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Market Structure and the Impact of RCEP in The Philippines: What are the Differences between the Melitz, Krugman and Armington Models

by
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June 6, 2017

Abstract: In this paper, we analyze the relative welfare impacts of modern international trade market structures in a full applied general equilibrium incorporating many previously unexamined features. We apply these models to assess the impacts of the Regional Comprehensive Economic Partnership on The Philippines. We assess how the results differ with three versions of market structure: (i) perfect competition (Armington style); (ii) monopolistic competition in the style of Krugman (1980); and heterogeneous firms in the style of Melitz (2003). All models are extended versions of the originals since they all include foreign direct investment, and the models with monopolistic competition include some sectors, like agriculture, that are assumed to be perfectly competitive.

Although the work of Arkolakis, Costinot and Rodriguez Clare (2012) initially suggested that the theoretical innovations of Krugman and Melitz did not add to the welfare gains, further developments, especially from Costinot and Rodriguez-Clare (2014) and Melitz and Redding (2015), have shown that, as the models become more realistic and complex, there typically are gains in monopolistic competition models over perfect competition and potential gains in Melitz over Krugman. Further, welfare comparisons of the three market calculations are not available for models with many real world features, such as foreign direct investment, intermediate inputs with actual data, heterogeneous tariffs across sectors, trade imbalances, specific factors and import of primary factors of production. Our models incorporate these features. Importantly, following the methodology of Costinot and Rodriguez-Clare (2014), we adjust the trade elasticities of our models so that the trade response is held constant across the models.

We find that our Krugman and Melitz models both produce significantly larger welfare gains than the Armington structure. The relationship between the welfare gains in the Krugman versus Melitz models is complex and depends on how the heterogeneous firms model is implemented in a small open economy framework as well as the small open economy model itself.

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Keywords: heterogeneous firms; Dixit-Stiglitz variety impacts; trade facilitation; trade costs; services liberalization; non-tariff barriers; regional integration; RCEP, The Philippines.

JEL categories: F14; F15; F17; O55; F55.

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1. Introduction

In this paper, we evaluate the welfare gains of a mega-regional trade agreement under negotiation (the Regional Comprehensive Economic Partnership, RCEP) using three popular model structures, commonly referred to as Armington, Krugman and Melitz. We use computable general equilibrium models that allow us to evaluate the relative impact of these market structures incorporating multiple important aspects of real world applied trade policy that to date have eluded solutions in the "theory with numbers" literature. As the same time, we incorporate the insight of the "theory with numbers" or "exact hat" literature regarding the importance of a constant trade response across the model types (to the extent possible), i.e., we adjust elasticities in our model such that the change in exports is held constant across the three model structures.

Additional innovation in our model is that we provide an extension of the Krugman (1980) model that breaks the all varieties are consumed everywhere property. This allows small economies to non-trivially impact the number of varieties available in their economy. Further, our models that contain imperfectly competitive sectors contain three kinds of market structure: perfect competition; monopolistic competition without FDI; and monopolistic competition with FDI. The Krugman or Melitz market structure is not applied to the perfectly competitive sectors in our models.

In an influential and surprising paper, Arkolakis, Costinot and Rodriguez-Clare (2012) showed that in the simplest version of their models, the welfare gains from the reduction of trade

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costs are identical in the Armington (1969) perfect competition model, the Krugman (1980) monopolistic competition model and Melitz (2003) monopolistic competition model with heterogeneous firms. Further, and also surprising to numerical modelers, they showed that in their simplest model, the welfare change in the Armington, Krugman or Melitz models may be calculated from only two statistics: (i) the percentage change in the share of expenditure on domestic (versus) imported goods (the "trade response"); and (ii) the elasticity of imports with respect to variable trade costs. Crucial to their results, they argue that, given the importance of the trade elasticity, and the wide acceptance of gravity models in international trade, all numerical model estimates of welfare gains from trade should be consistent with the estimates of the trade elasticity from a gravity model. This implies that numerical modelers must adjust different structural elasticities of the Armington, Krugman and Melitz models so that the trade responses of all three models are consistent with trade elasticity estimates from a gravity equation.

Subsequent research has shown (reviewed in more detail below) that the result regarding the equivalence of the welfare gains from a reduction of trade costs in the three model types is very fragile, i.e., fails to hold with minor departures from the assumptions of the simplest model of Arkolakis, Costinot and Rodriguez-Clare. In a very clever paper, Costinot and Rodriguez-Clare (2014) extended the exact hat methodology of Arkolakis, Costinot and Rodriguez-Clare in several directions. Two of their most notable extensions were tradable intermediate goods (through a composite good that is an aggregate of all intermediate and final goods) and multiple sectors. They find that with the introduction of tradable intermediate goods, the estimated gains from trade are higher under Krugman style monopolistic competition than under perfect competition; and heterogeneous firms in monopolistic competition increase the gains from trade above the Krugman style model. Further, with multiple sectors, due to variety losses, the welfare losses from a tariff are greater with monopolistic competition than under perfect competition, Costinot and Rodriguez-Clare (2014, table 4.3).[2] In addition, Melitz and Redding (2015) showed that in a comparative static version of the model in Melitz (2003), with the features of the simplest Arkolakis, Costinot and Rodriguez-Clare model, but with an upper bound on the Pareto

[2] Balistreri, Hillberry and Rutherford (2010) were the first to show that the Armington, Krugman or Melitz market structures matter if there are multiple sectors, and noted that intermediate goods would also destroy the equivalence of the welfare results under the three market structures. Arkolakis, Costinot and Rodriguez-Clare (2012) first showed the non-equivalence result for intermediate goods.

distribution of productivity, endogenous decisions of heterogeneous firms to enter and exit the market provides "an extra adjustment margin" that augments the gains from international trade with heterogeneous firms. There are larger welfare gains from reductions in trade costs and smaller welfare losses from increases in trade costs.

Despite the impressive achievement of Costinot and Rodriguez-Clare to generalize their approach in several directions, it remains an open question of the relative welfare impact of the three market structures where the models include: (i) intermediates with demand structures that reflect actual data on intermediate use; (ii) heterogeneous tariffs across sectors; (iii) examination of tariff changes without assuming a movement either from free trade or to autarky; (iv) foreign direct investment; (v) specific factors of production; (vi) trade imbalances; and (vii) import of primary factors such as specialized intermediate inputs. The model we employ in this paper incorporates all these features and provides insight into these open questions. Following the work of Arkolakis, Costinot and Rodriguez-Clare, we adjust elasticities so that the change in exports from a change in trade costs is identical across model structures.

We apply these models to the Regional Comprehensive Economic Partnership (RCEP). With the apparent collapse of the Trans-Pacific Partnership (TPP), 16 countries in Asia and the Pacific (the ASEAN 10, China, Japan, India, South Korea, Australia and New Zealand) have turned more earnestly to negotiations of RCEP.[3] Collectively, these countries account for almost half of the world's population and almost thirty percent of the world's GDP. This paper is the first to assess the market structure impacts of a regional trade agreement.

The guiding principles of RCEP[4] call on the member governments to progressively eliminate tariff and non-tariff barriers on substantially all trade in goods; to substantially eliminate restrictions or discriminatory measures with respect to trade in services among RCEP members; and to facilitate investment in the region. There are also discussions in RCEP meetings regarding trade facilitation, especially with respect to the improvement of customs procedures.

We build a small open economy model of The Philippines with the following seven external regions: (i) Rest of ASEAN; (ii) Japan; (iii) China; (iv) India; (v) South Korea, Australia and New Zealand; (vi) United States; and (vii) Rest of the World. We evaluate the impacts on

[3] Between 2012 and March 2017, there have been 17 negotiation rounds. For summaries of these rounds and Ministerial meetings, see: http://dfat.gov.au/trade/agreements/rcep/Pages/regional-comprehensive-economic-partnership.aspx

[4] http://dfat.gov.au/trade/agreements/rcep/Documents/guiding-principles-rcep.pdf

The Philippines of four policy changes as part of RCEP: (i) elimination of tariffs on trade in goods amount RCEP members; (ii) reduction in time in trade costs; (iii) reduction in non-tariff barriers; and (iv) improved treatment of barriers against foreign providers of services, both through foreign direct investment (FDI) and cross-border sales of services.

The paper is organized as follows. We provide a review of the literature in section 2 and an overview of the model in section 3. In section 4 we explain the data that we have developed or used in constructing this model. Results are presented in section 5. We conclude in section 6.

2. Literature Review

2.1 Rationales for the Gains from Trade

One of the oldest propositions in economics is that there are gains from international trade. Ricardo (1817) elucidated the principle of comparative advantage as the source of gains from international trade and Samuelson (1939) established it rigorously. Krueger (1974) and Bhagwati (1982)[5] showed that in the presence of "rent-seeking" the gains from trade liberalization would be significantly larger than from specialization gains from comparative advantage.

Since 1979, numerous authors showed that under conditions of increasing returns to scale and imperfect competition, the gains from trade liberalization could be larger than under perfect competition for multiple reasons. The reasons included: (i) increased competition from international trade could lower markups, which would lead to rationalization gains as firms slide down their average cost curves, Krugman (1979); (ii) additional varieties in monopolistically competitive markets are a source of gains from trade, Krugman (1980); (iii) international trade could add additional varieties of intermediate inputs, Ethier (1982); (iv) foreign direct investment of multinationals could be a source of significant gains from trade in imperfectly competitive markets, especially in producer services markets, Markusen (1989; 1995; 2002), Markusen and Venables (1998), Ethier and Markusen (1996).

