Reversal of Trade Creation and Trade Diversion Due to Preferential Rules of Origin

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Abstract

Restrictive preferential rules of origin (PROOs) moderate the "trade diversion and trade creation" effects associated with FTAs. Moderation of these effects occurs because restrictive PROOs reverse the course of trade creation and trade diversion brought about by FTAs. Such a reversal arises because restrictive PROOs induce compliance costs that lead to a lower utilization of tariff preferences by member-countries and a smaller increase in the relative price of imported goods from non-members. Restrictive PROOs cause less than full trade diversion from non-members to member countries, and less than complete trade creation to member countries. This paper infers this moderation effect of PROOs from the estimated parameters of the revenue function, since trade diversion refers to a decrease in the elasticity of substitution between import sources, and trade creation refers to a difference between the change in import price elasticity due to FTAs and the trade diversion effect. Empirical results support the conjectures that restrictive PROOs move in the opposite direction of FTAs partly undoing trade diversion and trade creation attributable to FTAs, that the moderation effect of restrictive PROOs does not fully offset the initial effect of FTAs on relative prices, and that the moderation effect of restrictive PROOs does not completely neutralize trade creation.

Key words: restrictive preferential rules of origin, revenue function, moderation of trade diversion/trade creation effects

JEL classification: F1

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I. Introduction

Preferential rules of origin (PROOs) prevent non-member country producers from transshipping goods from the country with the lowest-tariff to the one with the highest-tariff in the FTA. The origin rules thwart such "trade deflection" by keeping the lowest-tariff country from acting as port of entry for the entire FTA's imports (Cadot et al. (2005), Cadot and de Melo (2007)). At the same time, PROOs deny tariff preferences to FTA partners who fail to satisfy the origin rules. The origin rules have to be satisfied before a product is recognized as being eligible for tariff preferences. Yet the efforts to fulfill the requirements of PROOs generate compliance costs associated with meeting origin criteria and using expensive intermediate inputs. The resulting compliance cost set limits to the utilization of tariff preferences by FTA members. Restrictive PROOs lower the utilization of tariff preferences by increasing compliance costs.

The relative price of non-members' exports depends on tariff preferences given to FTA members (i.e. the preferential margin). Tariff preferences given to FTA members increase the relative price of non-members' exports, causing intra-regional trade to increase through "trade creation and trade diversion." Yet, if restrictive PROOs prevent the full utilization of preferential tariffs, the relative price of non-members' exports would not increase as much as it would have increased in the absence of such restriction. For example, if member-country producers fail the origin rules test, no tariff preferences will be given to them. Then the increase in the relative price of non-members' exports will be negligible. On the other hand, if member-country producers successfully comply with PROOs, the preferential margin will approach the "normalized" MFN rate.[1] Thus, the extent to which FTAs cause trade creation and trade diversion will be negatively related to the restrictiveness of PROOs (i.e. the magnitude of compliance costs). Lower compliance costs will cause greater trade creation and trade diversion within an FTA, while higher compliance costs will do the opposite. In that sense, the severity of PROOs actually sets the limits to the perimeter of trade creation and trade diversion.

The purpose of this paper is to estimate the extent to which restrictive PROOs "moderate" the effect of FTAs on trade creation and trade diversion. The moderation effect arises because restrictive PROOs increase compliance costs, which may in turn cause some member-country firms to take advantage of tariff preferences less extensively or even to give up preferential treatment, and the resulting incomplete utilization of tariff preferences keeps trade diversion and trade creation from being

[1] The preferential margin for member-country producers is defined as the normalized difference between MFN and preferential tariffs: $\tau = \dfrac{t - \tau_A}{1 + \tau_A}$, where t is the MFN rate and τ_A the preferential rate. (Cadot and De Melo, 2007)

materialized to the full. Thus, while FTAs may shift the destinations of import sourcing from non-members to members, restrictive PROOs may reverse the course of such trade diversion; and while FTAs may create new trade among member countries, restrictive PROOs may dampen such trade creation or even cause trade "depression." The lower utilization of tariff preferences by member countries not only leads to less than full trade diversion from non-member countries to member countries, but it also means less than full trade creation to member countries. Taken together, PROOs may partly undo trade diversion and trade creation associated with the formation of FTAs.

