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Abstract

The proliferation of overlapping free trade agreements (FTA) in the recent years has led to hub-and-spokes (HAS) throughout the world. Being avid subscribers to FTAs, many countries in the Asia-Pacific region including the USA, Japan, Singapore, South Korea, Thailand and Australia have become trade hubs to their partners who are in turn relegated to spoke status. In this paper, we question whether being a hub is welfare optimal for a small and open economy like Singapore compared to membership in a single bilateral FTA or a multi-member free trade zone. Within this context, we use a computable general equilibrium model to examine the welfare implications of the triangular trade relationship of the USA, Singapore and Japan. This is facilitated by the Japan-Singapore Economic Partnership Agreement, the USA-Singapore Free Trade Agreement, and a hypothetical USA-Japan Economic Partnership Agreement. The analysis is extended to incorporate "super-hub" effects; that is, the spoke countries can be trade hubs in other HAS systems. The experiment reveals that hub status generates positive welfare gain and is the highest Singapore can get from the trade configurations considered. Meanwhile, Japan loses more than the USA when both are relegated to spoke status. These findings prove robust under different market structures and production technologies, deeper economic integration, "super-hub" effects, as well as, uncertainty in the key model parameters and the extent of trade liberalisation shocks.

Keywords: hub and spokes; overlapping agreements; free trade; preference dilution; computable general equilibrium; GTAP; systems; trade configurations

JEL classification: C68, D58, F15,

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1. Introduction

The growth of free trade agreements (FTA) worldwide has accelerated since the mid-1990s. By March 2006, there are 193 regional trade agreements (RTA) reported to the World Trade Organisation (WTO), of which 66% or 127 are FTAs in force under the auspices of the General Agreement on Tariffs and Trade (GATT) Article XXIV and the Enabling Clause.[1] If services agreements and partial agreements are ignored, about 93% of RTAs are FTAs (WTO, 2006). Up to the early 1990s, FTAs were, with only a few exceptions, a set of non-intersecting areas.[2] However, an increasing number of countries and even RTAs have become members of more than one FTA, placing them at the centre of two or more "overlapping" preferential trade areas. Analysing an FTA in isolation generates conclusions that have little to speak about these networks of FTAs and may even mislead on the welfare impact of that FTA under scrutiny.

The hub-and-spokes (HAS) concept, which is prevalently used in the transportation literature and first introduced to international trade as a "two-sided triangle" by Wonnacott (1975), is a useful framework for unravelling this noodle bowl of FTAs. The HAS is unique to FTAs because there is no restriction on the number of FTAs a region can sign. As a result, the region acts like a "hub", linking up several free trade areas and trading on preferential terms with every "spoke" partner. To facilitate further discussion, we identify a HAS to be "pair-wise". That is, this system arises as the hub facilitates trade between a pair of regions. To illustrate, suppose a hub-aspiring Country j has bilateral FTAs with n countries. Any one of the n countries, say Country i should then have less then $n-1$ bilateral FTAs with the rest (excluding its trade pact with j) so that, at any time, country j would be serving its hub role with respect to country i and at least one other country.

The HAS introduces an extra dimension of FTAs which is not captured when we analyse a single agreement. The spoke countries will have less market access than the hub, because the hub enjoys preferential access to all spokes but each spoke has preferential access to the hub only. Thus a HAS arrangement effectively creates two layers of discrimination instead of one as in the case of a single bilateral. Consider Regions A, B and C. With a $A-B$ FTA, C would have poorer access to B

[1] While the WTO/GATT advocates non-discrimination in trade, there are exceptions to this fundamental principle. Paragraphs 4 to 10 of Article XXIV, GATT allows for RTAs, which facilitate trade and do not raise trade barriers on non-members. The Enabling Clause provides similar exceptions that apply to agreements among developing countries and it allows a partial free trade across a subset of goods.

[2] As of March 2006, there are 10 CUs compared to 127 FTAs notified to the WTO.

compared to A. In a HAS with $A-B$ and $A-C$ FTAs, not only will Spoke C have poorer access to B than Hub A, Spoke B also has poorer access to C compared to Hub A. When two or more HAS intersect, the discrimination becomes multilayered (Lloyd and Maclaren, 2004). One also has to consider the costs linked to inefficiencies insofar as HAS bilaterals are inconsistent (imagine administering multiple and usually complex sets of tariffs and rules of origin) and greater rent-seeking waste. The hub benefits because of the preferences it gets in each spoke market in competition with all other spokes, and because of its advantage in attracting investment as the only location with duty free access to all the participating countries (Wonnacott, 1996a).

Past case studies based on the HAS concept include Kowalczyk and Wonnacott (1992) on USA trade policy in the Americas, Wonnacott (1996b) on USA-Canada-Europe trade relations and Busse (2000) on the EU's HAS strategy in East Europe, South Africa and Latin America. All these studies are optimistic about the hub's welfare and the contrary for spokes, although as Busse pointed out, the latter may have consented to the economic integration because of non-economic gains. The EU FTAs, for example, provide East European countries a better chance of securing full membership in the union. They also keep the USA's influence in the Americas in check. Early theoretical works on the HAS include Kowalczyk et al (1992a) who use real income functions to measure the terms of trade and volume of trade effects of overlapping FTAs, and Krugman (1993) who demonstrates hub formation in the presence of asymmetric transportation costs and increasing returns in production. Recent contributions to the literature include Deltas, Desmet and Facchini (2005) and Hur (2006). Using a product endowment model, Deltas el al proposes that a HAS arrangement leads to a form of arbitrage, which gets translated into excess trade through the tariff-free hub, benefiting the latter. Hur demonstrates that hub status is coveted regardless of whether there is excess trade through it.

The purpose of this paper is to conduct a comparison study of the welfare returns from different trading regimes that of a single bilateral, a HAS and a free trade zone comprising all the HAS participants. Within this context, we examine the triangular trade relations of the USA, Singapore and Japan. The aforementioned configurations would arise from the Japan-Singapore Economic Partnership Agreement (JSEPA), the USA-Singapore Free Trade Agreement (USSFTA) and a hypothetical USA-Japan EPA. Estimating the effect of any configuration of FTAs on any participant, outsider and the world at large is a

computational challenge, because more than one country can be a trade hub and any country can assume the roles of hub and spoke at the same time given the wide repertoire of FTAs in the real world. We meet this challenge by utilising a computable general equilibrium (CGE) model for a counterfactual analysis. Past CGE studies on HAS were conducted by Brown, Kiyota and Stern (2004) on the USA and Japan FTAs, Zhai (2006) on alternative HAS in Asia, rotating between Japan, China and the ASEAN as potential hubs, and Das and Andriamananjara (2006) on the economic effects of a HAS in the Western Hemisphere centred on a Chilean hub and a more comprehensive regional FTA, the Free Trade Area of the Americas.

In the next section, we survey the USSFTA and JSEPA, and discuss whether a USA-Japan EPA is on the horizon. In Section 3, we introduce the Global Trade Analysis Project (GTAP) model and database, and explain how they are implemented in our analysis. This is followed by a presentation of our scenario design, which helps to account for the influence of the other FTAs that Singapore, the USA and Japan belong to. We call this "super-hub" effect, because, by the definition of pair-wise HAS, these countries of primary concern would each serve as trade hub to more than one pair of countries given their current portfolios of FTAs.[3] Our design thus allows us to analyse any trade configuration in which not one but many of the participants are concurrently trade hubs. Table 1 summarises the FTAs concluded by Singapore, the USA and Japan since 2001.

Table 1: FTAs involving Singapore, the USA and Japan (2001 – 2006)

Bilateral FTAs	Date of Entry Into Force	Bilateral FTAs	Date of Entry Into Force
FTAs of Primary Interest		**Other Singapore FTAs**	
Japan-Singapore*	Nov 2002	Singapore-New Zealand*	Jan 2001
USA-Singapore*	Jan 2004	EFTA-Singapore*	Jan 2003
USA-Japan	Hypothetical	Singapore-Australia*	Jul 2003
Other US FTAs		Singapore-India*	Jun 2005
USA-Chile*	Jan 2004	Korea-Singapore*	Mar 2006
USA-Jordan*	Dec 2001		
USA-Australia*	Jan 2005	**Other Japan FTAs**	
USA-Morocco*	Jan 2006	Japan-Mexico*	Apr 2005

Source: WTO, 2006. Note: (1) The EFTA consists of Switzerland, Iceland, Liechtenstein and Norway. (2) Only FTAs that entered into force since 2001 and are reported to the WTO are listed above. (3) Members in FTAs with asterisk (*) have also established among themselves services agreements allowed under GATS Article V.

In addition, we will quantify the barriers to services trade that arise due to regulatory measures and use them to determine the welfare effects of deeper integration. The inclusion of "super-hub" effects and

[3] Lloyd and Maclaren (2004, 459) also refer to countries or RTAs with a large number of spokes due to their involvement in multiple FTAs as "super-hubs".

varying depth of integration in our experiment can be regarded as robustness checks of the model results. Along this line of thought, we also run our experiment under different market structures – perfect competition and "large group" monopolistic competition. In Section 4, we report the model results and discuss their implications. In Section 5, we analyse how sensitive these results are if model parameters and shocks are uncertain.[4] In Section 6, we conclude.

2. Singapore-USA-Japan Trade Relations

2.1 USA-Singapore Free Trade Agreement

The USSFTA, entered into force on 1st January 2004, was the first free trade pact concluded between the USA and an Asian country. This Agreement sets out the obligations of both parties to liberalize bilateral trade through the elimination of import tariffs, export taxes, trade restrictions and processing fees for originating goods. Liberalisation of services trade would include lower entry barriers for retail banking, harmonised standards for licensing and certifying professional service providers (especially architects and engineers), greater mobility for business visitors and professionals, as well as, mutual access to public telecommunications networks. Both parties are also committed to a wide range of issues including heightened intellectual property (IP) protection, better foreign investment facilitation, dispute settlement procedures, competition policy, environmental protection, and mutual recognition of conformity assessments for telecommunications equipment.

Prior to USSFTA, 44 percent of the electronics and IT products, 74 percent of chemical and petrochemical products, 85 percent of processed foods, 52 percent of instrumentation equipment and 70 percent of textiles and apparel originating from Singapore were dutiable by the USA. Post FTA, the latter lifts tariffs on 92 percent of Singapore exports with immediate effect and the remainder will be phased out by 2014. Since the relatively open Singapore can offer few tariff concessions in return, much of the negotiations over the FTA concern access to her services market. The impediments to services trade rarely take the form of border measures. They are often embedded in domestic regulations, so liberalisation may entail reforms. Under the USSFTA, each country is committed to treat the other country's services suppliers at par with its own suppliers or other foreign suppliers under like circumstances. There will be no requirement for local presence as a condition for the cross-border supply of a service. Market access

[4] These extensions to our analysis provide a comprehensive touch that is crucial in rendering CGE findings credible.

commitments are also given for a wide range of services including construction, telecommunications, distribution such as wholesaling, retailing and franchising, financial services such as banking and insurance, engineering, and professional services.