Beginning with Melitz (2003), many theoretical papers have emphasized the heterogeneous nature of firms in an open economy monopolistic competition framework.[6] These models provide a further rationale for the gains from international trade, as the endogenous decisions of firms to enter or exit could lead to an increase in output by the more efficient firms

[5] Bhagwati used the term "directly unproductive profit-seeking" activities.
[6] See, for example, Arkolakis, Demidova, Klenow and Rodriguez-Clare (2008), Bernard, Redding and Schott (2007), Demidova and Rodriguez-Clare (2009) and Helpman, Melitz and Redding (2004).

and an increase in the gains from trade. Further there has been a substantial increase in research in international economics based on firm level data sets. Several new stylized facts about international trade have been identified that are consistent with the heterogeneous firms model, including that only the most productive firms export and trade liberalization induces an intra-industry reallocation of resources.

2.2. The Theory with Numbers Literature

As discussed above, Costinot and Rodriguez-Clare (2014) extended the results of Arkolakis, Costinot and Rodriguez-Clare with several models in which the welfare equivalence from a reduction in trade costs in the Armington, Krugman and Melitz models fails to hold. The assumptions of their simplest model are: it contains one sector per country; has one factor of production; does not contain intermediates; there is no labor-leisure choice; trade of each country is balanced; there is no foreign direct investment, and changes in trade costs impact variable costs only and are uniform across sectors.

Costinot and Rodriguez-Clare extended their market structure analysis with a ten region, sixteen sector model. In addition to multiple sectors, their numerical model contains tradeable intermediate inputs (with an aggregate of intermediates).[7] They analyze a change in a uniform tariff (not solely iceberg trade costs). They calculate that in seven of their ten regions (either with or without intermediates) the welfare losses of a global 40 percent uniform tariff are larger in a Krugman model compared with perfect competition due to variety losses in the Krugman monopolistic competition model. They find that without intermediates, losses with the Melitz model are smaller than under the Krugman model. On the other hand, with intermediates, Costinot and Rodriguez-Clare (2014, p.30) find that the losses with firm heterogeneity are larger than in the Krugman model. They argue that the variety losses are larger in the Melitz model. We discuss this further in section 5.3 below.[8]

[7] All firms allocate expenditure on intermediates from different sectors in the same proportions, not based on the proportions in which they use the intermediates based on the actual data. We investigate the implications of this assumption below.

[8] Costinot and Rodriguez-Clare extended their analysis to multiple factors of production. Then the welfare calculation also depends on changes in relative factor costs. Under perfect competition, these changes only impact variable costs of production, but under monopolistic competition they also impact fixed costs of exporting and entry, and the number of varieties. Consequently, there is no welfare equivalence between the Armington, Krugman and Melitz models. In the numerical application, they assume that factor cost shares are identical across all sectors and countries. Thus, it remains an open question whether the Heckscher-Ohlin mechanism could provide larger impacts in a model with factor costs shares that differ across sectors and countries, such as those that are based on actual cost shares.

The extension to ten regions, sixteen sectors and intermediate goods brings with it considerable computational complexity. Costinot and Rodriguez-Clare (2013, pp. 9-10) show that their model with heterogeneous tariffs, trade imbalances, multiple sectors and countries and intermediates contains $3nS + 2n^2S$ non-liner independent equations, where n is the number of regions and S is the number of sectors. Their ten sector, sixteen region model contains 3680 equations. If n=15 and S=16, it would contain 7920 independent non-linear equations. Thus, the more realistic models of applied trade policy modeling take the "exact hat" methodology well beyond two sufficient statistics for welfare analysis into models that can only be solved numerically with the help of a computer, and they contain a comparable number of non-linear equations to the computable general equilibrium model of Balistreri, Hillberry and Rutherford (2011).[9]

Compared with their 34 region Armington model, when analyzing Melitz and Krugman, they reduce dimensionality to 10 regions to "ease the computational burden." At the same time, they also introduce an aggregate intermediate good, eliminate initial trade imbalances, start with zero tariffs for all goods and countries and restrict the analysis to uniform tariffs (Costinot and Rodriguez-Clare, 2014, p. 229). Thus, while they have derived the equilibrium conditions for the more realistic models, solution with the more realistic features has not been accomplished with the exact hat methodology for the monopolistic competition models. Clearly, it is a non-trivial exercise to solve the more realistic Melitz and Krugman models, and we are not, in general, guaranteed that an equilibrium exists. Although we believe it should be possible to solve these more realistic models with the exact hat methodology, it remains to be shown that it can be done. It appears, however, that the computational simplicity of the exact hat methodology compared with CGE analysis is limited to rather small, simplified models.

Melitz and Redding (2015, p. 1121) show that the full trade elasticity with export market selection incorporates: (1) the direct effect of a change in trade costs on the extensive margin of trade through its impact on the export cutoff; and (2) an indirect effect through the price index via its impact on the domestic cutoff. Gravity models only estimate the first effect, known as the partial trade elasticity. With untruncated Pareto distributions, the partial and full trade elasticity are identical; but with a truncated Pareto distribution, the micro structure affects the full trade

[9] For the same number of regions and sectors, the Balistreri, Hillberry and Rutherford model contains 6,660 equations, But the Balistreri et al. model is more general in that it started from actual tariff data (not zero tariffs worldwide), contains heterogeneous tariff changes and multiple factors of production.

elasticity.[10] Finally, Balistreri, Hillberry and Rutherford (2010), have shown that if factor intensities across sectors are not identical and the trade shock is not uniform across sectors, the trade responses in the Armington and Melitz models are not identical.

In summary, it is not possible at this time to assess welfare consequences based on simple summary statistics in models that capture a wide range of realistic model features and policies relevant to governments today such as the RCEP policies under negotiation. Thus, there is a role for well-designed computable general equilibrium models to assess how large are the gains from trade. At the same time, the work of Arkolakis, Costinot and Rodriguez-Clare has shown the importance for CGE models of using appropriate trade elasticity estimates as a basis of calibrating model elasticities (to the extent possible), to produce a consistent estimated trade response across the model variants.

2.3 CGE Literature on the welfare gains from trade liberalization (a brief overview)

The early CGE literature was based on constant returns to scale models, where the gains were based on comparative advantage and calculated from "Harberger triangles." The estimated gains from trade liberalization were sometimes characterized by the "Harberger constant," i.e., the gains were generally less than one percent of GDP from trade liberalization. Among others, de Melo and Tarr (1990) and Jensen and Tarr (2003) showed that, even in a perfect competition constant returns to scale model, if there were rents involved, the gains could be many multiples of the gains from the "Harberger triangles."

Regarding imperfect competition models with homogeneous firms, the path breaking article was by Harris (1984), who showed that the gains might be much larger if the behavioral interaction of oligopolists is altered by the trade policy. Harrison, Rutherford and Tarr (1997) estimated that the impact of rationalization gains (sliding down the average cost curve) were small in a quantity adjusting model of oligopoly. Rutherford and Tarr (2002) showed that in a fully dynamic model based on Paul Romer style endogenous growth with gains from variety, the gains from trade liberalization would be many multiples of the gains in a constant returns to scale model. Markusen, Rutherford and Tarr (2005) and Rutherford and Tarr (2008) showed that introducing foreign direct investment in services with Dixit-Stiglitz endogenous productivity

[10] We employ untruncated Pareto distributions. Further, in multi-country models, the appropriate trade elasticity for welfare is specific to each exporter-importer pair. Gravity models (even with fixed effects for exporter-importer country pairs) capture the average effect across all country pairs in the sample. This elasticity may not be a good approximation for any specific exporter-importer pair.

effects would substantially increase the welfare gains. Francois, Manchin and Martin (2013) have summarized many approaches to modeling market structure in CGE models and suggested ways that the alternate model structures could be tested.

Regarding heterogeneous firms, the first effort at a CGE model was by Zhai (2008). His model was developed into an application to the Trans Pacific Partnership in Petri, Plummer and Zhai (2012) and employed in the *Global Economic Prospects* of the World Bank (2016). Unlike the Melitz model, however, neither Zhai's model, nor the model of Petri, Plummer and Zhai, allow entry or exit of firms, nor does it allow uncertainly about the productivity (Zhai, 2008, pp. 7, 8). But their models do allow existing firms to enter new markets and that type of entry creates a new variety and a welfare gain. Since domestic firms face increased competition from foreign entry, some would be expected to exit. The model of Zhai, however, does not allow firm exit; consequently, the model exaggerates the variety externality. This explains why Petri, Plummer and Zhai obtain such large increases in the variety externality in their model. Dixon, Jerie and Rimmer (2015) developed a stylized CGE model in which the Armington, Krugman and Melitz models are special cases. Like Arkolakis, Costinot and Rodriguez-Clare (2010), they find the models produce equivalent welfare results when the trade response is held constant across the models. Their model, however, is not applied to data from an actual economy or economies; in particular, all sectors in their model have identical factor shares, both within and across countries. Costinot and Rodriguez-Clare (2013) and Melitz and Redding (2015) have shown that the equivalence results found by Dixon, Jerie and Rimmer (2015) and by Arkolakis, Costinot and Rodriguez-Clare (2010) fail to generalize when more complex features of actual economies are brought into the model. The first CGE model of real economies that has been developed that is consistent with the model of Melitz (2003) is Balistreri, Hillberry and Rutherford (2011). In their multi-region model they find that the welfare gains from tariff reductions are several times larger than with a standard CRTS trade model. Balistreri, Hillberry and Rutherford (2011), however, did not hold the trade response constant across the market structures.