Evaluating the effects of PROOs crucially depends on the way trade creation and trade diversion are estimated. There are two conventional ways to estimate trade creation and trade diversion. First, sets of dummies can be used to estimate trade creation and trade diversion (Carrère (2006), Eicher et al. (2008), Fukao et al. (2002), and Gosh and Yamarick (2004)). For example, Gosh and Yamarick (2004) estimate trade creation and trade diversion using a gravity equation augmented with dummy variables for membership in a regional trading arrangement. Trade creation and trade diversion are inferred from the coefficient estimates of the regional dummy variables.[2] Carerre (2006) also estimates a gravity equation to infer trade creation and trade diversion effects using dummies for country specific fixed-effects and temporal effects. Yet reliance on dummies lacks theoretical justification, and, as Magee (2008) points out, coefficients on these dummy variables may capture more than just the effects of the regional trade agreement.

Second, direct measures of trade creation and trade diversion can be used. For example, Magee (2008) defines trade diversion as the rise in intra-bloc imports accompanied by a fall in extra-bloc imports, and trade creation as the difference between trade expansion and trade diversion, where trade expansion implies any increases in imports within the regional bloc above the counterfactual predicted level. Bown and Crowley (2003) estimate "trade deflection" and "trade depression" instead of trade creation and trade diversion. They define "trade deflection" as export growth to the third country market caused by the imposition of antidumping duties on the targeted country *only*, and "trade depression" as a decrease in export growth to the third country market caused by the *simultaneous* imposition of antidumping duties on *both* the targeted country and the third country. It is obvious that their "trade deflection" corresponds to trade creation, while their "trade depression" to trade diversion. Their approach is conceptually equivalent to the conventional one.

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[2] For example, the coefficient on $INRTA_{ij}^{k}$ ($INTRTA_{ij}^{k}=1$ if countries *i* and *j* belong to regional trade agreement *k*) represents the trade creation effect, while the coefficient on $EXTRTA_{i}^{k}$ ($EXTRTA_{i}^{k}=1$ if one of the two countries is a member of regional agreement *k*) captures the trade diversion effect on nonmembers (Gosh and Yamarik, 2004).

This paper introduces an alternative way to measure trade diversion and trade creation, which takes advantage of the estimated parameters of the revenue function.[3] Trade diversion is defined as a decrease in the elasticity of substitution, while trade creation as a "compensating variation," both of which are inferred from the properties of the isoquants. Trade diversion is equivalent to a decrease in the elasticity of substitution in the sense that imports from non-member countries become less substitutable for imports from FTA members for a given amount of total imports. Trade creation implies that the change in the total price elasticity is greater than the change in the elasticity of substitution. Trade diversion and trade creation thus defined correspond to the "substitution and income" effects of a change in the relative prices of traded goods, which can be inferred from the coefficient estimates of the revenue function. That is, the properties of the revenue function can be used to define trade diversion as a decrease in the elasticity of substitution between different import sources, and trade creation as a difference between the change in the total price elasticity and the change in the elasticity of substitution (i.e. trade diversion). The revenue function has been extensively used to specify many empirical models of international specialization (for example, Harrigan(1997), Kohli(1991), Redding(2002), and Woodland(1982)). However, it has not been applied to the estimation of trade diversion and trade creation. It is a contribution of this paper to show that the estimated coefficients of the revenue function can be used to infer trade diversion and trade creation.[4]

The assessment of the moderation effect involves calculating first the extent of trade diversion/trade creation due to FTAs and then the reversal of trade diversion/trade creation due to restrictive PROOs. Each calculation commonly measures changes in the substitutability of imports from non-members for imports from FTA members. That is, each calculation measures the change in the "gross" substitutability (i.e. the overall price effect of FTAs on non-members), the change in the "net" substitutability (i.e. the trade diversion effect), and the extent of trade creation defined as the difference between "gross" substitutability and "net" substitutability (or the difference between the overall decrease in total imports and trade diversion). Then trade diversion/trade creation that would arise in the presence of compliance costs associated with restrictive PROOs can be compared with

[3] The revenue (GDP) function is obtained as a solution to the problem of maximizing the value of final output subject to fixed aggregate factor supplies, constant returns to scale, and perfect competition. The revenue function used in this paper treats exports as an output distinguishable from the one for domestic consumption, and imports as a composite input of intermediate goods.