2.2 Japan-Singapore Economic Partnership Agreement

Negotiations between Japan and Singapore for an Economic Partnership Agreement were concluded in October 2001 and the JSEPA came into force on 30 November 2002. Unlike the USSFTA, not all products enjoy zero-tariff concessions. Although Singapore grants zero tariff rates on all Japanese imports as of entry into force of the EPA, Japan increases its zero-tariff commitments from 34 percent (under the WTO) to only 77 percent of total tariff lines. Even so, the percentage of Singapore's exports entering Japan tariff-free will rise from 84 percent to approximately 94 percent post-JSEPA. Out of the 6938 zero-tariff concessions offered by Japan, 6928 will take immediate effect, while the remaining 10 petrochemical products will be liberalised by 2010 on a gradual basis. The sectors that benefit include petroleum products, electrical and electronic products, chemicals, plastic products, pharmaceuticals, instrumentation and transport equipment, and fabricated metal products.

The number of service sectors which the country concerned will make regulations more transparent is increased from the commitment made under the General Agreement on Trade in Services (GATS) by both parties.[5] Japan commits an additional 32 sectors, totalling 134 of the 155 services sectors classified under GATS. For Singapore, an additional 77 sectors are committed beyond GATS, leading to increased transparency in regulation for 139 service sectors. Examples of sectors involved are business services, telecommunications, health-related and social services, distribution, finance, education, environmental services, and transportation.

2.3 Prospects of a USA-Japan EPA

Tapping bilateral channels is not new to USA-Japan trade relations. Past engagements between the two countries include the 1985 Market-Oriented Sector-Specific (MOSS) talks aimed to improve market access for American firms in the Japanese market and the Semiconductor Trade Agreement (STA) of 1986 under which a market share target was set for foreign semiconductor consumption in Japan. In 1989, the

[5] The GATS, entered into force in January 1995, extends the most favoured nation (MFN) treatment to services trade among all the WTO members and is the first multilateral agreement of this nature. It ensures transparency and predictability of rules and regulations pertaining to and promotes progressive liberalisation of services trade. Some 140 economies at present are GATS members and, to varying degrees, have assumed commitments in individual service sectors.

Structural Impediments Initiative (SII) was formed to address macroeconomic policies and Japanese business practices as barriers to trade. Agreements such as to deregulate the Japanese distribution system were subsequently reached in 1990. However, the SII was ended in 1993 to make way for a USA-Japan Framework for a New Economic Partnership, which calls for significant reduction in Japan's global current account surplus and addresses issues such as foreign direct investment in the eastern archipelago. However, negotiations collapsed from a lack of consensus over the quantitative targets for USA exports to Japan. Currently, a framework known as the Japan-USA Economic Partnership for Growth is in force. Inaugurated in 2000, it involves regular intergovernmental dialogue on specific fields such as regulatory reform, competition policy and investment. Further economic cooperation through an Economic Partnership Agreement is therefore not implausible.

The possibility heightens as both countries are no strangers to the practice of preferential trade. The USA began to establish FTAs since 1988 and currently has a portfolio of seven agreements reported to the WTO. Japan also became more receptive of preferential trade pacts after joint studies with South Korea (in 1998), Mexico (1999), and Singapore (2000) concluded in favour of bilaterals (Hatakeyama, 2002). The country now has EPAs with Singapore and Mexico, and is currently exploring or negotiating EPAs with South Korea, Thailand, and the Philippines (METI, 2006).

While the formation of the North American Free Trade Agreement (NAFTA) motivated Japan to launch an EPA with Mexico and move production facilities there to secure better access to the North American market, the recent safeguard tariffs imposed by the USA on steel imports (which hit Japan but exempted NAFTA partners) shows that Japan is still at risk of being discriminated.[6] Furthermore, Japanese firms that lack the resources to shift their production to Mexico, such as the textile manufacturers in East Asia, will continue to suffer (Hook et al, 2005). During the 43rd Japan-USA Business Conference held in November 2006, Nippon Keidanren, also known as the Japan Business Federation, called for a joint study for a Japan-USA EPA amid concerns that the Japanese businesses are losing their competitiveness to their counterparts in Singapore, Chile, Australia, Canada and Mexico in the USA market (Nippon Keidanren,

[6] The safeguard measure was imposed in March 2002 under Section 201 of the 1974 Trade Act. Three-year tariff rates of 8 to 30 percent were applied on a range of steel imports. These tariffs were lifted in December 2003 when Japan and other affected countries successfully petitioned the WTO under the dispute settlement mechanism.

2006).[7] This situation will worsen when the USA-Korea FTA is concluded and brought into effect. An USA-Japan EPA can also provide a counterweight to rising economic power China in East Asia and boost investor confidence in Japan given its enhanced trade relations with the USA (Bergstern, 2004). According to Bradford and Lawrence (2004), there are gains of about 3% of total GNP for Japan from any initiatives that could produce convergence between its high prices and the much lower levels that prevail in the USA and other industrialised countries. For the USA, an EPA with a major trading partner, especially a large purchaser of its agricultural products, would be very attractive. Moreover, an agreement that benefits Japan also strengthens the most important USA alliance in the region and helps to sustain political support for American engagement in East Asia.

However, the USA-Japan EPA seems as remote as twenty years ago when the then USA ambassador to Japan, Mike Mansfield mooted the idea. A major challenge that has to be overcome is the domestic resistance in Japan to liberalise its non-competitive agricultural sector and key services sectors, which the USA would likely require in order to conclude the EPA. The strong opposition is partly due to food security concerns and a weak Japanese agro industry (Hatakeyama, 2002). Furthermore, there are concerns about the impact on the global trading system when two of the largest economies give each other preferential treatment (Schott, 2004). In a different perspective, an USA-Japan EPA can spur the currently moribund APEC prospects for achieving “free and open trade and investment” within the region by 2010, a target set in the 1994 Bogor Declaration. For the same reason that a trade bloc of two hegemonies arising from the USA-Japan EPA hurts the rest of the world (RoW), it also garners support from outsiders to resume multilateral negotiations. Furthermore, an EPA reduces the risk that the current FTA strategies of the USA and Japan will create two mega trade blocs in Asia-Pacific, an outcome that can create instabilities in overall relations among countries in this region.

If a USA-Japan trade pact were to be established, what aspects should be covered? The USA still imposes substantial tariffs on Japanese goods such as pickup trucks and other commercial vehicles (25 percent), titanium sponge and wrought titanium materials (15 percent), bearings (4.4 percent to 9.9 percent), and flat-screen TVs (5 percent). On the Japanese side, goods such as cables (4.8 percent), plastic

[7] Nippon Keidanren (Japan Business Federation) is an economic organization established in May 2002 by amalgamation of the Japan Federation of Economic Organizations and the Japan Federation of Employers' Associations. Its membership of 1,662 comprised 1,351 companies, 130 industrial associations, and 47 regional economic organizations as of June 2006. It is one of the three major economic organisations in Japan, the other two being the Japan Chambers of Commerce and Industry, and the Japan Committee for Economic Development.

products (3.9 percent to 4.8 percent), and aluminium products (4.1 percent) are subject to tariffs, and since there are no domestic substitutes for these products, the costs incurred by the importing companies are increased and their profits are squeezed. Thus the dismantlement of tariffs remains a vital, core element of the EPA. However, the agreement is expected to also resolve ongoing issues such as the exemption of nationals from visa requirements, mutual recognition of patents, and a hassle-free system through which Japanese firms can help enhance the security of the import supply chain into the USA. For an USA-Japan EPA to take off, measures have to be taken to enhance the competitiveness of the Japanese agricultural sector so that it can survive the competition brought by foreign producers in the domestic market. The Japanese government should also liberalise legal services, education, healthcare, finance, civil aviation, and energy services - sectors which the American business community is interested in. As a step forward, an agreement on services trade under GATS rules should be explored (Hatakeyama, 2002).

3. Model, Database and Experimental Design

3.1 The GTAP Model

The framework used in this study is the multi-region GTAP model (Version 6.2) developed by the Center for Global Trade Analysis, Purdue University.[8] Each region in the model has three types of economic agents: private households, firms and the government, and is endowed with primary factors that can be disaggregated up to five categories: skilled and unskilled labour, natural resources, capital and land. The model assumes neoclassical behaviour on the part of agents. Labour and capital are perfectly mobile between sectors in each region, while natural resources and land are sluggish in adjusting to changes in their relative returns. In addition, labour and capital are required by all industries, but land is assumed useful only in agricultural production. The model is built on the Walrasian general equilibrium system, in which the central idea is that, all markets clear at a set of relative prices. Thus primary factors are fully-employed at every solution.

On the demand side, each "regional household" (a representative regional decision-maker), at the top-most level, maximizes a Cobb–Douglas utility function constrained by a budget made up of the tax revenue and endowment incomes of agents residing in this region. The utility maximization behaviour fosters demand equations, which are constant shares of the regional household income. Each region's disposable income is totally exhausted on consumption by the private households, spending by the

[8] Refer to Hertel (1997), Hertel and Tsigas (1997), and Itakura and Hertel (2001) for the details.

government, and savings. The incorporation of the latter helps to capture the medium-run capital accumulation effect of policy reforms. The utility from government spending approximates the welfare generated from the provision of public goods and services. The allocation of spending by the government across composite goods is based on a Cobb-Douglas utility function, while private household preferences are dictated by a constant difference of elasticities (CDE) implicit expenditure function.[9] Composite demand is then allocated between the imports and the domestically produced good, as well as, among imports at the border.

On the supply side, firms use intermediate inputs alongside primary factors for production. The derived demands for inputs are based on the profit-maximizing behaviour of firms. All markets are assumed perfectly competitive so firms earn zero profits at the equilibrium. Production in every sector exhibits constant returns to scale and can be divided into two levels. First, domestic and imported intermediates are used to produce a composite intermediate. Demanders treat imports from different sources as imperfect substitutes. Primary factors (land, labour and capital) are used to produce a new item called value-added. This level is characterized by no substitution possibilities between the intermediate inputs and the primary factors of production. However, substitution is possible among the primary factors and among the intermediates.[10] The demands in each case are represented by a constant elasticity of substitution (CES) function. At the final stage, both the value-added and the composite intermediate are used to produce the final output assuming a Leontief production function. With this technology, inputs are required in fixed proportions and thus there is no substitutability between the value-added and composite intermediates (Hertel and Tsigas, 1997; Piermartini and Teh, 2005). Each region, depending on transportation costs, participates in the trade with other regions.