3. Overview of the Model

In this paper, we build models with three market structures: (i) perfect competition in the style of Armington (1969); (ii) monopolistic competition with homogeneous firms. Consistent with the literature, we call this a Krugman style model; and (iii) monopolistic competition with

heterogeneous firms, what we call a Melitz style model. We have two important extensions of the Krugman (1980) and Melitz (2003) models.

First, with our approach, there is a fundamental difference from the Krugman (1980) model in that small countries may significantly impact the number of varieties available to them. That is, in the Krugman (1980) model, all countries consume all varieties that are produced anywhere. Thus, the model has the unrealistic feature that small countries have the same number of varieties available to them as large economies. Importantly for policy results, reduction of trade barriers by small countries will have only a negligible impact on their variety externality, since a country can impact the available varieties only insofar as it impacts global demand and the number of varieties available globally. In our model of The Philippines, varieties available in imperfectly competitive sectors in The Philippines depend on the profitability of sales in The Philippines; and a reduction in trade costs for foreign firms selling in The Philippines will induce entry into The Philippines, providing a variety externality.

Second, in both our Krugman and Melitz style models, there are three types of sectors: (i) perfectly competitive goods and services sectors; (ii) monopolistically competitive goods sectors (with homogeneous firms in the Krugman style model or heterogeneous firms in the Melitz style model); and (iii) monopolistically competitive services sectors with foreign direct investment (with homogeneous firms in the Krugman style model or heterogeneous firms in the Melitz style model). The Krugman style model builds on the structure in the model of Rutherford and Tarr (2008), Balistreri, Jensen and Tarr (2011) and Balistreri, Olekseyuk and Tarr (2016). We provide a mathematical appendix of those equations, taken from the model of Belarus by Balistreri, Olekseyuk and Tarr (2016). The Melitz style model builds on the structure of the model in Balistreri, Hillberry and Rutherford (2011) and Balistreri and Rutherford (2013). Here we provide a general description of the structure described there and provide more details where we depart from that structure.

There are 23 sectors in the model shown in table 1. In the Armington model, all sectors are perfectly competitive. In the Krugman and Melitz models, there are three categories of sectors: (1) nine perfectly competitive goods and services sectors: (2) seven imperfectly competitive goods sectors; and (3) seven services sectors in which there is imperfect competition and foreign direct investment. The cost, production and pricing structures in the three categories differ widely, but regardless of sector, all firms minimize the cost of production.

Primary factors are skilled labor, unskilled labor and capital (including land).[11] Regarding capital, there is mobile capital and sector-specific capital in imperfectly competitive goods sectors and services sectors with FDI; and primary inputs imported by multinational service providers, reflecting specialized management expertise or technology of the firm. There is some sector specific capital for each imperfectly competitive firm (and for firms in services sectors with FDI) for each region of the model. In the sectors where there is sector specific capital, there are decreasing returns to scale in the use of the mobile factors and supply curves in these sectors slope up. We calibrate the elasticity of substitution between sector specific capital and other inputs in each sector so that the elasticity of supply of the firms is consistent with econometric evidence that indicates that the supply response depends on the level of development and the technological complexity of the product. [12]

3.1 Perfectly competitive goods and services sectors

In these sectors, we employ the "Armington" structure, with goods and services differentiated by the country of origin. Exports are also differentiated by the country of destination.

3.2 Imperfectly competitive goods sectors (Krugman model)

Goods in these seven sectors (and all IRTS services) are differentiated at the firm level. Each firm produces a unique variety that is differentiated in the demand functions of users of the goods. Users of the differentiated goods have an elasticity of substitution (Dixit-Stiglitz) for the different varieties. The number of varieties affects the productivity of the use of imperfectly competitive goods based on the standard Dixit-Stiglitz formulation, i.e., the effective cost function for users declines in the total number of goods-firms in the industry. Manufactured goods may be produced domestically or imported from firms in any region in the model. Firms in these industries set prices such that marginal cost equals marginal revenue; and there is free entry, which drives profits to zero. For domestic firms, costs are defined by observed domestic primary factors and intermediate inputs to that sector in the base year data. Foreigners produce the goods abroad at constant marginal cost with respect to output (if factor prices are held constant), but incur a fixed cost of operating in The Philippines. The transportation cost inclusive 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.

[11] Given the nature of the shocks we consider (which are economy-wide), we do not believe the aggregation of capital and land has a significant impact on the results.
[12] See Appendix A.

We have a crucial difference between our model and the standard Krugman structure. Given the fixed costs of operating in The Philippines by any foreign firm, and the zero profit condition, foreign entry and exit within The Philippines is affected by trade costs within The Philippines. Then policies in The Philippines can significantly impact the number of firms, varieties and welfare gains of trade within The Philippines. On the other hand, in the structure of the standard Krugman model, small countries cannot obtain a significant variety externality by their own policies. That is, all countries consume some of any variety that is produced; then the number of varieties is determined by global demand and an open country can affect the number of varieties only insofar as it affects global demand.

In the models of Russian WTO accession of Jensen, Rutherford and Tarr (2007) and Rutherford and Tarr (2008), domestic firms faced a perfectly elastic demand curve on export markets and they exported at marginal costs. In this model, 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. Filipino firms then set marginal revenue equal to marginal costs in each of the seven export markets; then the export markets contribute to the quasi-rents of the firm and affect the entry and exit decisions of firms. If the partner countries of The Philippines reduce their barriers preferentially against exporters from The Philippines, that will induce entry in The Philippines and additional welfare gains from additional varieties. Introducing downward sloping demand curves into the model, however, means that there are possible terms of trade affects to consider in this model that were not present in the Rutherford and Tarr (2008) model.[13]

Following Krugman (1980), we assume that imperfectly competitive firms have a fixed cost of production and that marginal costs are constant with respect to output. Then, suppressing subscripts for firms, sectors and regions, total costs are:

$$TC(q; p) = q*MC(p) + FC(p) \qquad (1)$$

where TC is total costs, MC is marginal costs, FC is fixed costs, q is output of the firm and p is a vector of factor prices. Following the literature (e.g., Helpman and Krugman, 1985), we assume that the input proportions of fixed and marginal costs are identical, from which it follows that the ratio of fixed to marginal costs is constant. That is, for all firms producing under increasing returns to scale (in both goods and services), we have:

[13] Balistreri and Markusen (2009) show that since Chamberlinian firms choose an optimal markup based on the elasticity of substitution between firm varieties, which equals the export demand elasticity, the role for optimal tariffs is significantly reduced.

$FC(p)/MC(p) = k$ where k is a constant (2)

Equations (1) and (2), in the Chamberlinian framework, imply that output per firm 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.

3.3 Imperfectly competitive goods sectors (Melitz model)

We follow Melitz (2003) or more closely since this is a comparative static small open economy model, Demidova and Rodriguez-Clare (2009). Our model adopts most of the assumptions of the Krugman model, with two key additions. First, the marginal costs of firms depend on the productivity draw of firms. Firms do not know their productivity prior to entering the market. They receive a productivity draw from an untruncated Pareto probability density function after entering the market which determines their marginal costs. This gives rise to a heterogeneous structure of firms regarding their productivity, price and output. More productive firms charge a lower price and capture a larger market share. There is a cutoff productivity level, below which, firms do not produce, i.e., they are not active.

A second key modeling difference from Krugman is that firms face an additional fixed cost of selling in any export market. This gives rise to a second cutoff where only the more productive firms export as well as sell in their domestic market. Crucially, quasi-rents on exports of the firm must cover the fixed costs of exporting to that market. This breaks the all varieties are sold in all markets property of the Krugman model and, analogous to our version of the Krugman model, allows small open economies to significantly influence the number of varieties available in their home market. If partners of The Philippines lower their barriers on Filipino exports, exporting becomes more profitable and more firms export. Increased expected profits imply that more firms enter the market. The larger number of firms in the market, lowers the equilibrium domestic price and raises the productivity cutoff for firms to remain active. The reallocation of industry resources toward more efficient firms is an aspect of the Melitz model that contributes to potentially larger gains than the Krugman model. But the magnitude of this effect and whether there are offsetting variety effects relative to a Krugman model have not been shown in an applied model with the trade response held constant. We discuss the variety issues in more detail in section 5.3.

3.4 Imperfectly competitive service sectors in which foreign direct investment occurs (Krugman style)

In these services sectors, we observe that some services are provided by foreign service providers on a cross border basis analogous to goods supply from abroad. But a large share of business services are provided by service providers with a domestic presence, both multinational and local.[14] Our model allows for both types of provision of foreign services in these sectors.

The cost, production, demand and competition structure for firms in this group of industries follows the same structure as the imperfectly competitive goods firms with two differences. The first difference is that we allow multinational service firms to establish a local presence to produce in The Philippines and compete directly with Filipino service firms. Multinational service firms produce a Filipino region specific variety in The Philippines, which is differentiated from Filipino varieties and the varieties of other multinational services firms in The Philippines. Crucially, all firms (foreign and domestic) incur a fixed cost of operating in The Philippines.

For domestic firms, costs are defined by the costs of local primary factors and intermediate inputs. When multinationals service providers decide to establish a local presence in The Philippines, they will predominantly use Filipino inputs; but they will also import some of their technology or management expertise. That is, foreign direct investment generally entails importing specialized foreign inputs. Thus, the cost structure of multinationals differs from Filipino service providers. Multinationals incur costs related to both imported primary inputs and local primary factors, in addition to intermediate factor inputs. Provision of services through FDI differs from cross-border provision of services or exports of goods, since services provided through FDI use predominantly local primary inputs, i.e., Filipino inputs in our case.