[4] The methodology of this paper that infers trade diversion and trade creation from the coefficient estimates of the revenue (GDP) function has something in common with the concepts of trade diversion and trade creation introduced in the SMART model of the WITS software developed by the World Bank.

trade diversion/creation that would arise under hypothetical FTAs without compliance costs (restrictive PROOs) to determine the extent to which restrictive PROOs undo the effects of FTAs.

Empirical results in this paper support the conjectures that the influences of FTAs and PROOs move in the opposite direction, and that, while the moderation effect of PROOs is real, it does not fully offset the price effect of FTAs. While PROOs may cause "reverse trade diversion" and "trade depression," the moderation effect of PROOs is not large enough to nullify the initial effect of FTAs. Restrictive PROOs counteract a decrease in the substitutability of non-members for FTA members caused by FTAs, and such moderation effect accumulates over time.

Empirical results also show that trade creation due to FTAs is not completely offset by restrictive PROOs. That is, if trade diversion is initially much greater than trade creation, and if there is substantial reduction in trade diversion due to restrictive PROOs, then trade creation due to hypothetical FTAs without restrictive PROOs will be smaller than trade creation with restrictive PROOs. Trade depression will not necessarily arise from restrictive PROOs: trade creation still can be positive. These results bear out the claim that the effect of tariff preferences on intra-bloc trade expansion is large enough to offset that of compliance costs made in Baier and Bergstrand (2007) and Cadot et al. (2014), which is another contribution of this paper to the literature.

This paper is organized as follows. Section II defines trade diversion and trade depression. Section III provides empirical framework. Section IV presents empirical results and discusses main findings. Section V concludes.

II. Trade diversion and trade creation

Consider an open economy endowed with fixed factor supply, which produces and trades under constant returns to scale and perfect competition. The corresponding revenue (GDP) function of this economy is

$$\pi(p,v) \equiv \max_{y}\{p \cdot y : (y,v) \in S\},$$

where S is a production possibilities set, p a price vector, y the vector of domestic net outputs (a negative element is an input), and v the vector of fixed inputs.

According to Hotelling's lemma, differentiating the revenue function with respect to p_i yields the net output y_i, and differentiating the revenue function with respect to v_k yields the inverse factor demand w_k. The gradients of π with respect to p and v give the derived output supply and inverse input demand functions

$$y \equiv \nabla_p \pi(p,v) \text{ and } w \equiv \nabla_v \pi(p,v).$$

The GDP function can be defined as a function of consumption (C), investment (I), exports (X), imports (M), factors of production (K, L), and the time index (t). Consumption represents household spending plus government expenditures. Consumption and investment are non-traded goods.[5] Exports are distinguishable from the goods for domestic consumption, and imports are a composite input of intermediate goods.[6] The time index represents technological change.[7] For analytical purposes, it is conveniently assumed that imports are weakly separable from consumption, investment, exports, and factors of production, and that imports are disaggregated by countries of origin.

The open economy minimizes import costs by optimally determining the level and mix of imports in two stages. In the first stage, it determines the mix of origins that minimizes the cost of acquiring a certain amount of "aggregate imports." Then, in the second stage, it determines the level of aggregate imports while simultaneously choosing the levels of the other outputs and inputs.[8]

Let this open economy be the home country that trades with two foreign countries. One of the two foreign countries is a member of the FTA that the home country forms with it, and the other is not an FTA member. Let $y = (y_1, y_2)$ denote the vector of imports that the home country imports from its trading partners: y_1 from a non-FTA member country and y_2 from an FTA partner country respectively. The home country consumes a composite quantity of two imported inputs. Let $q = (q_1, q_2)$ be the price vector of these imports: q_1 is the price of imports from a non-member country and q_2 is the price of imports from an FTA member country.

The elimination of tariffs among FTA members causes the relative price of imports from non-members to rise. Such a change in the relative price relies on full compliance with PROOs, whose possibility is inversely related to the severity of PROOs. However, incomplete compliance against restrictive PROOs prevents a full pass-through of the FTA effect on the relative price of imports from non-members: increase in q_1 relative to q_2 will be less than what it would have been under full compliance. Formation of an FTA and restrictiveness of PROOs will exert influences on the relative price of imported inputs (q_1/q_2) moving in opposite directions, which will in turn make the *net* extent of trade creation and trade diversion ambiguous.

