unilateral Steady-state	Unilateral & Domestic	Unilateral & Domestic Steady-state
Reduction of discriminatory barriers on EU services firms	Yes	Yes	No	Yes	Yes	Yes
Reduction of discriminatory barriers on CIS services firms	Yes	Yes	No	Yes	Yes	Yes
Reduction of discriminatory barriers on ROW services firms	Yes	Yes	No	Yes	Yes	Yes
Reduction of regulatory barriers for all services firms	No	No	No	No	Yes	Yes
Removal of tariffs on EU sourced goods	Yes	No	Yes	Yes	Yes	Yes
Removal of tariffs on ROW sourced goods	Yes	No	Yes	Yes	Yes	Yes
Reduction in border costs	No	No	No	No	No	No
Reduction in standards for EU exports	No	No	No	No	No	No
Steady-state capital stock	No	No	No	Yes	No	Yes
Aggregate welfare						
Welfare (EV as % of consumption)	0.8	0.7	0.1	1.1	0.9	1.2
Welfare (EV as % of GDP)	0.6	0.5	0.1	0.8	0.6	0.9
Government budget						
Tariff revenue (% of GDP)		1.0				
Tariff revenue	-100.0	0.6	-100.0	-100.0	-100.0	-100.0
Aggregate trade						
Real exchange rate	2.0	0.5	1.4	2.3	2.1	2.5
Aggregate exports	6.9	-0.1	6.9	8.0	7.3	8.5
Factor Earnings						
Capital	2.3	0.9	1.3	1.3	2.5	1.6
Labor	2.4	1.1	1.3	3.4	2.8	3.8
Factor adjustments						
Capital	0.8	0.3	0.6	0.3	0.9	0.3
Labor	0.9	0.4	0.5	1.0	1.0	1.1
Capital stock and investment				1.8		1.9

Source: Authors' estimates.

Table 9: Output and Employment Impacts from Liberalization
(% change from benchmark)

	Unilateral Liberalization		EU-CIS FTA		CIS FTA		EU FTA	
	Output	Labor income	Output	Labor income	Output	Labor income	Output	Labor income
Business Services								
Transport via railways	1.8	2.2	0.6	1.5	0.2	0.1	0.5	1.4
Transport via pipelines	1.8	2.2	0.6	1.5	0.2	0.1	0.5	1.4
Air transport	14.2	14.7	7.1	8.1	-0.7	-0.7	7.9	9.0
Telecommunications	2.7	3.2	1.0	2.0	0.3	0.2	0.8	1.8
Insurance	4.5	5.7	1.4	2.8	0.9	0.6	0.5	2.2
Banking	4.1	5.4	1.2	2.6	0.7	0.4	0.5	2.2
Dixit-Stiglitz Goods								
Mining and quarrying	1.0	3.1	3.2	5.2	0.1	0.1	3.1	5.1
Manufacturing	-1.8	-0.1	-0.5	1.2	0.1	0.1	-0.6	1.1
Other goods and services								
Agriculture, hunting, forestry and fishing	-1.7	0.3	-0.6	1.2	0.1	0.1	-0.7	1.2
Electricity, gas and water supply	-0.2	1.4	-0.2	1.4	0.1	0.1	-0.3	1.4
Construction	0.0	2.1	0.0	1.9	0.0	0.0	0.0	1.9
Wholesale, retail trade and repair	4.2	6.1	2.7	4.5	0.1	0.1	2.6	4.4
Hotels and restaurants	7.2	7.4	-0.2	0.6	1.3	0.8	-1.4	-0.2
Other land transport	2.8	3.6	-0.3	0.8	0.2	0.2	-0.5	0.6
Auxiliary transport activities	2.8	3.6	-0.3	0.8	0.2	0.2	-0.5	0.6
Post and courier activities	2.8	3.6	-0.3	0.8	0.2	0.2	-0.5	0.6
Real estate and professional services	1.5	3.5	-0.4	1.4	0.1	0.1	-0.5	1.3
Public administration and defence	0.3	1.5	-0.1	1.3	0.0	0.0	-0.1	1.3
Education	-0.5	1.6	-0.9	1.0	0.0	0.1	-1.0	0.9
Health and social work	-0.2	1.9	0.1	2.0	0.0	0.1	0.0	1.9
Other social and personal services	0.1	1.9	-0.4	1.4	0.1	0.1	-0.4	1.3

Source: Authors' estimates.

Table 10: Impacts on Imports from Unilateral Liberalization (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		-0.4	
Transport via pipelines		-0.4	
Air transport	-23.3	-29.0	-20.7
Telecommunications	-1.3	-1.5	-1.2
Insurance	-4.6	-4.6	0.7
Banking	-1.2	-1.2	0.9
Dixit-Stiglitz Goods			
Mining and quarrying	-0.5	-0.5	-1.6
Manufacturing	10.9	-3.0	14.6
Other goods and services			
Agriculture, hunting, forestry and fishing	60.3	-22.2	60.3
Electricity, gas and water supply			-2.1
Construction			-1.9
Wholesale, retail trade and repair			
Hotels and restaurants			-2.5
Other land transport			-2.8
Auxiliary transport activities			-2.8
Post and courier activities			-2.8
Real estate and professional services			-0.1
Public administration and defence			-3.4
Education			-0.7
Health and social work			-2.3
Other social and personal services			-1.6

Source: Authors' estimates.

Table 11: Impacts on Exports from Unilateral Liberalization
 (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		2.8	
Transport via pipelines		2.8	
Air transport	-1.2	-1.2	-1.2
Telecommunications	3.7	3.7	3.7
Insurance	-1.4	-1.4	-1.4
Banking	1.1	1.1	1.1
Dixit-Stiglitz Goods			
Mining and quarrying	2.0	2.0	2.0
Manufacturing	9.3	9.3	9.3
Other goods and services			
Agriculture, hunting, forestry and fishing	-0.2	-0.2	-0.2
Electricity, gas and water supply			1.5
Construction			2.0
Wholesale, retail trade and repair			
Hotels and restaurants			13.1
Other land transport			7.0
Auxiliary transport activities			7.0
Post and courier activities			7.0
Real estate and professional services			2.8
Public administration and defence			3.9
Education			-0.3
Health and social work			1.8
Other social and personal services			2.4

Source: Authors' estimates.

Table 12: Impacts on Number of Firms from Unilateral Liberalization (% change from benchmark)

	Armenia	European Union	CIS	Rest of the World
Business Services				
Transport via railways			1.5	
Transport via pipelines			1.5	
Air transport	-17.1	175.2	25.7	247.8
Telecommunications		2.6	1.9	3.1
Insurance	-5.7	13.1	13.1	29.6
Banking	-0.8	5.3	5.3	11.2
Dixit-Stiglitz Goods				
Mining and quarrying	0.9	-0.4	-0.4	-1.2
Manufacturing	-1.6	6.0	-4.8	8.8
Other goods and services				
Agriculture, hunting, forestry and fishing				
Electricity, gas and water supply				
Construction				
Wholesale, retail trade and repair				
Hotels and restaurants				
Other land transport				
Auxiliary transport activities				
Post and courier activities				
Real estate and professional services				
Public administration and defence				
Education				
Health and social work				
Other social and personal services				

Source: Authors' estimates.

Table 13: Impacts on Imports from EU-CIS FTA (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		1.7	
Transport via pipelines		1.7	
Air transport	-4.1	-14.8	-16.6
Telecommunications	1.4	1.1	1.3
Insurance	-0.7	-0.7	-8.0
Banking	2.2	2.2	-0.2
Dixit-Stiglitz Goods			
Mining and quarrying	9.6	8.9	31.4
Manufacturing	44.0	2.1	-4.3
Other goods and services			
Agriculture, hunting, forestry and fishing	126.5	8.3	6.7
Electricity, gas and water supply			3.4
Construction			2.5
Wholesale, retail trade and repair			
Hotels and restaurants			0.5
Other land transport			2.1
Auxiliary transport activities			2.1
Post and courier activities			2.1
Real estate and professional services			4.4
Public administration and defence			1.5
Education			4.3
Health and social work			2.7
Other social and personal services			2.5

Source: Authors' estimates.

Table 14: Impacts on Exports from EU-CIS FTA (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		-0.7	
Transport via pipelines		-0.7	
Air transport	-1.7	-1.7	-1.7
Telecommunications	-0.3	-0.3	-0.3
Insurance	-5.1	-5.1	-5.1
Banking	-3.0	-3.0	-3.0
Dixit-Stiglitz Goods			
Mining and quarrying	19.6	14.0	14.0
Manufacturing	37.0	11.1	11.1
Other goods and services			
Agriculture, hunting, forestry and fishing	17.8	5.4	5.4
Electricity, gas and water supply			-3.4
Construction			-2.4
Wholesale, retail trade and repair			
Hotels and restaurants			-0.6
Other land transport			-2.1
Auxiliary transport activities			-2.1
Post and courier activities			-2.1
Real estate and professional services			-3.9
Public administration and defence			-1.6
Education			-5.1
Health and social work			-2.3
Other social and personal services			-3.8

Source: Authors' estimates.

Table 15: Impacts on Number of Firms from EU-CIS FTA (% change from benchmark)

	Armenia	European Union	CIS	Rest of the World
Business Services				
Transport via railways			0.5	
Transport via pipelines			0.5	
Air transport	-9.5	311.2	33.4	-32.8
Telecommunications		2.0	0.3	1.5
Insurance	-6.1	14.8	14.8	-12.5
Banking	-1.8	6.2	6.2	-2.2
Dixit-Stiglitz Goods				
Mining and quarrying	2.8	7.1	6.6	23.4
Manufacturing	-0.5	31.2	-0.8	-5.8
Other goods and services				
Agriculture, hunting, forestry and fishing				
Electricity, gas and water supply				
Construction				
Wholesale, retail trade and repair				
Hotels and restaurants				
Other land transport				
Auxiliary transport activities				
Post and courier activities				
Real estate and professional services				
Public administration and defence				
Education				
Health and social work				
Other social and personal services				

Source: Authors' estimates.

Table 16: Impacts on Imports from CIS Preferential Services Agreement (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		0.0	
Transport via pipelines		0.0	
Air transport	-2.2	-1.4	-2.2
Telecommunications	-0.1	-0.1	-0.1
Insurance	-5.8	-0.4	-7.3
Banking	-1.7	0.3	-2.1
Dixit-Stiglitz Goods			
Mining and quarrying	0.0	0.0	0.1
Manufacturing	3.2	3.2	3.3
Other goods and services			
Agriculture, hunting, forestry and fishing	0.0	0.0	0.0
Electricity, gas and water supply			-0.2
Construction			-0.1
Wholesale, retail trade and repair			
Hotels and restaurants			-0.6
Other land transport			-0.2
Auxiliary transport activities			-0.2
Post and courier activities			-0.2
Real estate and professional services			0.0
Public administration and defence			-0.3
Education			0.0
Health and social work			0.0
Other social and personal services			-0.1

Source: Authors' estimates.

Table 17: Impacts on Exports from CIS Preferential Services Agreement (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		0.2	
Transport via pipelines		0.2	
Air transport	0.3	0.3	0.3
Telecommunications	0.6	0.6	0.6
Insurance	-1.1	-1.1	-1.1
Banking	0.4	0.4	0.4
Dixit-Stiglitz Goods			
Mining and quarrying	0.1	0.1	0.1
Manufacturing	0.2	0.2	0.2
Other goods and services			
Agriculture, hunting, forestry and fishing	0.1	0.1	0.1
Electricity, gas and water supply			0.4
Construction			0.1
Wholesale, retail trade and repair			
Hotels and restaurants			2.4
Other land transport			0.5
Auxiliary transport activities			0.5
Post and courier activities			0.5
Real estate and professional services			0.2
Public administration and defence			0.4
Education			0.1
Health and social work			0.1
Other social and personal services			0.2

Source: Authors' estimates.

Table 18: Impacts on Number of Firms from CIS Preferential Services Agreement (% change from benchmark)

	Armenia	European Union	CIS	Rest of the World
Business Services				
Transport via railways			0.1	
Transport via pipelines			0.1	
Air transport	-0.9	-3.7	40.8	-4.5
Telecommunications		0.2	0.4	0.2
Insurance	-3.5	-4.8	17.0	-9.3
Banking	-0.5	-1.1	6.2	-2.3
Dixit-Stiglitz Goods				
Mining and quarrying	0.1	0.0	0.0	0.1
Manufacturing	0.1	0.1	0.0	0.1
Other goods and services				
Agriculture, hunting, forestry and fishing				
Electricity, gas and water supply				
Construction				
Wholesale, retail trade and repair				
Hotels and restaurants				
Other land transport				
Auxiliary transport activities				
Post and courier activities				
Real estate and professional services				
Public administration and defence				
Education				
Health and social work				
Other social and personal services				

Source: Authors' estimates.

Table 19: Impacts on Imports from EU FTA (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		1.6	
Transport via pipelines		1.6	
Air transport	-2.1	-14.2	-15.1
Telecommunications	1.5	1.1	1.4
Insurance	5.2	-0.4	-1.1
Banking	3.9	1.9	2.0
Dixit-Stiglitz Goods			
Mining and quarrying	9.6	8.9	31.3
Manufacturing	43.9	2.1	-4.4
Other goods and services			
Agriculture, hunting, forestry and fishing	126.5	8.3	6.7
Electricity, gas and water supply			3.6
Construction			2.6
Wholesale, retail trade and repair			
Hotels and restaurants			1.1
Other land transport			2.3
Auxiliary transport activities			2.3
Post and courier activities			2.3
Real estate and professional services			4.4
Public administration and defence			1.9
Education			4.3
Health and social work			2.7
Other social and personal services			2.5

Source: Authors' estimates.

Table 20: Impacts on Exports from EU FTA (% change from benchmark)

	European Union	CIS	Rest of the World
Business Services			
Transport via railways		-0.9	
Transport via pipelines		-0.9	
Air transport	-1.7	-1.7	-1.7
Telecommunications	-0.9	-0.9	-0.9
Insurance	-4.1	-4.1	-4.1
Banking	-3.3	-3.3	-3.3
Dixit-Stiglitz Goods			
Mining and quarrying	19.6	13.9	13.9
Manufacturing	36.8	10.9	10.9
Other goods and services			
Agriculture, hunting, forestry and fishing	17.6	5.3	5.3
Electricity, gas and water supply			-3.8
Construction			-2.5
Wholesale, retail trade and repair			
Hotels and restaurants			-2.9
Other land transport			-2.5
Auxiliary transport activities			-2.5
Post and courier activities			-2.5
Real estate and professional services			-4.0
Public administration and defence			-2.0
Education			-5.2
Health and social work			-2.5
Other social and personal services			-4.0

Source: Authors' estimates.

Table 21: Impacts on Number of Firms from EU FTA (% change from benchmark)

	Armenia	European Union	CIS	Rest of the World
Business Services				
Transport via railways			0.4	
Transport via pipelines			0.4	
Air transport	-8.7	328.8	-10.7	-30.6
Telecommunications		1.9	0.0	1.4
Insurance	-2.8	20.6	-2.1	-4.1
Banking	-1.3	7.5	0.0	0.1
Dixit-Stiglitz Goods				
Mining and quarrying	2.7	7.1	6.6	23.3
Manufacturing	-0.5	31.1	-0.8	-5.9
Other goods and services				
Agriculture, hunting, forestry and fishing				
Electricity, gas and water supply				
Construction				
Wholesale, retail trade and repair				
Hotels and restaurants				
Other land transport				
Auxiliary transport activities				
Post and courier activities				
Real estate and professional services				
Public administration and defence				
Education				
Health and social work				
Other social and personal services				

Source: Authors' estimates.