A "global bank" ensures that the global demand for savings equals the global demand for investment in the post-solution equilibrium. It assembles savings and disburses investment through the sales of a homogenous savings commodity to regional households in order for them to purchase a composite investment good and hold shares in a portfolio of net regional investments (gross investment less depreciation). Savings and investment need not be equal at the regional level. A region saves by buying the

[9] Total differentiation of this function and use of Shephard's Lemma allow for the derivation of the relationship between minimum expenditure, utility and prices.

[10] The imported intermediate is a composite good made up of imports distinguished by country of origin. The demand for imports from various sources is also characterised by a CES function.

savings commodity. At the same time, it produces capital goods (or invests). These goods are sold, after accounting for depreciation, by the global bank together with other regions' capital goods as a portfolio in the form of a composite investment good. Savers claim shares in this portfolio depending on how much of the savings commodity they buy. In this study, we assume that the global bank's allocation of investment across regions will equate the expected rates of return to capital, thus giving rise to cross-border capital mobility. This is a useful assumption because trade liberalisation by a region may boost the production of capital-intensive manufactures, thereby increasing the rate of return to capital. It can also enhance efficiency thus shifting upwards the economy-wide production function. Either way, with fixed saving rates, an income increment accumulates capital stock which translates into further income gains. This multiplier effect is allowed to run its course in the model.

3.2 The GTAP Database

Like most CGE models, our data come from published sources. The main source is GTAP 6.0 Beta (Release 5, Nov 2004) Data Package. The database provides disaggregated data up to 86 regions across a maximum of 57 sectors. All monetary values of the data are expressed in US dollar (millions) and the reference year is 2001. From this source, we have extracted the following data aggregated to our sectors and regions: (i) bilateral trade flows, (ii) bilateral protection data for merchandise trade, (iii) input/output (I-O) tables, (iv) factor substitution elasticities, (v) source substitution (Armington) elasticities, (vi) behavioural parameters for households, and (vii) factor transformation elasticities. These data originate from the single-country I-O tables contributed by researchers worldwide to the GTAP consortium, the UN COMTRADE, the IMF BOP statistics and the MAcMap database. We do not reproduce the methodology for building the database. See Hertel (1997) and Dimaranan and McDougall (2006) for details.

3.3 Sectoral and Regional Aggregation

A reduced dimension 13 x 20 aggregation of the database is used to calibrate the model. The choice of regional dimension is motivated by our primary focus on the FTAs concluded by Singapore, the USA and Japan among themselves and, as will be elaborated later, with the countries in RoW. Refer to Table 2 for the regional aggregations. For sectoral aggregation, we consider twenty composite clusters, of which five comprise services. Table 3 shows the sectoral aggregations and provides a sense of what the products are in each aggregate.

Table 2: Regional Aggregations Used for the Implementation

Regions with Identifier	
Singapore [SING]	Morocco [MOR]
United States of America [US]	Canada [CAN]
Japan [JAP]	Mexico [MEX]
India [IND]	Chile [CHILE]
Australia [AUST]	South Korea [KOR]
European Free Trade Area [EFTA]	Rest of the World [ROW]
New Zealand [NZ]	

Source: GTAP database.

Table 3: Sectoral Aggregations Used for the Implementation

Sectors with Identifier	Sectoral Composition	Sectors with Identifier	Sectoral Composition
Agriculture [AGRICULTURE]	Paddy rice, Wheat, Cereal grains nec, Vegetables, fruit, nuts, Oil seeds, Sugar cane, sugar beet, Plant-based fibers, Crops nec, Bovine cattle, sheep, goats, horses, Raw milk, Wool, silk-worm cocoons, Animal products nec, Fishing	Non-metallic Mineral Products [NM_MIN_PROD]	Mineral products nec
		Metal Products [METAL_PROD]	Metal products
		Transportation Equipment [TRANSPORT]	Motor vehicles & parts, Transport equipment nec
Mining [MINING]	Coal, Oil, Gas, Minerals nec, Ferrous metals, i.e. contain iron, Metals nec	Electronic Equipment [ELECTRONICS]	Electronic equipment
Food, beverages & tobacco [FOOD_BEV_TOB]	Bovine meat products, Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar, Food products nec, Beverages and tobacco products	Machinery & Equipment [MACH_EQUIP]	Machinery and equipment nec
		Other Manufactures [OTH_MNFCS]	Manufactures nec
Textiles [TEXTILES]	Textiles	Elec., gas & water [UTILITIES]	Electricity, Water, Gas manufacture, Distribution
Wearing Apparel [WEAR_APP]	Wearing apparel	Construction [CONSTRUCTN]	Construction, Dwellings
Leather Products [LEATH_PROD]	Leather products	Trade & transport [TRADE_TRANS]	Trade, Sea transport, Air transport, Transport nec
Wood & Wood Products [WOOD_PROD]	Forestry, Wood products, Paper products, publishing,	Other Private Services [OTH_PTE_SVCS]	Communication, Insurance, Financial services nec, Business services nec, Recreation and other services
Chemicals [CHEM]	Chemical, rubber, plastic products		
Petroleum & Coal Products [PETROL_COAL]	Petroleum, coal products	Government Services [GOVT_SVCS]	Public Admin, Defence, Education, Health

Source: GTAP database.

3.4 Scenario Design

We consider first, a singular bilateral FTA in a group of three countries, then a hub-and-spokes system with one of the FTA members as a trade hub to the other two and finally, a "threesome" free trade scenario caused by overlapping bilateral FTAs. The *agreements of primary concern* that form the building blocks of these trading regimes are the USSFTA, JSEPA and a hypothetical FTA between Japan and the USA which we shall call USJFTA (in this paper, we use "EPA" and "FTA" interchangeably). Table 4 presents the three basic scenarios: (S1), (S2) and (S3). We also want to find out how sensitive the model results are to "noise" caused by Singapore, the USA and Japan serving as trade hubs to other countries in RoW. That is, we want to measure the welfare effect of each trading regime formed by the *agreements of primary concern* given that all the three constituents are super-hubs, and then contrast the outcomes with those of Scenarios 1 to 3 respectively. Scenarios 4 to 6 in Table 4 account for this "super-hub" effect. Figure 1 illustrates the network of FTAs involved in the analysis.

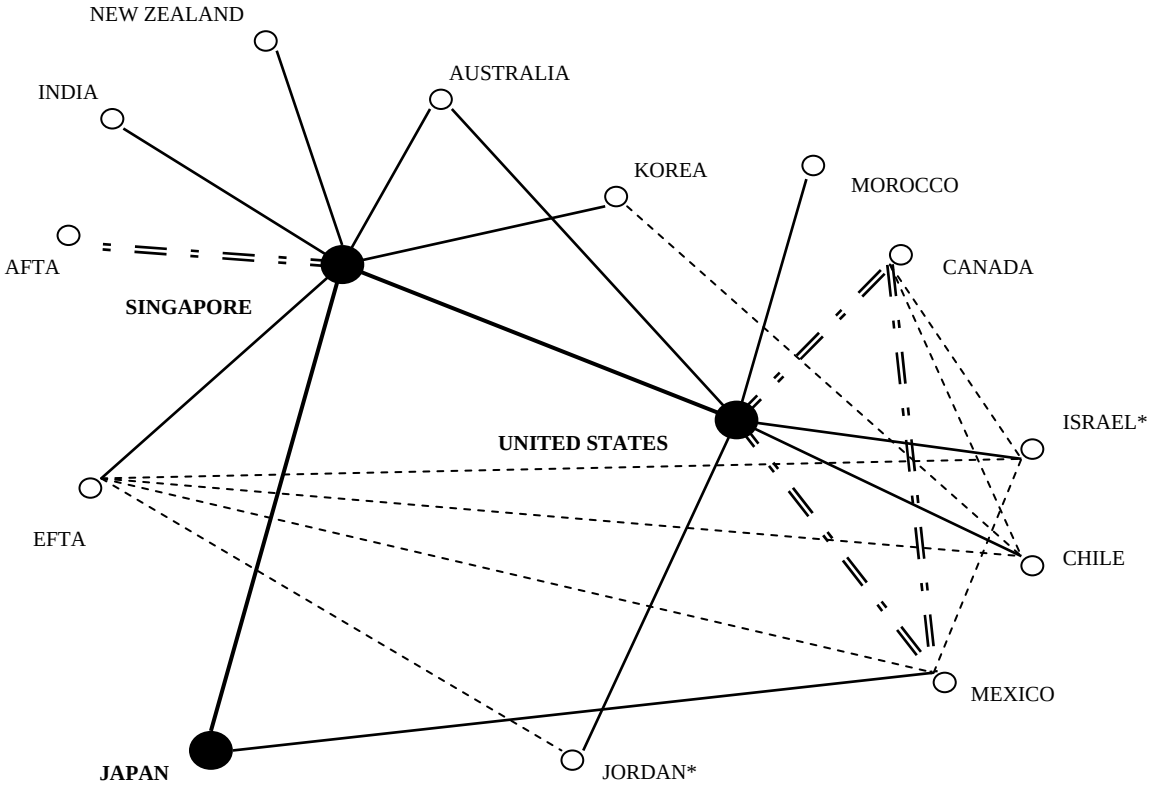
Table 4: Primary Scenarios and Scenarios that Account for "Super-hub" Effects

Scenario	Description of Scenario	Configuration	Status		
			USA	SING	JAP
(S1)	JSEPA only *	Single FTA	Outsider	Member	Member
(S2)	USSFTA & JSEPA	HAS System	Spoke	Hub	Spoke
(S3)	USSFTA, JSEPA & USJFTA	Free Trade Zone	Member	Member	Member
(S4)	JSEPA only | **	Single FTA	Outsider	Member	Member
(S5)	USSFTA & JSEPA | **	HAS System	Spoke	Hub	Spoke
(S6)	USSFTA, JSEPA & USJFTA | **	Free Trade Zone	Member	Member	Member

Note: * Since JSEPA entered into force in November 2002 and the USSFTA in January 2004, therefore by the criterion of chronological order, JSEPA is chosen for the solo FTA case. | ** Conditional on the fact that Singapore, the USA and Japan have FTAs with other countries outside the configuration, i.e. super-hub effects.