For multinational firms, the barriers to foreign direct investment raise their costs of production. The reduction of the barriers lowers these costs, raises the profitability of FDI and induces entry by multinationals until zero expected profit is restored.XXX This leads to a welfare gain from the Dixit-Stiglitz variety externality. In addition, liberalization of FDI barriers frees capital and labor that was used to overcome the barriers for use elsewhere in the economy. In all model variants, we assume that the reduction in the constraints on foreign direct investment allows

[14] 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).

the domestic economy to capture rent rectangles. In addition, reducing barriers induces foreign entry until profits are driven to zero, so there are also "Harberger" triangles of efficiency gains.

3.5 Imperfectly competitive service sectors in which foreign direct investment occurs (Melitz style).

Again, the key departure from the Krugman style model discussed in section 3.3.1 is that the marginal costs of firms depend on the productivity draw of firms. Foreign firms who wish to enter the market of The Philippines do not know their productivity prior to entering the market. They receive a productivity draw from a Pareto probability density function after entering the market which determines their marginal costs. This gives rise to a heterogeneous structure of foreign firms regarding their productivity, price and output. There is a cutoff productivity level, below which, foreign firms do not provide the service in The Philippines.

Note that we model FDI with heterogeneous firms differently than Helpman, Melitz and Yeaple (2004) in three aspects. First, Helpman, Melitz and Yeaple assume that the product that the firm sells in its home market is identical to the product it sells through cross-border sales or through FDI. Their choice between cross-border sales or FDI is driven by the tradeoff between the higher transport costs of cross-border sales versus the higher fixed costs of serving the foreign market through FDI. In our model, while we assume that home market and cross-border sales are the same product, we assume that the product sold through FDI is differentiated from the home and cross-border product. We believe that the proximity burden literature implies that the home market and FDI products are differentiated. A local presence in services allows FDI provided services to be better substitutes for host country services than cross-border services. For example, banks with a physical presence in The Philippines are a better substitute for Filipino banks in The Philippines than foreign banks that provide banking services cross-border on an electronic basis. More strikingly, in services such as mobile telephone services or trucking services, it is very difficult for foreign firms to compete with domestic firms without a physical presence in the host country. Our model incorporates the stylized fact that FDI services are better substitutes for host country services than cross-border services. Second, foreign firms who provide services through FDI in The Philippines, produce in The Philippines with predominantly Filipino primary inputs (except for the specialized imported input discussed above in the model with homogeneous firms). We believe this is consistent with the data. For example, the two

major mobile telephone companies in The Philippines, which are primarily owned by nationals of Hong Kong and Singapore, use almost all Filipino workers. Third, given the one-to one correspondence between firms and varieties, we are treating foreign firms who supply The Philippines through FDI as firms who either sell through FDI or do not produce anything. Consequently, we cannot explain the choice between exports versus FDI, which was the focus of the paper by Helpman, Melitz and Yeaple.

4. Data of the Model and Evidence for Key Elasticities

4.1 Ad Valorem Equivalents (AVEs) of the Barriers Against Foreign Suppliers of Business Services.

Our estimates of the ad valorem equivalents of discriminatory barriers against foreign providers of services in the services sectors are taken from Jafari and Tarr (2015). The Jafari and Tarr estimates are based on the World Bank database of discriminatory regulatory barriers in 11 services sectors in 103 countries; that database is described in Borchert, Gootiiz and Mattoo (2014). Borchert et al. produced "Services Trade Restrictiveness Indices," but did not transform their indices of the regulatory regimes into ad valorem equivalents. The Jafari and Tarr methodology uses the World Bank database for an assessment of the regulatory regimes, but builds on a series of studies, supported by the Australian Productivity Commission, to convert assessments of services regulatory regimes into ad valorem equivalents for all 11 sectors in 103 countries. Jafari and Tarr define mappings from the World Bank database to the scoring matrices of the Australian authors. In this manner, they score the regulatory regimes of the 11 sectors in the 103 countries according to the Australian authors' criteria.

4.2 Estimates of the Ad Valorem Equivalents of the Costs of Time in Exporting and Importing.

In order to estimate the impact of improved trade facilitation, in this paper we apply the time cost of trade dataset of Hummels and Schaur (2013) and Hummels *et al*., (2007). Using the estimates of Hummels and his co-authors, Peter Minor (2013) provided estimates for the regions and products in the GTAP database on a bilateral basis. We use estimates from Peter Minor, which we aggregate to the sectors and regions of our model, yielding the cost of trade by product and country on a bilateral trade basis.

4.3 Estimates of the Ad Valorem Equivalents (AVEs) for Non-Tariff Measures (NTMs) for the Regions of our Model

Cadot and Gourdon (2014) have shown that the old command and control non-tariff measures, like quotas, bans, licenses and foreign exchange rationing have significantly declined in importance; but sanitary and phyto-sanitary (SPS) regulations and standards as technical barriers to trade (TBTs) have become the new non-tariff measures that restrict trade. In the case of the RCEP countries, there are a total of 3,813 SPS measures and 4,367 TBTs in effect. The RCEP countries with the most SPS measures reported are China (1,020), New Zealand (524), South Korea (518), Japan (430), Australia (386) and The Philippines (332). The RCEP countries with the most TBTs are China (1,162), Japan (758), South Korea (742) and Thailand (584) and The Philippines (250).[15] SPS regulations and standards on industrial goods, however, have legitimate regulatory functions. For example, in the case of SPS, countries have the right and obligation to protect human, animal and plant life. The World Trade Organization SPS and TBT agreements recognize these legitimate regulatory functions, but call for these regulations to be applied in a manner that does not discriminate against imports.[16] Where the non-tariff measure has a regulatory function, we assume that our measure is the discriminatory component of the regulation.

Our estimates of the AVEs of NTMs are based on the estimates of Kee *et al*., (2009). Building on Kee *et al*., (2008), Kee *et al*., (2009) estimate the AVEs of NTMs for 105 countries at the 6-digit level as well as aggregated estimates for manufacturing and agriculture.[17]

The measure we use from Kee *et al*. is the uniform tariff equivalent that generates the same level of import value for the country in a given year, based on applied tariffs, which take into account bilateral trade preferences.[18] At the six-digit level, the estimates of Kee *et al*. are sometimes subject to a substantial margin of error that may lead to misleading results in a CGE model policy analysis. Consequently, we have chosen to use the aggregated estimates of Kee *et*

[15] "Standards and Testing in RCEP," Asian Trade Centre Policy Brief No. 11-16, June 2015. Available at: www.asiantradecentre.org
[16] See: https://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm
[17] The dataset is available at: http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:22574446~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html.
[18] Specifically, we take the difference between the Overall Trade Restrictiveness Index (OTRI) and for the Tariff-only OTRI (OTRI_T), which gives us the AVE of the NTMs.

al., i.e., for each country, we have two AVEs: one AVE of the NTMs in manufacturing and one AVE of the NTMs in agriculture. Results are in table [19]

4.4 Tariff and Trade Data

Trade data and tariff rates are taken from the GTAP 9.1 database. For tariff rates, GTAP uses the MAcMap-HS6 database, described in Guimbard, Jean and Mimouni (2011). The ASEAN members have committed themselves to a maximum tariff of five percent. The five percent maximum tariff has reportedly been achieved among the original six members of ASEAN (The Philippines, Brunei, Indonesia, Malaysia, Singapore and Thailand). The remaining four members, Cambodia, Myanmar, Laos and Vietnam, have committed to implement the maximum five percent tariff, but have been allowed a longer adjustment period. Consequently, we adjust all tariffs above five percent among ASEAN members to five percent in our benchmark. The tariff rates and the ad valorem equivalents of the barriers on FDI are listed in table 3.

4.5 Social Accounting Matrices

The core structural data of the model comes from the GTAP 9.1 dataset.[20] Data at the sector level on value-added and its components, exports and imports and by trading partner of The Philippines are available in the tables.

4.6 Share of Market Captured by Foreign Direct Investors in Services

In the business services sectors of our model, it was necessary to calculate their market share in The Philippines of each region of our model. Except for telecommunications, for the shares of the sector captured by the aggregate of foreign firms, we used data from the final Census of Philippine Business and Industry for 2012.[21] To allocate the shares among foreign firms, we used data from the Central Bank of the Philippines in their report "Net Foreign Direct Investment Flows by Country of Origin, 2014-2016, in millions of dollars."[22] This report provides data on aggregate foreign direct investment (FDI) in The Philippines by source country for the years 2014-2016. We assumed that the foreign ownership shares sectors correspond to the

[19] For our aggregate regions, we take simple averages of the AVEs of the individual countries. In the case of Rest of ASEAN, estimates are available for Brunei, Indonesia, Malaysia, Singapore and Thailand, but not for Cambodia, Laos, Myanmar and Vietnam. We take an average of the available estimates.

[20] See https://www.gtap.agecon.purdue.edu/databases/default.asp.

[21] https://psa.gov.ph/content/2012-census-philippine-business-and-industry-economy-wide-all-establishments-final-results. We thank Daniel Reyes for the calculations based on these data.

[22] http://www.bsp.gov.ph/statistics/spei_new/tab10_fdc.htm. Calculations based on equity flows as data on reinvested earnings and debt are not available by country.

shares of aggregate FDI by source country. We took the average of FDI flows for 2015 and 2016 to calculate the shares.