Table 22: Piecemeal Sensitivity of impact on Armenia of a DCFTA with the EU

Results are estimated changes in welfare (Hicksian EV) as a percent of consumption

Parameter	Parameter value			Results for EV		
	Lower	Central	Upper	Lower	Central	Upper
$\sigma(q_i, q_j)$ – services sectors	2	3	4	1.39	1.44	1.51
$\sigma(q_i, q_j)$ – goods sectors	See below			1.76	1.44	1.30
$\sigma(va, bs)$	0.625	1.25	1.875	1.39	1.44	1.52
$\sigma(D, M)$	2	4	6	1.42	1.44	1.46
$\sigma(M, M)$	4	8	12	1.44	1.44	1.44
$\sigma(L, K)$	0.5	1	1.5	1.44	1.44	1.44
$\sigma(A_1, \dots, A_n)$	NA	0	0.25	NA	1.44	1.45
$\sigma(D, E)$	2	4	6	1.44	1.44	1.44
ϵ_{ARM}	Central values of all 4 sets of ϵ parameters are listed in table 6B. Lower and upper values are 0.5 and 1.5 times central values.			1.46	1.44	1.43
ϵ_{EU}				0.96	1.44	1.77
ϵ_{CIS}				1.44	1.44	1.45
ϵ_{ROW}				1.53	1.44	1.39
θ_r	NA	0	1	NA	1.44	1.37
θ_r - CRTS model	NA	0	1	NA	0.73	0.67
θ_m	0.025	0.05	0.075	1.44	1.44	1.45
$\sigma(q_i, q_j)$ – goods sectors						
Mining & quarrying	8.5	17.00	25.5			
Manufacturing	4	8.00	12			

Key:

- $\sigma(q_i, q_j)$: Elasticity of substitution between firm varieties in imperfectly competitive sectors
- $\sigma(va, bs)$: Elasticity of substitution between value-added and business services
- $\sigma(D, M)$: Elasticity of substitution between domestic production and imports
- $\sigma(M, M)$: Elasticity of substitution between imported varieties
- $\sigma(L, K)$: Elasticity of substitution between primary factors of production in value added
- $\sigma(A_1, \dots, A_n)$: Elasticity of substitution in intermediate production between composite Armington aggregate goods
- $\sigma(D, E)$: Elasticity of transformation (domestic output versus exports)
- ϵ_{ARM} : Elasticity of national service firm supply with respect to price of output
- ϵ_{EU} : Elasticity of EU service firm supply with respect to price of output
- ϵ_{CIS} : Elasticity of CIS service firm supply with respect to price of output
- ϵ_{ROW} : Elasticity of Rest of World service firm supply with respect to price of output
- θ_r : Share of rents in services sectors captured by domestic agents
- θ_m : Shares of value added in multinational firms due to specialized primary factor imports

Source: Authors' estimates.

Table 23: Piecemeal Sensitivity of impact on Armenia preferential services liberalization with the CIS region

Results are estimated changes in welfare (Hicksian EV) as a percent of consumption

Parameter	Parameter value			Results for EV		
	Lower	Central	Upper	Lower	Central	Upper
$\sigma(q_i, q_j)$ – services sectors	2	3	4	0.22	0.10	0.07
$\sigma(q_i, q_j)$ – goods sectors	See below			0.11	0.10	0.10
$\sigma(va, bs)$	0.625	1.25	1.875	0.09	0.10	0.12
$\sigma(D, M)$	2	4	6	0.10	0.10	0.10
$\sigma(M, M)$	4	8	12	0.10	0.10	0.10
$\sigma(L, K)$	0.5	1	1.5	0.10	0.10	0.10
$\sigma(A_1, \dots, A_n)$	NA	0	0.25	NA	0.10	0.10
$\sigma(D, E)$	2	4	6	0.10	0.10	0.10
ε_{ARM}	Central values of all 4 sets of ε			0.11	0.10	0.10
ε_{EU}	parameters are listed in table 6B.			0.11	0.10	0.10
ε_{CIS}	Lower and upper values are 0.5			0.05	0.10	0.15
ε_{ROW}	and 1.5 times central values.			0.11	0.10	0.10
θ_r	NA	0	1	NA	0.10	0.01
θ_r - CRTS model	NA	0	1	NA	0.06	-0.03
θ_m	0.025	0.05	0.075	0.10	0.10	0.10
$\sigma(q_i, q_j)$ – goods sectors						
Mining & quarrying	8.5	17.00	25.5			
Manufacturing	4	8.00	12			

Key:

- $\sigma(q_i, q_j)$: Elasticity of substitution between firm varieties in imperfectly competitive sectors
- $\sigma(va, bs)$: Elasticity of substitution between value-added and business services
- $\sigma(D, M)$: Elasticity of substitution between domestic production and imports
- $\sigma(M, M)$: Elasticity of substitution between imported varieties
- $\sigma(L, K)$: Elasticity of substitution between primary factors of production in value added
- $\sigma(A_1, \dots, A_n)$: Elasticity of substitution in intermediate production between composite Armington aggregate goods
- $\sigma(D, E)$: Elasticity of transformation (domestic output versus exports)
- ε_{ARM} : Elasticity of national service firm supply with respect to price of output
- ε_{EU} : Elasticity of EU service firm supply with respect to price of output
- ε_{CIS} : Elasticity of CIS service firm supply with respect to price of output
- ε_{ROW} : Elasticity of Rest of World service firm supply with respect to price of output
- θ_r : Share of rents in services sectors captured by domestic agents
- θ_m : Shares of value added in multinational firms due to specialized primary factor imports

Source: Authors' estimates.

Figure 1: Sample Distribution of the Welfare Results of Armenian-EU DCFTA—30,000 simulations.

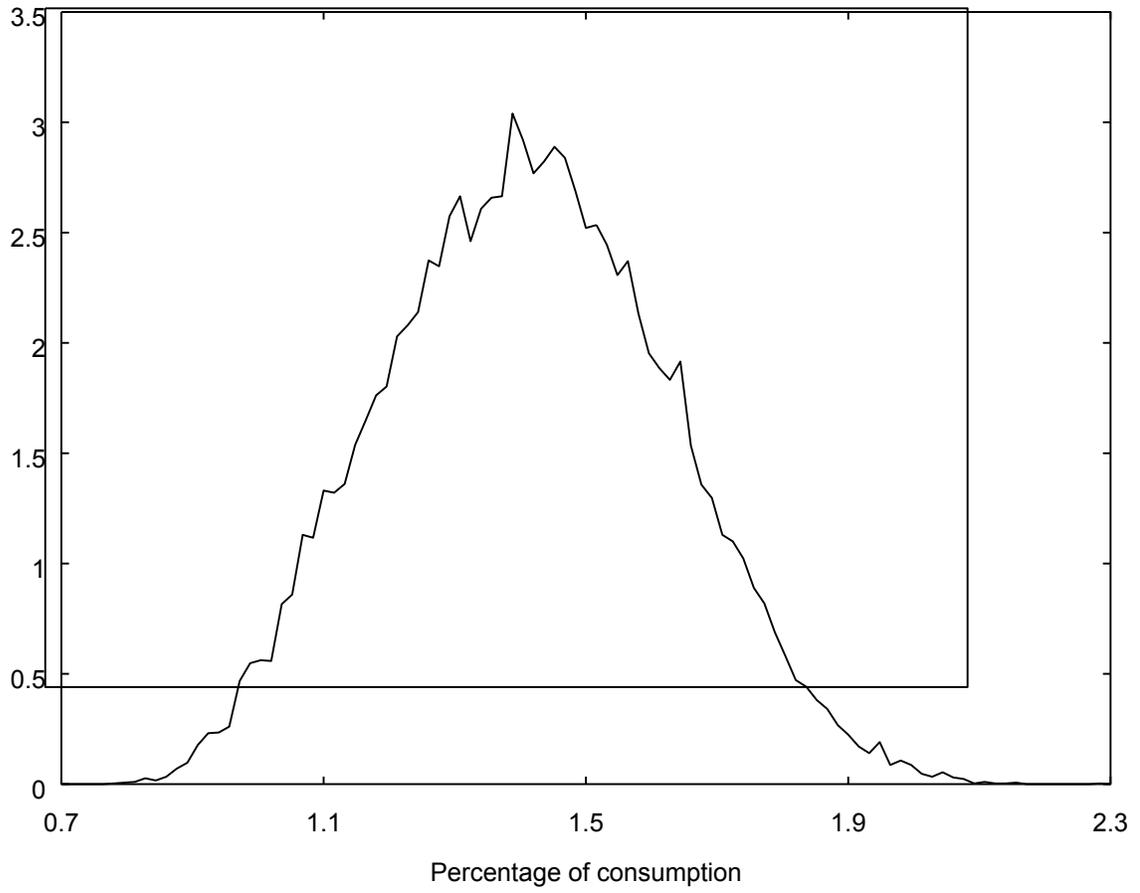
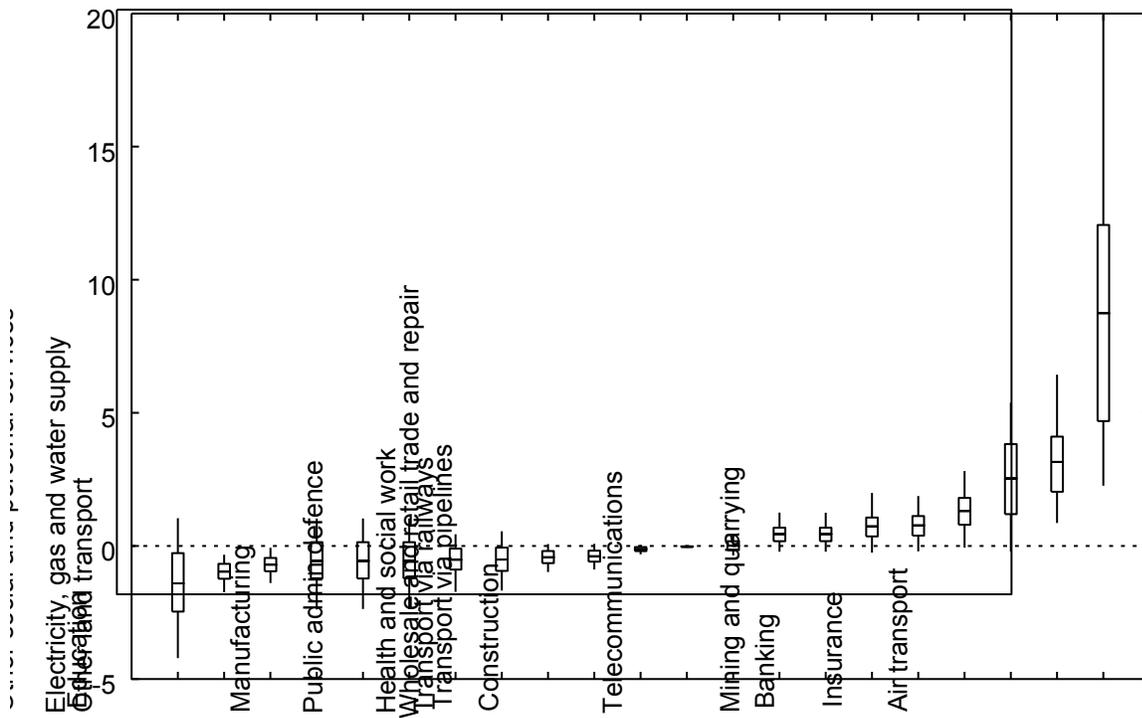
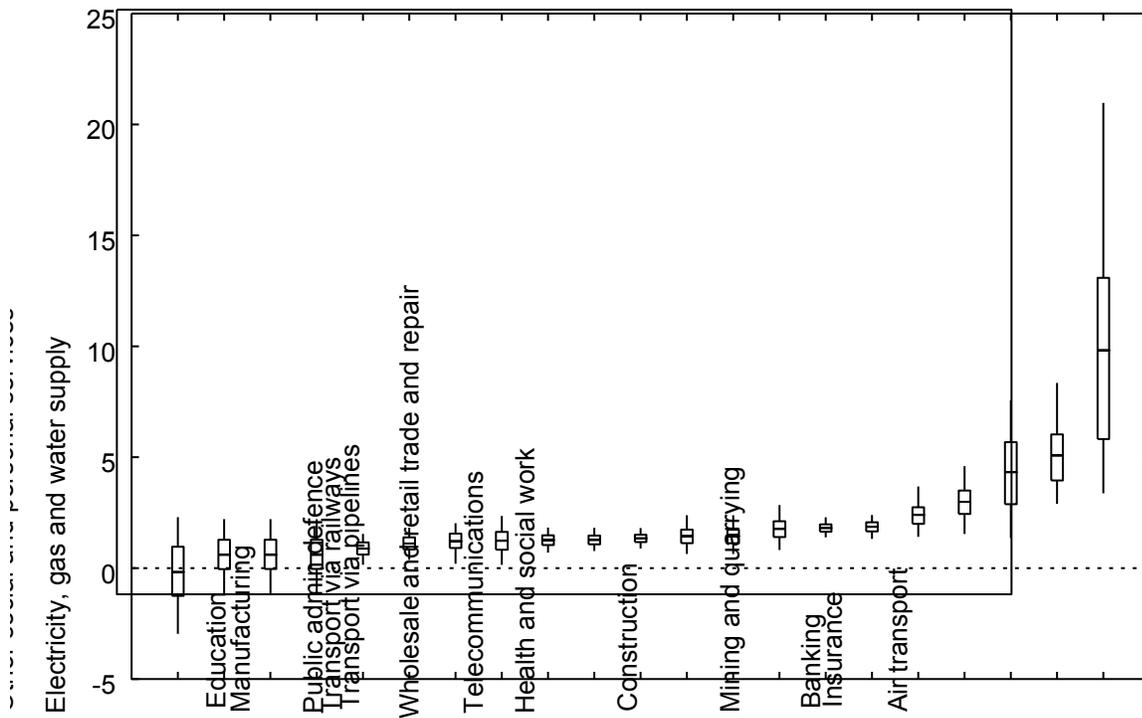


Figure 2: Means, 50 and 95 Percent Confidence Intervals of the Sample Distributions of the Output Changes by Sector from Armenian-EU DCFTA—30,000 simulations.



Note: The boxes are limited vertically by the 25% and 75% quartiles. The bars in the box are the means. The vertical lines extend to the 2.5% and 97.5% percentiles.

Figure 3: Means 50 and 95 Percent Confidence Intervals of the Sample Distributions of the Labor Payment Changes by Sector from Armenian-EUFTA—30,000 simulations.



Note: The boxes are limited vertically by the 25% and 75% quartiles. The bars in the box are the means. The vertical lines extend to the 2.5% and 97.5% percentiles.

Figure 4: Sample Distribution of the Welfare Results of Armenian-CIS FTA—30,000 simulations.