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[5] Kohli (1991, 116)
[6] Kohli (1991, 180-196)
[7] Kohli (1991, 103-106)
[8] Kohli (1991, 280-284)

Figure 1 shows how the change in the relative price (q_1/q_2) affects the extent of trade diversion and trade creation. Following the elimination of tariffs among FTA members, the new relative price line, $(q_1/q_2)^1$, becomes steeper than the old relative price line, $(q_1/q_2)^0$. Yet the extent of increase in the relative price is less than what it would have been without restrictive PROOs, $(q_1/q_2)^*$.

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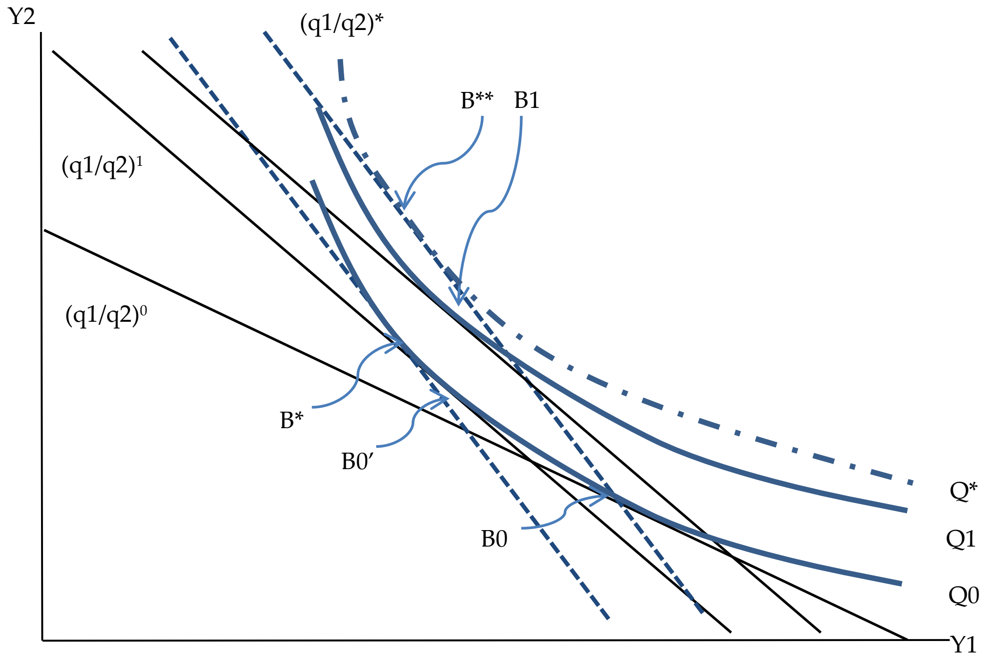

Figure 1: *Elasticity of substitution* (*trade diversion*) *and compensating variation* (*trade creation/depression*)

In Figure 1, B_0 denotes the initial equilibrium point before an FTA, and B_1 denotes the observable equilibrium point after an FTA with restrictive PROOs. B^* and B_0' are the hypothetical tangent points that would have been arrived at after an FTA without restrictive PROOs and one with restrictive PROOs respectively, with the level of total imports remaining at the previous level. Trade diversion refers to the shift of the tangent points from B_0 to B_0' for an FTA with restrictive PROOs or B_0 to B^* for an FTA without restrictive PROOs. B^{**} is another hypothetical point that would have been obtained after an FTA without restrictive PROOs. The move from B_0' to B^{**} represents the trade creation effect for an FTA without restrictive PROOs. At B^{**}, trade creation is undisturbed by restrictive PROOs. Yet the trade creation effect is eroded by the presence of restrictive PROOs. As a result, B_1 instead of B^{**} is reached under an FTA with restrictive PROOs. The shift of the tangent points from B_0' to B_1 indicates the trade creation effect realized under an FTA with restrictive PROOs.