While the welfare effects of Scenarios 1 to 3 can be computed directly from the baseline data, getting the same information from Scenarios 4 to 6 is not so straightforward. We first find the welfare change (relative to the baseline) for the case where all the three countries are super-hubs independent of any FTA amongst them. Then we subtract this from the welfare change that results when they are super-hubs *and* the stipulated trade configuration is established. This approach allows for the evaluation of the single FTA (S1, S4), the HAS (S2, S5) and the free trade zone (S3, S6) comprising our three primary countries, while controlling for the existence of their other FTAs in the background. To shed further light on our scenario design, Figure 2 illustrates all six scenarios and their respective benchmarks. For Scenarios 1 to 3, the benchmark is simply the baseline data without any alteration. For Scenarios 4 to 6, the super-hub effect is accounted for in advance, forming an alternative background for analysing the three trading regimes.

Figure 1 Network of FTAs involving Singapore, the USA and Japan

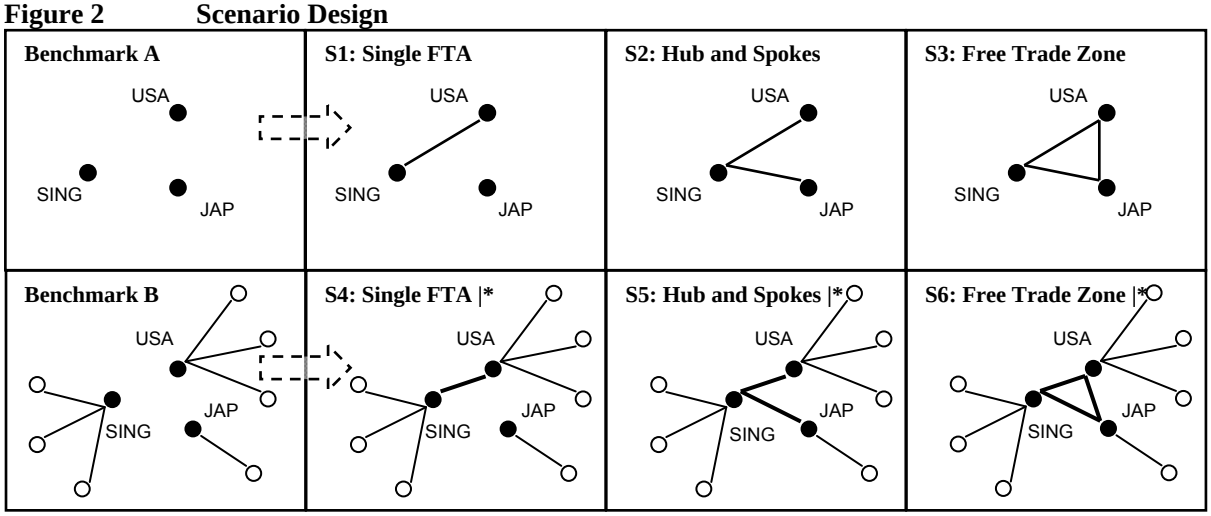


LEGEND

- FTA between spokes
- FTA between hub and spoke
- FTAs between hubs
- Links Members in a Free Trade Area

Note: (*) Country is excluded from the analysis as data is not available. The figure is constructed based on the FTAs in force and notified to WTO as at 2006.

Figure 2 Scenario Design



3.5 Modifications to Database: Services Trade Barriers

The GTAP database does not provide estimates of the barriers to services trade and assumes by default, zero barriers. This is as good as assuming that impediments are non-existent in international services transactions, which is unrealistic. Many service sectors remain highly regulated, facing restrictive policies such as entry fee, visa requirement, discriminatory access to local distribution networks, licensing, environmental standards and market share restrictions. These measures are designed to limit the access of foreign services suppliers to the domestic markets. Although most countries in the world are bound by the GATS, the commitments differ significantly from one member to the other.[11] Furthermore, under Article V of the GATS, members are allowed to form agreements on a bilateral or plurilateral basis to further liberalize services trade. From Table 1, we observe that all the FTA partners in our study have some form of services agreement with each other under this provision. As such, it would be interesting to find out what happens to regional welfare in each trading regime when trade liberalisation goes beyond tariff elimination. To be specific, we quantify the barriers *that arise from regulatory measures* and use them to determine the welfare effects of deep economic integration.

We adopt the methodology of Hoekman (1995) for estimating services trade barriers. Alternative works have since been contributed by Francois and Hoekman (1999), Kalirajan et al. (2000) and Warren (2000a, 2000b). However, the coverage of sectors by Hoekman (1995) is, by far, one of the most extensive and many CGE studies still employ these figures (McGuire, 2003; Dihel, 2003). Hoekman estimates the relative restrictiveness of policy regimes for services by assuming that the coverage of each nation's GATS schedule of commitments is an indicator of the policy stance pursued. The higher is the coverage ratio of a nation's schedule, the more liberal it is relative to other nations. Each nation's coverage ratio is then related to a benchmark "guesstimate" of what the tariff equivalent of services trade barriers in the most protectionist nation might be in order to obtain country-specific "tariff equivalents". The tariff equivalent list for the most restrictive nation is arbitrarily determined. An ad valorem rate of 200 percent applies for sectors where access tends to be prohibited and which do not appear in most schedules. These include air transport proper, postal and voice telecommunications. The rest varies between 20 and 50 percent.

[11] Refer to Footnote 6 about the GATS. Article XX of the GATS requires from each member a schedule of specific commitments that defines the trade conditions for services (such as national treatment and market access), but does not prescribe the sector scope or the degree of liberalization. Thus, while some members limit their commitments to a handful of sectors, others have listed several dozens. Furthermore, any of the entries may vary between full commitment without limitation and full discretion to apply measures falling under the relevant GATS Article.

To be useful for empirical work, Hoekman first concorded the GATS list to the International Standard Industrial Classification of All Economic Activities (ISIC). The ad valorem "tariff equivalents" (or AVEs) for 49 selected GATS members are then computed. Adjustment is made so that this data fits our sectoral aggregation. We sum up the 2-digit weights (w_j) of the ISIC sectors that fall within each sectoral aggregate k. The share of an ISIC sector in the sectoral aggregate (v_j) is then obtained by expressing its 2-digit weight as a fraction of the respective sum total,

$$v_j = w_j / \sum_j w_j \Big|_k$$

where $\sum_j v_j \Big|_k = 1$. This effectively assigns equal weights to all the 2-digit ISIC sectors in our sectoral aggregation. The region-specific AVE of services trade barriers for sectoral aggregate k is then obtained by summing up the products between the share of each ISIC sector j in k and its tariff equivalent value (t_j) reported in Hoekman (1995, Annex 2),[12]

$$t_k = \sum_j v_j t_j \Big|_k$$

Table 5 reports the AVEs for our sectoral and regional aggregations. We assume that all regions supplying a service face the same regulatory obstacles in an importer region. Since the services agreements, allowed under Article V, GATS were established before 2001 (our reference year) among the NAFTA members, between Canada and Chile, and between Chile and Mexico, we let the corresponding services trade barriers be zero in the modified database. We also assume that there are no trade barriers to essential services such as electricity, water and gas.

Next, we incorporate this new set of AVEs into the GTAP database using the approach by Malcolm (1998). This procedure is used for changing taxes in the initial, pre-simulation GTAP database when the user acquires better information than that used originally for its construction, while maintaining its internal consistency. We shock the exogenous variable, ad valorem import tax [tms] for services from their original

[12] Due to data constraints, the figures for EFTA are approximated by the unweighted average of those for Norway and Switzerland. For RoW, the "tariff equivalent" of a sectoral aggregate is the unweighted average of thirty-six representative countries in RoW reported in Hoekman (1995). The list of countries includes large economies such as the EU and China, South American countries such as Argentina and Brazil, as well as, representative nations from Africa, the Middle East and Asia. The complete list of countries will be furnished upon request.

values of zero to levels commensurate with the estimated tariff equivalents, solve a variant of the standard GTAP model, and use the updated database as a benchmark for subsequent counterfactual experiments.

Table 5: Services Trade Barriers due to Regulations (Ad Valorem Equivalent, AVE)

Sector	SING	US	JAP	IND	AUST	EFTA	NZ	MOR	CAN	MEX	CHILE	KOR	ROW
UTILITIES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTN	12.0	5.0	5.0	34.0	12.0	5.0	5.0	30.0	6.0	24.0	40.0	16.0	27.4
TRADE & TRANS	60.0	43.8	42.4	61.9	46.9	45.6	50.2	59.9	41.3	52.2	60.7	54.1	56.5
OTH_PTE_SVCS	58.2	41.0	33.7	67.0	48.4	50.2	48.0	66.1	44.6	60.8	61.4	58.3	59.4
GOVT_SVCS	45.5	28.0	24.5	48.6	23.7	23.6	38.8	43.8	35.4	34.4	50.0	42.2	42.0

Source: Figures constructed from Hoekman (1995).

3.6 Modifications to Theory: Monopolistic Competition

Many empirical studies have found evidence of scale economies and imperfect competition (Helpman, 1986; de Melo and Tarr, 1992; Tybout, 1993; Antweiler and Trefler, 2002).[13] Thus we need to test the robustness of our results to the variation in market structure and production technologies from the default GTAP settings of perfect competition and constant returns. To be succinct, we introduce scale economies internal to firms and "large group" monopolistic competition for all manufacturing and services sectors based on Francois and Roland-Horst (1997) and Francois (1998). This approach builds on the theoretical foundations laid by Ethier (1982), Helpman and Krugman (1985), and Venables (1987).