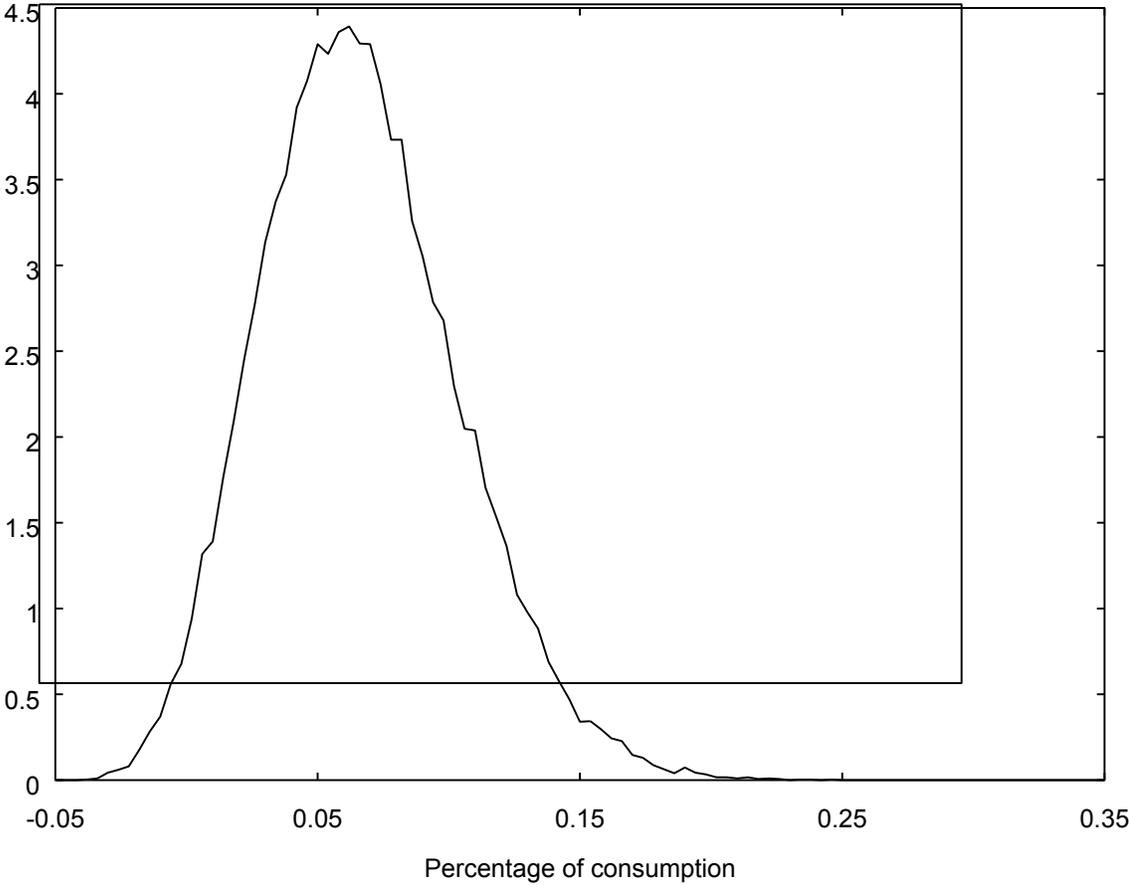
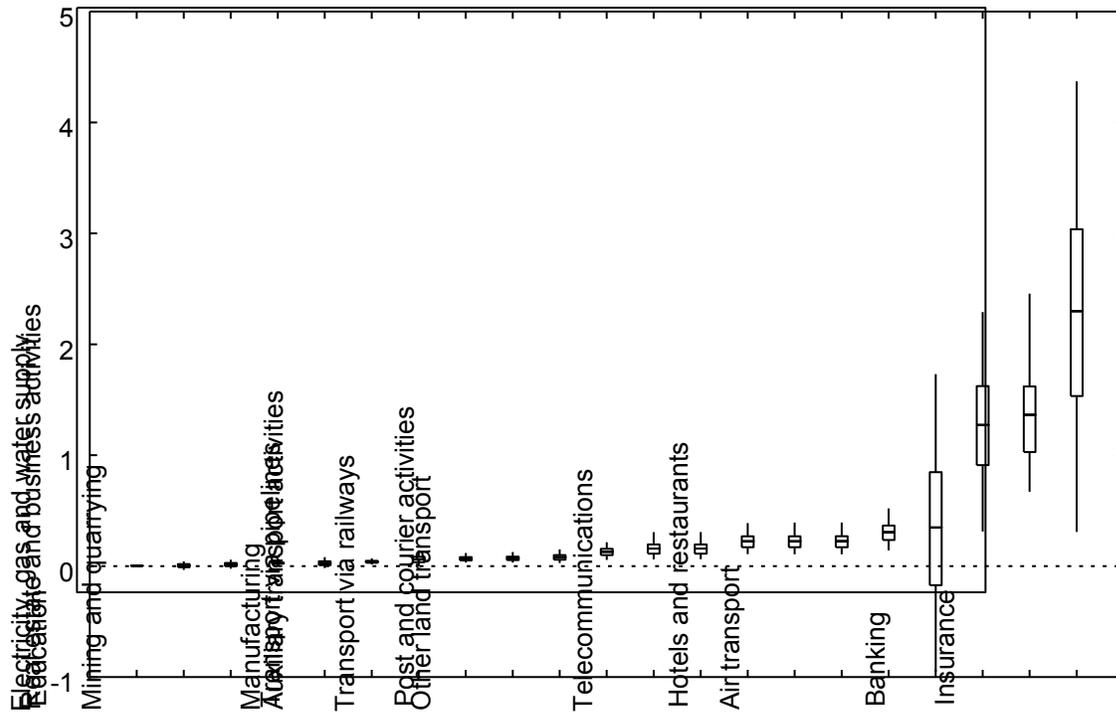
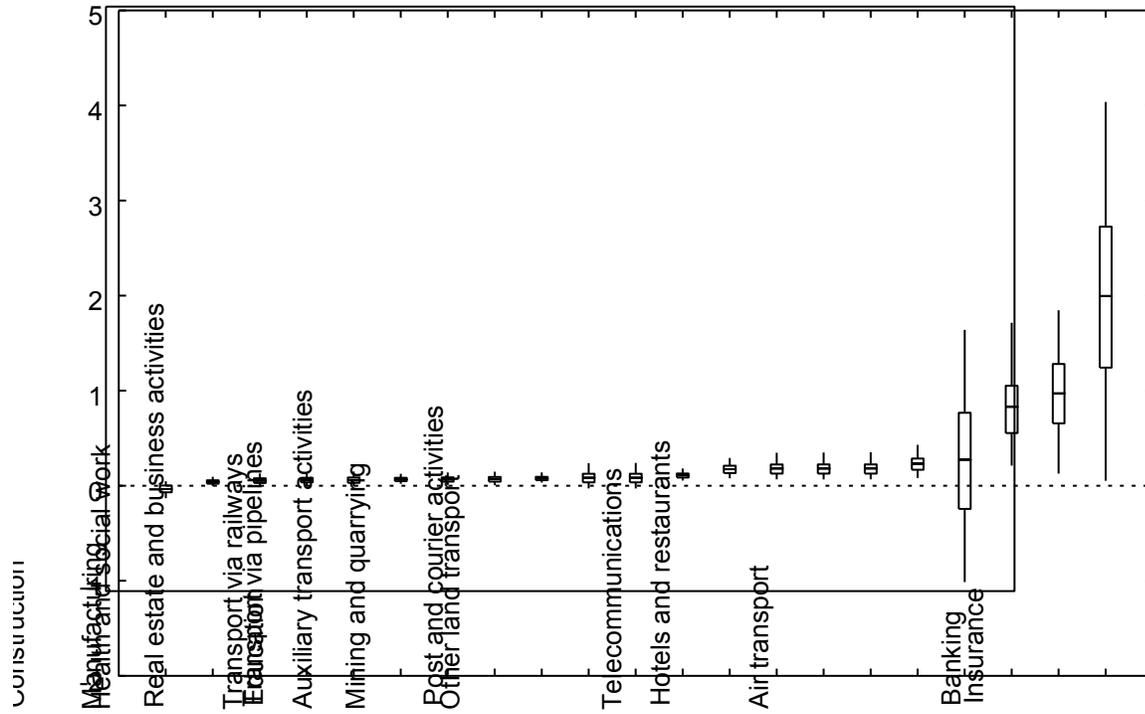


Figure 5: Means 50 and 95 Percent Confidence Intervals of the Sample Distributions of the Output Changes by Sector from Armenian-CISFTA—30,000 simulations.



Note: The boxes are limited vertically by the 25% and 75% quartiles. The bars in the box are the means. The vertical lines extend to the 2.5% and 97.5% percentiles.

Figure 6: Means 50 and 95 Percent Confidence Intervals of the Sample Distributions of the Labor Payment Changes by Sector from Armenian-CIS FTA—30,000 simulations.



Note: The boxes are limited vertically by the 25% and 75% quartiles. The bars in the box are the means. The vertical lines extend to the 2.5% and 97.5% percentiles.

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Appendix F is available as Modebadze and Eroyants (2010) at
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Appendix A: Trade Data and Tariff Rates for Armenia's Trade Partners

Trade Data by Regional Partner and Sector

To obtain the shares of imports and exports from the different regions of our model, we used trade data published by the National Statistical Service of the Republic of Armenia²¹. The data is for the year 2007 and shows exports and imports by country and commodity.

The regions of our model are Armenia, the European Union, the CIS, and the Rest of the World. For the European Union, we took the 27 member countries as of 2007. For the CIS, we include Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Rest of the World is the residual.

The data is reported according to the Harmonized System (HS) classification at the two digit level. We mapped the HS-commodities into the sectors of our model. The exact mapping is defined in the first table below. Results for both exports and imports are reported in the subsequent two tables.

Tariff Data.

We use detailed collected tariff data from the Armenian Customs Authority. That is, we received data on collected import duties (tariffs) and import values at the four digit tariff line level (again using the Harmonized System classification). The collected tariff rates for the sectors in our model are obtained by first aggregating the four digit tariff line level tariff collections and import values to the sectors of our model. The ratio of tariff collections to import values for each sector of our model is then calculated to give estimates of the collected tariff rates, which in turn are incorporated into our dataset. The tariff rates are shown in Table 4. Applying these tariff rates across all sectors implies that tariff revenue in the revised database is about 1% of GDP, which is consistent with collected revenues in Armenia.²²

Given that Armenia participates in preferential trade areas with the other CIS member states, it was necessary to make further adjustments. That is, since, in principle, tariff rates should be zero within these preferential trade areas, we set tariff collections on imports from CIS countries at zero. We then increased the tariff rates for the other regions in our model so that the overall weighted average collected tariff rate is unchanged. We used the trade flow data, disaggregated by regions and sectors of our model to weight the tariff rates. This adjustment has the impact of raising the collected tariff rates for the regions in our model where positive tariff rates apply. The resulting adjusted tariff rates are also reported in Table 4.

²¹ http://www.armstat.am/file/article/ft_2nish_07_14.pdf

²² For the year 2008, aggregate data from Armenia show that tariff collections are 1% of GDP.

Table 1 Correspondences between sectors of the model and two digit HS Classification

Agriculture, hunting, forestry and fishery	1-10
Mining and quarrying	25-27
Manufacturing	11-24, 28-97

Source: Authors' estimates.

Table 2 Armenian imports by sector and partner of the model, 2007 (in thousands of USD)

	European Union	CIS	Rest of the World
Agriculture, hunting, forestry and fishery	15057	92032	127837
Mining and quarrying	145367	272520	98488
Manufacturing	753763	406486	1356241

Source: Authors' calculations from data provided by the National Statistical Service of the Republic of Armenia.

Table 3 Armenian exports by sector and partner of the model, 2007 (in thousands of USD)

	European Union	CIS	Rest of the World
Agriculture, hunting, forestry and fishery	3192	5068	16640
Mining and quarrying	72795	2340	98404
Manufacturing	317146	208070	428649

Source: Authors' calculations from data provided by the National Statistical Service of the Republic of Armenia.

Table 4 Armenian collected tariff rates by sector and partner of the model, 2008 (in %)

	Weighted average	European Union	CIS	Rest of the World
Agriculture, hunting, forestry and fishery	5.2	8.5	0	8.5
Mining and quarrying	0	0	0	0
Manufacturing	3.2	3.8	0	3.8

Source: Authors' calculations from data provided by the Armenian Customs Authority.

Appendix B:

Market Shares by Region in Key Services Sectors in Armenia

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To obtain data on market shares of the business services sectors in the Armenia CGE model we explored all the available sources and prepare the data by key region in Armenia. These are: Armenia, CIS less Armenia, the EU, the USA and the Rest of the World (RoW). Collected data is based on the market shares of services firms that have a domestic presence in Armenia, mostly focusing on the following sectors: Banking and Credit Organizations, Insurance, Telecommunication sector, Air transportation, Railroad Transportation, and Pipeline sectors. As shows results in the table below more than half of ownership shares are being held by representatives from CIS countries, mostly by Russian Federation, which has very significant participation in several sectors. Russian "South Caucasus Railways" has monopoly rights fully controlling railway transportation in Armenia, Russian "Gazprom" is taking 80 % shares of gas pipeline's, in addition having about 40% in telecommunication service sector. The rest of the paper documents the results in details.

Market shares in percent						
	ARM	CIS	EU	USA	ROW	
Banking and other financial	25,97	36,17	15,59	10,12	12,15	100
Insurance	31,2	38,87	20,3	8,45	1,18	100
Telecommunication sector	0	38,96	5,73	31,7	23,61	100
Air transportation service	70,42	8,73	8,73	0	12,12	100
Pipeline transportation service	20	78	2	0	0	100
Railroad Transportation	0	100	0	0	0	100
Total shares by regions	147,59	300,73	52,35	50,27	49,06	600

Documentation of the Calculation of Ownership Shares for Armenia

I. Bank Shares in Armenia

Bank Market Shares

The data source concerning to banks was the financial-banking portal www.armbanks.am, the leading Internet edition in Armenia covering the countries financial and banking sectors,¹ exploring <http://www.armbanks.am/en/banks/> for banks information and <http://www.armbanks.am/en/credit-companies/> for credit organizations (CO).

Through the portal I obtained data on total assets by bank and credit organizations (CO) in Armenia, owners-shareholders of the bank and the percent of the bank owned by each owner-shareholder. After collecting data I defined the market share of each bank and CO as a share of total bank and CO assets in the country. Then I divided the regions into Armenia (ARM), CIS, the European Union (EU), USA, and the Rest of the World (RoW) to calculate the market shares by region.

Ownership Shares of Banks

Each bank's market share was then allocated among geographic regions according to the shares of ownership of the bank. Then I summed across the banks to obtain total market shares by region. However, in some cases, I had to investigate bank websites to get the required ownership information. In the Table 1, I list the result of these calculations. The results of our supplementary inquiries are listed below

The results we get on the owners shares of the banking sector of Armenia are as follows (in percent): Armenia, 25.98; CIS, 36.17; EU, 15.59; USA 10.12; ROW 12.15, (see Table 1).

Supplementary Information on Ownership Shares of Armenian Banks

- 1. ACBA-Cedit Agricole CJSC:** The ACBA bank was established in 1996, within TACIS program of the European Union. On September 15, 2006 European leading French Credit Agricole bank became the biggest shareholder of ACBA Bank, becoming a closed joint stock company and it was renamed ACBA-CREDIT AGRICOLE BANK. The shareholders are Credit Agricole Group (France) – 15.56%, JSC Sacam International (France) – 12.44%, Armenian regional farm unions particularly: Armavir - 14.08% and Ararat 12.28%. <http://www.armbanks.am/en/banks/?org=3&lang=en>, <http://acba.am/index.php>
- 2. Ameriabank CJSC:** The bank was established in 1910 as a branch of Caucasian Trade Bank, which during the Soviet years was transformed to the Armenian branch of the USSR Vneshtorgbank. In July 1992, Armenian Import-Export Bank CJSC was founded, which received a banking license from the Central Bank of Armenia on September 8 of the same year. In August 2007, the main share holdings of the Bank (96%) were obtained by TDA Holdings Limited, an investment company affiliated with the leading and largest Russian investment group company – Troika Dialog. In 2007-2008, gradually increasing the Charter Capital of the Bank, the major shareholder TDA Holdings Limited increased its equity participation up to 99.9956044%. TDA Holdings Limited - 99.99% <http://www.armbanks.am/en/banks/?org=4&lang=en>, <http://www.ameriabank.am/23>
- 1. Araratbank OJSC:** ARARATBANK was established as a result of the reorganization of Haykap Bank, operating on Armenian financial market since 1991. ARARATBANK has been functioning as an open joint stock company since August 2007. The bank is a shareholder and a full member of "Armenian Card" company since 2006. The shareholders are Flesh Ltd - 74.1%, EBRD - 25%, Resident

23 Apart from on-line information the www.armbanks.am portal offers also analytical research, exclusive stories and information about banks, insurance and credit organizations, their comparative financial indices as well as statistical data.

