Deep Trade Policy Options for Armenia: The Importance of Trade Facilitation, Services and Standards Liberalization

by

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Abstract: In this paper we develop an innovative 21 sector computable general equilibrium model of Armenia to assess the impact on Armenia of a Deep and Comprehensive Free Trade Agreement (DCFTA) with the EU, as well as further regional or multilateral trade policy commitments. 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. 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 EU 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. We estimate only small gains from a services agreement with the CIS countries, but significant gains from expanding services liberalization multilaterally.

JEL categories: F12; F13; F14; F15; F17; C68; L16.

Keywords: trade facilitation; services liberalization; standards harmonization; preferential liberalization; multinationals; monopolistic competition; foreign direct investment; endogenous productivity effects.

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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 FTAs 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 manufacturing sector and contributes to its international

[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.

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 immizerising? 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 welfare gains from a deep agreement with a developed country, rather than a free trade agreement with a developing country? How do the welfare 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 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. Among the better known papers are Levy and Van Wignbergen (1995), Harris (1984), Smith and Venables (1988) and Harrison, Rutheford and Tarr (1993; 1996; 1997a; 2002; 2004). So the literature now contains a substantial number of good studies that examine regional agreements in goods. But

2 See Francois and Hoekman (2010) for a summary of the evidence.

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 sanitary and phyto-sanitary (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 (2007) 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 form 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 standards[3] and most importantly, from a trade facilitation which includes 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, 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.

[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.

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 due to a combination of two effects: (i) larger assumed distortions in the CASE study;

and (ii) different modeling assumptions. Regarding the distortions, the larger the distortions are, the more gains there are from their removal. As we explain in Jensen and Tarr (2011, 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.

Finally, we mention that we conducted surveys in Armenia to assess the regulatory environment in the services sectors and calculated the shares of ownership by foreign region in the services sectors. We employed the former survey to estimate the ad valorem equivalents of the barriers to investment in the services sectors. We also constructed an input-output table for Armenia. This work is an example of our experience that shows that data limitations is a small developing economies can be overcome so that modern models can be applied in these countries.

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. Further documentation is available in the appendixes of Jensen and Tarr (2011). This includes a discussion of the trade and tariff data; our calculation of ownership shares by sector and region; how we obtained

estimates of the Dixit-Stiglitz elasticities in goods; our estimation of the reduction in trade or border costs as a result of a DCFTA; our estimate of the reduction in standards costs; and our construction of a balanced input-output table for Armenia. The estimates and methodology of the ad valorem equivalents of barriers in services is explained in Modebadze and Eroyants (2010).

II. Estimation of the Ad Valorem Equivalents of the Border and Trade Cost Barriers, the Regulatory Barriers in Services and the Standards Costs

In tables 1, we present the sectors and regions of our model and the factors of production. In table 2 and 3, we show the value added by sector and the trade flows by sector for Armenia. We need to estimate key distortions in the traded goods sectors and the services sectors with foreign direct investment.

Services Barrier Estimates

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.

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

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 and Schulele (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 barriers[6] 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). While we believe our approach uses the best available methodology and is based on a survey we conducted, we acknowledge that, as with the estimation of the ad valorem equivalents of non-tariff barriers in goods, the estimation is subject to a margin of error.

[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.

[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.

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.[7] This is an improvement from 131st in the world in 2007,[8] 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.

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 Jensen and Tarr (2011, appendix D).

Standards Costs

[7] See: http://info.worldbank.org/etools/tradesurvey/mode1b.asp.
[8] See http://siteresources.worldbank.org/INTTLF/Resources/lpireport.pdf.

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 Jensen and Tarr (2011, appendix E).[9]

[9] 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.

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

III. Overview of the Model

This paper builds on the algebraic structure of the models of Jensen, Rutherford and Tarr (2007; 2010) and especially Balistreri and Tarr (2011, appendix F) where a full algebraic description of the model is available (except for the trade facilitation and standards costs extensions). 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.

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

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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.

three regions are: (1) the European Union; (2) the CIS plus Georgia[10]; 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. In each of these two sectors, we have four firm types: one firm type for each region. Firms in each region have the same cost structure. We assume that each firm type requires sector specific capital unique

[10] Georgia is not a member of the CIS, but Armenia and Georgia have a bilateral free trade agreement and provide equivalent preferential treatment to each other.

to its firm type. 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.

All imperfectly competitive goods enter the production function of firms and consumption function of the representative consumer as Dixit-Stiglitz aggregates. That is, if Z is an imperfectly competitive good, we assume (suppressing sector subscripts) that:

$$Z = \left[\sum_{i=1}^{m} Z_i^{\rho}\right]^{1/\rho} \quad \text{and} \quad Z_i = \left[\sum_{j=1}^{m_i} z_{ij}^{\rho}\right]^{1/\rho} \quad i = 1,\ldots,m,$$

where m is the number of regions, Z_i is the Dixit-Stiglitz aggregate of firm output in the sector from region i and z_{ij} is the output of firm j in region i. We assume that $1 > \rho > 0$, which implies that the elasticity of substitution $\sigma = 1/(1-\rho) > 1$. Given that the elasticity of substitution is equal at all levels, this is equivalent to pure firm level product differentiation. Given identical costs for firms within a region i, firms in the same region i in equilibrium will charge the same price p_{zi} (although prices will differ between regions). Then dual to the Dixit-Stiglitz quantity aggregates Z_i are the Dixit-Stiglitz unit cost functions C_i. These represent the quality adjusted minimum cost of purchasing the inputs z_{ij}. We have:

$$C_i = \frac{p_{zi}}{n_i^{1/(\sigma_i-1)}}$$

Since $\sigma_i > 1$, C_i declines in the number of varieties available from region i. This is the Dixit-Stiglitz externality.

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. Without this modeling extension, firms would have to sell at marginal costs on exports, and fixed costs would have to be covered by domestic sales alone. It has been established empirically that there are significant fixed costs of exporting and the heterogeneous firms literature has built on that idea, showing that only the most efficient firms export. Although we do not have heterogeneous firms, our new modeling extension allows us to be consistent with the heterogeneous firms models by allowing markups on fixed costs of exports.

Introducing downward sloping demand curves into the model means that there are possible terms of trade effects 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.[11] 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.[12]

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. There are four firms types in each of these sectors: one firm type for each region. The cost structures of firms within a region are identical, and each firm type requires its own sector specific capital. 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 foreign inputs. Thus, the cost structure of multinationals

[11] 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).