We assume commodities are differentiable at the firm level in the monopolistically competitive sectors. Each firm in sector j of region i produces a unique variety and is a monopolist in its chosen market niche because of less-than-perfectly elastic demand. However, varieties substitute for each other and, with free entry and exit, firms are forced to price at average costs (AC) and make zero profits in the long run. We assume that scale economies arise from fixed costs; some subset of a firm's inputs is committed a priori to production and its costs must be covered regardless of the output level (Y). As Y increases, AC falls, realizing internal scale economies. The firm faces an AC function of the form,

[13] Using 1972 - 1992 data on 34 industries in 71 countries, Antweiler and Trefler (2002) found evidence of modest scale economies if industries are assumed to exhibit the same degree of returns to scale. When heterogeneity among industries is factored into the analysis, 1/3 of all industries face scale economies. de Melo and Tarr (1992, 146) demonstrated, using econometric and engineering estimates, that there were unexploited economies of scale in the USA steel and automobiles industries during the 1980s. Helpman (1987) found that, in cross-country comparisons, the larger the similarity in factor composition, the larger the share of intra-industry trade. In time series data, the more similar the factor composition of a group of countries becomes over time, the larger is the share of intra-industry trade within the group. These findings support the monopolistic competition model of Helpman and Krugman (1985), which predicts that much trade will be intra-industry when endowments are similar. Tybout (1993) attributes the welfare improvement from trade policies to imperfect market structures, which open the possibility that the policy will enrich product menus for consumers, shift rents between countries and reduce waste. In the case of services, it is usually safe to assume that sectors like utilities and transportation are run by the public sector for reasons such as security, and not subject to market forces, especially foreign players.

$$AC = \frac{FC}{Y} + MC$$

A condition for equilibrium in the monopolistically competitive sector defined by AC-pricing, monopoly pricing and increasing returns at the firm level is that, the price elasticity of demand for a variety in that sector, $\varepsilon_{j,i}$ is related inversely to the firm's cost disadvantage ratio (CDR),

$$CDR = \frac{AC - MC}{AC} = \frac{\alpha_{j,i}}{\alpha_{j,i} + \beta_{j,i} Y_{j,i}} = \frac{1}{\varepsilon_{j,i}}$$

where $\alpha_{j,i}$ and $\beta_{j,i}$ are the fixed and marginal costs of a firm respectively, $Y_{j,i}$ is the firm's output, and CDR is a measure of the firm's unrealised scale economies in production.[14]

We assume that the number of firms populating a monopolistically competitive sector is arbitrarily large. From the complete set of equilibrium conditions, $\varepsilon_{j,i}$ would be fixed and equal to the elasticity of substitution between varieties σ_j (see Francois, 1998, 12). CDR is constant as well because it is the inverse of $\varepsilon_{j,i}$. Firms in a sector are assumed to share the same cost function, so one set of values for CDR, $\varepsilon_{j,i}$ and σ_j per sector would suffice. A new parameter $SCALE$ and variable $OSCALE$ is introduced to the model. The latter is exogenous for sectors where firms compete imperfectly and face internal scale economies, while $SCALE$ is a function of CDR,

$$SCALE = \frac{CDR}{1 - CDR}$$

When trade barriers are removed, consumers and firms gain better access to foreign varieties. The resultant increase in demand and free entry will encourage firm participation. New entrants will not affect the size of incumbents since CDR is fixed, and the industry expands as a result of an increase in the number of identically-sized firms.

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[14] Solving the following equations simultaneously yields the equilibrium condition,

Monopoly pricing by a firm fi in region i: $(P_{fi} - MC_{fi}) / P_{fi} = 1/\varepsilon_{fi}$

AC pricing by a firm fi in region i: $P_{fi} = AC_{fi}$

Cost function of a firm in sector j in region i: $C(x_{j,i}) = (\alpha_{j,i} + \beta_{j,i} Y_{j,i}) P z_{ij}$

Where $P_{z_{ji}}$ is the price of a bundle of primary and intermediate inputs, z_{ji} used by a firm in sector j of region i. The production technology for z_{ji} is assumed to exhibit constant returns to scale.

After modification, we calibrate the model by inferring the price-cost mark-up of each sector (MU_j). These mark-ups are then used to compute the Implied CDR and substitution elasticities where,

$$\text{Implied } CDR = \frac{MU - 1}{MU}$$

$$\text{Substitution Elasticity } \sigma_j = \frac{1}{\text{Implied} CDR}$$

We obtain plug-in estimates of MU_j adjusted to our sectoral aggregation from Martins, Scarpetta and Pilat (1996), Francois (2000) and Francois, Meijl and Tongeren (2005). The implied CDR is then used to compute the values for $SCALE$. We assume that the same set of estimates applies to all regions. Refer to Table 6 for the data.

Table 6: Parameter Estimates for "Large Group" Monopolistic Competition Modelling

Sectoral Aggregates	MU	Implied CDR = (MU-1)/MU	ESUBD*	σ_j = 1/Implied CDR**	SCALE
AGRICULTURE	1.00	0	2.41	-	0
MINING	1.16	0.139	4.17	7.20	0.161
FOOD_BEV_TOB	1.11	0.102	2.49	9.80	0.114
TEXTILES	1.14	0.121	3.75	8.28	0.137
WEAR_APP	1.12	0.109	3.70	9.15	0.123
LEATH_PROD	1.15	0.129	4.05	7.74	0.148
WOOD_PROD	1.18	0.154	3.06	6.49	0.182
PETROL_COAL	1.14	0.120	2.10	8.32	0.137
CHEM	1.22	0.180	3.30	5.57	0.219
NM_MIN_PROD	1.24	0.195	2.90	5.14	0.242
METAL_PROD	1.15	0.134	3.75	7.47	0.155
TRANSPORT	1.17	0.143	3.15	7.01	0.166
ELECTRONICS	1.26	0.209	4.40	4.78	0.265
MACH_EQUIP	1.19	0.160	4.05	6.25	0.190
OTHER_MNFCS	1.24	0.196	3.75	5.10	0.244
UTILITIES	1.27	0.213	2.80	4.70	0.270
CONSTRUCTN	1.27	0.213	1.90	4.70	0.270
TRADE_TRANS	1.27	0.213	1.90	4.70	0.270
OTH_PTE_SVCS	1.27	0.213	1.90	4.70	0.270
GOVT_SVCS	1.27	0.213	1.90	4.70	0.270

Sources: Column 4 is from GTAP 6.0 database and the rest are constructed based on estimates from Martins et al (1996), Francois (2000) and Francois et al (2005). Note: *For regional differentiation. The Armington substitution elasticities continue to hold in the perfectly competitive agricultural sector. However, we assume non-nested Armington structure. That is, ESUBD = ESUBM. ** The monopolistically competitive sectors involve firm-level product differentiation and the corresponding substitution elasticities are given in the fifth column.

3.7 Implementation

In our experiment, an FTA shock involves the complete elimination of all agriculture and merchandise tariff barriers between the members without raising tariffs against outsiders. This is in accordance with

GATT Article XXIV. For cases of deep integration, services trade barriers are also completely removed. The source-specific ad valorem tariff (for agriculture and merchandise trade) and tariff equivalent (of services trade barriers) imposed by region s on region r for commodity or service i, [tms(i,r,s)] is set exogenous in the model and shocked to a target rate of zero for this purpose. The standard GTAP model is implemented and solved using Release 8.0 of the General Equilibrium Modelling Package (GEMPACK) software suite. In particular, we use the visual interface, RunGTAP (Version 3.40) to analyse scenarios under perfect competition. Windows for GEMPACK or WinGEM (Version 2.62) is used for cases where monopolistic competition is assumed.

We examine each scenario twice, once assuming that all markets are characterised by perfect competition (PC) and constant returns (CRTS). Then we let all manufacturing and service industries face increasing returns (IRTS) and firms compete monopolistically (MP), but the assumptions on agriculture stay unchanged. We also run all scenarios thrice, once assuming that there are no pre-existing services trade barriers (that is, we utilise the GTAP database without adjustment). On the next run, we estimate and incorporate services trade barriers beforehand, but only the trade in goods is liberalised; any impact on the service sectors reflects the spillover effect of tariff cuts. On the third run, these built-in barriers are eliminated between the FTA partners to replicate deep integration. Due to the multitude of simulations carried out, we categorise each simulation exercise according to the underlying assumptions made. This is summarised in Table 7. Every exercise involves all six scenarios.

Table 7: List of Experiments & Underlying Model Assumptions

Exercise	Services Trade Barriers		Market Structure		Product Differentiation
	Built In?	Eliminated with FTA(s)?	Competition / Technology	Sectors	
A	No	-	PC / CRTS	All	Armington
B	Yes	No	PC / CRTS	All	Armington
C	Yes	Yes	PC / CRTS	All	Armington
D	No	-	MP / IRTS	Mnfcs & Svcs	Firm-level
E	Yes	No	MP / IRTS	Mnfcs & Svcs	Firm-level
F	Yes	Yes	MP / IRTS	Mnfcs & Svcs	Firm-level

4. Model Results and Implications

4.1 Sources of Welfare Effects

The welfare impact on a region due to trade policy changes (either of its own or its trading partners') can accrue from the changes in its terms of trade (TOT), allocative efficiency and the relative prices of savings and investment. A TOT gain occurs when there is an incomplete pass-through of a newly imposed

tariff to domestic prices. This happens when foreign exporters absorb some of the tariff burden. The importer region is better off because the world price of its imports falls (in other words, its TOT improves). Unilateral tariff cuts work in the reverse and it suffers a TOT loss. However, when tariff liberalisation is reciprocal like in an FTA, the cost of imports is reduced for both trading partners and an exchange gain results. In addition, as industries expand in some regions and capture an increasing share of the global market, the same industries in other regions may shrink, thus leading to the geographical specialisation of activities and therefore specialisation gains. For allocative efficiency effect, the removal of distortion caused by tariffs re-directs the factors of production to sectors where they are valued the most. Meanwhile, those regions that are net suppliers of savings to the global bank will benefit from a rise in the price of savings, relative to investment goods.

When we incorporate firm-level product differentiation in the model via "large group" monopolistic competition, regional welfare changes may also result from changes in the number of varieties that the consumers face (usually alluded to as "love-of-variety" effect). When an economy lifts its import tariffs, domestic firms' profits fall as they enjoy less protection from their foreign counterparts. Free entry and exit thus becomes the means through which countries realise specialisation gains. However, the scale of production is assumed fixed, so firms do not enjoy the cost savings that come with realising internal scale economies. Such a setting is required to motivate "large group" monopolistic competition. Nonetheless, new entrants intensify competition, squeezing the incumbents' mark-ups of price over marginal cost, thus generating some pro-competitive gains. The resultant fall in prices is beneficial to the consumers.

4.2 Equivalent Variation

As a measure of welfare change, we report in this section the equivalent variation (EV) that arises from each scenario for all the regions involved. The regional EV can be interpreted as the amount of income that if given to the region at the initial state, would have exactly the same effect on its welfare, as the move to the alternative state. If EV is positive, then the counterfactual state is preferred to the benchmark. We also find out the impact of the trading regimes on the world community. A global EV, computed as the simple summation of the regional EVs, provides us with a gauge. If global EV turns out to be positive, then it is *hypothetically* possible for those regions that stand to gain ($EV > 0$) to compensate the losers using some lump-sum re-distribution scheme. Thus a potential Pareto improvement in world welfare is possible. The related figures are reported in Tables 8 and 9.