Individuals 0.9%. <http://www.armbanks.am/en/banks/?org=6&lang=en>,
<http://www.araratbank.am/>

2. [Ardshininvestbank](#) was registered by the decision of the RA Central Bank Board (license N 83) in 2003. Acquired a significant part of assets and liabilities, as well as wide branch network. The main shareholders are Business Investment Center LLC 86.96%, International Financial Corporation 10.00%, and Resident Individuals 3.04%. <http://www.armbanks.am/en/banks/?org=7&lang=en>, www.ashib.am
3. **Areximbank**: Areximbank-Gazprombank Group was founded in August 1998 to support entrepreneurship and manage the financial flows between Russia and Armenia. Since September 2008 Gazprombank is 100% owner of the bank. The shareholders of Gazprombank are as follows: Zao Leader (On Behalf Of Gazfond) - 42.89%, Joint Stock Company 'Gazprom – 41.73%, Treasury Stock -8.21%, Negosudarstvennyi Pensionnyi Fond Gazfond – 7.11%, Individuals – 0.06% <http://www.armbanks.am/en/banks/?org=8&lang=en>, www.areximbank.am
4. **Armbusinessbank**: was established as shareholding bank “Arminvestbank” in 1991. Chrystie Management owned 86.99% shares Armbusinessbank, while the remaining 13.01% is owned Ukrprombank, who intends to sell all the shares (13,01%) of the company Chrystie Management.Gasprombank OJSC <http://www.armbanks.am/en/banks/?org=12&lang=en>, www.armbusinessbank.am
5. **Armeconombank**: OAO «Armeconombank» registered in 1991. 75% of its shares owned by the founders of "Sil" group - the family business Sukiasyans and the rest 25% are owned by EBRD. <http://www.armbanks.am/en/banks/?org=17&lang=en>, <http://www.aeb.am/>
6. **Armenian Development Bank** is one of the first commercial banks in Armenia. The bank was established in 1990 under the rule of former Soviet Union Prime Minister N. Rzhzhikov. The Bank’s legal status is Open Joint Stock Company (OJSC).The government does not have a share in Bank’s capital. The resident individuals’ and jurisdictional entities’ contribution to the statutory fund makes up 52.057% and non-resident individuals’ and jurisdictional entities’ contribution to the statutory fund makes up 47.94%. <http://www.armbanks.am/en/banks/?org=2&lang=en>, www.armdb.com
7. Armswissbank was registered November 22, 2004 with 100% Swiss capital, and February 25, 2005 received a license № 84 of the Central Bank to conduct banking activities. The 100% owner is Vardan Sirmakes from Switzerland. <http://www.armbanks.am/en/banks/?org=18&lang=en>, www.armswissbank.am
8. **Artsakhbank, CJSC** was established on February 12, 1996 (the RA Central Bank’s License No.75 of July 14, 1996) The shareholders are Vardan Sirmakes (CH) 43,13%, Hratch K. Gabrielyan (US) 44,08%, Non-resident Individuals 5,10%, Resident Individuals and Legal Entities 7,69% <http://www.armbanks.am/en/banks/?org=19&lang=en>, www.ab.am
9. **“Anelik Bank” CJSC** was founded in 1990 August 1, by enterprises and organizations of Light Industry as a Shareholding Commercial Bank. In 2007 “Anelik Bank” LTD was reorganizaed into Closed Joint Stock Company. “Anelik Bank” CJSC is a universal commercial bank, which has an active participation in the social-economical area of the country. The shareholders are CreditBank S.A.L. (LB) 51% and physical persons (AM) 49%. <http://www.armbanks.am/en/banks/?org=5&lang=en>, www.anelik.am
10. CJSC "BTA Bank" is a strategic partner of one of the largest banks in Kazakhstan JSC "BTA Bank", which owns 48.9% stake in the Armenian "BTA Bank". The other shareholders are the Austrian company ZRL (with share of 31.1%) and the Kazakh-Armenian company MOBILEX (16.3%) <http://www.armbanks.am/en/banks/?org=20&lang=en>, www.bta.am
11. "Byblos Bank": In 2007 the Lebanese "Byblos Bank" Chevron-EI ("Byblos Bank" SAL) became the major shareholder of the Armenian CJSC "ITB" International Trade Bank with 65% of the shares, then the bank was renamed the Byblos Bank Armenia. The other shareholders are the EBRD with 25% stake and the International Fund for Development OPEC - with 10% stake.

<http://www.armbanks.am/en/banks/?org=21&lang=en>, <http://www.byblosbankarmenia.am/>

12. **Cascade Bank** was founded in 2005 after Cascade Capital Holdings acquired 100 percent shares of Emporiki Bank (Armenia). On March 31 Cascade Capital Holdings and TDA Holdings Ltd, the shareholders of Cascade Bank and Ameriabank signed a merger agreement.
<http://www.armbanks.am/en/banks/?org=22&lang=en>, www.cch.am
13. **Converse Bank** created in 1993 as a "North -Armenian" joint stock Bank. In 1997 reconstructed to "Converse Bank" Closed Joint Stock Company. The main shareholder is Advanced Global Investments LLC (US) with 95%, the rest is owned by The Armenian Saint Apostolic Church (5%).
<http://www.armbanks.am/en/banks/?org=23&lang=en>, www.conversebank.am
14. **HSBC Bank Armenia** was established as a closed joint stock company under the name Midland Armenia Bank J.S.C. in 1996 and has been renamed into HSBC Bank Armenia cjsc in 1999. The bank is a joint venture between the HSBC Group, which has a 70% ownership, and members of overseas Armenian businesses with 30% ownership (Wings Establishment, Liechtenstein).
<http://www.armbanks.am/en/banks/?org=25&lang=en>, www.hsbc.am
15. **INECOBANK CJSC** was registered on February 7, 1996 (banking license number 68 issued by the Central Bank of Armenia). INECOBANK's Profile: International audit: since 1998 (by KPMG). First Armenian bank which introduced Point of Sales lending program. The significant participants are Armenian physical persons with 76.50% share, Deutsche Investitions und Entwicklungsgesellschaft with 13.50%, and the IFC with 10 % of share.
<http://www.armbanks.am/en/banks/?org=26&lang=en>, www.inecobank.am
16. **Mellat Bank, Yerevan** was established in the R.A based on the mutual agreement on Cooperation, friendship and good neighborhood announced between the R.A and the I.R.I on 1995. Bank Mellat of Iran is a state owned commercial bank and is 100% shareholder of Mellat Bank, Yerevan.
<http://www.armbanks.am/en/banks/?org=28&lang=en>, www.mellatbank.am
17. **ProCredit Bank:** The Central Bank of Armenia granted ProCredit Bank license to conduct banking operations in Armenia on December 7, 2007. The shareholders of ProCredit Bank are ProCredit Holding AG with the 66.66% of shares, KfW with 16.67% of shares, and EBRD with 16.67% of shares.
<http://www.armbanks.am/en/banks/?org=30&lang=en>, www.procreditbank.am
18. **Prometey Bank** commercial bank was founded in 1990 and renamed into "Prometey Bank" Limited Liability Company in 2001. The main participants are ZNGS-Prometey CJSC with 92.25% share and Armenian physical person. <http://www.armbanks.am/en/banks/?org=32&lang=en>, www.prometeybank.am
19. **Unibank CJSC** was founded in October 2001 with an authorized capital of \$ 5, its shareholders are Ripatonso Holdings Limited (75.43%), and physical persons from RF (24.57%).
<http://www.armbanks.am/en/banks/?org=35&lang=en>, <http://www.unibank-armenia.com/>
20. **VTB Bank Armenia:** the Bank's 100% shareholder is "VTB Bank" OJSC.
<http://www.armbanks.am/en/banks/?org=59&lang=en>, www.vtb.am

II. Armenian Insurance Companies

The source of data for Armenian insurance companies was the financial-banking portal <http://www.armbanks.am/en/insurance-market/>. From this information agency the list of Armenian active insurance companies was obtained. In addition I found all required information about shareholders, market shares and total assets. After collecting data I divided the regions into Armenia (AM), CIS, the European Union (EU), USA, and the Rest of the World (RoW) to calculate the market shares by region.

The results for market share owners of the Insurance sector in Armenia are as follows Armenia – 31.20 %, CIS – 38.88%, EU – 20.30%, US – 8.45%, RoW – 1.18%. Detailed results are listed in Table 2.

Supplementary Information on Ownership Shares of Armenian Insurance Companies

1. **Alfa Insurance** "Alfa Insurance" Insurance Company was founded in 2008: founders are STIVENS INVEST and FAYNENS S.A. (50%) and NORLIN ASSETS Investment Companies Inc. (50%).
<http://www.armbanks.am/en/insurance-market/?org=60&lang=en>, www.alfa-insurance.am
2. **Cascade Insurance** Company CJSC (CIRCO) is a subsidiary of Cascade Capital Holdings, which in turn is 65% owned by the Cafesjian Family Foundation, a United States organization. The European Bank for Reconstruction and Development purchased a 35% equity share in August 2005. This is the only EBRD investment into the insurance sector in Armenia. <http://www.armbanks.am/en/insurance-market/?org=62&lang=en>, www.cascadeinsurance.am
3. **Garant-Limens CJSC** was registered on Feb. 2, 1999. A significant shareholder of the company is Ara Babloyan with 27,4% of shares. <http://www.armbanks.am/en/insurance-market/?org=63&lang=en>, www.glinurance.am
4. **Griar Insurance** Company's 100% shareholder is LLC Ches TOR (Russia) <http://www.armbanks.am/en/insurance-market/?org=64&lang=en>, www.griar-insurance.am
5. **Ingo Armenia CJSC** was founded in 1997 as an insurance company "EFES". In December 2003, 75% of the shares of the company was bought by Russian Insurance AO Ingosstrakh, after which the company was renamed "INGO ARMENIA" Insurance CJSC. Today, the main shareholder of the company is Invest-Policy CJSC "with 75% of the shares and Levon Altunian with 25% share.
<http://www.armbanks.am/en/insurance-market/?org=85&lang=en>, www.ingoarmenia.am
6. ISG Ltd was registered on Dec. 25, 2007. A 100% shareholder of the company is "Mika Limited" (UK). <http://www.armbanks.am/en/insurance-market/?org=65&lang=en>, www.isg.am
7. **London-Yerevan Co** was registered as insurance Ltd. in 1998. Commercial activities "London-Yerevan Co has launched since February 2000. 100% shareholder of the company is "Londongeyt Investment and Menedzhmentnd Pi-E-C" (UK). <http://www.armbanks.am/en/insurance-market/?org=80&lang=en>, www.london-yerevan.com
8. Ltd. Nairi Insurance was established in December 1996, and insurance activities launched since April 1997. It belongs to Levon Kocharyan (Armenia) - 30%, Hovik Shahinyan (Armenia) - 22.5%, Vahan Gabrielyan (Armenia) - 22.5%, Vahagn Shahinyan (Armenia) - 12.5%, Vahagn Khachatryan (Armenia) - 12.5%. <http://www.armbanks.am/en/insurance-market/?org=81&lang=en>, www.nairi-insurance.am
9. "Rasco" Ltd. was created August 30, 2004. Today shareholders are Investment Financial Corporation "Region" CJSC with a share 94.83% and E. Arabhanyan (Armenia) - 5.17%.
<http://www.armbanks.am/en/insurance-market/?org=82&lang=en>, www.rasco.am
10. JSC "Reso" was registered in 2008 as the Company "Yunireso". The company was renamed "Reso" in 2009. The founders of the company is "Polygraphy" CJSC - Gagik Zakarian Tigranovich, co-owner of "Uniastrum Bank", "Unibank" with a share of 50%, and "CIS Equity Partners Limited" Ltd - Sarkisov Sergey, CJSC "RESO-Garantia" owner with the rest 50%. Thus, RESO is a "daughter" of the most reliable insurance companies in Russia. <http://www.armbanks.am/en/insurance-market/?org=86&lang=en>, www.reso.am
11. Rosgosstrakh - Armenia was established in May 2008, by an investment holding company "RGS

Assets Limited" (100% stake). In April 2010 Rosgosstrakh became 100% shareholder of Rosgosstrakh – Armenia. <http://www.armbanks.am/en/insurance-market/?org=61&lang=en>, www.rgs.am
12. "Sil Insurance" was registered in March 1, 2000. Shareholders are Sukiasyans family (4 shareholders, Armenia) with 80% stake and "Armeconombank" Ltd.
<http://www.armbanks.am/en/insurance-market/?org=83&lang=en>, www.silinsurance.am

III. Telecommunications Shares in Armenia

The primary source of data was from websites of domestic telecommunication companies and several web sites which provide worldwide information on telecommunication. I defined market share as the share of total subscribers, summing up fixed-line and mobile subscribers. Then I calculated obtained shares by regions. Table 3 contains mobile phone subscription statistics by company and the number of fixed-line phone subscribers, shareholders %, and market shares by regions.

The results for market share owners of the telecommunication sector in Armenia are as follows: Armenia – 0 %, CIS – 38.96%, EU – 5,73%, US – 31,7%, RoW – 23,61%.

Supplementary Information on Ownership Shares of Armenian Telecommunications Companies

ArmenTel CJSC (brand Beeline): The Armenia Telephone Company is the largest telecommunications company in [Armenia](#). Its 100% belongs to the second largest [Russian](#) mobile network operator [VimpelCom](#) (brand [Beeline](#)) since 2006. ArmenTel is the second largest taxpayer of Armenia (e.g. in the year 2005 15.3 billion Dram, converted approximately 28 millions euro). Armentel provides 100% of fixed line service, and 19.36% out of mobile services in Armenia. <http://www.beeline.am>

K-Telecom CJSC (trading as VivaCell-MTS) is a subsidiary of Russian powerhouse Mobile TeleSystems OJSC a leading telecoms operator in Russia and CIS countries, which owns 80% of shares of company, the remaining 20% owned by the Lebanese investment group Fattouch Group. VivaCell-MTS controlled 73.53 % of the domestic mobile market as at 31 December 2009
<http://www.vivacell.am>

Orange Armenia is 100% daughter of France Telecom (brand name Orange), entered the Armenian market from 5-th November 2009, providing 83% network coverage and access to mobile networks and the Internet in 500 communities (cities and villages) of the republic. By the end of 2009 orange Armenia operated with a share of 7.1% out of total Armenian mobile market.
<http://www.orangearmenia.am>

24 <http://hitech.mail.am/index.php?category=312&id=2638>, <http://telecom.arka.am/rus/mobile/2010/01/25/3365.html>,
<http://www.armtown.com/news/ru/pan/20100318/44411/>,
<http://www.internetworldstats.com/asia/am.htm>Executive summary,
<http://www.totel.com.au/european-telecommunications-research.asp?cid=AM>
<http://www.telegeography.com>

IV. Pipeline Transportation

Gas Companies

Today in Armenia there are two gas pipeline - from Georgia and from Iran. Armenia has no proven reserves of oil or natural gas and currently imports nearly all of it from Russia.

Russia-Georgia-Armenia pipelines

The Russian gas export monopoly Gazprom supplies Armenia with gas through a pipeline that runs through Georgia. In 2007, Gazprom provided Armenia with just under 2 billion cubic meters of natural gas. As a transit fee, Armenia pays Georgia approximately 10% of the gas that was destined to reach Armenia. Russian natural gas supplies to Georgia and Armenia are provided by two main pipelines: the North Caucasus-Transcaucasus pipeline (1,200 mm diameter) and the Mozdok-Tbilisi pipeline (700 mm diameter).