Trade diversion and trade creation effects can be inferred from the properties of the isoquants. In particular, trade diversion is equivalent to a change in the elasticity of substitution, and trade creation to a "compensating variation."[9] For illustration, consider an FTA with restrictive PROOs. If the isoquant is not a CES production function, trade diversion is represented by a shift of the tangent points from B_0 to B_0' on the isoquant Q_0, which entails a reduction in the elasticity of substitution. The elasticity of substitution effectively measures "the ease with which the varying factor can be substituted for others," so that a decrease in the elasticity of substitution would follow if the imports from the FTA partner and non-FTA member countries become less substitutable.[10] That is, the elasticity of substitution will become smaller at B_0' than at B_0. A small percentage change in the marginal product of y_2 relative to the marginal product of y_1 (or MRTS) will induce a very large percentage change in the (y_2/y_1) ratio. However, the tangent point B_0' is not observable, so the new elasticity of substitution cannot be estimated at that point. Yet, for a homothetic import aggregator, the elasticity of substitution remains the same at B_0' as at B_1 on the new price line. Thus, the new elasticity of substitution at B_1 can be used instead. On the other hand, trade creation is equivalent to compensating variation, a shift of tangent points from B_0' to B_1. Yet again B_0' is not observable. So trade creation (the move from B_0' to B_1) is indirectly measured as the difference between the actual change in the composite imports (the move from B_0 to B_1) and trade diversion (the move from B_0 to B_0').

In sum, Figure 1 shows the "combined" effects of FTAs and restrictive PROOs. The effects of FTAs and restrictive PROOs on the relative price are moving in the opposite direction. Restrictive PROOs moderate the potential effects of trade diversion and trade creation associated with FTAs. Without

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9 It measures the maximum amount of composite good production that the final good producer would give up in order to avoid the relative price change.

10 The elasticity of substitution was designed as "a measure of the ease with which the varying factor can be substituted for others" (Hicks, 1932: p.117). The elasticity of the ratio of two inputs to a production (or utility) function with respect to the ratio of their marginal products (or utilities). With competitive demands, this is also the elasticity with respect to their price ratio. For example, with factors L, K and factor prices w, r, the elasticity of substitution of a production function $F(K, L)$ is $\sigma = -d\ln(L/K)/d\ln(w/r)$. (Deardorff's *Glossary of International Economics*) Obviously, if the CES function is used, the elasticities of substitution between imports from any pair of regions will be the same. The model in this paper is not of a CES function.

PROOs, the relative price (q_1/q_2) would have been steeper and compensating variation would have been greater.

III. Empirical implementation

The empirical model takes advantage of the derivative properties of the revenue (GDP) function, the elasticity of substitution and others, to measure trade diversion and trade creation.

Model

A. 1st Stage Optimization: Determination of Aggregate Shares

The revenue (GDP) function is approximated by a translog function as in Harrigan (1997).

$$\ln(\pi) = \alpha_0 + \sum_{i=1}^{I} \alpha_i \ln \theta_i \, p_i + \sum_{j=1}^{K} \beta_j \ln v_j + \frac{1}{2}\sum_{i=1}^{I}\sum_{h=1}^{I} \gamma_{ih} \ln \theta_i p_i \ln \theta_h \, p_h + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \delta_{kl} \ln v_k \ln v_l + \sum_{i=1}^{I}\sum_{k=1}^{K} \phi_{ik} \ln \theta_i \, p_i \ln v_k$$

This revenue function is assumed to be linearly homogeneous and symmetric. The linear-homogeneity assumption stipulates that $\sum_{i=1}^{I} \alpha_i = 1$, $\sum_{j=1}^{K} \beta_j = 1$, $\sum_{i=1}^{I} \gamma_{ih} = \sum_{h=1}^{I} \gamma_{ih} = 0$, $\sum_{k=1}^{K} \delta_{kl} = \sum_{l=1}^{K} \delta_{kl} = 0$, and $\sum_{i=1}^{I} \phi_{ik} = \sum_{k=1}^{K} \phi_{ik} = 0$. The symmetry assumption requires that $\gamma_{ij} = \gamma_{ji}$ and $\delta_{kl} = \delta_{lk}$. The parameter θ_i represents Hicks-neutral technological differences across countries.[11]

The supply and demand functions derived from differentiating the revenue function with respect to p_i and the revenue function with respect to v_k respectively can be conveniently rewritten as the revenue shares of output and the cost shares of input equations

$$s_i = \alpha_i + \sum_{h=2}^{M} \gamma_{ih} \ln \frac{\theta_h}{\theta_1} + \sum_{h=2}^{M} \gamma_{ih} \ln \frac{p_h}{p_1} + \sum_{k=2}^{K} \phi_{ik} \ln \frac{v_k}{v_1} \quad (1A)$$

$$s_k = \beta_k + \sum_{l=2}^{K} \delta_{kl} \ln \frac{v_l}{v_1} + \sum_{i=2}^{M} \phi_{ik} \ln \frac{\theta_i}{\theta_1} + \sum_{i=2}^{M} \phi_{ik} \ln \frac{p_i}{p_1} \quad (1B)$$

for $i = 1, \ldots, M$ and $k = 1, \ldots, K$.