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

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).

Closure rules

Total labor and capital is fixed. Labor is mobile across sectors, so receives the same real wage in all sectors. Total capital is constant. A share of capital is mobile and receives the same real rental rate across all sectors; a share is sector and firm type specific in each of the imperfectly competitive sectors. We assume that the real exchange rate adjusts so that the balance of trade is constant. We also assume that government revenues are unchanged, so that any loss of revenue due to tax or tariff decreases must be made up in alternate taxes. The latter two assumptions allows us to conduct welfare analysis based on equivalent variation of the representative consumer.

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 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.[13] To analyze trade policy, this comparative steady state approach has been employed by many authors, including Harrison, Rutherford and Tarr (1996, 1997), Baldwin et al. (1999) and Francois et al. (1996). The approach, however, dates back to the 1970s, when both Hansen and Koopmans (1972) and Dantzig and Manne (1974) used it. The approach ignores the foregone consumption necessary to achieve the higher level of investment and thus, is an 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. [14] 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

[13] 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.

[14] We thank Miles Light for his contribution to this work..

table contains 21 sectors. Details of the construction are explained in Jensen and Tarr (2011, appendix G).

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 Armenia[15]. 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 Jensen and Tarr (2011, appendix A). The results are shown in table 5.

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 Jensen and Tarr (2011, appendix A). Applying these tariff rates across all sectors implies that

[15] http://www.armstat.am/file/article/ft_2nish_07_14.pdf

tariff revenue in the revised database is about 1% of GDP, which is consistent with collected revenues in Armenia.[16]

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 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.

We also note that we have only three sectors where tariff rates apply in our model. It is well known that the distortion costs of a diverse tariff structure decline with aggregation. Thus, the limited number of sectors in our model is likely to lead to an underestimate of the welfare gains from tariff reduction.

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 table 6A and explained in more detail in Jensen and Tarr (2011,appendix B).

Share of Expatriate Labor Employed by Multinational Service Providers.

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

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.[17] 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.[18] We have found that multinational service providers use mostly local primary factor inputs and only small amounts of expatriate labor or specialized technology.

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 Jensen and Tarr (2011, 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 Jensen and Tarr (2011, 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

[17] 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.

[18] Based on Jensen, Rutherford and Tarr (2007) for Russia and Jensen and Tarr (2008) for Kazakhstan, we employed the following shares: railway transportation, 3%; pipeline transportation, 3%; air transportation, 12.5%; telecommunications, 10%; insurance, 10%; banking, 10%.

Grossman and Helpman (1991) have developed models of economic growth that have highlighted the role of trade in providing 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.

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. 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."

As discussed above, we employ the Dixit-Stiglitz-Ethier[19] mechanism, whereby additional varieties of business services increase the productivity of the firms that use the services. This is the key mechanism used in the Grossman Helpman models, endogenous growth theory as well as the economic geography literature. It provides a micro-foundation for the link between a change in policy and productivity growth.

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 Jensen and Tarr (2011, appendix H). In

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

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.[20]

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. 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.

Unless otherwise stated, all results in this section are reported in table 7. In table 7 we present results with no rent capture of the barriers against foreign direct investment by Armenians. We have also executed all the scenarios under the assumption that Armenians capture the rents from the barriers against FDI. The results with rent capture lower the gains from regional integration, but do not change the sign of the results (although there is almost a sign reversal in one case discussed below). So we discuss the key results with rent capture in the text and refer the reader to Jensen and Tarr (2011) for detailed results.

[20] 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 (Table 7, EU-FTA column). 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 (see the EU-FTA steady state column). We estimate that in this scenario, there will be a substantial increase in EU firms operating in Armenia in the air transportation services sector (329 percent increase) and insurance sector (21 percent increase), and a substantial increase in varieties of EU goods available in the manufacturing sector (31 percent increase). Although varieties decline from other regions in this scenario, there is a net increase in varieties, and this leads to a reduction in the quality adjusted price of these goods and services. For details, and comparison with the CIS preferential agreement, see Jensen and Tarr (2011, tables 18, 21). 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 (Table 7, EU Discriminatory Services column). In view of the evidence on the importance of services for productivity growth (see Francois and Hoekman, 2010), it is crucial to estimate these impacts. 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 fifty 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.[21] 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. As we show in table 4, only insurance and air transportation services have significant discriminatory barriers against foreign direct investment. 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. There could be further losses from preferential services liberalization if there are rents captured by Armenians on the barriers to FDI.[22]

EU Tariff Liberalization (Table 7, EU Tariffs column). We assess the impacts of preferentially removing tariffs on imports of goods imported from the EU, with no other policy changes. We 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 six 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.

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

[22] We note that tariff liberalization results in lost fiscal revenue that the government must replace, but services liberalization does not involve a loss of revenue to the government. The lost tariff revenue on third country imports is a welfare loss.

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 (Table 7, Border Costs column). 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 Jensen and Tarr (2011, 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 (Table 7, EU standards column). We evaluate the impact of harmonization with EU standards as part of the DCFTA. As we explain in Jensen and Tarr (2011, 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 two 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 (Table 7, EU-FTA Steady-state column)**.** As discussed above, we assess the potentially positive impact of the DCFTA on the investment climate by executing a "steady-state" scenario. We assume 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 and 70 percent increase, respectively, 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 (Table 7, "CIS FTA" column)**.**

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. In the case of rent capture by Armenians of the barriers against FDI, the gains are almost zero (see Jensen and Tarr, 2011). 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 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.[23] 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 the estimated expansion of varieties from the CIS region is much more modest in response to preferential liberalization with respect to the CIS region. In air transportation services, we estimate a 41 percent increase in the number of CIS firms and a 17 percent increase in insurance. For details, see Jensen and Tarr (2011, tables 18, 21). This is a more modest increase than in the DCFTA with the EU. 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.

Combining the CIS FTA with a DCFTA with Europe-- more substantial gains (Tables 7, "EU-CIS FTA" column).

[23] 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.

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 (Table 7, "Unilateral" column)**.** Preferential services liberalization can result in losses or reduced gains due to a loss in rents, if Armenians are capturing rents from the barriers to FDI in services. In addition, it will result in losses or reduced gains due to the exit of firms from excluded countries and the loss of varieties that entails. 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 from preferential services liberalization 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. Over 85 percent of the gains from unilateral liberalization come from liberalization of services and less than 15 percent comes from tariff liberalization.