In the case of telecommunications, we obtained shares of the market by company from the Annual Report of the Philippine National Telecommunications Commission, 2014. Company shares were calculated based on the number of subscribers.[23] There are two large telephone service providers (who also own some of the smaller brands): Globe, with a 30.7% market share and PLDT with 69.3% of the market. Globe owns the Innove and Bayantel brands, while PLDT owns the Digitel brand. Based on the PLDT disclosure letter to the Filipino Stock Exchange of January 12, 2017, we know the top 100 stockholders.[24] Globe reports its ownership structure on its website.[25] Ownership shares by nationality in each company were weighted by the company shares in the overall market. The results of all these calculations are in table 1.

4.7 Key Elasticities: Dixit-Stigliz, Armington and Supply Elasticities

In the Krugman model, the Dixit-Stiglitz elasticities are the crucial elasticities for the trade response. We based our values of these Dixit-Stiglitz elasticities on the estimates of Broda, Greenfield and Weinstein (2006). Since the Philippines is not in the Broda, Greenfield and Weinstein dataset, we chose their estimates for Indonesia as our proxy for The Philippines.[26] We aggregate the estimates of Broda, Greenfield and Weinstein dataset for three digit industries in Indonesia to the Dixit-Stiglitz sectors of our Krugman style model of The Philippines. The results are in table 4.[27] We take the trade response in the Krugman model as our central trade response and adjust the elasticities in the Armington and Melitz models to be consistent with the trade response of the Krugman model.

In the Armington model, the key elasticities that determine the trade response are the elasticities of substitution of domestic for foreign, $\sigma(D,M)$ and the elasticities of substitution of

[23] http://ntc.gov.ph/wp-content/uploads/2015/10/reports/Annual_Report_2014.pdf

[24] http://www.pldt.com/docs/default-source/shareholders-information/top-stockholders/2016/pse_pldt-list-of-top-100-stockholders_dec-31-2016.pdf?sfvrsn=0

[25] http://corporate-governance.globe.com.ph/shareholding-structure.html. Singtel is from Singapore and Ayala is Filipino. We assigned the balance to Filipino owners.

[26] Indonesia has many characteristics similar to The Philippines that makes it a good proxy: their annual per capita incomes are close. According to the IMF in 2016, in thousands of USD on a PPP basis, Indonesia's per capita income was 10.5 and The Philippines is 8.3; they are both island economies with populations of more than 100 million and both are ASEAN members.

[27] In the "other manufacturing," out of 44 estimates, we excluded two outliers of 33.5 and 35.3; other values were less than 9. In "textiles and apparel," out of 23 estimates, we excluded three outliers with values above 33.5. All other estimates were less than 11.4.

imports from different regions, σ(M,M). We do not nest the demand structure and start with the values of the σ(M,M) elasticities in the GTAP database and scale all of them such that the export response of the Philippines is the same as in the Krugman model. In the Melitz model, we adjust the shape parameters in the Pareto distributions to hold the export response in the Melitz model equal to the export response in the Krugman model. Further details are in the section immediately following.

For supply elasticities, see appendix A.

5. Results: RCEP and its Key Components: Comparing Market Structures

We evaluate RCEP and its components in three model classes: Armington, Krugman and Melitz. Consistent with the insights of Arkolakis et al. (2012) and Costinot and Rodriguez-Clare (2014), we hold the change in the value of imports and exports in The Philippines constant across the three models. We adjust elasticities in the Armington and Melitz models such that the trade response in these two models is consistent with the trade response in the Krugman model. For the Armington model, all of the GTAP values of the Armington elasticities of substitution were adjusted equi-proportionately, (multiplied by 1.63 as reported in tables 5-7) such that the trade response for The Philippines is the same in the Armington and Krugman models for the aggregate RCEP policy change. For the Melitz model, we retain the same Dixit-Stiglitz elasticities in both the Krugman and Melitz models (so as to not directly impact the variety externality); we achieve the equivalent trade response by adjusting the shape parameter in the Pareto distribution in all IRTS goods and services sectors. The value of the shape parameter in our application is 4.3, which is a slightly more heterogeneous distribution that the distribution of Balistreri, Hillberry and Rutherford (2011) who had a preferred value of 4.58. The value of 4.3 mutes the trade response so that it is the same as in the Krugman model and yields slightly larger welfare gains compared with 4.58.

5.1 Aggregate Impacts of RCEP, Scenario Definition

We evaluate the impact of the principle changes under negotiation by the RCEP member and the aggregate of those changes. These changes are: (i) 50 percent reduction of the ad valorem equivalent of the barriers against providers of services through foreign direct investment; (ii) a full reduction in the tariffs by The Philippines on RCEP members and reciprocal action by the RCEP members on Filipino exports (ASEAN tariffs are assumed to be maximum 0-5 percent in the benchmark equilibrium); and (iii) a fifty percent reduction in the ad

valorem equivalent of non-tariff barriers in goods by The Philippines and reciprocal action by the RCEP members on Filipino exports. We will add time in trade cost reductions in subsequent drafts.

5.2 Aggregate Effects of RCEP, Armington versus Krugman

Our aggregate results for the Armington and Krugman models are presented in table 5. Decomposed results for the Krugman model are also in table 5, while the decomposed results for Armington model are in table 7. Welfare gains as a percent of consumption are: 2.4 percent in the Armington model; and 4.6 percent in the Krugman model. The largest difference in the gains is from the removal of barriers against foreign providers of services through FDI. Since we allow rent capture by The Philippines from the removal of FDI barriers, the gains in the Armington model are a significant 0.4 percent of consumption; but they are 1.5 percent of consumption in the Krugman model. Since we do not have rationalization gains in the Krugman model, the difference is the welfare impacts between the Krugman and Armington models is entirely due to the additional varieties. As we emphasized above, our model allows small countries to significantly impact varieties since our version of the Krugman model does not have the property of Krugman (1980) that all varieties are consumed in all regions.

5.3 Aggregate Effects of RCEP in the Melitz model

Our aggregate results with the Melitz model are presented in table 6. At 3.3 percent of consumption, welfare gains as a percent of consumption in the Melitz model are significantly larger than in the Armington model. But they are also significantly less than the gains of 4.6 percent of consumption in the Krugman model.

Decomposition of the aggregate RCEP scenario into its components shows that the MOST important difference in the Krugman versus Melitz results is in the scenario in column 6, in which we reduce non-tariff barriers on Filipino exporters of goods: the estimated welfare gains as a percent of consumption are 1.5 percent in the Krugman model versus 0.9 percent in the Melitz model. First, we note that the Dixit-Stiglitz variety externality of Filipino welfare is dependent on the number of varieties that are available domestically in The Philippines. Varieties available in foreign markets do not influence welfare in The Philippines. Second, in this decomposed scenario, foreign firms do not obtain a reduction in the non-tariff barriers they face in The Philippines, so

there is no first order impact on foreign firm participation in The Philippines. i.e., the principal impact derives from what happens to domestic firms.

Third, given the nature of the scenario, the selection effect in the Melitz model results in a reduction in the number of varieties available in The Philippines. To see this, recall that in the Melitz model, there is a Zero Cutoff Productivity level for firms to be active in the domestic market, ϕ^*, and a Zero Cutoff Productivity for exporting, ϕ_x^*. The reduction in barriers on exports increases the profitability of exporting and lowers the Zero Cutoff Productivity for exporting, ϕ_x^*. Since the expected profits of entry must be zero, and the expected profits from exporting increases, the expected profits from serving only the domestic market must decrease. The equilibrium requires that the Zero Cutoff Productivity level for firms to be active in the domestic market, ϕ^* increases. Thus, there is a decrease in the share of active or surviving firms that serve only the domestic market, i.e., the selection effect by itself in the Melitz model results in a decrease in the Dixit-Stiglitz variety externality. There is, however, a positive entry effect; that is, the mass of entrants increases until expected profits of entry is zero. In our numbers, the negative selection effect on domestic varieties is stronger than the positive entry effect. Thus, even though firms are more productive on average, the estimated gains are not larger than in the Armington model in this scenario.

To verify this intuition, we have executed several additional simulations in the Melitz model with lower and higher Dixit-Stiglitz elasticities. With lower Dixit-Stiglitz elasticities, a lost variety will cost more in welfare terms, so if selection is leading to a loss in varieties, the welfare gain should be smaller than in our central scenario. Consistent with our interpretation, we find that with Dixit-Stiglitz elasticities at 80 percent of our central values in the Melitz model, the estimated welfare gains from the removal of non-tariff barriers on Filipino exporters of goods falls from 0.86 percent to 0.73 percent. We find symmetric results for the increase in Dixit-Stiglitz elasticities.

On the other hand, in the Krugman model, we only have the entry effect on varieties with no selection effect. That is, the additional profits on exports induce more entry as the quasi-rents on exports help to cover the fixed production costs. As long as price exceeds marginal costs in the domestic market, any firm that supplies the export market also supplies the domestic market, so there are more domestic varieties available as a result of increased profits on exports. But since all domestic firms have the same cost structure, there is no selection effect to reduce the number of

domestic varieties. This explains why the welfare gains under the Krugman model are significantly larger for this scenario.