Table 8: Equivalent Variation, Perfect Competition (in US$ Millions)

	EXERCISE A						EXERCISE B						EXERCISE C					
	S1	S2	S3	S4	S5	S6	S1	S2	S3	S4	S5	S6	S1	S2	S3	S4	S5	S6
SING	**216**	**464**	**347**	**184**	**380**	**276**	**265**	**546**	**409**	**217**	**426**	**309**	**1396**	**2672**	**2154**	**912**	**1603**	**1205**
US	-29	**-102**	4055	-22	**-68**	4105	-38	**-121**	4621	-27	**-73**	4677	-203	**241**	9923	-137	**748**	10496
JAP	-117	**-126**	570	-72	**-78**	800	-131	**-144**	451	-73	**-80**	706	-248	**-415**	-39	-13	**-166**	423
IND	-5	-13	-80	1	1	-67	-7	-16	-91	1	2	-74	-40	-89	-218	1	-36	-176
AUST	-6	-9	-313	-4	-5	-294	-8	-12	-362	-4	-6	-338	-35	-72	-497	-22	-70	-466
EFTA	-4	-6	-91	194	367	196	-5	-8	-105	242	445	246	-30	-72	-308	1202	1654	956
NZ	-1	-2	-66	-1	-1	-64	-1	-2	-74	-1	-1	-71	-6	-12	-98	-4	-14	-99
MOR	-1	-1	-17	0	-1	-12	-1	-1	-19	-1	-1	-14	-2	-5	-32	-2	-5	-26
CAN	-4	-14	-675	-3	-9	-657	-6	-19	-710	-4	-11	-690	-31	-128	-1219	-19	-117	-1194
MEX	-1	-14	-399	-3	-10	-487	-2	-16	-415	-4	-10	-513	-13	-56	-578	-12	-48	-723
CHILE	-2	-2	-46	-1	-1	-43	-2	-2	-53	-1	-1	-49	-5	-9	-76	-3	-8	-71
KOR	-8	-14	-439	-5	-9	-426	-10	-18	-478	-6	-10	-462	-43	-90	-638	-25	-89	-639
ROW	-115	-270	-3256	-98	-210	-3148	-174	-380	-3834	-132	-262	-3669	-1225	-2759	-9308	-805	-1847	-8390
WLD	-76	**-110**	-410	170	**355**	178	-120	**-194**	-659	208	**417**	58	-485	**-793**	-932	1074	**1606**	1297

Table 9: Equivalent Variation, Monopolistic Competition (in US$ Millions)

	EXERCISE D						EXERCISE E						EXERCISE F					
	S1	S2	S3	S4	S5	S6	S1	S2	S3	S4	S5	S6	S1	S2	S3	S4	S5	S6
SING	**2589**	**2648**	**1555**	**2121**	**2144**	**1316**	**4177**	**4242**	**2349**	**3120**	**3158**	**1902**	**4550**	**5086**	**3708**	**2911**	**3353**	**2577**
US	-1175	**-1162**	2286	-280	**-220**	3296	-1230	**-1251**	3530	-287	**-371**	4639	-1061	**131**	11920	-435	**997**	12603
JAP	-1304	**-1307**	2890	-829	**-844**	3599	-1686	**-1674**	2511	-894	**-889**	3464	-1061	**-925**	9332	-325	**-281**	10124
IND	-97	-98	-80	51	43	29	-156	-159	-129	18	-3	7	-156	-170	-164	82	-31	-204
AUST	-161	-172	-70	-57	-90	53	-269	-267	-204	-91	-75	-66	-297	-229	-79	-70	-96	65
EFTA	-149	-146	-232	-750	-735	-520	-181	-181	-301	-764	-764	-546	-171	-179	-379	-710	-685	-572
NZ	-22	-23	-10	-4	-9	9	-36	-36	-27	-9	-7	-8	-40	-31	-11	-6	-15	-5
MOR	-105	-107	-107	-4	-7	-11	-131	-131	-133	-6	-5	-17	-131	-121	-83	-43	-36	3
CAN	-8	5	-211	-30	4	-260	-13	-15	-149	-32	-55	-164	40	-33	-169	-61	-48	-196
MEX	3	5	-282	-82	-62	-590	15	10	-205	-77	-91	-566	41	-10	-226	-89	-72	-569
CHILE	-15	-15	-41	-8	-9	-30	-22	-22	-53	-10	-11	-38	-18	-19	-55	-11	-10	-36
KOR	141	-45	-737	257	-380	29	-415	-364	-968	-352	77	-1295	-1311	-106	-734	269	-75	-687
ROW	-4587	-4441	-1449	-2930	-2285	-1705	-7525	-7592	-4822	-3166	-3477	-2296	-6851	-6668	-2649	-3749	-3009	-2065
WLD	-4891	**-4857**	3512	-2545	**-2449**	5214	-7471	**-7438**	1398	-2551	**-2513**	5015	-6463	**-3274**	20412	-2235	**-8**	21038

Three observations prove robust regardless of the market structure, depth of economic integration and presence of super-hub effects. First, Singapore enjoys positive welfare gains relative to the benchmark regardless of the trading regime the country is in. Second, hub status generates the highest welfare gain for Singapore. Third, when both are relegated to spoke status, Japan loses more than the USA. As expected, most of the trading partners having FTAs with these three countries are worse off when some discriminatory trade pact is formed among the latter. The situation is especially detrimental with a USJFTA. Results also suggest that the world is likely to lose with the HAS formation but the costs can be minimised if the integration is deep. The outcome is more promising for the free trade zone scenario especially if services trade is liberalised as well.

4.3 Sectoral Outputs

To have a grasp of the industry-level effect, we report in Tables 10 and 11 the changes in sectoral output arising from the HAS and free trade zone respectively. These are the trade configurations which we would expect in a world of overlapping FTAs. For brevity sake, we restrict our analysis in this paper to perfect competition cases.[15] For ease of reference, the figures of the top five producing merchandise sectors in each region are shaded grey. Substantial changes in excess of 1 percent benchmark output are highlighted in bold print.

4.3.1 Hub-and-Spokes

In an asymmetric case such as ours, the sectoral effects are acute in the small economy and insignificant in the hegemonies. Even if integration is deep, the impact on industries in Japan and the USA remains negligible. We also observe that the "super-hub" effect tends to dilute the impact of the trading regime (compare Scenarios 2 and 5). For Singapore, we observe a shift toward services and certain types of manufactures. Productions increase significantly for food, beverages and tobacco, textiles, wearing apparel, leather products, construction, trade and transportation, as well as, other private services. In particular, the wearing apparel industry experiences the biggest two-digit growth between 18 to 42 percent of benchmark output. However, manufacturing sectors such as chemicals, electronics, and machinery and equipment display much bigger declines in output than under shallow integration. Overall, the HAS formation lowers the output of electronics by 0.9 to 3.8 percent, machinery and equipment by 1.2 to 14.6 percent, and chemicals by up to 16.6 percent. The metal products and transportation equipment industries

[15] Model results for the single FTA scenario and monopolistic competition cases will be furnished upon request.

Table 10: Change in Sectoral Output, Hub-and-Spokes (Percentage of Benchmark)

	EXERCISE A						EXERCISE B						EXERCISE C					
	S2			S5			S2			S5			S2			S5		
	SING	US	JAP	SING	US	JAP	SING	US	JAP	SING	US	JAP	SING	US	JAP	SING	US	JAP
AGRICULTURE	0	0	0	0	0	0	-0.1	0	0	0	0	0	**-1.7**	0	0	**-1.3**	0	0
MINING	**-2.3**	0	0	**-2**	0	0	**-2.8**	0	0	**-2.4**	0	0	**-17.2**	-0.1	0	**-11.3**	-0.1	0
FOOD_BEV_TOB	**16.6**	0	-0.1	**12.6**	0	-0.1	**16.7**	0	-0.1	**12.1**	0	0	**7.1**	0	-0.1	**7.2**	0	0
TEXTILES	**18**	-0.1	0	**15.3**	0	0	**16.6**	-0.1	0	**14.1**	0	0	0.6	-0.2	0	**6.1**	-0.2	-0.1
WEAR_APP	**42**	-0.1	0	**32.5**	0	0	**40.5**	-0.1	0	**28.4**	0	0	**18**	-0.1	0	**18.6**	-0.1	0
LEATH_PROD	**13.8**	0	-0.1	**10.5**	0	0	**13.2**	0	-0.1	**9.3**	0	0	**-11.4**	-0.1	-0.1	0	-0.2	-0.1
WOOD_PROD	**-1.1**	0	0	-0.8	0	0	**-1.4**	0	0	-0.9	0	0	**-11.5**	0	0	**-6**	0	0
PETROL_COAL	0.8	0	0	0.8	0	0	0.7	0	0	0.7	0	0	-0.6	0	0	0	0	0
CHEM	0.3	0	0	0.2	0	0	-0.3	0	0	-0.2	0	0	**-16.6**	-0.1	0.1	**-9**	-0.1	0
NM_MIN_PROD	-0.5	0	0	-0.4	0	0	-0.8	0	0	-0.5	0	0	**-9.4**	-0.1	0	**-4.5**	-0.1	0
METAL_PROD	-0.4	0	0	-0.4	0	0	-0.7	0	0	-0.6	0	0	**-10.8**	0	0	**-6**	-0.1	0
TRANSPORT	**-2.1**	0	0	**-1.4**	0	0	-2.6	0	0	**-1.5**	0	0	**-15.7**	0	0.1	**-7.4**	-0.1	0
ELECTRONICS	**-1**	0	0	-0.9	0	0	**-1.2**	0	0	**-1**	0	0	**-3.8**	-0.1	0.1	**-2.1**	-0.2	0
MACH_EQUIP	**-1.5**	0	0	**-1.2**	0	0	**-2.1**	0	0	**-1.5**	0	0	**-14.6**	-0.1	0.1	**-7.8**	-0.1	0
OTHER_MNFCS	**-1.5**	0	0	-0.5	-0.1	0	**-1.9**	0	0	-0.6	-0.1	0	**-8.8**	-0.1	0	**-2.2**	-0.6	-0.1
UTILITIES	**1**	0	0	0.4	0	0	0.9	0	0	0.3	0	0	**-2.8**	0	0	**-1.4**	0	0
CONSTRUCTN	0.7	0	0	0.5	0	0	0.9	0	0	0.5	0	0	**6.1**	0	0	**3.1**	0	0
TRADE_TRANS	-0.3	0	0	-0.2	0	0	-0.3	0	0	-0.1	0	0	**2.7**	0	0	0.9	0	0
OTH_PTE_SVCS	**-1.1**	0	0	-0.6	0	0	**-1**	0	0	-0.4	0	0	**6.9**	0	-0.1	**3.2**	0.1	0
GOVT_SVCS	0.3	0	0	0.2	0	0	0.4	0	0	0.3	0	0	0.5	0	0	-0.5	0	0