Additional gains would be derived from reduction in the barriers that domestic as well as foreign firms face (Table 7, "Unilateral and Domestic" column)**.**

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 (Table 8)

In table 8, 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 provided in table 7.

Business Services. 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. We define the output of multinational firms in the business services sectors who locate in Armenia as part of Armenian industry output (as is the case under a GDP calculation). 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 number of firms operating in Armenia and the output of the sector expands. Since multinational firms operating in Armenia use primarily Armenian labor, employment in these sectors also 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.

Manufacturing, Agriculture and Other Services. 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. Sector output will tend to increase relative to other sectors based primarily on the following three considerations: (i) the

more intensively the sector exports (due to a depreciation of the real exchange rate from trade liberalization); (ii) the lower the tariff was relative to other sectors prior to liberalization; and (iii) the more intensively the sector uses services that are liberalized. What is striking about the output results is how small the output declines are in the unilateral liberalization scenario. In other applications, we have observed small output declines in the declining sectors in preferential liberalization scenarios, but significant output declines in some sectors in the unilateral liberalization scenario. The greater sector impacts in the unilateral scenario are 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 1.7 and 1.8 percent, respectively, 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. Since the liberalization is preferential, not multilateral, the expansion of business services is less strong than in unilateral liberalization. Then the 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 9, we examine the prospective free trade agreement with the EU and in table 10 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 θr 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 "θr –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, σ(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 10), 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 whisper" 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.

VI. Conclusions and Possible Extensions for Future Work

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.

Possible Extensions. Future work could usefully examine the distributional and poverty consequences of the DCFTA, by introducing multiple households. Rutherford and Tarr (2008) have applied this style of model with an aggregate rest of world to examine the case of Russian WTO accession. But, we have not seen a regional model with FDI and monopolistic competition that has examined poverty and distributional impacts. An important extension would be to extend the model to a heterogeneous firms model, to better assess the consequences for industry structure. Balistreri, Hillberry and Rutherford (2010, 2011) have developed a heterogeneous firms CGE model, but it does not include FDI in services. Further, although we have captured the impacts of market shares of multinationals and their differences in the use of imported inputs, there are other dimensions in the way multinationals might differ from domestic firms. The paper by Latorre and Gomez-Plana (2011) is an interesting effort to capture some of these aspects.

References

Baldwin, Richard E., Forslid, Rikard and Haaland, Jan (1999), "Investment Creation and Investment Diversion: Simulation Analysis of the Single Market Programme," in R. Baldwin and J. Francois (eds.), *Dynamic Issues in Applied Commercial Policy Analysis*, Cambridge: Cambridge University Press.

Balistreri, Edward J., Russell H. Hillberry and Thomas F. Rutherford (2010), "Trade and Welfare: Does Industrial Organization Matter?" *Economic Letters*, Vol. 109, 85-87.

Balistreri, Edward J., Russell H. Hillberry and Thomas F. Rutherford (2011), "Structural Estimation and Solution of International Trade Models with Heterogeneous Firms," *Journal of International Economics*, Vol. 83, 95-108.

Balistreri, Edward J. and James Markusen (2009), "Sub-national differentiation and the role of the firm in optimal international pricing," *Economic Modeling*, 26(1), 47 - 62.

Balistreri, Edward J., Thomas F. Rutherford and David G. Tarr (2009) "Modeling Services Liberalization: The Case of Kenya," *Economic Modeling*, Vol. 26 (3), May, 668-679.

Balistreri, Edward J. and David G. Tarr (2011) "Services Liberalization in Preferential Trade Arrangements: the Case of Kenya" World Bank Policy and Research Working Paper No. 5552.

Broda, Christian and David Weinstein (2004), "Variety, Growth and World Welfare," *American Economic Review*, 94 (2), May, 139-144.

Broda, Christian, Josh Greenfield and David Weinstein (2006), "From Groundnuts to Globalization: A Structural Estimate of Trade and Growth," National Bureau of Economic Research Working Paper No. 12512. Available at: http://faculty.chicagobooth.edu/christian.broda/website/research/unrestricted/BrodaGroundnuts.pdf .

Coe, David T., and .Elhanen Helpman (1995), "International R&D Spillovers," *European Economic Review* 39 (5): 859-887.

Daniels, P.W. (1985), *Service Industries: A Geographical Appraisal*, New York: Methuen & Co.

Dantzig, George and Alan Manne (1974), "A Complementary Algorithm for an Optimal Capital Path with Invariant Proportions," *Journal of Economic Theory*, 9, 312-323.

Dixit, A. and J. Stiglitz (1977), "Monopolistic Competition and Optimum Product Diversity," *American Economic Review*, 76(1):297-308.

Ethier, W.J. (1982), "National and International Returns to Scale in the Modern Theory of International Trade," *American Economic Review*, 72(2):389-405.

Francois, Joseph and Bernard Hoekman (2010), "Services Trade and Policy," *Journal of Economic Literature*, Vol. 48 (September), 642-692.

Grossman, Gene and Elhanan Helpman (1991), *Innovation and Growth in the World Economy*, Cambridge, MA, MIT Press

Hansen, Terje and Tjalling Koopmans (1972), "On the Definition and the Computation of a Capital Stock Invariant Under Optimization," *Journal of Economic Theory*, 5, 487-523

Harris, Richard (1984), "Applied General Equilibrium Analysis of Small Open Economies with Scale Economies and Imperfect Comp," *The American Economic Review*, Vol. 74 (5), December, 1016-1032

Harrison, Glenn H., Thomas F. Rutherford and David G. Tarr (1993), "Trade Reform in the Partially Liberalized Economy of Turkey," *The World Bank Economic Review*, May.

Harrison, Glenn H., Thomas F. Rutherford and David G. Tarr. (1996), AIncreased Competition and Completion of the Market in the European Community: Static and Steady-State Effects,@ *Journal of Economic Integration*, 11(3), September 1996, 332-365.

Harrison, Glenn H., Thomas F. Rutherford and David G. Tarr (1997), "Quantifying the Uruguay Round," *Economic Journal*, Vol. 107 (444), September, 1405-1430.

Harrison, Glenn H., Thomas F. Rutherford and David G. Tarr (1997a), Economic Implications for Turkey of a Customs Union with the European Union, *European Economic Review*, 41(3-5), 861-870.