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[11] With the inclusion of θ_i, the model can account for relative technology differences in addition to relative factor supply differences. Technology differences supplement factor supply differences in the determination of specialization patterns. Harrigan (1997, 477)

Consumption and investment goods are non-traded, and the productivity of these non-traded sectors is not observable. Harrigan (1997) provided ways to deal with this problem. First, he defined $d_{it} = \sum_{h=2}^{M1} \gamma_{ih} \ln \frac{p_h}{p_1}$ in s_i (and $d_{kt} = \sum_{i=2}^{M1} \phi_{ik} \ln \frac{p_i}{p_1}$ in s_k), and substituted them for the traded goods prices, where M_1 is the number of traded goods (the number of non-traded goods is $M - M_1$). Second, he replaced the sum of the non-traded goods price and technology terms with a flexible stochastic term: that is, he replaced $\varepsilon_{it} = \sum_{h=M1+1}^{M} \gamma_{ih} \ln \frac{p_h}{p_1} + \sum_{h=M1+1}^{M} \gamma_{ih} \ln \frac{\theta_h}{\theta_1}$ with $\varepsilon_{it} = \xi_i + \mu_t + e_{it}$ in s_i (and replaced $\varepsilon_{kt} = \sum_{i=M1+1}^{M} \phi_{ik} \ln \frac{p_i}{p_1} + \sum_{i=M1+1}^{M} \phi_{ik} \ln \frac{\theta_i}{\theta_1}$ with $\varepsilon_{kt} = \xi_k + \mu_t + e_{it}$ in s_k), where ξ_i is country fixed effects, μ_t time fixed effects, and e_{it} a random component with constant variance. Then the revenue share equations can be expressed as

$$s_i = \psi_i + \varphi_t + \sum_{h=1}^{M1} \gamma_{ih} \ln \theta_h + \sum_{k=2}^{K} \phi_{ik} \ln \frac{v_k}{v_1} + e_{it} \qquad (2A),$$

$$s_k = \kappa_k + \omega_t + \sum_{i=1}^{M1} \phi_{ik} \ln \theta_i + \sum_{l=2}^{K} \delta_{kl} \ln \frac{v_l}{v_1} + e_{it} \qquad (2B),$$

where $\psi_i = \alpha_i + \xi_i, \kappa_k = \beta_k + \xi_k, \varphi_t = d_{it} + \mu_t$ and $\omega_t = d_{kt} + \mu_t$ for $i = 1, \ldots, M$ and $k = 1, \ldots, K$.[12]

The sum of technology effects $\sum_{h=1}^{M1} \gamma_{ih} \ln \theta_h$ in s_i (and $\sum_{i=1}^{M1} \phi_{ik} \ln \theta_i$ in s_k) indicates a change in productivity for aggregate components. In general, productivity growth reflects a fall in costs (or an increase in value-added) over time due to technological change. For the calculations of productivity growth at the industry level, Harrigan (1997) replaced technology parameters with value-added productivity indexes. Alternatively, Feenstra (2004) calculated the theoretical productivity index at the aggregate level, drawing on the fact that the total change in GDP over time can be decomposed into the chain of indexes relating the productivity index, the GDP price index, the terms of trade index and the quantity index of factor endowments. This paper follows Feenstra (2004) to construct the productivity index from the ratio of nominal value-added to the product of the price index of an output component and the quantity index of endowment growth. That is, the technology effect term