Table 11: Change in Sectoral Output, Free Trade Zone (Percentage of Benchmark)

	EXERCISE A						EXERCISE B						EXERCISE C					
	S3			S6			S3			S6			S3			S6		
	SING	US	JAP	SING	US	JAP	SING	US	JAP	SING	US	JAP	SING	US	JAP	SING	US	JAP
AGRICULTURE	-0.7	**2.8**	**-5.7**	-0.7	**2.7**	**-5.6**	-0.8	**2.9**	**-5.7**	-0.8	**2.8**	**-5.6**	**-2.2**	**2.6**	**-5.6**	**-1.9**	**2.6**	**-5.5**
MINING	**-1.9**	-0.7	0.7	**-1.7**	-0.6	0.7	**-2.3**	-0.7	0.8	**-2**	-0.7	0.7	**-15.1**	**-1.6**	**1.4**	**-9.6**	**-1.6**	**1.2**
FOOD_BEV_TOB	**7.8**	**2.3**	**-2.4**	**6**	**2.3**	**-2.3**	**7.8**	**2.5**	**-2.4**	**5.7**	**2.4**	**-2.3**	0.4	**2.4**	**-2.4**	**2.1**	**2.3**	**-2.2**
TEXTILES	**18.2**	-0.6	**1.3**	**15.5**	-0.6	**1.3**	**17**	-0.7	**1.3**	**14.4**	-0.6	**1.3**	**2.9**	**-1.5**	**1.6**	**7.8**	**-1.5**	**1.5**
WEAR_APP	**43**	-0.2	0	**33.3**	-0.2	0	**41.8**	-0.3	0	**29.3**	-0.2	0	**21.8**	-0.8	0.1	**21.1**	-0.8	0.1
LEATH_PROD	**13.9**	0.5	0.7	**10.5**	0.5	0.8	**13.4**	0.5	0.8	**9.3**	0.5	0.8	**-9**	-0.7	0.9	**1.4**	-0.8	0.8
WOOD_PROD	**-1**	-0.1	-0.2	-0.7	-0.1	-0.2	**-1.3**	-0.1	-0.2	-0.8	-0.1	-0.2	**-10.4**	-0.4	-0.1	**-5.2**	-0.4	-0.2
PETROL_COAL	0.8	0	-0.1	0.8	0	-0.1	0.8	0	-0.1	0.8	0	-0.1	-0.4	-0.1	-0.1	0.1	-0.1	-0.1
CHEM	0.8	-0.4	0.6	0.6	-0.4	0.6	0.3	-0.5	0.6	0.3	-0.5	0.6	**-14.2**	**-1.2**	**1.1**	**-7.1**	**-1.2**	1
NM_MIN_PROD	-0.7	-0.3	0.4	-0.5	-0.3	0.4	-0.9	-0.4	0.4	-0.5	-0.4	0.4	**-8.6**	-0.9	0.7	**-4**	-0.9	0.6
METAL_PROD	-0.5	-0.3	0.5	-0.4	-0.3	0.4	-0.8	-0.4	0.4	-0.6	-0.4	0.4	**-9.7**	-0.9	0.8	**-5.2**	-0.9	0.7
TRANSPORT	**-1.8**	-0.7	**2.6**	**-1.1**	-0.7	**2.6**	**-2.1**	-0.8	**2.6**	**-1.1**	-0.8	**2.5**	**-13.9**	**-1.3**	**3.3**	**-6**	**-1.3**	**3.1**
ELECTRONICS	-0.7	**-1.1**	0.3	-0.6	**-1**	0.3	-0.9	**-1.2**	0.4	-0.7	**-1.2**	0.3	**-2.5**	**-2.8**	**1.1**	**-1**	-2.9	**1**
MACH_EQUIP	**-1.1**	-0.8	**1.3**	-0.8	-0.8	**1.2**	**-1.5**	-0.9	**1.3**	**-1**	-0.9	**1.2**	**-12.5**	**-1.8**	**2.2**	**-5.9**	**-1.9**	**2.1**
OTHER_MNFCS	**-1.2**	-0.7	0.5	-0.4	-0.6	0.5	**-1.6**	-0.8	0.5	-0.4	-0.7	0.5	**-7.1**	**-2**	0.7	**-1.7**	**-2.2**	0.6
UTILITIES	0.9	0.1	0.1	0.3	0.1	0.1	0.8	0.1	0.1	0.2	0.1	0.1	**-2.5**	-0.1	0.2	**-1.3**	-0.1	0.2
CONSTRUCTN	0.5	0.1	0	0.3	0.1	0	0.6	0.1	0	0.3	0.1	0	**5.2**	0.2	0.1	**2.6**	0.2	0.1
TRADE_TRANS	-0.2	0	0	-0.1	0	0	-0.2	0	0	0	0	0	**2.6**	0.2	0.1	0.9	0.2	0.1
OTH_PTE_SVCS	-0.9	0	0	-0.4	0	0	-0.8	0	0	-0.3	0	0	**6**	0.3	-0.5	**2.6**	0.3	-0.5
GOVT_SVCS	0.2	0	-0.1	0.2	0	-0.1	0.3	0	-0.1	0.2	0	-0.1	0.1	0.1	-0.2	-0.7	0.1	-0.2

are also adversely affected. These sectors contract in Singapore because, following tariff liberalisation, participant countries specialise their production. This is evident in the expansion of American and Japanese industries whose counterparts in Singapore shrank, and vice versa. When services trade is liberalised as well, these manufacturing industries contract further because the reduction in regulatory barriers renders services trade more profitable and service providers can entice skilled labour, which they use intensively, with higher pay. For example, chemicals include, at a more disaggregated level, pharmaceuticals, which are skilled labour-intensive. When these resources are diverted to services, chemical output falls.

4.3.2 Free Trade Zone

Compared to the HAS, the increase in the production of food, beverages and tobacco is at least halved, but contraction is also smaller in the electronics, machinery and equipment, and transportation equipment sectors. Apart from what have been mentioned, the sectoral outcome for Singapore in the free trade zone is similar to that under the HAS. For example, the expansion of the textiles, wearing apparel and leather product industries found in the HAS are preserved. Deep integration through the USJFTA benefits the construction, trade and transport services in both the USA and Japan, harms (aid) the major manufacturing sectors in the USA (Japan) and benefits (hurts) the American (Japanese) agricultural, food, beverage and tobacco, and private services sectors. For example, agricultural output in the USA expands by 2.6 to 2.9 percent, but the same economic activity in Japan contracts. The USJFTA thus causes further specialisation in production among the members.

4.4 Real Returns to Primary Factors

We report in Tables 12 and 13 the changes in real return to primary factors arising from the HAS and free trade zone respectively for perfect competition cases. In Singapore, the workers (both skilled and unskilled) and capital owners will always gain in both trade regimes, while natural resources always lose. In most scenarios, landowners lose as well. When services trade is not liberalised, unskilled labour and capital will gain the most on average in the HAS (0.5 percent to 0.7 percent increase in benchmark real returns). When services trade is liberalised as well, the real returns to unskilled labour rises by more than 6.1 percent, while skilled labour and capital would gain as much as, if not more than, unskilled labour (6.1 percent to 7.6 percent increase). The increases in real returns are comparatively smaller and the losses, bigger under the free trade zone scenario. Meanwhile, the HAS system has little impact on the primary factors employed in Japan and the USA. However, the landowners in the USA are better off (17 percent to

Table 12: Change in Real Return to Primary Factors, Hub-and-Spokes (Percentage of Benchmark)

	EXERCISE A										EXERCISE B										EXERCISE C									
	S2					S5					S2					S5					S2					S5				
	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR
SING	0.4	0.6	0.5	0.6	-0.4	0.3	0.5	0.4	0.5	-0.6	0.1	0.7	0.6	0.7	-0.9	0.2	0.6	0.5	0.5	-0.7	-6.9	7.1	7.6	7.4	-10	-2	6.1	6.1	6.1	-4.1
US	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.2	0	0	0	-0.1	-0.3	0	0	0	-0.2
JAP	-0.2	0	0	0	-0.1	-0.1	0	0	0	-0.1	-0.2	0	0	0	-0.1	-0.1	0	0	0	-0.1	-0.1	0	0	0	-0.1	-0.1	0	0	0	-0.1
IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	-0.1	-0.1	0.3
AUST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0.3	0	0	0	0.3
EFTA	0	0	0	0	0	-0.2	0	0	0	-0.2	0	0	0	0	0	-0.2	0	0	0	-0.2	0	0	0	0	0.1	-0.4	0.1	0.1	0.1	-0.5
NZ	-0.1	0	0	0	0	0	0	0	0	0	-0.1	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0.4	0	-0.1	0	0.3
MOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.1	0	0	0	0.1
CAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0.1	0	0	0	0.1
MEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHILE	-0.1	0	0	0	0	-0.1	0	0	0	0	-0.1	0	0	0	0	0	0	0	0	0	-0.1	0	0	0	0.1	0	0	0	0	0.1
KOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0.1

Table 13: Change in Real Return to Primary Factors, Free Trade Zone (Percentage of Benchmark)