Harrison, Glenn H., Thomas F. Rutherford and David G. Tarr (2002), "Trade Policy Options for Chile: The Importance of Market Access," *World Bank Economic Review*, Vol. 16, Number 1.

Harrison, Glenn H., Thomas F. Rutherford, David G. Tarr and Angelo Gurgel (2004) "Trade Policy and Poverty Reduction in Brazil," *The World Bank Economic Review*, Vol. 18, 289-317, 2004.

Hummels, D. and P. Klenow (2005), "The Variety and Quality of a Nation's Trade," *American Economic Review*, Vol. 95, 704-723.

Jensen, Jesper, Thomas Rutherford and David Tarr (2010), "Modeling Services Liberalization: the Case of Tanzania," *Journal of Economic Integration*. Also available as World Bank Policy and Research Working Paper No. 4801.

Jensen, Jesper, Thomas Rutherford and David Tarr (2007), "The Impact of Liberalizing Barriers to Foreign Direct Investment in Services: The Case of Russian Accession to the World Trade Organization," *Review of Development Economics*, Vol. 11 (3), August, 2007, 482-506.

Jensen, Jesper and David Tarr (2008), "Impact of local content restrictions and barriers against foreign direct investment in services: the case of Kazakhstan accession to the WTO," *Eastern European Economics*, Vol. 46 (5), September-October 2008, 5-26.

Jensen, Jesper and David Tarr (2011), "Deep trade policy options for Armenia : the importance of services, trade facilitation and standards liberalization," World Bank Policy and Research Working Paper number 5662. Available at: http://econ.worldbank.org/external/default/main?pagePK=64165259&theSitePK=469372&piPK=64165421&menuPK=64166093&entityID=000158349_20110518082525

Kang, Joog-Soon (2000), "Price Impact of Restrictiveness on Maritime Transportation Services," in *Impediments to Trade in Services: Measurement and Policy Implications*, Christopher Findlay and Tony Warren (eds.), London: Routledge.

Kimura, Fukunari, Mitsuyo Ando and Takamune Fujii (2004a), "Estimating the Ad Valorem Equivalent of Barriers to Foreign Direct Investment in the Telecommunications Services Sectors in Armenia" Available at http://www.worldbank.org/trade/russia-wto.

Latorre, Maria C. and Antonio Gomez Gomez-Plana (2011), "On the differential behaviour of national and multinational firms: A within and across sectors approach," Paper presented at the 14th Annual GTAP conference, Venice, Italy.

Levy, Santiago & van Wijnbergen, Sweder (1995), "Transition Problems in Economic Reform: Agriculture in the North American Free Trade Agreement," *American Economic Review*, Vol. 85(4), September, 738-54.

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.

Markusen, James R, Thomas Rutherford and David Tarr (2005), Trade and Direct Investment in Producer Services and the Domestic Market for Expertise," *Canadian Journal of Economics*, Vol. 38 (3), 758-777.

McGuire, Greg and Michael Schuele (2000), "Restrictiveness of International Trade in Banking Services," in *Impediments to Trade in Services: Measurement and Policy Implications*, Christopher Findlay and Tony Warren (eds.), London: Routledge.

McKee, D.L. (1988), *Growth, Development, and the Service Economy in the Third World*, New York: Praeger Publishers.

Modebadze, Grigol and Karine Eroyants (2010), "Ad Valorem Equivalence to FDI Restrictiveness in Armenia," mimeo. Available at: https://docs.google.com/leaf?id=0B0V-t-Bs4-hXYjA3MTQ5MDctNTAxYy00M2I4LWI3NDAtZGRiNDI3NmYwOGU2&hl=en

National Bureau of Statistics of Armenia, Gross Domestic Product at Current Prices by Selected Economic Activities for the Years 2001-2006, unpublished data.

National Bureau of Statistics of Armenia (2007), Revised National Accounts Estimates For Armenia Mainland - Base Year, 2001, Dar es Salaam, July.

Navaretti, Giorgio and David G. Tarr (2000), "International Knowledge Flows and Economic Performance: A Review of the Evidence," *World Bank Economic Review*, Vol. 14 (1), 1-15.

Rutherford, Thomas F. and David Tarr (2008), "Poverty Effects of Russian WTO accession: modeling "real" households with endogenous productivity effects," *Journal of International Economics*, Vol. 75 (1), 131-150.

Rutherford, Thomas F. and David Tarr (2003), "Regional Trading Arrangements for Chile: Do the Results Differ with a Dynamic Model?" *Integration and Trade*, Vol. 7, Number 18, 117-139.

Rutherford, Thomas F. and David G. Tarr (2002), "Trade Liberalization and Endogenous Growth in a Small Open Economy," *Journal of International Economics*, 56 (2), March, 247-272

Rutherford, Thomas F., Rutstrom, E.E. and Tarr, David G. (1993). "Morocco's free trade agreement with the European Community: A quantitative assessment," *Economic Modeling*, Vol. 14, No. 9, 237-269.

Rutherford, Thomas, Rutstrom, E.E. and Tarr, David (1995), "The free trade agreement between Tunisia and the European Union," World Bank: Washington, D.C. Mimeo. Reprinted as

Rutherford, Thomas F.; Rutstrom, E.E.; and Tarr, David G. (2000) "A Free Trade Agreement Between the European Agreement and a Representative Arab Mediterranean Country: A Quantitative Assessment," in Bernard Hoekman and Jamel Zarrouk (eds.), *Catching Up with the Competition: Trade Opportunities and Challenges for Arab Countries*, Ann Arbor: University of Michigan Press.

Schiff, Maurice and Yanling Wang (2006), "North-South and South-South Trade Related Technology Diffusion: An Industry Level Analysis of Direct and Indirect Effects," *Canadian Journal of Economics*, Vol. 39 (3), August, 831-844.

Schiff, Maurice, Yanling Wang and Marcelo Olarreaga (2002), "Trade Related Technology Diffusion and the Dynamics of North-South and South-South Integration," World Bank Policy and Research Working Paper 2861, June.

Schott, P.(2004), "Across-Product versus Within-Product Specialization in International Trade," *Quarterly Journal of Economics,* 119, 647-678.

Smith, Alasdair, and Venables, Anthony J. (1988), "Completing the Internal Market in the European Community: Some Industry Simulations", *European Economic Review*, 32, 1501-1525.

Tarr, David (2002), "On the Design of Tariff Policy: Arguments for and Against Uniform Tariffs," in B. Hoekman, A. Mattoo and P. English (eds.), *Development, Trade and the WTO: A Handbook*, Washington: World Bank.