In 2008, Armenia imported 2.2 billion cubic meters of natural gas from Russia.²⁵

Iran-Armenia pipeline

A new gas pipeline, the Iran-Armenia Natural Gas Pipeline, was completed in October, 2008. It is owned and operated by ArmRosGazProm and links Armenia to neighboring Iran, which has the world's second largest natural gas reserve after Russia. It has a capacity to pump 2.3-2.5 billion cubic meters of Iranian gas per year.

In 2009 Armenia was importing 1-1.5 million cubic meters of Iranian natural gas, paying for this by electricity exports.

ArmRosGazprom (ARG) was founded in 1997 as a joint Russian-Armenian natural gas pipeline project. In April 2006, Gazprom and Armenia signed a contract for 25 years about strategic principles of cooperation in gas and energy projects in the Armenian territory. The company is the owner of the whole gas transmission and distribution system of the Republic of Armenia organizing the gas supply for Armenia's domestic gas market. The ARG organizes the gas supply for Armenia's domestic gas market. ARG buys the gas at the border from [Gazexport](#), an export unit of Gazprom, and distributes it through the ARG pipeline, mainly to the domestic market. The company is registered in Armenia as Closed Joint Stock Company and when it was founded, the Russian state gas monopolist [Gazprom](#) owned 45% of stock, the Armenian Energy Ministry 45% and the [ITERA](#) company 10%.²⁶ In March 2009 former ownership ITERA International Energy L.L.C sold its nominal shares to Gazprom OSC.

As at 31.12.2009 Gazprom OSC owns 80% of shares and the rest 20% is under control of Ministry of Energy of RA. At the same time the Russian government controls 50.002 percent of shares in Gazprom through Rosimushchestvo (38.373%), Rosneftegaz (10.740%), and Rosgazifikatsiya (0.889%). The rest of shares are allocated between American Depositary Receipts (ADR) holders 24.350% and other registered entities (25.648%) as at 31.12.2009.

²⁵ http://en.wikipedia.org/wiki/Energy_in_Armenia

²⁶ <http://www.minenergy.am/en/en/2010-06-12-19-38-02/gas-companies>, www.gazprom.ru, <http://www.armrusgasprom.am>, http://en.wikipedia.org/wiki/Iran%E2%80%93Armenia_gas_pipeline

The market share for gas pipeline in Armenia are as follows: 20% (Arm) 78% (CIS), and 2% (EU).

V. Maritime Transportation

The Republic of Armenia is under unilateral transport isolation by its two neighboring countries: Turkey and Azerbaijan. The nearest seaport is Poti in Georgia, through which Armenia gets access to the countries of the Black Sea region.

VI. Air transport infrastructure

Civil aviation infrastructure consists of two international airports: "Zvartnots" and "Gyumri", and nine local (non-military) airports.

Armenia International airport "Zvartnots" is under the management of CJSC "Armenia - International Airports". The 100% owner of the company is Argentinean Company "American International Airports", which belongs to the citizen of Argentine of Armenian origin Eduardo Eurnekian.²⁷

Today about 28 aircompanies are serving Armenia: BMI - "BRITISH MIDLANDAIRWAYS LIMITED", Armenian Branch (UK), Aeroflot -Russian Airlines (Russia), Austrian Airlines (Austria), Czech Airlines (Czech Republic), Armavia (Armenia), Air France (France), Siberia Airlines (Russia), Air Arabia (UAE), etc.

13 domestic airlines have received licenses for flight operations and currently perform scheduled as well as non-scheduled flights. The following Air Companies have obtained Certificates of Operator from the General Department of Civil Aviation of RA: "Armavia" Aviacompany LLC, "Atlantis European Airways" LLC, "South Airlines" LLC, "Hayk Avia" Aircompany CJSC, "Air Armenia" CJSC, "Reliable unique service aviation" LLC, "Phoenix Avia" LLC, "Ararat International airlines" LLC, "Taron-Avia" LLC, "Vertir" LLC, "Air Highnesses" LLC, "V-Berd Avia" LLC, "Ark airways" LLC, "Veteran Avia" LLC²⁸.

The leading company **Armavia Air Company LLC** is the national air carrier of Armenia. Armavia was established in 1996 replacing the old Armenia Airlines on flights to Europe, Middle East and CIS routes and.

In 2005 the full package of shares was transferred to Mikhail Baghdasarov, President of the company "Mika Armenia Trading". Armavia is a member of the International Association of Air Transport (IATA). The carrier is based in Zvartnots Airport, Yerevan Armavia operates over 102 flights to 35 destinations in 20 countries every week. The company flew 700,000 passengers, which is 47,64% out of volume of passenger transport (1469,3 th.man) in 2009.

²⁷ http://en.wikipedia.org/wiki/Zvartnots_International_Airport

²⁸ <http://www.aviation.am/eng/gorc/user.htm>, <http://www.ch-aviation.ch/airlines.php>

Armavia has the right to conduct air passenger transportation from Armenia, while the other air companies do not have such a right. They carry freight from Armenia, for example, "Air of Armenia", which operates flights to Europe, but has no right to carry passengers.

Companies engaged in cargo transportation are rather big - they have 4-5 large cargo aircraft IL-76.²⁹

Air Armenia is possessing cargo airplanes and operating cargo flights from Armenia to the rest of the world. This company operates regular flights twice a week from Yerevan to Frankfurt (Hahn) and from Frankfurt to any other destination. Air Armenia is a private airline established in 2003 and based at Yerevan Zvartnots Airport in Armenia (EVN, UGEE).³⁰

The most challenging was to obtain data on air transportation in Armenia. Through National Statistical Service of RA we got the total air passenger and cargo traffic data for 2009 in Armenia. (8,4 th. Tons of cargo freight and 1496,3 th. Man). Majority of armenian air companies do not have web-sites and did not provide any private information. Only the national carrier of Armenia Armavia publicly report information on its air traffic. The company flew 700,000 passengers, which is 47,64% out of volume of passenger transport in 2009.

So, We define the share of airline in passenger carrying market by a company share in total passenger turnover, the same for the cargo carrying market. To derive the total market share we put weights to be equal 50% for passenger and 50% for cargo carrying market.

As the only Armavia has the right to conduct air passenger transportation from Armenia, we assume that the rest of market share (52,36%) refers to foreign air companies mentioned above. Unfortunately there is no public available information of passenger allocation among foreign companies. So we allocate equally 33,33% to CIS, EU, and ROW region in the same amount (8,73%), and rescale the total to be equal 100%.

In 2009 the leader of cargo flights Air Armenia served 4,6 th. tons or 54,76% of cargo carrying. Unfortunately there is no any information concerning domestic cargo flights aircompanies. Several of them have started to operate in 2010, so we just allocated the rest of market shares. After rescaling the results for market share by regions (in percent) are as follows:

ARM 70.43%, CIS 8.73%, EU 8.73%, ROW 12.12%.

VII. Railroad Transportation

Since Armenia does not have a direct exit to the sea and located in mountains 1800 meters high above the sea level, the railway transportation has an important strategic value in maintenance with the reliable transport communication promoting economic and social development of the Republic.

29 <http://www.newsarmenia.ru/exclusive/20100412/42230623.html>

30 <http://www.armenianairlines.com/>, <http://www.armats.com/eng/activity/statistics.htm>Statistics

Joint-Stock Company "SCR": "South Caucasus Railways" CJSC is 100% subsidiary of Russian Railways OJSC. Armenian Railways OJSC was transferred to the SCR CJSC under a concession agreement signed on February 13, 2008.³¹
So, we infer 100 % ownership to CIS.

31 <http://www.ukzhd.am>

Table 1: Armenia Banks' Ownership Shares, by Region											
No	Name of bank	Shareholders (ISO Country Code)		Ownership, %	Total assets, thousands AMD	Company market share, %	Market shares by regions, %				
							ARM	CIS	EU	USA	ROW
1	ACBA-Cedit Agricole				160889534	11,24					
		Credit Agricole Group	(FR)	15,60					1,75		
		JSC Sacam International	(FR)	12,40					1,39		
		Armenian regional farm unions	(AM)	72,00			8,10				
2	Ameriabank				103238090	7,21					
		TDA Holdings Limited	(RU)	96,97				7,00			
		Ministry of Finance and Economy	(AM)	3,03			0,22				
3	Araratbank				43466009	3,04					
		Flesh LTD	(AM)	74,10			2,25				
		EBRD	?	25,00							
		Resident Individuals	(AM)	0,90			0,03				
4	Ardshininvestbank				119481150	8,35					
		LLC	?	87,23							
		International Financial Corporation	?	10,00							
		Resident Individuals	(AM)	2,77			0,23				
5	Areximbank	Gasprombank OJSC			39021943	2,73					
		Non-State Pension fund «Gazfond»	(RU)	50,00				1,36			
		GAZPROM OJSC	(RU)	41,73				1,14			
		Novfinteh Ltd.	(RU)	6,58				0,18			
		INDIVIDUALS	(RU)	1,69				0,05			
6	Armbusinessbank				106007365	7,41					

		Ukrprombank LLC	(UA)	13,01				0,96		
		Christie Management Company	(UA)	86,99				6,44		
7	Armeconombank				52186800	3,65				
		EBRD	?	25,00						
		Resident Individuals	(AM)	75,00			2,74			
8	Armenian Development Bank				21571119	1,51				
		Resident Individuals	(AM)	52,06			0,78			
		Non-resident Individuals	(US)	47,94					0,72	
9	Armswissbank	Vardan Sirmakes	(CH)	100,00	29711610	2,08				2,09
10	Artsakhbank				44688021	3,12				
		Vardan Sirmakes, Non-resident	(CH)	43,13						1,35
		Hratch K. Gabrielyan, Non-resident	(US)	44,08					1,38	
		Non-resident Individuals	(CH)	5,10						0,16
		Entities	(AM)	7,69			0,24			
11	Bank Anelik				49019874	3,43				
		CreditBank S.A.L.	(LB)	51,00						1,75
		Physical persons	(AM)	49,00			1,68			
12	BTA Bank				8442624	0,59				
		BTA Bank Kazakhstan		48,95						
		<i>Samruk-Kazyna National Welfare Fund</i>	(KZ)	75,10				0,22		
		<i>EBRD, IFC, East capital</i>	?							
		ZRL Beteiligungs	(AT)	31,10					0,18	
		Mobilex Energy Limited Ltd	(KZ)	16,30				0,10		

13	Byblos Bank Armenia				17588919	1,23					
		Byblos Bank S.A.L.	(LB)	65,00							0,80
		EBRD	?	25,00							
		Development ?		10,00							
14	Cascade Bank	T D A Holding Limited	(RU)	100,00	19068692	1,33		1,49			
15	Converse Bank				78655756	5,50					
		Advanced Global Investments L	(US)	95,00							5,22
		The Armenian Saint Apostolic C	(AM)	5,00				0,27			
16	HSBC Bank Armenia				135755820	9,49					
		HSBC Europe BV Group	(NL)	70,00						6,64	
		Wings Establishment	(LI)	30,00							2,85
17	Inecobank				48483671	3,39					
		Physical persons	(AM)	76,50				2,59			
		Entwicklungsgesellschaft	(DE)	13,50						0,46	
		Corporation	?	10,00							
18	Mellat Bank	Iranian "Mellat" state bank	(IR)	100,00	12464718	0,87					0,92
19	ProCredit Bank				16963647	1,19					
		ProCredit Holding	(DE)	68,40							0,81
		EBRD	?	16,67							
		KfW	(DE)	14,87							0,18
20	Prometey Bank				21518193	1,50					
		ZNGS-Prometey CJSC	(RU)	92,25						1,39	
		physical persons	(RU)	7,75						0,12	
21	Unibank				108782450	7,60					
		Ripatonso Holdings Limited ?		75,43							
		physical persons	(RU)	24,57						1,87	

22	VTB Bank (Ar	VTB OJSC			118953000	8,31					
		Non-resident Individuals	(RU)	87,62				7,28			
		Mellur limited	(CY)	0,31							0,03
	Tempel	on russia and european fund inc	(US)	0,23						0,02	
		Palgrave enterprises limited	(CY)	0,12							0,01
		Others ?		11,72							
1	ACBA-Leasing				7589709	0,53					
		ACBA-CREDIT AGRICOLE I	(FR), (54,00			0,21		0,08		
		CREDIT AGRICOLE LEASIN	(FR)	38,00					0,20		
		Resident Individuals	(AM)	8,00			0,04				
2	Agroleasing	"AGROLIZING" UCO LTD	(AM)		291036	0,02	0,20				
3	Aniv	"ANIV"UCO LTD	(AM)		505561	0,04	0,40				
4	Aregak	- 100%	(USA)	100,00	11174124	0,78				0,79	
5	Arfin	Resident Individual	(AM)	80,00	457576	0,03	0,03				
6	Avangard Inves	Non Resident	(RU)	100,00	293249	0,02		0,02			
7	Bless	Resident Individual	(AM)	100,00	2618425	0,18	0,18				
8	Bnakaran Et	100%	(AM)	100,00							
9	CARD AgroCr	Rural Development		100,00	1068813	0,07				0,08	
10	Credit Union				653631	0,05					
11	Ecumenical	Armenian National ECLOF			817675	0,06	0,06				
12	Express Credit				2128521	0,15					
13	Fides	UCO CJSC			501059	0,04					
14	Finca	Finca UCO CJSC			9410376	0,66					
15	First Mortga	UCO LLC	(AM)		3018753	0,21	0,21				
16	GARNI IN	UCO		100,00	1503372	0,11					

17	GFCUCO	Resident Individuals	(AM)	100,00	514094	0,04	0,04				
18	GladzorUCO	Resident Individuals	(AM)	100,00	475993	0,03	0,03				
19	MalatiaUCO	Resident Individuals	(AM)	100,00	1926670	0,13	0,14				
20	National Mo	Central Bank of Armenia	(AM)	100,00	7413622	0,52	0,52				
19	Nor Horizon	Nor HorizonUCO LLC	(AM)	100,00	1105677	0,08	0,08				
20	NorvikUCO	bank)	(EU)	100,00	15015313	1,05			1,06		
21	PMZ NERD	CJSC			1918355	0,13					
22	SEF Interna	SEF InternationalUCO LLC			3343779	0,23					
23	Unileasing	UnileasingUCO CJSC			124570	0,01					
		Polygraph CJSC - 99%		99,00							
		Resident Individuals		1,00			0,00				
24	VTB Leasing	Credit Organization CJSC			167650	0,01					
25	Washington	Resident Individual	(USA)	100,00	947185	0,07				0,07	
TOTAL OF BANKS' AND CO's ASSETS					1430943793	100,00					
TOTAL OF BANKS' ASSETS					1355959005						
TOTAL OF CO's ASSETS					74984788						
							ARM	CIS	EU	USA	ROW
TOTAL SHARES BY REGIONS						81,86	21,27	29,61	12,76	8,28	9,94
ADJUSTED TOTAL SHARES BY REGIONS						100,00	25,98	36,17	15,59	10,12	12,15

Table 2: Armenia Insurance Companies' Ownership Shares, by Region											
No	Name of Insurance	Shareholders (ISO Country Code)		Ownership, %	Total assets,	Company	Market shares by regions, %				
							AM	CIS	EU	USA	ROW
1	Alfa Insurance				517781	3,05					
		Stivens Invest & Finance S.A.	?	50,00							
		Norlin Assets	?	50,00							
2	Cascade Insurance				1922515	11,31					
		Cascade Capital Holdings	(US)	65,00						7,35	
		EBRD	?	35,00							
3	Garant-Limens				1136370	6,68					
		Physical person	(AM)	27,00			1,80				
4	Griar Insurance	Ches-Tor Ltd.	(RU)	100,00	1223094	7,19		7,01			
5	Ingo Armenia				2105410	12,38					
		Invest-Polis Ltd. (Russia)	(RU)	75,00				9,29			
		Levon Altunyan (Armenia)	(AM)	25,00			3,10				
6	ISG	"Mika Limited" Company (Great	(GB)	100,00	1802179	10,60				10,34	
		Londongate Investment & Management plc (Great									
7	London-Yerevan C	Britain)	(GB)	100,00	1275783	7,50				7,32	
8	Nairi Insurance	Physical persons (A)	(AM)	100,00	1135381	6,68	6,51				
9	Rasco				1746168	10,27					
		Region CJSC (A)	(AM)	94,83			9,74				
		E. Abrahamyan (Armenia)	(AM)	5,17			0,53				