	EXERCISE A										EXERCISE B										EXERCISE C									
	S3					S6					S3					S6					S3					S6				
	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR	T	UL	SL	K	NR
SING	-5.4	0.5	0.4	0.4	-4.5	-4	0.4	0.4	0.4	-3.6	-5.7	0.6	0.5	0.5	-4.9	-3.9	0.5	0.4	0.4	-3.5	-11	6.5	6.9	6.8	-13	-5.1	5.6	5.5	5.6	-5.8
US	18	0	-0.1	0.1	-0.5	18	0	0	0	-0.5	18.8	0	-0.1	0.1	-0.6	18.8	0	0	0.1	-0.6	17.2	0.1	0.1	0.2	-2.1	17	0.1	0.1	0.2	-2.1
JAP	-27	0.5	0.6	0.5	-20	-26	0.5	0.6	0.5	-19	-26	0.5	0.6	0.5	-19	-26	0.5	0.6	0.5	-19	-26	0.8	0.9	0.8	-19	-25	0.8	0.9	0.8	-19
IND	-0.2	0	0	0	0.1	-0.2	0	0	0	0.1	-0.2	0	0	0	0.1	-0.2	0	0	0	0.1	-0.1	0	0	0	0.3	-0.1	0	-0.1	-0.1	0.5
AUST	-5.1	-0.1	0	-0.1	1.2	-5	-0.1	0	0	1.1	-5	-0.1	-0.1	-0.1	1.4	-4.9	-0.1	0	-0.1	1.2	-4.5	-0.1	-0.1	-0.1	1.8	-4.3	-0.2	-0.1	-0.1	1.6
EFTA	-2.2	0	0	0	-0.1	-2.3	0	0	0	-0.2	-2.2	0	0	0	-0.1	-2.3	0	0	0	-0.2	-2	-0.1	0	0	0.3	-2.2	0.1	0.1	0	-0.1
NZ	-5.5	-0.1	0	0	-0.5	-5.3	-0.1	0	0	-0.5	-5.4	-0.1	0	0	-0.4	-5.2	-0.1	0	0	-0.4	-4.7	-0.1	-0.1	-0.1	0	-4.3	-0.1	-0.1	-0.1	0.2
MOR	-0.7	-0.1	0	0	0.1	-0.5	-0.1	0	0	0.1	-0.7	-0.1	0	0	0.1	-0.5	-0.1	0	0	0.1	-0.4	-0.1	-0.1	-0.1	0.7	-0.1	-0.1	-0.2	-0.1	0.6
CAN	-0.3	-0.1	-0.1	-0.1	0.4	-0.3	-0.1	-0.1	-0.1	0.4	-0.4	-0.1	-0.1	-0.1	0.5	-0.4	-0.1	-0.1	-0.1	0.4	0.2	-0.2	-0.2	-0.2	0.8	0.2	-0.2	-0.2	-0.2	0.7
MEX	2.8	-0.1	-0.1	-0.1	0.4	2.2	-0.1	-0.1	-0.1	0.6	2.9	-0.1	-0.1	-0.1	0.4	2.3	-0.1	-0.1	-0.1	0.6	3.1	-0.1	-0.2	-0.2	0.4	2.6	-0.2	-0.2	-0.2	0.8
CHILE	-1.2	-0.1	0	0	0.1	-1.1	-0.1	0	0	0.1	-1.2	-0.1	-0.1	0	0.2	-1.1	-0.1	0	0	0.1	-1	-0.1	-0.1	0	0.4	-0.9	-0.1	-0.1	-0.1	0.4
KOR	-1.6	0	0	0	-1.1	-1.5	0	0	0	-1	-1.5	0	0	0	-1	-1.5	0	0	0	-1	-1.4	-0.1	-0.1	0	-0.9	-1.4	-0.1	-0.1	0	-0.8
ROW	-0.8	0	0	0	0	-0.7	0	0	0	0	-0.7	0	0	0	0	-0.7	0	0	0	0	-0.6	0	0	-0.1	0.3	-0.5	0	0	-0.1	0.3

18.8 percent increase in real returns) and those in Japan are worse off (25.4 percent to 26.5 percent decrease) following the USJFTA, while the returns on natural resources fall in both countries.

5. Sensitivity Analysis

Results from simulation models are sometimes highly dependent on the values employed for exogenous variables such as substitution elasticities and policy distortions like taxes. In GTAP, the values of key economic parameters in the disaggregated database are derived from a survey of econometric work. Such estimates are most appropriately viewed as random. To address this issue, we conduct formal systematic sensitivity analysis (SSA) using the multivariate order-three Gaussian Quadrature (GQ) procedure (see Arndt, 1996; Stroud, 1957; DeVuyst and Preckel, 1997). It is more efficient than a Monte Carlo approach because it requires much less information and solves of the model and is more systematic than an ad hoc analysis.

SSA is conducted for the primary scenarios, and involves the GTAP supply-side parameters: elasticities of substitution between the primary factors (ESUBVA), between domestic and imported goods or inputs (ESUBD) and between the valued added by primary factors and composite intermediate (ESUBT), as well as, factor mobility across sectors (ETRAE). On the demand side, we vary the own-price and income elasticities of consumer demand (SUBPAR and INCPAR respectively). We also extend SSA to shocks caused by the FTAs of primary concern. We originally assumed 100 percent tariff cuts on a reciprocal basis. These “simplified” shocks closely approximate what was actually agreed. Furthermore, 100 percent tariff cuts are in accordance with WTO regulations on FTAs. Thus we view the liberalisation of merchandise trade through USSFTA and JSEPA as “a matter of fact” and not subjected to sensitivity analysis. However, since USJFTA is hypothetical, the extent of liberalisation is uncertain. We also assumed that the services agreements abolish regulatory barriers totally, but this is unlikely. Taking these considerations into account, the SSA involves varying tariff cuts for USJFTA and, where applicable, uncertainty is factored in on the extent of services trade liberalisation achieved by each agreement.

An arbitrary but plausible bound of maximum 30 percent variation from the original value is imposed for each element in INCPAR, SUBPAR, ESUBVA, ESUBD and FTA shock per sensitivity solve. For the latter, this bound applies both ways between members. Since ETRAE and ESUBT have zero entries, we allow a maximum variation of 0.5 in absolute terms. For simplicity, we let the variations of substitution

elasticities be perfectly correlated across sectors, and for ETRAE, across endowments. The demand elasticities will also vary together across sectors and regions. Taking into consideration that tariff cuts may differ between sectors, we allow them to vary independently of each other. The same applies for services trade liberalisation. In Table 14, we report the estimates of the mean $\hat{\mu}_{EV}$ and standard deviation $\hat{\sigma}_{EV}$ of EV for Singapore. The 95% confidence intervals (C.I.) are constructed using Chebyshev's Inequality ($\hat{\mu}_Y - 4.5\hat{\sigma}_Y, \hat{\mu}_Y + 4.5\hat{\sigma}_Y$). This method of determining C.I. does not require any assumptions about the distribution of EV. However, the C.I. computed this way is wider than if we knew its distribution. They should thus be treated as conservative estimates.

Contrary to our model results, the 95% C.I.s indicate that a HAS with deep integration can be welfare reducing for Singapore. This is a crucial discovery because many recent agreements such as the JSEPA are moving toward deeper integration compared to their predecessors. Keeping in mind that the C.I. is a conservative estimate, we find this implication reversed at the 90% level of confidence. Otherwise, our simulation results prove robust to the variations in exogenous variables.

6 Concluding Remarks

Our findings highlight the importance of hub-and-spokes as a trading system in a world of overlapping free trade agreements. Our study indicates that small and open economies like Singapore prefer hub status to a free trade zone involving the same country group. They are not likely to stop at one agreement once they embark on the FTA path. Although FTAs especially those with deep integration can be attractive, significant changes in industrial composition (due to specialisation in production) can lead to temporary spells of frictional unemployment. This is not captured in our experiment. Furthermore, although Japan suffers more than the USA in a HAS centred on Singapore, this is not sufficient to kickstart negotiations for a spoke-spoke FTA because their welfare losses are insignificant when expressed in percentages of benchmark GDPs. While this may be expected of small country-large country FTA per se, being spokes to multiple HAS may tip the balance in favour of an USA-Japan EPA in the future. Already, Japan and the USA are spokes in another HAS centred on Mexico and more will materialise as the two continue to pursue the FTA path.

Table 14 Systematic Sensitivity Analysis: Equivalent Variation (Singapore)

Exogenous Variable	Scenario	No Services Trade Barriers			Services Trade Barriers Exist & Hold			Services Trade Barriers Exist & Eliminated			
		$\hat{\mu}_{EV}$	$\hat{\sigma}_{EV}$	95% C.I.	$\hat{\mu}_{EV}$	$\hat{\sigma}_{EV}$	95% C.I.	$\hat{\mu}_{EV}$	$\hat{\sigma}_{EV}$	95% C.I.	90% C.I.
FTA Shock	S1	-	-	-	-	-	-	1403	384	(-323, 3130)	(190, 2617)
	S2	-	-	-	-	-	-	2647	599	(-47, 5341)	(754, 4540)
	S3	347	12	(295, 399)	408	14	(344, 473)	2492	551	(13, 4970)	(750, 4233)
ESUBVA	S1	216	0	(215, 218)	265	0	(264, 267)	1396	0	(1395, 1396)	(1395, 1396)
	S2	464	0	(464, 464)	546	0	(545, 546)	2672	1	(2668, 2677)	(2670, 2675)
	S3	347	1	(345, 349)	408	1	(405, 412)	2155	1	(2152, 2157)	(2153, 2156)
ESUBD	S1	218	8	(181, 255)	267	12	(213, 321)	1403	57	(1149, 1658)	(1224, 1582)
	S2	467	8	(431, 502)	549	13	(491, 608)	2698	96	(2265.9, 3129)	(2394, 3001)
	S3	348	1	(344, 353)	410	1	(406, 415)	2172	21	(2078, 2266)	(2106, 2238)
ESUBT	S1	217	15	(148, 287)	267	19	(183, 350)	1404	100	(953, 1856)	(1087, 1722)
	S2	467	32	(322, 612)	549	38	(380, 714)	2691	222	(1691, 3691)	(1988, 3394)
	S3	349	23	(246, 452)	411	27	(290, 532)	2172	194	(1299, 3044)	(1559, 2784)
ETRAE	S1	216	0	(216, 216)	265	0	(265, 265)	1396	0	(1395, 1396)	1395, 1396)
	S2	464	0	(464, 464)	546	0	(545, 546)	2672	0	(2672, 2673)	(2672, 2673)
	S3	347	0	(345, 349)	409	0	(407, 411)	2155	0	(2153, 2156)	(2153, 2156)
INCPAR	S1	216	0	(216, 216)	265	0	(265, 265)	1396	0	(1395.6, 1395.6)	(1396, 1396)
	S2	464	0	(464, 464)	546	0	(546, 546)	2672	0	(2672.4, 2672.4)	(2672, 2672)
	S3	347	0	(347, 347)	409	0	(409, 409)	2154	0	(2154.4, 2154.4)	(2154, 2154)
SUBPAR	S1	216	1	(213, 219)	265	1	(261, 270)	1396	5	(1375.1, 1416.1)	(1381, 1410)
	S2	464	1	(458, 471)	546	2	(536, 555)	2672	8	(2636.5, 2708.3)	(2647, 2698)
	S3	347	1	(343, 352)	409	1	(402, 415)	2154	6	(2125.4, 2183.5)	(2134, 2175)

Source: SSA output is obtained via RunGTAP.

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