Warren, Tony (2000), "The Impact on Output of Impediments to Trade and Investment in Telecommunications Services," in *Impediments to Trade in Services: Measurement and Policy Implications*, Christopher Findlay and Tony Warren (eds.), London: Routledge.

World Bank (2007), *Food Safety and Agricultural Health Management in CIS Countries: Completing the Transition*, Agriculture and Rural Development Department, Washington D.C.: The World Bank.

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)

			GDP	
	Capital (%)	Labor (%)	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 (%)

			Border costs		Standards	Regulatory barriers	
	Output tax	Tariff	Imports	Exports	for EU 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 FTA	EU Discriminatory Services	EU Tariffs	Border Costs	EU Standards	EU FTA 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 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)	**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: 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 9: 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 Lower	Central	Upper	Results for EV Piecemeal sensitivity analysis 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
σ(va, bs)	0.625	1.25	1.875	1.39	1.44	1.52
σ(D, M)	2	4	6	1.42	1.44	1.46
σ(M, M)	4	8	12	1.44	1.44	1.44
σ(L, K)	0.5	1	1.5	1.44	1.44	1.44
$\sigma(A_1,\ldots A_n)$	NA	0	0.25	NA	1.44	1.45
σ(D, E)	2	4	6	1.44	1.44	1.44
ε_{ARM}	Central values of all 4 sets of ε			1.46	1.44	1.43
ε_{EU}	parameters are listed in table 6B.			0.96	1.44	1.77
ε_{CIS}	Lower and upper values are 0.5			1.44	1.44	1.45
ε_{ROW}	and 1.5 times central values.			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

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

σ(D, M): Elasticity of substitution between domestic production and imports

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

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

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

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

ε_{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 10: 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 Lower	Central	Upper	Results for EV Piecemeal sensitivity analysis 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
σ(va, bs)	0.625	1.25	1.875	0.09	0.10	0.12
σ(D, M)	2	4	6	0.10	0.10	0.10
σ(M, M)	4	8	12	0.10	0.10	0.10
σ(L, K)	0.5	1	1.5	0.10	0.10	0.10
$\sigma(A_1,\ldots A_n)$	NA	0	0.25	NA	0.10	0.10
σ(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
σ(va, bs): Elasticity of substitution between value-added and business services
σ(D, M): Elasticity of substitution between domestic production and imports
σ(M, M): Elasticity of substitution between imported varieties
σ(L, K): Elasticity of substitution between primary factors of production in value added
$\sigma(A_1,\ldots A_n)$: Elasticity of substitution in intermediate production between composite Armington aggregate goods
σ(D, E): Elasticity of transformation (domestic output versus exports)
ε_{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.