As a general vehicle for assessing the relative gains in Melitz versus Krugman, we believe our small open economy model produces rather conservative gains for the Melitz model relative to an equivalent multi-region trade model (MRT). Ignoring import variety gains for the moment, the key gains in Melitz derive from efficient firms selecting into export markets in the goods sectors. Relative to the MRT, however, there are no reciprocal increases in foreign productivity and income that would stimulate export demand for these goods sectors. Regarding import variety, foreign firms select into The Philippines after trade liberalization, but we do not assume there is net entry by foreign firms into the market of The Philippines. That is, following Demidova and Rodriguez-Clare (2009), we assume that the mass of foreign firms that enter The Philippines market is not impacted by polices in The Philippines. Rather the mass of foreign firms is determined by their worldwide expected profits. Selection into The Philippines by foreign firms, induces exit by small high-cost domestic firms; but with only selection by foreign firms, but no increase in the mass of foreign firms that serve The Philippines market, there are fewer import varieties such that the welfare impacts of variety are diminished or eliminated; this impact has been shown by Arkolakis et al. (2008; 2012). We show larger welfare gains in our Melitz application compared with Armington, but these are smaller than under our Krugman structure where we do not have selection working against domestic varieties. These considerations suggest that it is difficult to conclude that Krugman or Melitz market structures will dominate the other under all market variations and counterfactual scenarios.[28]

[28] Two additional interpretations are the following:

Trade liberalization induces a reallocation toward more efficient firms in Melitz. This selection effect leads to welfare gains from the reallocation of resources toward more efficient firms. Melitz and Redding (2015) employ less complex model of one sector and no intermediates note with a truncated Pareto probability distribution of productivity and conclude endogenous decisions of heterogeneous firms to enter and exit the market provides "an extra adjustment margin" that augments the gains from international trade with heterogeneous firms, and by itself this should lead to larger gains than in Krugman. At the same time, this feature means firms are bigger, so there are fewer firms and varieties than would exist if firms are homogeneous as in the Krugman model.

In a model with an untruncated Pareto probability distribution, Feenstra (1994; 2010) has shown that if new varieties are consumed in lower quantities, then their impact on the quality adjusted price index or the expenditure function will be less compared to where the same number of varieties are consumed in equal amounts. Arkolakis et al. (2008) argue that the firms with the highest productivity are already present in the market prior to the trade liberalization. Thus, the Melitz model would imply that the firms that enter after trade liberalization have lower productivity and lower value of sales on average compared with incumbent firms. Calling this the "curvature" effect, Arkolakis et al., apply the Feenstra methodology to conclude the variety gains from trade in the Melitz model are muted. With homogeneous firms in the Krugman model, there is no "curvature effect" that mutes the variety gains.

6. Conclusions

In this paper we have evaluated the welfare impacts of a mega regional trade agreement in a small open economy version of a CGE model employing three market structure variants: Armington, Krugman and Melitz. Consistent with the results of Costinot and Rodriguez-Clare (2014), we held the trade response constant across the three market structure variants. We compared welfare outcomes across the market structures with a variety of features that previously had not be analyzed across these market structures including unbalanced trade, foreign direct investment, real data taken from a country's input-output table on intermediate inputs, reduction of heterogeneous trade barriers across sectors, and import of primary factors such as specialized inputs.

We found that the Krugman model produced welfare gains almost twice that of the Armington model, a result that we attribute in large part to the fact that our adaptation of the Krugman model does not have the property that all produced varieties are consumed everywhere. In our model, small countries are capable of significantly influencing the number of foreign or imported varieties in their home market by their own policies.

We found that the Melitz model also produces greater estimated welfare gains larger than the Armington model, but less than the Krugman model. We offer several plausible explanations for why the welfare gains are smaller in our model with heterogeneous firms compared with our Krugman model. The most important explanation is that with our parameterization, the selection effects mute the variety gains in the Melitz model, but not in Krugman. We believe there are several model variants of the Melitz model as well as the Krugman model under which we can evaluate the welfare impacts, and we believe it is likely that the ranking of the relative gains will depend on these model variants and scenarios. That is, it is difficult to conclude that either Krugman or Melitz will dominate in all model variants.

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Table 1: Sectors, Factors of Production, Regions and Their Ownership Shares in Business Services of The Philippines

Sectors									
Constant Returns to Scale Sectors	code								
Agriculture and Forestry	AGR								
Meat and Dairy	M_D								
Other Services	OSE								
Primary Energy and Minerals	PEM								
Processed Rice	PCR								
Sugar	SGR								
Trade	TRD	**Regions and their Ownership Shares in Business Services of The Philippines**							
Utilities	UTL								
Wheat and cerial grains	WCG								
Business Services		**Philippines**	**China and Hong Kong**	**Japan**	**India**	**USA**	**Korea, Australia and New Zealand**	**Rest of ASEAN**	**Rest of World**
		PHL	CHN	JPN	IND	USA	KAN	ASN	ROW
Business services nec	OBS	93.0%	1.3%	2.5%		1.3%	0.2%	0.6%	1.1%
Communication	CMN	51.1%	21.4%	12.5%		0.6%		14.4%	
Financial services nec	OFI	97.0%	0.5%	1.1%		0.5%	0.1%	0.3%	0.5%
Insurance	ISR	97.0%	0.5%	1.1%		0.5%	0.1%	0.3%	0.5%
Air Transport	ATP	95.0%	0.9%	1.8%		0.9%	0.2%	0.5%	0.8%
Water Transport	WTP	95.0%	0.9%	1.8%		0.9%	0.2%	0.5%	0.8%
Other Transport	OTP	95.0%	0.9%	1.8%		0.9%	0.2%	0.5%	0.8%
IRTS Goods									
Beverages and Tobacco	B_T		**Primary Factors of Production**						
Chemicals Mineral and Metal products	CMM		Compensation of unskilled employees						
Electronic equipment	EEQ		Compensation of skilled employees						
Food Products	FPR		Capital -- Gross operation surplus, mixed income						
Other manufacturing	OMF								
Petroleum and Coal Products	OIL								
Textiles and Apparel	T_A								

Table 2: Imports and Exports of The Philippines by Region and Sector of our Model

	China and Hong Kong	Japan	India	USA	Korea Australia and New Zealand	Rest of ASEAN	Rest of World		China and Hong Kong	Japan	India	USA	Korea Australia and New Zealand	Rest of ASEAN	Rest of World
Sector															
Wheat and cerial grains	0.001		0.006	0.672	0.367	0.018	0.126		0.000	0.000	0.000	0.000	0.000	0.000	0.001
Agriculture and Forestry	0.329	0.011	0.038	0.118	0.046	0.192	0.330		0.536	0.962	0.003	0.233	0.349	0.088	0.620
Primary Energy and Minerals	0.043	0.002	0.004	0.013	0.651	1.802	8.103		1.905	0.401	0.007	0.001	0.282	0.036	0.051
Food Products	0.587	0.034	0.058	0.551	0.164	1.635	0.972		0.174	0.311	0.008	1.273	0.129	0.326	0.791
Processed Rice	0.000	0.000	0.007	0.000	0.000	0.613	0.019		0.002	0.001	0.000	0.003	0.001	0.001	0.019
Meat and Dairy	0.036	0.000	0.111	0.333	0.685	0.047	0.427		0.005	0.032	0.001	0.009	0.004	0.052	0.074
Sugar	0.000	0.000	0.000	0.001	0.006	0.133	0.001		0.016	0.052	0.000	0.276	0.021	0.055	0.009
Beverages and Tobacco	0.185	0.001	0.003	0.111	0.086	0.170	0.127		0.010	0.004	0.000	0.012	0.077	0.132	0.036
Petroleum and Coal Products	1.897	0.132	0.007	0.019	0.680	1.385	0.845		0.078	0.004	0.002	0.014	0.027	0.462	0.364
Textiles and Apparel	1.967	0.131	0.049	0.041	0.271	0.294	0.467		0.196	0.133	0.004	1.331	0.072	0.050	0.678
Chemicals Mineral and Metal products	3.883	2.952	0.350	0.573	2.551	3.805	3.818		1.634	1.526	0.116	0.590	0.606	1.757	1.356
Electronic equipment	1.813	2.258	0.015	1.717	2.108	3.257	4.384		8.684	1.164	0.139	3.230	1.397	3.124	6.376
Other manufacturing	4.929	5.360	0.261	1.111	1.494	4.332	3.546		1.605	3.111	0.168	2.594	0.494	1.989	3.071
Utilities	0.001	0.000	0.000	0.002	0.001	0.001	0.010		0.001	0.000	0.000	0.001	0.000	0.000	0.007
Other Services	0.037	0.015	0.004	0.253	0.039	0.027	0.524		0.063	0.049	0.012	0.126	0.055	0.047	0.840
Trade	0.415	0.005	0.003	0.046	0.017	0.020	0.240		0.048	0.028	0.009	0.095	0.040	0.031	0.568
Transport nec	0.038	0.009	0.016	0.036	0.014	0.027	0.453		0.141	0.082	0.026	0.298	0.123	0.094	1.713
Water Transport	0.006	0.002	0.001	0.005	0.003	0.008	0.069		0.013	0.021	0.006	0.022	0.019	0.015	0.233
Air Transport	0.044	0.029	0.003	0.105	0.032	0.052	0.592		0.091	0.116	0.032	0.358	0.117	0.082	1.402
Communication	0.006	0.002	0.004	0.023	0.004	0.008	0.145		0.024	0.012	0.008	0.083	0.021	0.031	0.545
Financial services nec	0.020	0.008	0.005	0.108	0.009	0.016	0.330		0.016	0.010	0.004	0.042	0.013	0.011	0.243
Insurance	0.006	0.005	0.004	0.055	0.005	0.009	0.191		0.006	0.003	0.001	0.020	0.003	0.004	0.066
Business services nec	0.065	0.027	0.052	0.160	0.034	0.060	0.903		0.097	0.145	0.089	0.364	0.103	0.137	2.393