10	Reso				1140262	6,71				
		CIS Equity Partners Limited LLC ,	(RU)	50,00				3,35		
		Polygraphiya CJSC	(RU)	50,00				3,35		
11	Rosgosstrakh-Arm	“ROSGOSSTRAKH” Ltd.			1838091	10,81				
		Depository Clearing Company CJSC (RUS)	(RU)	49,00				5,30		
		Troyka Invest. limited liability company (RUS)	(RU)	26,00				2,81		
		Ministry of State Property of the Russian Federation (RUS)	(RU)	25,00				2,70		
12	Sil Insurance				1159079	6,82				
		Armeconombank ojsc (RoW)		20,00						
		the Sukiasyan Family (Armenia)	(AM)	80,00				5,45		
					17002113	100,00				
								AM	CIS	EU
								USA		
								Total shares by regions	86,98	27,13
								33,81	17,66	7,35
								Adjusted total shares by regions	100,00	31,20
								38,88	20,30	8,45

Table 3: Armenia Telecommunications Sector Ownership Shares, by Region										
Telecommunications Company	Shareholders (ISO Country Code)	Ownership %	Subscribers			Market Share by Region %				
			Mobile	Fixed	Market Share	AR	CIS	EU	USA	ROW
1 ArmenTel CJSC (brand Beeline)	OJSC "VimpelCom"	100,00	545 000	675 000	34,96					
	Telenor (NOR)	33,60								11,75
	Alfa group (RUS)	37,00					12,93			
	Free float (Bank of New York) (USA)	27,30							9,54	
	Treasury Stock (RUS)	1,30					0,45			
	Other (RUS)	0,80					0,28			
	1 220 000									
2 K-Telecom CJSC (trading as VivaCell-MTS)			2070000		59,31					
	Mobile TeleSystems (MTS)	80,00								
	AFK Sistema (RUS)	52,8					25,05			
	Free float (traded on NY stock exchange) (USA)	46,7							22,16	
	Others (RUS)	0,5					0,24			
	Investment group Fattouch Group (LB)	20,00								11,86
3 Orange Armenia	France Telecom (FR)	100,00	200 000		5,73			5,73		
	Total Subscribers (Fixed-line and Mobile)		2 815 000	3 490 000	100,00	ARM	CIS	EU	USA	ROW
	Total Market Share				100,00	0	38,96	5,73	31,70	23,61

Table 4: Armenia Air Transportation Sector Ownership Shares, by Region													
NN	Airlines Company	Shareholders (Ownership %)		Cargo carrying		Passenger carrying		market s	ARM	CIS	EU	ROW	
				th. Tons	%	th. Man	%						
1	"Armavia" Aviacompany LLC	Armenia Trading	(AM)	100			700	47,64	23,82	23,82			
2	"Air Armenia" CJSC	Resident	(AM)		4,6	54,76			27,38	27,38			
	Domestic carriers				3,8	45,24			22,62				
4	<i>Airways" LLC, "Taron-Avia" LLC, "Vertir" LLC, etc.</i>		(AM)	85						19,23			
	<i>"Ararat International airlines" LLC, "Taron-Avia" LLC</i>		ROW	15								3,39	
15	Foreign carriers						769,3	52,36	26,18				
	<i>Airlines, DonbassAero, Belavia, Dniproavia</i>		CIS	33,33						8,73			
	<i>Czech Airlines, LOT, airBaltic, Lufthansa, Virgin Atlantic, Air Italy</i>		EU	33,33							8,73		
	<i>Syrian Air, Georgian Airways, Flydubai</i>		ROW	33,33								8,73	
	Total carrying				8,4		1469,3						
									AR	CIS	EU	ROW	
					Total Market Share by regions				100,00	70,43	8,73	8,73	12,12

Table 5: Armenia Pipeline Sector Ownership Shares, by Region										
					Market Share	Market Share by Region %				
	Gas company	Shareholders (ISO Country Code)		Ownership %		AR	CIS	EU	USA	ROW
1	The Armenia-Iran gas pipeline	Armrosgazprom		100,00	100					
		Ministry of Energy of RA	(AM)	20,00		20,00				
		Gazprom OSC		80,00						
		<i>Russian government</i>	(RUS)	40,00			40,00			
		<i>E.ON Ruhrgas GPD GmbH</i>	(EU)	2,00				2,00		
		<i>Other registered entities</i>	(RUS)	38,00			38,00			
						AR	CIS	EU	USA	ROW
		Total Market Share			100	20,00	78,00	2,00	0,00	0,00

Appendix C : Estimates of the Dixit-Stiglitz Elasticities of Substitution for 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. Christian Broda, Joshua Greenfield and David Weinstein (2006) estimated Dixit-Stiglitz product variety elasticities of substitution at the 3 digit level in 73 countries. There were no Commonwealth of Independent States (CIS) in their sample, but they did estimate elasticities for Lithuania. As a former Soviet Union country of about the same population as Armenia, we choose Lithuania as our proxy for Armenia.

Broda et al., estimate 3 digit elasticities for 130 goods sectors, but there is only one manufacturing sector in our model, It was necessary to map the sectors estimated by Broda et al. into the sectors of our model. In table C1 of this appendix, we show the mapping for the imperfectly competitive sector. (These elasticities are not relevant in our model for perfectly competitive sectors.)

Next, since there are 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 un-weighted 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. We obtained the data for the import and export shares from the COMTRADE database. The resulting elasticities are reported in table C1. XXX

For the sensitivity analysis, we must take upper and lower bounds of the elasticities. Unfortunately, Broda et al. only report point estimates in their on-line Excel file. In the paper itself, however, Broda et al. (2006, table 4, p. 36) list the standard error of the median Dixit-Stiglitz estimate for the country. The standard errors are rather small for most countries. In the case of Lithuania, the median Dixit-Stiglitz elasticity is 3.8 with a standard error (of the median estimate) of 0.23.

Although we don't have standard errors at the product line level, we use the overall estimate of the standard error to guide our choice of upper and lower values of the estimates. The low standard error suggests that we do not need to take very large ranges to check for robustness. For central values of 3.8 or less, we took plus or minus three times the average standard error of 0.23. CGE modelers have often doubled and halved the central estimate in the sensitivity. For central values greater than 3.8, we took plus or minus 50% of the value of the parameter, which gives a wider band than plus or minus three times the standard error. For these elasticities, this presents a tougher test of the robustness of our model.

Broda, Christian , Joshua Greenfield and David Weinstein (2006), "From Groundnuts 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>.

Table C1: Estimated Elasticities of Substitution for Varieties in Tanzanian Imperfectly Competitive Goods Sectors

Sector in our Model	Matching HS-3 Code from Broda et al estimates	weighted elasticity of substitution
Processed food	110, 150, 151, 160, 170, 180 190, 200, 210	10
Beverages & tobacco products	220, 240	2
Textile & leather products	510-630, 650, 420	4
Manufacture of basic & industrial chemicals	280-391	3
Manufacture of fertilizers & pesticides	310	2
Petroleum refineries	271	4
Glass & cement	680-702	5
Iron steel & metal products	720-831	7
Mining & quarrying	270, 271	4
Grain milling	110	3

Source: Authors calculations based on estimates from Broda, Greenfield and Weinstein (2006).

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Mining & quarrying	270, 271	4
Grain milling	110	3

Source: Authors calculations based on estimates from Broda, Greenfield and Weinstein (2006).

Appendix D: Border Costs

Estimate of the impact of a Deep and Comprehensive Free Trade Agreement with the European Union on Armenian Border Costs

For the estimate of Armenian border costs associated with exporting and importing we begin with the survey of border costs undertaken by Maliszewska *et al.*, (2008) in late 2007. They report that import and export procedures are regarded by Armenian businessmen as one of the most corrupt areas of public administration. Customs procedures are riddled by rent seeking and corruption. The results of their survey (see Maliszewska *et al.*, (2008, table 9.2) reveal that the average costs of exporting to the European Union are higher by 10.4 percent due to customs procedures. Although they report the results of their survey by sector, and in some sectors the reported costs are considerably higher (as high as 60 percent), they argue that the size of the sample is too small to distinguish exporting costs by sector. We thus take the average costs of customs procedures of 10.4 percent as applying to all sectors in 2007, both for exports and imports.

To update the estimate to 2010, we employ data from the Cost of Doing Business Survey of the World Bank.³² According to the Doing Business Survey, in 2007, the cost of exporting a container from Armenia was \$1600, but had risen to \$1731 in 2010. Prices in Armenia have risen by 27 percent between 2007 and 2010 (January to September average).³³ Converting the \$1731 estimate for 2010 to 2007 prices, we estimate the cost of exporting a container from Armenia in 2010 are \$1365 in 2007 prices (which are $\$1731/1.27$) This suggests that the costs of exporting a container in Armenia in 2010 are .854 times the costs in 2007 ($\$1365/1600$). Finally, we estimate that the border costs of exporting to the EU from Armenia in 2010 are 8.9 percent (which is $10.4\% * .854$) of export revenues. This means that for each dollar of revenue from export sales to the EU in 2010, Armenian exporters lose 8.9 cents to border costs.

Similarly for imports, the cost of importing a container into Armenia was \$1880 in 2007, but had risen to \$2096 in 2010. Converting the \$2096 estimate for 2010 to 2007 prices, we estimate the cost of importing a container into Armenia in 2010 are \$1652 in 2007 prices (which are $\$2096/1.27$) This suggests that the costs of exporting a container in Armenia in 2010 are .88 ($\$1652/1880$) times the costs in 2007. We estimate that the border costs of importing from the EU to Armenia in 2010 are 9.1 percent (which is $10.4\% * .88$) of import revenues.

Given the focus of the EU on institutional development for trade facilitation, a deep and comprehensive free trade agreement with the EU is likely to reduce these costs for exports to the EU. To estimate the extent of a reduction in these costs, we note that the border costs of exporting by the transition countries that are now members of the EU, again from the Doing Business survey. The border costs of exporting a container in 2010 are as follows: Bulgaria, \$1551; Czech Republic, \$1060; Estonia, \$730; Hungary, \$1225; Latvia, \$600; Lithuania, \$870; Poland, \$884; Romania, \$1275; Slovak Republic, \$1445; and Slovenia, \$1075. All have lower border costs of exporting in 2010 than the \$1731 of Armenia. But the border costs of exporting a container from Bulgaria suggests that EU membership is not a magic bullet for reducing the border costs of exporting down to the level of the Baltic countries. It appears reasonable,

³² For the raw Doing Business data see: <http://www.doingbusiness.org/Data/ExploreTopics/trading-across-borders>.

³³ Price index data are taken from the website of the Armenian Statistical Office. See <http://www.armstat.am/en/?nid=126&id=07001>.

however, that with institutional development for trade facilitation associated with a deep and comprehensive trade agreement with the EU, that Armenia could reduce its border costs of exporting to the 2010 costs of Ukraine (\$1230) or Georgia (\$1270). We assume, therefore, that the impact of a deep and comprehensive free trade agreement with the EU would reduce the border costs of exporting to the EU to \$1250 from \$1731. That is, the costs will fall by 28 percent of their present value.³⁴ Thus, in the scenario for a deep and comprehensive free trade agreement with the EU, we assume that, due to cost reduction, exporters save 2.5 cents of each dollar of export revenue from sales to the EU (28 percent of 8.9 percent), and importers will save 2.5 cents on each dollar of import costs (28 percent of 9.1 percent).

Improved institutional development for trade facilitation is likely to reduce trade facilitation costs for imports from and exports to all regions. If customs is more efficient in processing imports from the EU, these procedures will generally facilitate trade with all regions. For example, if trucks with imports from the EU can pass through Armenian borders more quickly, trucks with imports from other countries are also likely to see reduced delays. Given that the EU will monitor trade with the EU much more carefully, it is possible that not all institutional reforms in trade facilitation will transmit to trade with non-EU countries. So we shall assume that the border costs of exporting to or importing from non-EU countries will fall by 25 percent. Then, we assume that exporters save 2.2 cents of each dollar of export revenue from sales to the EU (25 percent of 8.9 percent), and importers will save 2.3 cents less on each dollar of import costs from non-EU countries (25 percent of 9.1 percent).

We summarize these calculations in the table below.

Summary of Estimates of the impact of a Deep and Comprehensive Free Trade Agreement with the European Union on Armenian Border Costs	
	percentage of export and import revenues
Border costs of trade in 2007	10.4
Border costs of exporting in 2010	8.9
Border costs of importing in 2010	9.1
Reduction in exporting border costs for EU trade	2.5
Reduction in exporting border costs for non-EU trade	2.2
Reduction in importing border costs for EU trade	2.5
Reduction in importing border costs for non-EU trade	2.3
Source: Authors' calculations based on sources described above.	

³⁴ Maliszewska *et al.*, (2008) assume that a deep and comprehensive free trade agreement between Armenia and the EU would reduce Armenian border costs of exporting to the EU by 50 percent.

Maliszewska, Maryla, editor (2008), "Economic Feasibility, General Economic Impact and Implications of a Free Trade Agreement Between the European Union and Armenia," CASE Network Report No. 80. Warsaw: CASE.

Appendix E: Impact of harmonization of Armenian standards with the European Union

In order to assess the National Quality Infrastructure³⁵ of Armenia, the World Bank, in collaboration with the EU Advisory Group in Armenia and the Armenian-European Policy and Legal Advice Centre (AEPLAC), conducted enterprise surveys and visited various National Quality Infrastructure institutions in October 2009 and February 2010. Their study, World Bank (2010), shows that the National Quality Infrastructure is very poorly developed in Armenia, imposes significant costs on Armenian enterprises, and will have to be significantly improved to meet the requirements of a Deep and Comprehensive Free Trade Agreement with the European Union. The study documents several problems. Among them are the following:

(i) Laboratories in Armenia have poorly trained personnel, poor equipment and produce results that are subject to much skepticism; only one-quarter are accredited. Armenian enterprises complain about a shortage of certification bodies and testing laboratories. The Armenian legislative requirement that certification bodies must have their own testing laboratories limits the development of certification facilities. This is not a requirement in the EU.

(ii) There is no real industrial calibration system in place in Armenia.

(iii) “Armenian certificates are not recognized abroad, including in Russia. This is one of the main obstacles for Armenian companies wishing to export. This is directly linked to the quasi-nonexistence of internationally accredited certification bodies in Armenia, the lack of international recognition of the national accreditation system and the lack of international traceability in the national metrology system. Among the surveyed enterprises, the evaluation of NQI services varied from “very good” to “incompetent and corrupt”, but the majority expressed dissatisfaction with the NQI system.” World Bank (2010)

(iv) “The mandatory nature of certain standards differs from the international practice of voluntary standards.’ This is a significant problem since mandatory requirements for products not subject to these requirements in export markets, limit that capacity to adapt to market needs in addition to imposing direct compliance costs.

Although Maliszewska et al., (2008) conducted a survey of Armenian exporters, they were not able to obtain estimates of their costs of compliance with EU standards. In the case of Ukraine, however, such estimates are available based on the survey of 500 Ukrainian firms that export to the EU. Those results shown in Jakubiak et al., (2006), and we shall base our estimate for Armenia on the Ukrainian data, with an adjustment for Armenian circumstances that we discuss below.