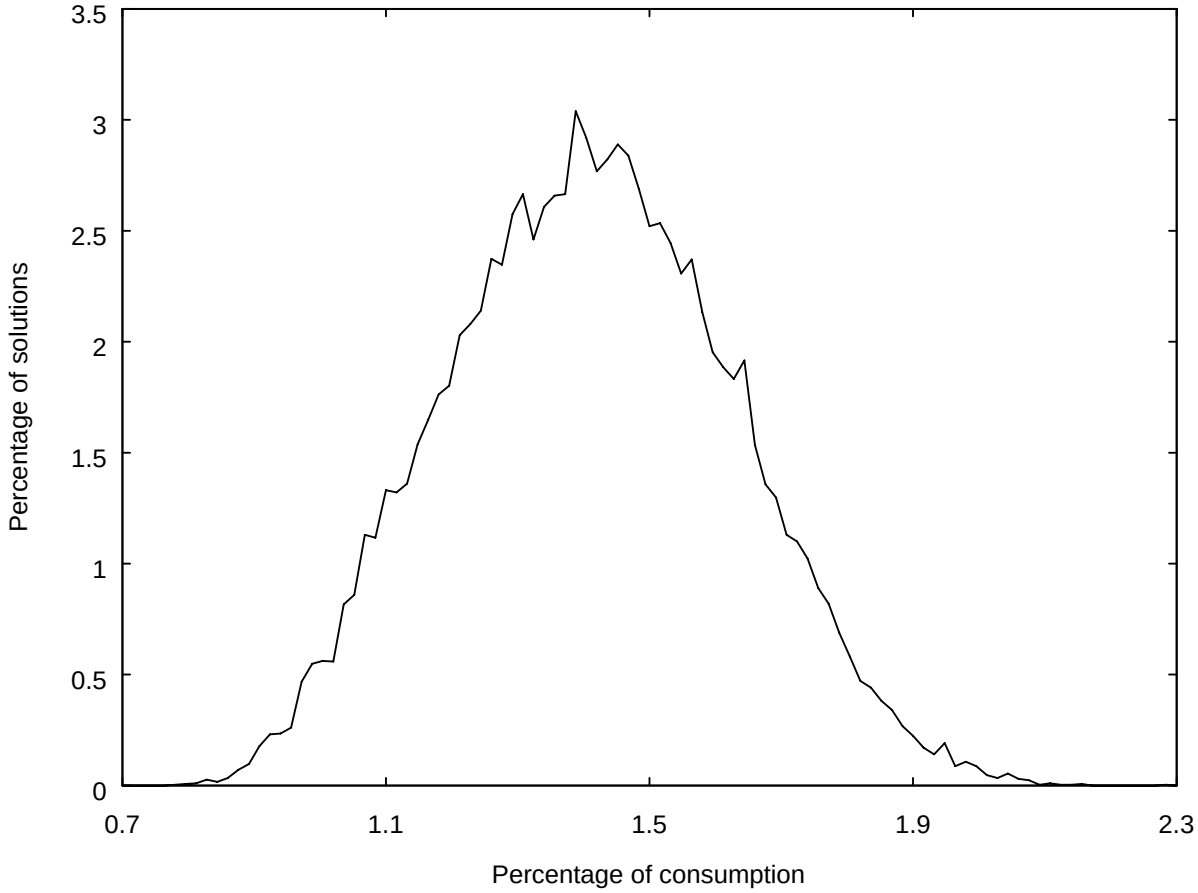
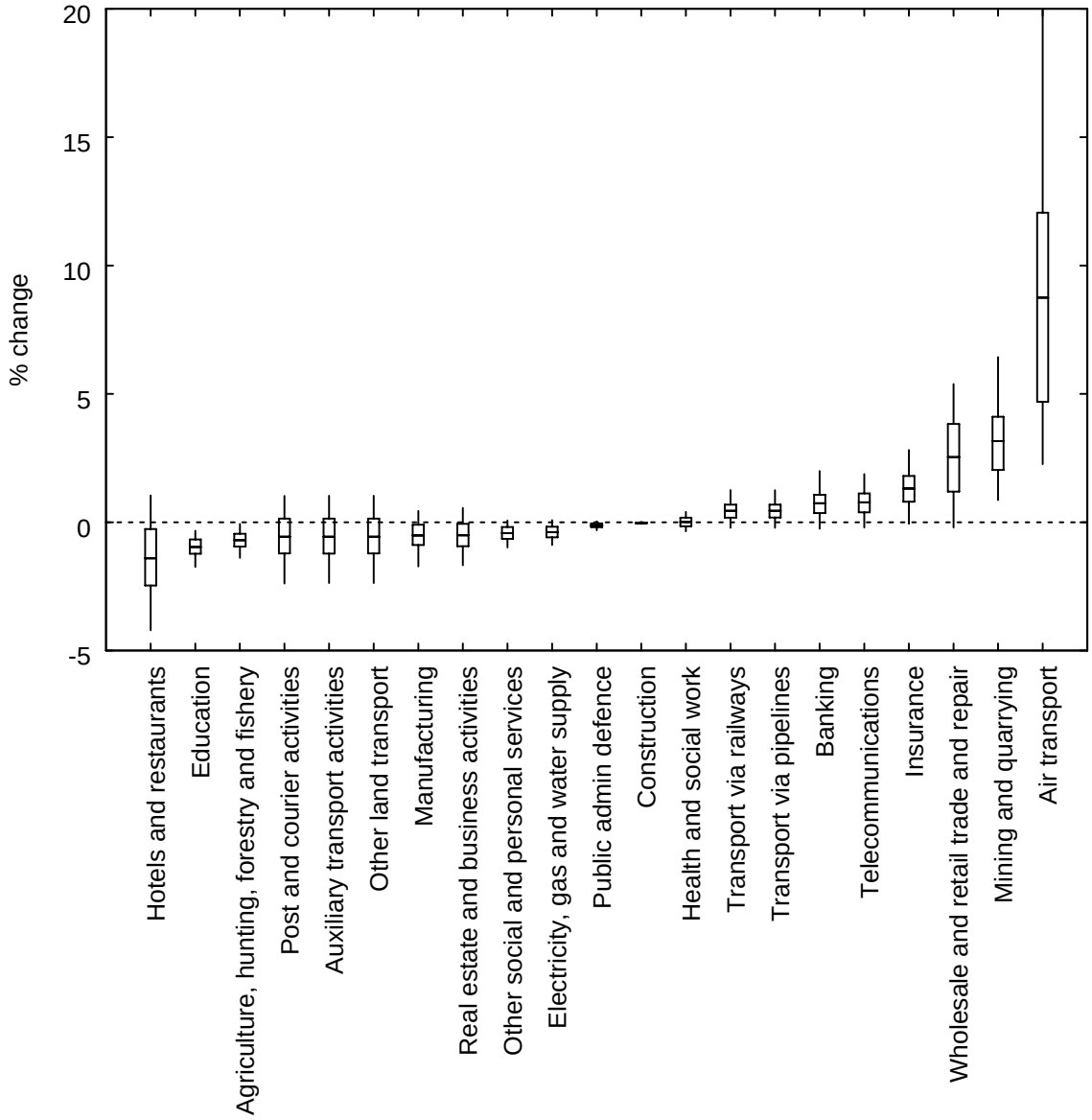
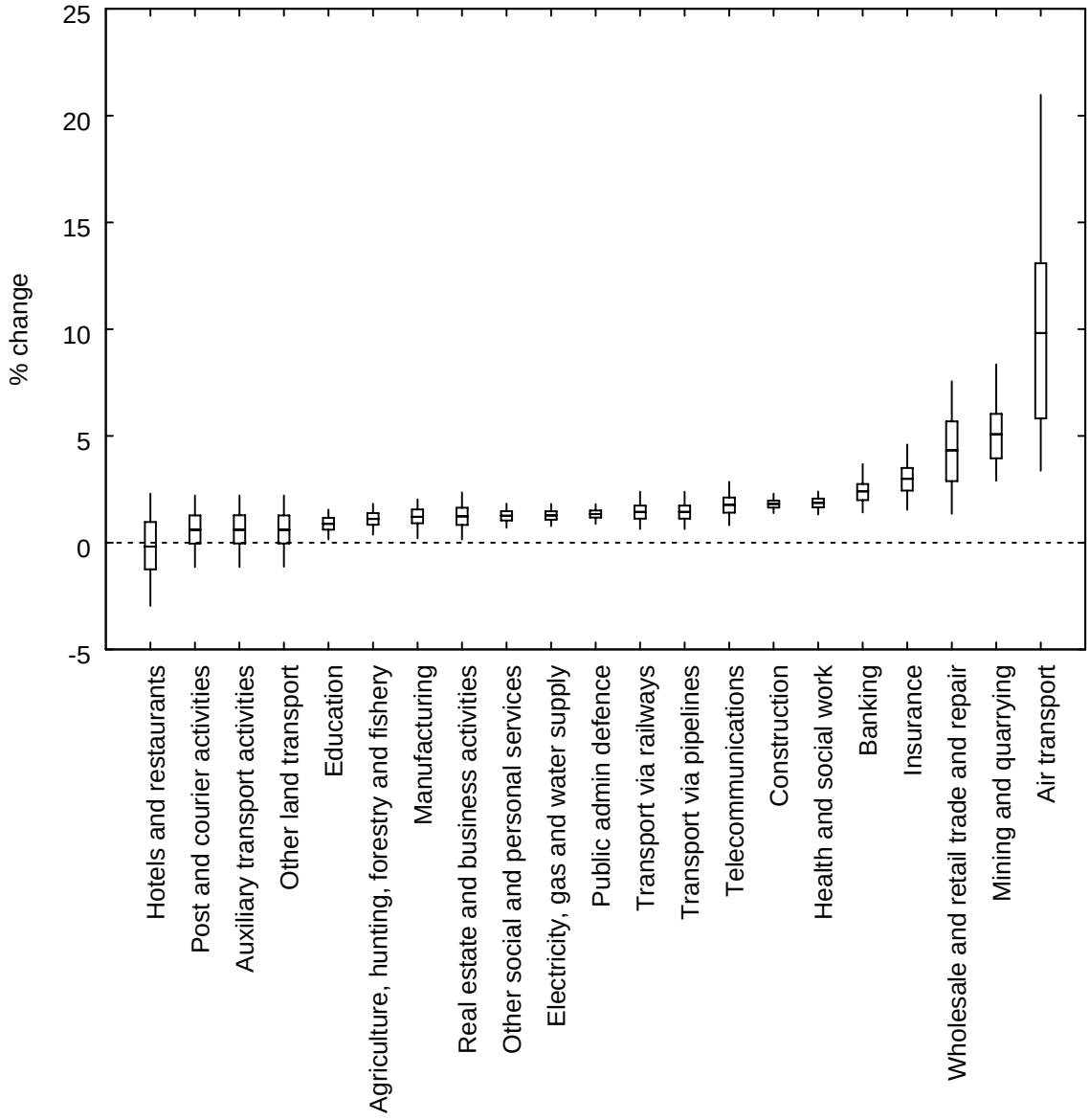