Source: GTAP 9 Database

Table 3: Barriers on FDI Services into The Philippines; Tariffs on Imports into the Philippines; and Tariffs on Exports of The Philippines (ad valorem)

	Tariffs on Imports into the Philippines								Tariffs Levied Against Exports from the Philippines							Discrimina-tory Barriers on FDI Services
Sector	China and Hong Kong	Japan	India	USA	Korea Australia and New Zealand	Rest of ASEAN	Rest of World		China and Hong Kong	Japan	India	USA	Korea Australia and New Zealand	Rest of ASEAN	Rest of World	
Wheat and cerial grains	2.3%		2.7%	3.4%	0.0%	1.9%	3.3%		0.7%					1.7%	0.2%	
Agriculture and Forestry	1.1%	1.8%	11.3%	6.1%	1.0%	5.0%	5.8%		0.0%	8.0%	17.2%	0.6%	22.9%	5.0%	5.7%	
Primary Energy and Minerals		0.7%	1.5%	2.3%	2.9%	0.0%	0.5%				3.7%		0.5%	0.1%	0.6%	
Food Products	1.7%	3.1%	4.0%	4.8%	2.1%	0.4%	5.2%		0.5%	3.7%	37.0%	1.4%	12.2%	5.0%	9.2%	
Processed Rice		50.0%	50.0%	50.0%	44.9%	5.0%	47.8%					0.5%			0.5%	
Meat and Dairy	4.8%	9.6%	8.0%	8.4%	0.7%	1.1%	13.3%			6.3%	5.7%	7.0%	5.3%	2.0%	10.7%	
Sugar	26.6%	4.0%	39.4%	9.2%	40.3%	5.0%	13.6%		49.8%	19.0%		11.1%	0.1%	5.0%	22.7%	
Beverages and Tobacco	7.7%	4.4%	10.1%	4.3%	0.4%	0.9%	6.5%		1.6%	3.2%	101.0%	6.4%	12.4%	5.0%	20.6%	
Petroleum and Coal Products		0.0%	0.0%	0.0%	0.0%	0.3%	0.0%		0.2%	0.2%	4.3%	0.1%	0.4%	0.2%	1.5%	
Textiles and Apparel	0.8%	0.1%	5.8%	6.3%	1.9%	0.2%	9.0%			0.3%	12.0%	13.0%	7.0%	5.0%	10.7%	
Chemicals Mineral and Metal products	0.7%	2.1%	3.4%	4.7%	0.7%	0.9%	3.6%		0.3%	0.0%	6.9%	0.2%	1.5%	1.5%	3.0%	
Electronic equipment	0.1%	0.4%	0.2%	1.3%	0.0%	0.6%	0.9%		0.1%		1.3%	0.0%	0.1%	0.2%	0.3%	
Other manufacturing	1.9%	2.7%	10.3%	4.4%	5.6%	0.4%	4.7%		0.4%	0.2%	9.1%	0.6%	1.5%	5.0%	2.0%	
Utilities																
Other Services																
Trade																
													Transport nec			30.0%
													Water Transport			33.0%
													Air Transport			30.0%
													Communication			32.0%
													Financial services nec			29.0%
													Insurance			19.0%
													Business services nec			49.0%

Note: Tariffs on all services are zero.

Source: GTAP 9 Database for tariffs; Jafari and Tarr (2015) for FDI barriers.

Table 4: Key Elasticities

	Unadjusted Armington Elasticities (see summary results table for scalar adjustment to IRTS sectors)			
	Import-Domestic	**Import-Import**	**Dixit-Stiglitz**	**Pareto shape**
Constant Returns to Scale Sectors	sigma_dm	sigma_mm		
Agriculture and Forestry	4.6	4.6		
Meat and Dairy	8.0	8.0		
Other Services	3.8	3.8		
Primary Energy and Minerals	11.3	11.3		
Processed Rice	5.2	5.2		
Sugar	5.4	5.4		
Trade	3.8	3.8		
Utilities	5.6	5.6		
Wheat and cerial grains	5.7	5.7		
Business Services				
Business services nec	3.8	3.8	3.8	4.3
Communication	3.8	3.8	3.8	4.3
Financial services nec	3.8	3.8	3.8	4.3
Insurance	3.8	3.8	3.8	4.3
Air Transport	3.8	3.8	3.8	4.3
Water Transport	3.8	3.8	3.8	4.3
Other Transport	3.8	3.8	3.8	4.3
IRTS Goods				
Beverages and Tobacco	2.9	2.9	2.9	4.3
Chemicals Mineral and Metal products	2.9	2.9	2.9	4.3
Electronic equipment	4.2	4.2	4.2	4.3
Food Products	4.7	4.7	4.7	4.3
Other manufacturing	4.0	4.0	4.0	4.3
Petroleum and Coal Products	4.8	4.8	4.8	4.3
Textiles and Apparel	5.1	5.1	5.1	4.3

Note: **Supply elasticities** for this draft corresponding to the specific factor in all IRTS goods and Business Services sectors are 6.0 for the United States, Japan and Korea, Australia and New Zealand and Rest of the World; 5.0 for China; and 3.0 for the remaining regions. Supply elasticities consistent with appendix A will be adopted in a revision.

Table 5: Summary of Results of RCEP on The Philippines with the Krugman and Armington Structures

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

		Krugman Structure (FDI and IRTS Goods)						Armington
	Benchmark	RCEP	FDI Services Barriers Only	Import Tariffs Only	RCEP Partner Tariffs Only	Import NTMs	Export NTMs	RCEP
Scenario definition		1	2	3	4	5	6	7
RCEP FDI barriers (% reduction)		50	50					50
Tariffs on Philipino Imports from RCEP (% reduction)		100		100				100
Tariffs on Philipino Exports to RCEP (% reduction)		100			100			100
NTMs on Philipino Imports from RCEP (% reduction)		50				50		50
NTMs on Philipino Exports to RCEP (% reduction)		50					50	50
Trade Elasticity Multiplier		1.00	1.00	1.00	1.00	1.00	1.00	1.63
Aggregate welfare								
Welfare (EV as % of consumption)		4.6	1.5	0.0	0.3	1.0	1.5	2.4
Welfare (EV as % of GDP)		3.7	1.2	0.0	0.3	0.8	1.2	2.0
Government budget								
Tariff revenue (% of GDP)	0.7	0.3	0.7	0.3	0.7	0.7	0.7	0.4
Tariff revenue		-49.8	2.5	-50.8	1.1	2.3	5.4	-47.0
Aggregate trade								
Real exchange rate		-0.1	0.8	0.5	-0.5	1.0	-2.0	-1.3
Aggregate exports		18.5	3.4	2.3	1.1	4.1	6.0	18.5
Factor Earnings								
Skilled labor		5.0	2.4	0.4	0.1	1.2	0.8	2.1
Unskilled labor		6.1	1.3	-0.1	1.4	-0.5	2.8	4.5
Capital		4.1	1.4	0.3	0.2	0.8	1.3	2.6

Source: Authors' estimates

Table 6: Summary of Results of RCEP on The Philippines with the Melitz and Armington Structures

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

		Melitz Structure (FDI and IRTS Goods)						Armington
	Benchmark	RCEP	FDI Services Barriers Only	Import Tariffs Only	RCEP Partner Tariffs Only	Import NTMs	Export NTMs	RCEP
Scenario definition		1	2	3	4	5	6	7
RCEP FDI barriers (% reduction)		50	50					50
Tariffs on Philipino Imports from RCEP (% reduction)		100		100				100
Tariffs on Philipino Exports to RCEP (% reduction)		100			100			100
NTMs on Philipino Imports from RCEP (% reduction)		50				50		50
NTMs on Philipino Exports to RCEP (% reduction)		50					50	50
Trade Elasticity Multiplier		1.00	1.00	1.00	1.00	1.00	1.00	1.63
Aggregate welfare								
Welfare (EV as % of consumption)		3.3	1.4	-0.1	0.2	0.9	0.9	2.4
Welfare (EV as % of GDP)		2.6	1.1	-0.1	0.1	0.7	0.7	2.0
Government budget								
Tariff revenue (% of GDP)	0.7	0.3	0.7	0.3	0.7	0.7	0.7	0.4
Tariff revenue		-47.6	2.1	-49.5	1.0	3.3	4.3	-47.0
Aggregate trade								
Real exchange rate		-0.1	0.8	0.5	-0.5	1.0	-1.8	-1.3
Aggregate exports		18.5	3.0	2.2	1.1	4.2	6.4	18.5
Factor Earnings								
Skilled labor		3.8	2.3	0.2	0.0	1.0	0.3	2.1
Unskilled labor		5.5	1.3	-0.2	1.3	-0.6	2.5	4.5
Capital		3.2	1.4	0.2	0.1	0.7	0.8	2.6

Source: Authors' estimates.