On average, the Ukrainian respondents reported that 13.9 percent of their production costs in the prior year were due to the costs of compliance with EU norms, regulations or product quality standards. One of the more significant expenditures in this regard was testing

³⁵ The term “National Quality Infrastructure” denotes the complete public and private infrastructure required to establish and implement the standardization, metrology, inspection, testing, certification, and accreditation services needed to prove that products and services meet defined requirements, whether demanded by authorities or the market.

and certification procedures, which they found amounted to 4.2 percent of production costs. Costs varied considerably across sectors, with, perhaps surprisingly, textile and apparel and mineral products being the two sectors where the cost of compliance with EU standards was the highest.

Due to the problems mentioned above, we assume that the costs for Armenian exporters to meet EU standards are fifty percent higher than for Ukrainian exporters. Maliszewska *et al.*, (2008) made the same assumption and publish their estimate by sector for Armenia in their table 9.4. Averaging the data in their table 9.4 to obtain the sectors in our model, we get the results in column 1 below. The EU devoted considerable resources to assisting its new member states with standards and, similarly, is allocating resources to this problem for the countries who may potentially have a DCFTA. Consequently, we assume these costs will fall as a result of a Deep and Comprehensive Free Trade Agreement. We assume they will fall by 25 percent on exports to the EU.³⁶ These results are in column 2 of the table below.

We must also take into account, however, that adaption to EU standards is costly. It is costly for private firms since firms must purchase capital equipment to adapt production processes and train personnel to meet EU standards. It is also costly for the government to help develop the National Quality Infrastructure institutions. These costs may be high, but they are primarily one off costs of adjustment, unlike the permanent and repeated decrease in compliance costs once the adaption has been accomplished. Nonetheless, they mute the gains from adapting to EU standards for firms exporting to the EU. Since our model is a comparative static model, we assume that these one-time adaption costs are equivalent to a permanent increase in costs of two percent of production costs. In column 2, we ignore adaption costs and therefore exaggerate the reduction in compliance costs. Incorporating the adaption costs, yields that compliance costs would fall to the level shown in column 4 of the table below.

Some firms who do not export to the EU, may decide to start exporting if costs of exporting to the EU decline. Others may continue selling in only the domestic market or the CIS market where standards may remain different from EU standards. For firms who do not export to the EU, provided EU standards are not made mandatory for all firms, there should be no change in their costs of production as a result of the DCFTA.

The bottom line estimate is that for Armenian firms exporting agricultural products to the EU, their costs of standards will fall by two percentage points of their costs, from 15.8 to 13.8 percent of their production costs. For firms exporting manufactured products, their costs will fall by 3.2 percentage points, from 21.6 percent of their production costs to 18.2 percent of their production costs. Standards costs for firms exporting to the CIS or Rest of the World do not change.

These results are summarized in the table below.

³⁶ Maliszewska *et al.*, (2008) assumed a fifty percent cost reduction. Clearly there is considerable uncertainty in our estimate, but we believe fifty percent is an upper bound on the range of possible cost reductions. A cost reduction of this magnitude would likely generate private demand for the National Quality Infrastructure, something that is not evident in Armenia.

Cost of Compliance with EU standards*						
as a percentage of annual production costs						
			1	2	3	4
			pre-FTA	post-DCTFA	adjustment costs	post-DCFTA costs including adjustment
Agriculture, forestry and fisheries			15.8	11.8	2	13.8
Mining			0.0	0.0	0	0.0
Manufacturing			21.6	16.2	2	18.2
*The change is costs of compliance for firms not exporting to the EU is zero.						
Source: Authors' estimates						

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Appendix F: Estimate of the ad valorem equivalents of barriers in services in Armenia.

Appendix F is available as Modebadze and Eroyants (2010) at
<https://docs.google.com/leaf?id=0B0V-tBs4-hXYjA3MTQ5MDctNTAxYy00M2I4LWI3NDAtZGRiNDI3NmYwOGU2&hl=en>

Appendix G: Documentation of Input-Output table for Armenia

Jesper Jensen and David G. Tarr

Summary

The core of the model data consists of an input-output table. There exists no recent input-output table for Armenia, so we produced the table based on data provided by the National Statistical Office of the Republic of Armenia. Lacking resources for a full survey, these data were obtained by the National Statistical Office by a pilot sample survey. Our data sources include an unbalanced supply-use table with 16 sectors for the year 2006 and detailed data on GDP for 2007 by types of income, expenditure, and production. The supply-use table contains all the elements we need for the input-output table, but supply deviates significantly from use in most of the sectors. Accounting identities require that supply must equal use for a balanced input-output table and for a table that we can use in our model. The sheer size of the deviations in the supply-use table calls for funding a full survey by the National Statistical Office to obtain additional and more accurate detailed data to reduce the deviations.

Without access to more accurate and detailed data, we develop a balancing procedure to arrive at a balanced input-output table. The procedure involves an optimization problem in which the elements of the table are adjusted such that the sum of the squared deviations from the initial values are minimized and subject to a number of side constraints, including supply-use balance. As part of the procedure, we also use detailed GDP data to update the dataset to the year 2007. Finally, we disaggregate two services sectors to get more details on transport, communication and financials sectors. The final table contains 21 sectors.

Introduction

We begin with a dataset compiled by Light (2010), whose data sources include an unbalanced supply-use table with 16 sectors for the year 2006, and detailed data on GDP for 2007. All data is provided by the National Statistical Office of the Republic of Armenia.

Light (2010) documents a procedure to balance the data, and also shows how the data is used to implement a simple CGE model of Armenia. The balancing procedure is very simple, however, as the majority of adjustments are made to only two elements of the data: household consumption and compensation of employees. The large imbalances in the supply-use table translate into large adjustments in these two data elements. In turn, this implies large changes in GDP.

We use an alternative balancing procedure which extends the procedure by Light (2010) in several ways. First, the procedure allocates adjustments to the entire dataset, and auxiliary data and information is used to guide the adjustments. Second, we explicitly account for GDP in the balancing procedure, so that GDP in the final data set is indeed close to official GDP. This applies to both total GDP and the components of GDP.

The next section shows how we construct the initial estimate of our input-output table and reports the imbalances in the data set. The following section documents the procedure we

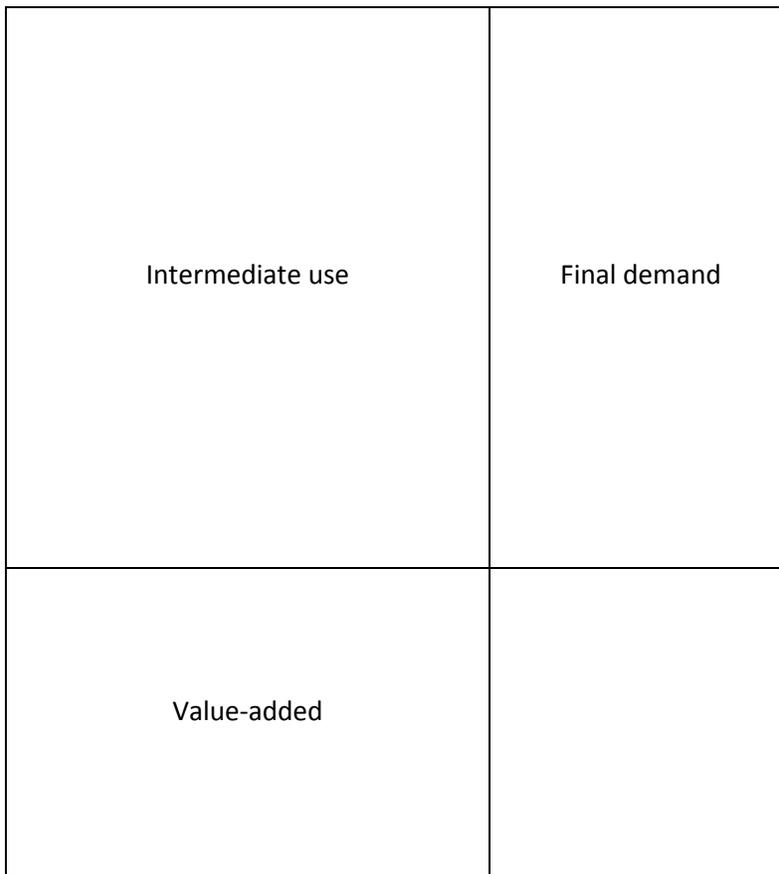
use to balance the data and summarizes our results. The final section shows how we disaggregate two services sectors.

Construction of the input-output table

We follow Light (2010) and the structure of the supply-use table in the construction of the initial estimate of the input-output table. Figure 1 shows the structure of a typical input-output table. There are three major matrices in the table: Value-added, intermediate use, and final demand.

The supply-use table and the official GDP data are reported with details for 16 sectors. The intermediate use matrix thus has 16 rows and 16 columns. Correspondingly, the final demand matrix has 16 rows, and the value-added matrix has 16 columns.

Figure 1. The structure of an input-output table



The value-added data in the supply-use table is taken directly from official GDP data for 2006. We estimate the matrix with value-added data in our input-output table using the same type of data, but update to 2007.

The official GDP data also contains data on total intermediate consumption by sector (a total for each column). To estimate our matrix of intermediate use, we combine these totals with the matrix of coefficients for intermediate use reported in the supply-use table. The coefficients sum to 100% for each sector (column), and thus allow us to allocate total intermediate consumption to individual sectors (rows).

The supply-use table also has details on final demand and international trade. The totals in the table are again taken directly from official GDP data for 2006, and again we update to 2007. To estimate our matrix of final demand, in which we also include both exports and imports, we combine these totals with the matrix of coefficients reported in the supply-use table. Thus, the sectoral structure of the final demand matrix in our input-output table corresponds to the structure of the supply-use table.

This completes our estimate of the input-output table. Next we analyze the data. Our analysis of the data is mainly concerned with the supply-use balance. Supply consists of domestic production and imports. Use (or demand), consists intermediate use and final demand, including exports. In a final input-output table supply must equal demand.

Table 1 shows supply-demand imbalances by sector. We report excess demand, that is demand less supply. In absolute terms, excess demand is biggest for manufacturing followed by agriculture and construction. In relative terms, excess demand is large for most sectors. Excess demand is more than 25% of total supply in 10 out of 14 sectors³⁷.

The imbalances need to be resolved before using the data with a model. The following section develops a balancing procedure for this purpose.

The size of the imbalances suggests significant problems in the data. This calls for additional data work before adjusting the data with a balancing procedure. Unfortunately, we could not obtain additional data to improve our initial estimate of the input-output table. Instead, we assess the quality of the different parts of the data, and collect data on the structure of input-output tables for similar countries. We use the quality assessment and the auxiliary data to guide the necessary adjustments.

Balancing of the input-output table

We now develop a balancing procedure that produces a balanced input-output table. All data points in the input-output table are included and may be adjusted.

The heart of the procedure is an optimization problem that in which the elements of the table are adjusted such that an objective function is minimized subject to side constraints. The objective function is of the popular form which adds the sum of the squared deviations from the initial estimates³⁸. The side constraints include supply-use balance by sector, and a GDP accounting identity. The latter equates total GDP by measured by income with total GDP measured by expenditure.

³⁷ We did a similar analysis using data from the supply-use table only (using 2006 data only and without updating to totals for 2007). The analysis revealed similar imbalances.

³⁸ All of the squared deviations are scaled by the corresponding size of the original estimate to preserve the density of the input-output table.

We adapt the procedure to account for our quality assessment of the data and for auxiliary data. We first review the quality of the data used to construct our initial estimate of the input-output table. To assess the quality, we evaluate whether we believe the data are representative of what they are supposed to report. That is, to what extent do we consider the underlying data complete and accurate?

We distinguish three levels of quality: high, medium and low. The purpose is to have more adjustments in data of low quality and fewer adjustments in data of high quality. This is one way (albeit indirect) of correcting for problems in data.

We begin with data of high quality. The first are data on imports and exports, which in turn are based on customs data. These data are typically collected with lots of detail and in a format consistent with input-output tables. The second are the data on total GDP. This data point can be and is calculated in several ways, and should be identical independently of the method used. This provides a check on the data. Moreover, GDP data is widely used and thus frequently reviewed.

As data of medium quality we include industrial structure, measured as output by sector. These data are in part based on commodity balances and on wage data by sector, both of which are typically collected with lots of details.

As data of low quality we include the structure of intermediate demand, and household, government, and investment expenditure. These data are to some extent based on surveys. In this sense they are less complete and must subsequently be scaled appropriately to become representative. Also, the surveys used are not always consistent with the classifications of the input-output table.

We account for data quality in the objective function by assigning weights to the data elements depending on quality. High, medium and low quality data are assigned the weights of 5, 3, and 1, respectively.

This setup implies that a given adjustment in data carry different penalties depending on what data element is adjusted. For example, a given adjustment in imports carries a five times higher penalty in the objective function than an identical adjustment in intermediate demand. Obviously, this results in more and larger adjustments in data with low weights (quality) than in data with high weights (quality). This is exactly the purpose of the design.

This brings us to our second adaptation of our balancing procedure: the use of auxiliary data. The use of weights implies that most adjustments will take place in intermediate demand³⁹. Now, we want to avoid that intermediate demand is adjusted in an unrealistic way. To achieve this, we install lower and upper bounds based on GTAP data on the variables representing intermediate demand⁴⁰.

Specifically, we aggregate version 7 of the GTAP database to the level of aggregation in the Armenian supply-use table. We then compute coefficients of intermediate demand by

³⁹ Low weights also apply to several final demands, but they also make up GDP, which is assigned a high weight, and they are therefore less likely to change. Also, adjustments in intermediate demands may in some cases serve two purposes simultaneously: Reduce excess demand in one sector, and reduce excess supply in another sector. The reason is that intermediate demand is part of domestic supply.

⁴⁰ See Narayanan and Walmsley (2008) for documentation of the GTAP data.

sector for the following countries: Albania; Azerbaijan; Bulgaria; Belarus; Czech Republic; Estonia; Croatia; Hungary; Kazakhstan; Kyrgyzstan; Lithuania; Latvia; Poland; Romania; Russian Federation; Slovakia; Slovenia; and Ukraine.

For each cell in the matrix with intermediate coefficients in the Armenian data we apply the GTAP coefficients to the corresponding variable. The lower (upper) bound is set equal to the minimum (maximum) of the values calculated for the countries listed above. That is, for each input-output coefficient, we constrain the rebalancing procedure such that each coefficient in the balanced Armenian table we create lies within the observed bounds of the coefficients of the 19 Transition countries we consider.

Results

Table 1 reports calculations based on the supply-use table provided by the National Statistical Office of the Republic of Armenia. In each sector, as an accounting identity, we must have that domestic production plus imports (total supply) is equal to domestic consumption (for intermediate and final use) plus exports (total demand). The excess demand columns show the extent that total demand exceeds or is less than total supply (both in Armenian DRAM and as a percentage of total supply). Excess demand in the original data varies from +75% in the case of electricity to -48% in the case of mining. These percentages show very large inaccuracies in the data at the sector level, and must be corrected to have a correct input-output table or a table that can be used in our model.

“Official” estimates of total GDP are available on the website of the National Statistical Office of the Republic of Armenia. We compare the official estimate with the supply-use table and our balanced table in Table 2. For the supply-use table, the imbalance is below and beyond official GDP depending on the method used. GDP in our balanced table is less than 1% off official GDP, and consistent across methods.

The adjustments in the components that make up GDP are slightly larger (see Tables 3 and 4). The largest change is reported for household expenditure. The main reason is that the official data for the large manufacturing sector report 50 percent more use than is available from production and imports. To attain consistency, a large decrease in consumption of manufactured goods is required; this accounts for about half of total consumption. Similarly, our optimized balancing routine results in an increase in imports of manufacturing goods as a percentage of total imports; this is required in order to balance the officially reported excess demand for manufactured goods (see Table 5).