Figure 2: Means, 50 and 95 Percent Confidence Intervals of the Sample Distributions of the Output Changes by Sector from Armenian-EU DCFTA—30,000 simulations.



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.

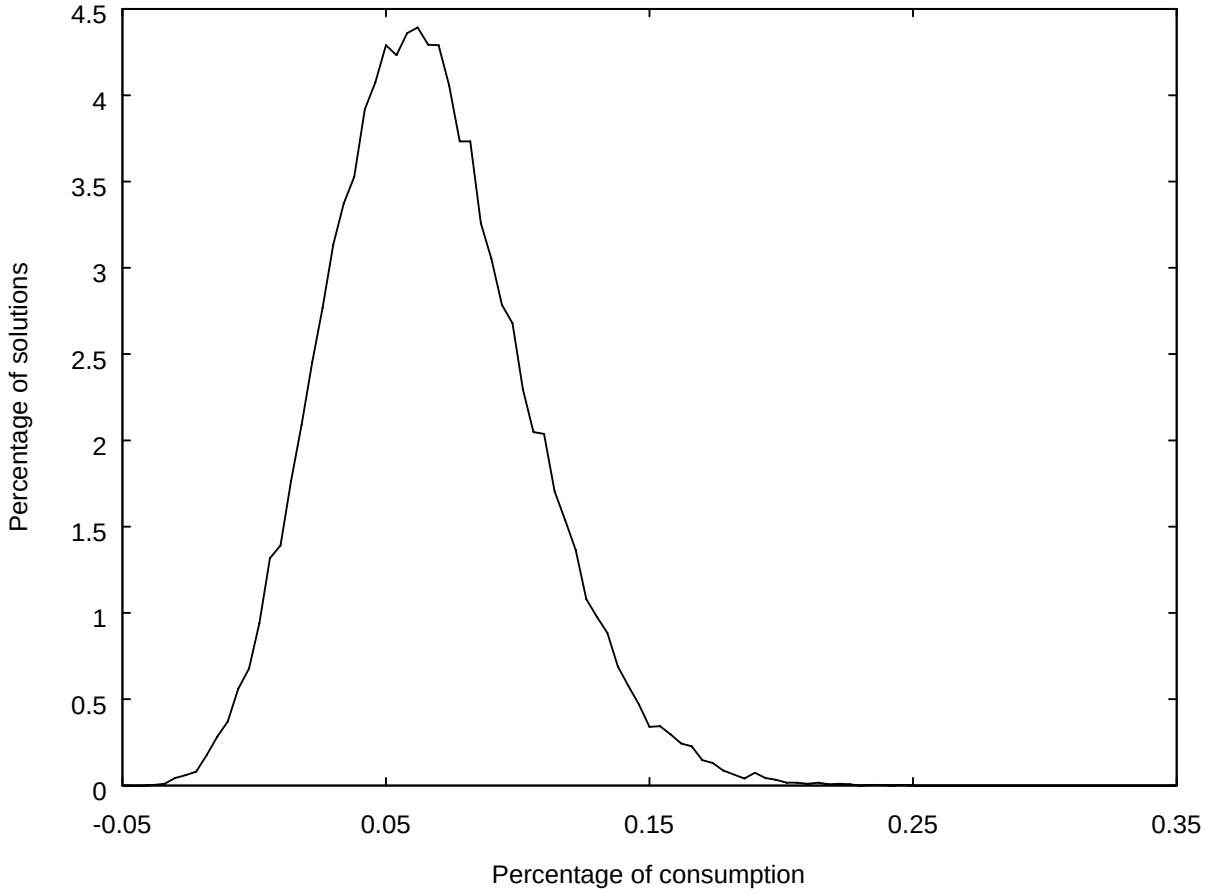