Table 7: Summary of Results of RCEP on The Philippines with the Armington Model: Decomposed Results

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

	Armington Decomposition					
	RCEP	FDI Services Barriers Only	Import Tariffs Only	RCEP Partner Tariffs Only	Import NTMs	Export NTMs
Scenario definition	**1**	**2**	**3**	**4**	**5**	**6**
RCEP FDI barriers (% reduction)	50	50				
Tariffs on Philipino Imports from RCEP (% reduction)	100		100			
Tariffs on Philipino Exports to RCEP (% reduction)	100			100		
NTMs on Philipino Imports from RCEP (% reduction)	50				50	
NTMs on Philipino Exports to RCEP (% reduction)	50					50
Trade Elasticity Multiplier	1.63	1.63	1.63	1.63	1.63	1.63
Aggregate welfare						
Welfare (EV as % of consumption)	2.4	0.4	-0.1	0.2	0.8	0.9
Welfare (EV as % of GDP)	2.0	0.3	-0.1	0.2	0.7	0.7
Government budget						
Tariff revenue (% of GDP)	0.4	0.7	0.3	0.7	0.7	0.7
Tariff revenue	-47.0	0.6	-49.4	1.3	3.7	6.2
Aggregate trade						
Real exchange rate	-1.3	0.3	0.5	-0.6	0.8	-2.1
Aggregate exports	18.5	0.8	2.3	1.3	4.7	7.7
Factor Earnings						
Skilled labor	2.1	0.7	0.2	0.0	0.9	0.2
Unskilled labor	4.5	0.4	-0.2	1.3	-0.7	2.4
Capital	2.6	0.4	0.2	0.1	0.6	0.9

Source: Authors' estimates

Appendix A: The elasticity of varieties with respect to price—larger from large technologically rich countries in research and development intensive goods and services.

Grossman and Helpman (1991) have developed models of economic growth that have highlighted the role of trade in a greater variety of intermediate goods as a vehicle for technological spillovers that allow less developed countries to close the technological gap with industrialized countries. Similarly, Romer (1994) has argued that product variety is a crucial and often overlooked source of gains to the economy from trade liberalization. In our model, it is the greater availability of varieties that is the engine of productivity growth, but we believe there are other mechanisms as well through which trade may increase productivity.[29] Consequently, we take variety as a metaphor for the various ways increased trade can increase productivity. Winters et al. (2004) summarize the empirical literature by concluding that "the recent empirical evidence seems to suggest that openness and trade liberalization have a strong influence on productivity and its rate of change." Some of the key articles regarding product variety are the following. Broda and Weinstein (2004) find that increased product variety contributes to a fall of 1.2 percent per year in the "true" import price index. Hummels and Klenow (2005) and Schott (2004) have shown that product variety and quality are important in explaining trade between nations. Feenstra et al. (1999) show that increased variety of exports in a sector increases total factor productivity in most manufacturing sectors in Taiwan (China) and Korea, and they have some evidence that increased input variety also increases total factor productivity. In business services, because of the high cost of using distant suppliers, the close availability of a diverse set of business services may be even more important for growth than in goods. The evidence for this was cited in the introduction section.

Beginning with the path-breaking work of Coe and Helpman (1995), a rich literature now exists that has empirically investigated the transmission of knowledge through the purchase of imported intermediate goods and through foreign direct investment. Coe and Helpman found that OECD countries benefit from foreign research and development (R&D), that they benefit more from trading with countries that have a larger stock of research and development, and that the benefits are greater the more open the country is to foreign trade. Moreover, while in large countries the elasticity of total factor productivity (TFP) with respect to domestic R&D capital stocks is larger than that with respect to foreign R&D capital stocks, the opposite holds in small countries; that is, foreign R&D is more important for small countries. Coe, Helpman, and Hoffmaister (1997) extend these results based on a sample of 77 developing countries. They find developing countries that do little R&D on their own, have benefited substantially from industrialized country R&D through trade in intermediate products and capital equipment with industrialized countries. They find that R&D spillovers through trade with the U.S. are the largest, since the U.S. stock of R&D is the highest and it is the most important trading partner for many developing countries. A one percent increase in the R&D stock of the U.S. raises total factor productivity for all 77 developing countries in their sample by 0.03 percent. By comparison, a one percent increase in the R&D stock of Japan, Germany, France or the U.K. raises total factor productivity only between 0.004 percent and 0.008 percent. Crucially, they find that countries that trade more with the U.S., such as the Latin American countries, get more productivity spillover increases from the U.S. R&D stocks. And the relatively more open East Asian countries have benefited the most from foreign R&D through trade. Keller (2000) also

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

finds that trade is an important conveyor of R&D and is especially important for small countries. Several other studies, including Lumenga-Neso et al. (2005), Schiff et al., (2002) and Falvey et al., (2002), confirm these results. Lumenga-Neso et al. (2005) show that technological spillovers can occur from indirect trade with technologically advanced countries. i.e., imports from the U.K. embody some U.S. technology due to U.K. imports from the U.S.. Since the data show that OECD countries have the vast majority of R&D stocks,[30] it implies that it is important for small developing countries to trade with large technologically rich countries, such as the U.S. and the EU, at least indirectly.

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

Schiff and Wang (2006) estimate the relative importance for technology diffusion to developing countries of trade with industrialized versus developing countries. They note that technology from the industrialized countries may indirectly diffuse to a developing country through trade with another developing country, if the other developing country has traded with industrialized countries. They conclude that trade with industrialized countries has a stronger impact on productivity in developing countries and that spillovers from developing country trade occurs with more of a lag. They find that the elasticity of productivity (TFP) with respect to current trade with all industrialized countries is 0.16, but only 0.01 for current trade with all developing countries. That is, trade with the industrialized countries in 16 times better for productivity spillovers. In addition, since trade may be expected to have an impact on productivity with a lag, Schiff and Wang estimate the impact of lagged trade with developing countries. They find that the productivity spillovers from **current** trade with industrialized countries are only about 1.5 times greater than the productivity spillovers from **lagged** trade with developing countries.[31] Moreover, Schiff et al. (2002) show that developing country trade with technologically advanced countries is very important in technology intensive sectors, but trade with developing countries can be important for productivity spillovers in less technologically complex products in which developing countries have comparative advantage. So on low R&D products like footwear and textiles and apparel, trade with China and Indonesia could be as important for technology diffusion as trade with the EU and the US.

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

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

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

In our model, the parameter that reflects the ability of a region to increase total factor productivity through the transmission of new technologies is the elasticity of varieties with respect to the price. Schiff *et al*., (2002, table 1) have shown that for R&D intensive sectors, trade with industrialized countries contributes significantly to total factor productivity in developing countries, but trade with developing countries does not. Averaging over the industries in Schiff *et al*.,(2002, table 3) yields that trade with industrialized countries in R&D intensive products is about eight times more valuable for developing country TFP increases. On the other hand, for sectors that are low in R&D intensity, their results suggest that for technology diffusion trade with developing countries can be as important as trade with industrialized countries. Based on these considerations, we first classify the increasing returns to scale sectors of our model into low, medium and high technology sectors. The classification is defined by the share of R&D expenditures in total sales, based on U.S. data and use this information to set the elasticities of firm supply in each region by sector. The greater the elasticity of firm supply in a sector the more varieties will be received in response to a price increase with respect to that country. Since developing countries are more competitive in low technology products, in The Philippines we assume that the elasticity of firms' supply with respect to price is 4 for low technology sectors, 3.5 for medium technology sectors, and 3 for high technology sectors. Since insurance markets are often exceptionally underdeveloped in developing countries, we assume the elasticity of firms' supply with respect to price is 3 in The Philippines. For the other regions in the model the supply elasticities are multiples of the supply elasticities of The Philippines, as follows. On high tech products and insurance, consistent with Schiff, Wang and Olarreaga (2002), the supply elasticities of the US and ROW are 8 times greater; Japan and the Korea, Australia, New Zealand region are 6 times greater; ASEAN and China-Hong Kong are three times greater, except in communications where, since Hong Kong and Singapore are the leaders in mobile telecommunications in The Philippines, the supply elasticity is six times greater; India is twice that of The Philippines. On medium tech products, we multiply the supply elasticity of The Philippines by 4 for US, ROW, Japan and Korea, Australia and New Zealand; by 3 for China-Hong Kong and Rest of ASEAN; and by 2 for India (on all products). On low tech products, except for financial services, based on Schiff et al. (2002), all foreign regions have supply elasticities twice that of The Philippines. On financial services other than insurance, the OECD regions (US, Japan, the ROW and Japan and Korea, Australia, New Zealand) are 4 times The Philippines; remaining regions are twice that of The Philippines. The results are in the table below. We conduct sensitivity analysis on these parameters, to determine the impact of these parameter values on the results.

Table: Estimates of elasticities of supply of firms with respect to price in The Philippines by sector and trading partner

	R&D expenditures divided by sales (times 1000) for the US*	Philippines	China and Hong Kong	Japan	India	USA	Korea Australia and New Zealand	Rest of ASEAN	Rest of World
Business Services									
Business services nec	116-high	3	6	18	6	24	18	6	24
Communication	52-high	3	18	18	6	24	18	18	24
Financial services nec	4-low	4	8	16	8	16	16	8	16
Insurance	4-low	3	9	18	6	24	18	9	24
Air Transport	medium	3.5	10.5	14	7	14	14	10.5	14
Water Transport	medium	3.5	10.5	14	7	14	14	10.5	14
Other Transport	low	4	8	8	8	8	8	8	8
IRTS Goods									
Beverages and Tobacco	14-low	4	8	8	8	8	8	8	8
Chemicals, Minerals and Metals	medium-low	3.5	10.5	14	7	14	14	10.5	14
Electronic equipment	33-medium	3.5	10.5	14	7	14	14	10.5	14
Food Products	14-low	4	8	8	8	8	8	8	8
Other manufacturing	33-medium	3.5	10.5	14	7	14	14	10.5	14
Petroleum and Coal Products	medium	3.5	10.5	14	7	14	14	10.5	14
Textiles and Apparel	low	4	8	8	8	8	8	8	8

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

SOURCE: R&D and sales data from National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005, Data Tables. Elasticity values are authors' estimates based on Schiff, Wang and Olarreaga (2002).

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