Disaggregation of the input-output table

Two sectors in the input-output table, “Transport, storage and communications” and “Financial intermediation”, account for most business services in Armenia. Given our focus on these services in the model, these sectors are disaggregated into 9 sectors using two data sources.

For “Transport, storage and communications” we obtained unpublished national accounts data for the year 2007 from the National Statistical Office of the Republic of Armenia. Table 7 shows the data.

Within the aggregate sector in the input-output table, the share of gross domestic product by disaggregate sector is used to decompose the aggregate sector. It is furthermore assumed that the input output structure for all the disaggregate sectors is identical to the input output structure of the corresponding aggregate sector.

For “Financial intermediation”, comparable national accounts data is not available. The two major sub-sectors are banking and insurance services. To obtain data on the share of the two sub-sectors, we collected data for the year 2007 on assets in the sub-sectors from the Central Bank of Armenia website. Table 8 shows the data. The share data is used to disaggregate the aggregate sector “Financial intermediation” as explained above.

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Table 1. Excess Demand in Supply-Use Table, 2007

Sector	Demand (Million Drams)	Supply (Million Drams)	Excess Demand (Million Drams)	Excess Demand (% of total supply)
Agriculture, hunting, forestry and fishing	667674	946682	-279008	-29
Mining and quarrying	140383	265814	-125431	-47
Manufacturing	2628702	1696509	932192	55
Electricity, gas and water supply	309011	167184	141827	85
Construction	1199096	1349184	-150089	-11
Wholesale and retail trade and repair	462281	511197	-48917	-10
Hotels and restaurants	103346	138806	-35460	-26
Transport, storage and communications	328311	436416	-108105	-25
Financial intermediation	69604	109189	-39585	-36
Real estate and professional services	95704	175056	-79352	-45
Public administration and defence	176585	162771	13814	8
Education	203286	120656	82631	68
Health and social work	157127	129786	27341	21
Other social and personal services	29630	84707	-55077	-65

Source: Authors' calculations based on data from National Statistical Office of the Republic of Armenia

Table 2. Total GDP, 2007 (million Drams)

GDP	Official Estimate	Supply-Use Table	Authors' balanced table
Income	3149283	2860584	3044640
Expenditure	3149283	3137365	3044640
Production	3149283	2906200	3044640

Source: Authors' calculations based on data from National Statistical Office of the Republic of Armenia

Table 3. Composition of GDP by expenditure category, 2007

	Total (Millon Dram)	Household (%)	Government (%)	Investments (%)	Net Exports (%)
Supply-Use Table	3137365	72	10	38	-20
Authors' balanced table	3044640	67	10	42	-19

Source: Authors' calculations based on data from National Statistical Office of the Republic of Armenia

Table 4. Composition of GDP by income category, 2007

	Total (Million Dram)	Compensation of employees (%)	Gross operating surplus (%)	Taxes on production (%)	Import tariffs (%)
Supply-Use Table	2860584	42	55	2	1
Authors' balanced table	3044640	43	55	1	1

Source: Authors' calculations based on data from National Statistical Office of the Republic of Armenia

Table 5. Imports, 2007 (% , unless otherwise noted)

Sector	Supply-Use Table	Authors' balanced table
Agriculture, hunting, forestry and fishing	4	4
Mining and quarrying	12	6
Manufacturing	67	75
Electricity, gas and water supply	0	0
Construction	0	0
Wholesale and retail trade and repair		
Hotels and restaurants	2	1
Transport, storage and communications	10	9
Financial intermediation	1	1
Real estate and professional services	1	1
Public administration and defence	1	1
Education	1	1
Health and social work	0	0
Other social and personal services	0	0
Total	100	100
Total (million Dram)	1147289	1102425

Source: Authors' calculations based on data from National Statistical Office of the Republic of Armenia

Table 6. Exports, 2007 (% , unless otherwise noted)

Sector	Supply-Use Table	Authors' balanced table
Agriculture, hunting, forestry and fishing	1	1
Mining and quarrying	8	10
Manufacturing	68	66
Electricity, gas and water supply	1	1
Construction	1	1
Wholesale and retail trade and repair		
Hotels and restaurants	1	1
Transport, storage and communications	10	10
Financial intermediation	1	2
Real estate and professional services	4	4
Public administration and defence	1	1
Education	2	2
Health and social work	1	1
Other social and personal services	0	1
Total	100	100
Total (million Dram)	518529	528637

Source: Authors' calculations based on data from National Statistical Office of the Republic of Armenia

Table 7. GDP by sub-sector, 2007

Sector	Share (%)
Transport, storage and communication	100.0
Transport via railways	5.9
Other land transport	17.8
Transport via pipelines	3.6
Air transport	20.7
Supporting and auxiliary transport activities; activities of travel agencies	7.0
Post and courier activities	0.5
Telecommunications	44.4

Source: National Statistical Office of the Republic of Armenia

Table 8. Assets by sub-sector, 2007

Sector	Million AMD	Share (%)
Financial intermediation	1372961	100.0
Banking	1355959	98.8
Insurance	17002	1.2

Source: Central Bank of Armenia

Appendix H: Empirical literature summary on the role of trade and FDI in increasing total factor productivity through technology transfer as a function of research and development intensity of the trading partner, and implications for parameter choices in regional trade policy models

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.⁴¹ 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 research and development, 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

⁴¹ Trade or services liberalization may increase growth indirectly through its positive impact on the development of institutions (see Rodrik, Subramanian 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.

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,⁴² it implies that it is important for 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, forthcoming; Jabbour and Mucchielli, 2007; and Harris and Robinson, 2004). Saggi (2006) summarizes the theory and additional empirical papers that show the spillovers of FDI on supplying industries. Regarding FDI in services, Arnold, Mattoo and Javorcik (2007) show that in the Czech Republic, services sector liberalization led to increased productivity of downstream industries, and the key channel through which reform led to increased productivity was allowing foreign entry. Fernandes and Paunov (2008) found a positive and significant effect of foreign direct investment in services on productivity growth in Chile. Fernandes (2007) finds a positive and significant effect of services liberalization in both finance and infrastructure on the productivity of downstream manufacturing in the fifteen Eastern European countries.

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 is 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

⁴² 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 1995.

with developing countries.⁴³ 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. For low R&D intensive sectors, we assume that the elasticity of firms with respect to price is the same for the CIS region as for the EU, but the elasticity is only one-third of Rest of the World elasticity (trade with the CIS or EU regions misses out on trade with China or the U.S.). For medium and high R&D intensive sectors, we assume that trade and FDI with the CIS region is only one-eighth as valuable as trade with the Rest of the World (as discussed above), while trade with the EU is two-thirds as valuable as trade with the Rest of the World. Finally, we allow the elasticity of the Rest of the World to vary 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 6b.

⁴³ 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.

Appendix I: Comparison of the CASE study of the impact on Armenia of the Deep and Comprehensive Agreement between Armenia and the European Union with the present study

Maliszewska et al. (2008) (hereafter the CASE study) estimated the impacts on Armenia of a Deep and Comprehensive Free Trade Agreement (DCFTA) with the EU. As we do in the present study, they estimate four likely impacts of the DCFTA for Armenia: (i) reduced border costs; (ii) standards harmonization; (iii) commitments in the services sectors; and (iv) improvements in the investment climate. The CASE study estimates that gains from the first three components will be 3.4 percent (this is the comparative static DCFTA scenario). When the improvement in the investment climate is added to the first three, the gains are an estimated 8.0 percent of GDP (this is the comparative steady state DCFTA scenario). The estimates of the CASE study are considerably higher than the comparable estimates of this study: we estimate that the gains from the first three components will be 1.4 percent. When the improvement in the investment climate is added to the first three, our estimated gains increase to 1.6 percent.⁴⁴

In this appendix we explain the reason for the differences in the estimates. They are due to a combination of two effects: (i) larger assumed distortions in the CASE study; and (ii) different modeling assumptions. In all cases, the assumptions of the CASE study lead to larger estimated gains. The CASE study systematically assumes larger distortions are present in the Armenia than we assume in the present study. The larger the distortions are, the more gains there are from their removal. The larger distortions in the CASE study partly reflect the fact that our study was based on estimates of distortions in 2010, while the CASE study uses estimates of distortions from 2006 or 2007. Since Armenia has implemented substantial reforms in the interim, the initial distortions in the CASE study are significantly higher. This is the case with border costs. But it is also due, in some cases, to the fact that we had greater data available to us that allowed a more accurate estimate, for example in the services survey and estimates that we conducted. Further, there is a key modeling assumption difference in the assumption of which countries benefit from preferential liberalization of services that results in larger estimated gains in the CASE study, and a further modeling assumption difference in the comparative steady state scenario.

I. Comparative Static Estimates

(i) Barriers in Services.

The estimated gains of the CASE team from services commitments as part of a DCFTA should be substantially greater than the estimates in the present study for two reasons. First, the CASE team assumed that the barriers to foreign direct investors in services are much higher than we have estimated. Second, while our study assumed that commitments to foreign services suppliers under the DCFTA will be limited to EU suppliers, the CASE team assumed that the commitments under the DCFTA will be provided to all foreign suppliers (Maliszewska et al., 2008, p.154). We elaborate on each of these two aspects.

⁴⁴ The latter estimates is for our “unilateral” scenario.

As elaborated in Modebaze and Eroyants, our estimates of the ad valorem equivalents of the barriers against foreign direct investment in Armenian services sectors is based on a survey of the regulatory barriers in services in Armenia. As listed in table 4, our estimates are as follows: banking, 5.6 percent; insurance, 15.8 percent; pipeline transportation, 0 percent; rail transportation, 0 percent; air transportation, 106.8 percent; and telecommunications, 0.3 percent. The CASE team did not conduct a survey of the barriers in Armenia. Rather they assumed that the barriers in Armenia are 25 percent lower than in Ukraine. The estimates for Ukraine were done by the Institute for Economic Research with guidance from Jesper Jensen, and were done using the same methodology as ours in Armenia. The resulting estimates by CASE of the ad valorem equivalents of the barriers against foreign direct investment in Armenian services sectors were considerably higher than the present study, with the exception of air transportation. The CASE study estimates are as follows: banking and insurance, 18 percent; transportation, 12 percent; and telecommunications, 4.5 percent.

Regarding the second issue, the CASE study assumed that commitments to foreign investors in services as part of a DCFTA with the EU will be extended to all services suppliers, i.e., that the preferential commitments will become multilateral. The assumption that the commitments will be multilateral implies substantially larger estimated gains for two reasons. First, the cost reduction from foreign suppliers is for all FDI, not just the EU share. Second, in our framework, since commitments are preferential, the gains from liberalizing with the EU come at a cost of some lost varieties of services from foreign suppliers. We have shown that there is an imperfect competition analogy in preferential liberalization of services to the trade diversion issue in goods. By assuming all commitments are multilateral, there is no trade diversion.

(ii) Border costs.

The CASE study assumes that border costs amounted to 10.6 percent of the value of imports and exports, and that these costs would fall by 50 percent as a result of the DCFTA (see pages 149-150). The CASE study was conducted based on 2007 data. Although we are close to CASE in the estimate of the border costs in 2007, the Costs of Doing Business data shows that border costs have fallen in Armenia between 2007 and 2010. We estimate that border costs are only 8.9 percent of the costs of importing and exporting in 2010. Moreover, no rationale is provided for the assumption of a fifty percent cut in border costs. We assume that border costs of land-locked Armenia will not fall below those of Georgia and Ukraine, who have ports. Based on these assumptions we estimate that border costs will fall between 2.2 percentage points and 2.5 percentage points, depending on destination country and imports or exports. This compares with the larger assumed cut by the CASE study of 5.3 percentage points. Had we assumed the same cut in border costs

as in the CASE study, we would obtain more than one percent additional welfare gain as a percent of GDP.

(iii) Standards costs.

Due to the lack of a survey for Armenia, both the CASE study and our study start with data for Ukraine (Jakubiak et al., 2006). The Ukrainian survey revealed that, on average for agriculture, mining and manufacturing, the cost of compliance with EU standards and regulations was 13.9 percent of production costs. Due to the extremely poor status of the National Quality Infrastructure in Armenia, both the CASE authors and our study assume that these costs are higher in Armenia than in Ukraine by 50 percent (or 20.9 percent of production costs on average). The CASE study assumes that Armenian production costs on exports to the EU will fall by 50 percent as a result of a DCFTA with the EU. Our estimates are smaller for two reasons. First, although the EU is likely to assist in the development of the National Quality Infrastructure, it is not likely to invest as heavily as it did in the countries involved in the Eastern Expansion of the EU. Consequently, we assume only a 25 percent decline in production costs. Second, it is necessary for Armenians to invest in the National Quality Infrastructure to be able achieve harmonization. We further limit the production costs cuts by two percentage points in agriculture and manufacturing to reflect the adjustment costs. In summary, we estimate that production costs of exports to the EU will fall, on average, from 20.9 percent of costs to 17.7 percent, whereas CASE assumes that they will fall from 20.9 percent of costs to 10.5 percent of the costs of exporting to the EU.

II. Comparative Steady State Estimates--Improvement in the investment climate

The CASE study simulates improvement in the long run investment climate from the DCFTA in a scenario (called deep FTA+). This is the scenario that gives the CASE study the large 8.0 percent estimated gains—otherwise gains are a maximum of 3.4 percent of GDP. The CASE study employs a modeling approach first introduced into international trade analysis by Glenn Harrison, Thomas Rutherford and David Tarr for analysis of the impact of the EU single market (Harrison, Rutherford and Tarr, 1996) and the Uruguay Round (Harrison, Rutherford and Tarr, 1997). Harrison, Rutherford and Tarr have made their software publicly available and the CASE study uses it and acknowledges the source.⁴⁵ The present study uses the same modeling approach for its long run scenario to assess improvements in the investment climate. The CASE study gets a much larger gain in the long run than the present study. The reasons are two-fold: (i) with this methodology, the larger gains in the comparative static scenario of the CASE study are compounded and magnified

⁴⁵ See Maliszewska *et al.*, 2008, p.145). The CASE authors also acknowledge Jensen and Tarr as the source of the Social Accounting Matrix for Armenia.

in the long run steady state scenario; and (ii) the CASE study assumes an exogenous reduction in the price of capital in the long run that generates considerable additional gains. The technical explanation is as follows.

In the comparative static scenario, the capital stock is fixed and the rental rate on capital is allowed to adjust. In the “steady state” scenario, the capital stock is allowed to adjust to maintain a constant real rate of return to capital, where the real rate of return to capital depends on the price of new capital relative to the rental rate on capital. We assume the capital stock was in equilibrium initially, so when the rental rate of capital increases in the comparative static scenario, it becomes profitable to invest in capital. The capital stock will have to increase in the steady state until the marginal productivity of capital falls enough to bring the real return on capital investments back into equilibrium. Since the CASE study finds larger gains in the comparative static scenario, there is a larger increase in the rental rate on capital, which induces a larger increase in the capital stock in the steady state scenario. In addition and importantly, the CASE study exogenously reduces the price of new capital, which further boosts the expansion of the capital stock.

Drawing on wording in Harrison, Rutherford and Tarr (1996), the CASE authors acknowledge that the result should be discounted due to the failure of the steady state scenario to adjust for forgone consumption to get to a higher capital stock. That is, the gains are an upper bound estimate within the context of this model.⁴⁶ But the upper bound estimate of the CASE study is larger than that of the present study due to the magnification effect on the welfare gains of the larger increase in the rental rate on capital in the comparative static scenario and the fact that the CASE study exogenously reduced the price of new capital to further boost the capital stock in the new equilibrium.

⁴⁶ If endogenous growth effects were incorporated in the model, it is possible that larger gains would be estimated.