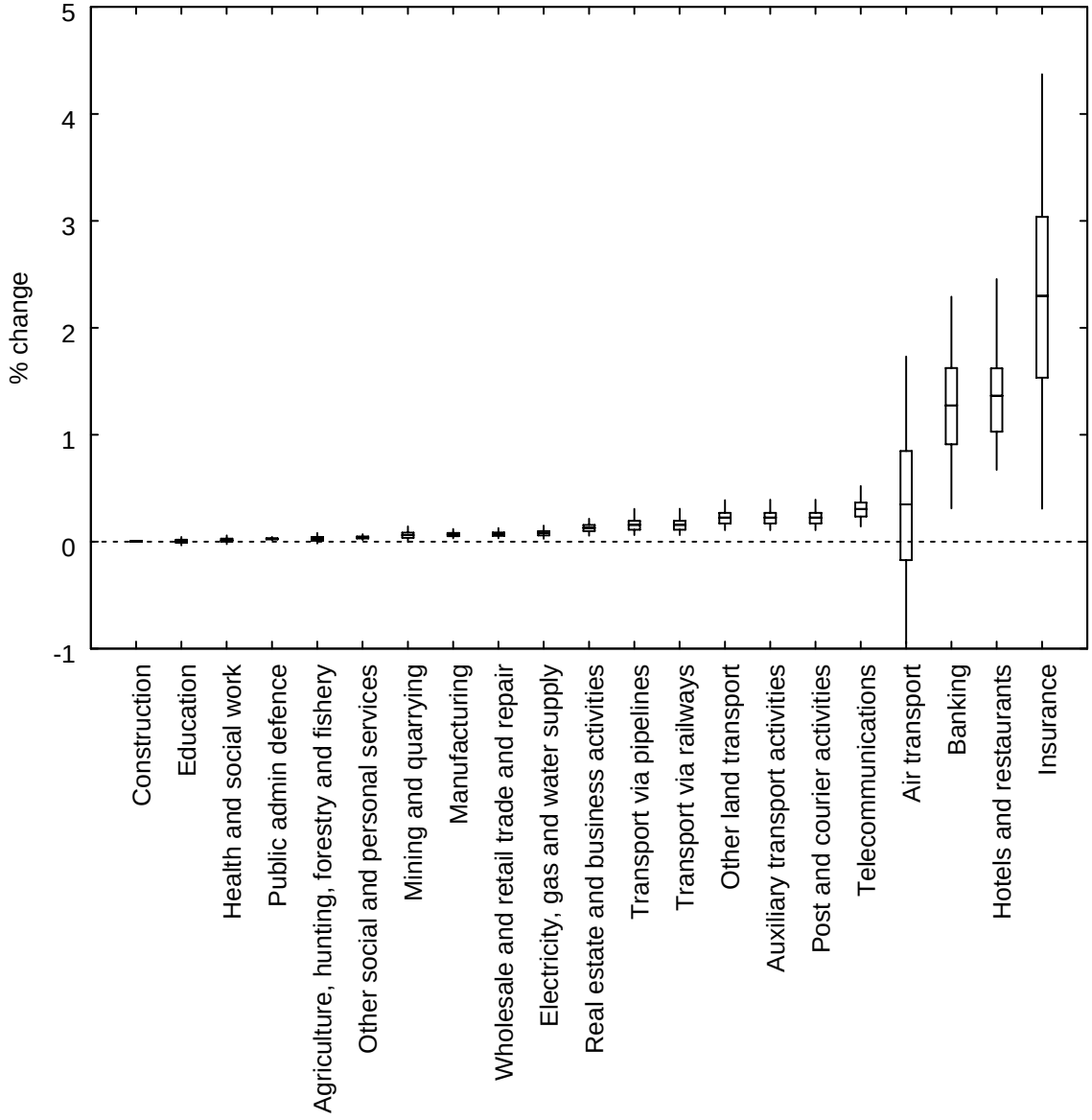
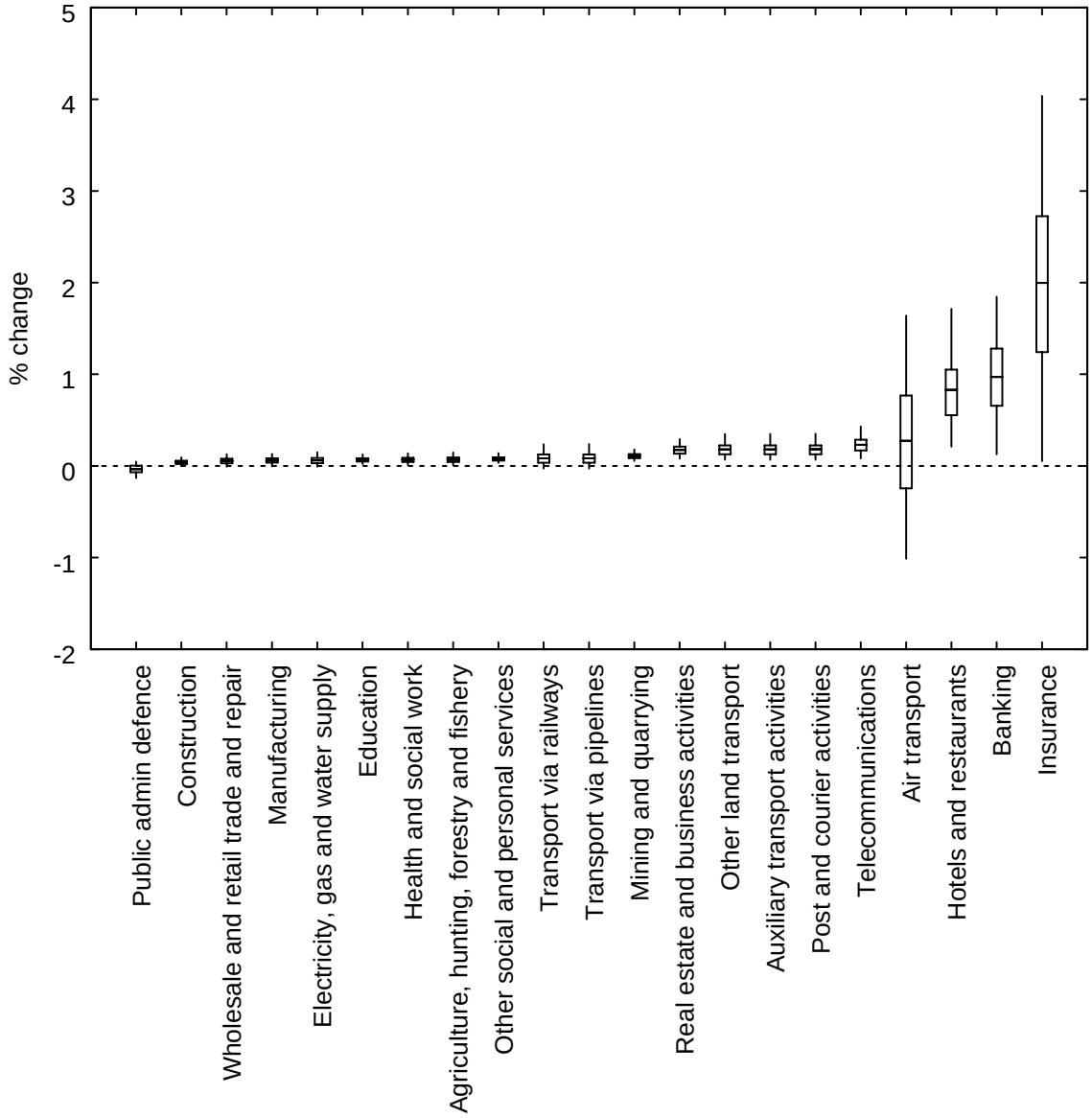


Figure 5: Means 50 and 95 Percent Confidence Intervals of the Sample Distributions of the Output Changes by Sector from Armenian-CISFTA—30,000 simulations.



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.