[12] Since not all technology parameters are observed, no homogeneity restriction is imposed on the sum of the observable technology effects. Harrigan (1997, 479)

in equation (2*A*), $\ln\theta_h$, is replaced by $\left(\ln\frac{p_h{}^1Q_h{}^1}{p_h{}^0Q_h{}^0} - \ln PI_h - s_h \ln QI_h\right)$, where $p_h{}^1Q_h{}^1$ and $p_h{}^0Q_h{}^0$ are component value-added observed in periods 1 and 0, $\sum_{h=1}^{M1}\ln PI_h = \sum_{h=1}^{M1}\frac{1}{2}\left(\frac{p_h^0Q_h^0}{p^0Q^0} + \frac{p_h^1Q_h^1}{p^1Q^1}\right)\ln\frac{p_h^1}{p_h^0}$ is the Tornqvist price index, $\sum_{h=1}^{K}\ln QI_h = \sum_{h=1}^{K}\frac{1}{2}\left(\frac{w_h^0v_h^0}{w^0v^0} + \frac{w_h^1v_h^1}{w^1v^1}\right)\ln\frac{v_h^1}{v_h^0}$ is the Tornqvist quantity index, and the subscript h (k) denotes an output (input) component.[13].

On the other hand, the sum of relative factor supply effects $\sum_{k=2}^{K}\phi_{ik}\ln\frac{v_k}{v_1}$ (or $\sum_{l=2}^{K}\delta_{kl}\ln\frac{v_l}{v_1}$) represents the effects of changes in factor endowments. Aggregate factor supplies are measured in relation to the reference factor input. For example, $\ln\frac{v_K}{v_L}$ represents non-residential capital stock per worker.

B. 2nd Stage Optimization: Determination of Origin Shares

Once the "aggregate imports" are determined along with the other aggregate output supply and input demand shares, importers minimize the cost of "aggregate imports" by determining the optimal import mix outsourced from different trading partners. Import aggregation entails minimizing the import cost function that is linearly homogeneous in import component prices.

Let p_M and q_g be the aggregate import price index and the import price for the goods originated from country g respectively. The aggregate import price index is identical to the import cost function that measures the costs of procuring imports from different origins. The aggregate import-price function is expressed in a translog form as

$$\ln\left(p^M\right) = a_0 + \sum_{g=1}^{G} b_g \ln\left(\frac{\mu_g}{\lambda_g}q_g\right) + \frac{1}{2}\sum_{g=1}^{G}\sum_{f=1}^{F} d_{gf}\ln\left(\frac{\mu_g}{\lambda_g}q_g\right)\ln\left(\frac{\mu_f}{\lambda_f}q_f\right),$$

where $d_{gf} = d_{fg}$, $\sum_{g=1}^{G} b_g = 1$, μ_g, μ_f represent the price effects of FTAs and λ_g, λ_f the "moderating" effects of restrictive PROOs. The import cost function "allocates" imports to different sources. FTAs change the composition of import sources and the amount of the composite good imported from the member country, but restrictive PROOs "reverse" the change in the opposite

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[13] Feenstra (2004, 426)

direction. Differentiating the import cost function with respect to $\mu_g q_g$ yields the demand for imports from country g in share form.

$$s_g^M = b_g + \sum_{f=2}^{F} d_{gf} \ln\left(\frac{\mu_f q_f}{\mu_1 q_1}\right) - \sum_{f=1}^{F} d_{gf} \ln \lambda_f \quad (3)$$

Equation (3) shows the combined influence of FTAs and restrictive PROOs moving in the opposite direction. Preferential tariffs owing to FTAs increase the relative price of imported inputs from a non-member country, $\frac{\mu_f q_f}{\mu_1 q_1}$. The parameter λ_f captures the extent to which restrictive PROOs reverse the FTA-induced change in the relative price of imports from different origins. If country f is a member country (i.e. $f = g$), then $\lambda_f > 1$(or $\ln \lambda_f > 0$). If country f is a non-member country (i.e. $f \neq g$), then $\lambda_f = 1$ (or $\ln \lambda_f = 0$). There is no homogeneity restriction on the sum of the PROO effects.

The relative price of imported inputs, $\frac{\mu_f q_f}{\mu_1 q_1}$, and the severity of PROOs are unobservable. For lack of relative price data, the number of FTAs is used as an instrumental variable (IV) for the relative price of imported inputs, $\sum_{f=2}^{F} d_{gf} \ln\left(\frac{\mu_f q_f}{\mu_1 q_1}\right)$. The idea is that, since FTAs increase the relative price of imported inputs from non-members, the influence of FTAs on the import price of a country would increase with the number of FTAs it enters into.[14]

The demand functions for imports by origin given in share form sum to unity. Given two groups of countries, only one equation is independent. Then, under the assumption that the relative price of imported inputs has a random part with country fixed effects (c_g), time fixed effects (r_t), and a random component (e_{gt}), the cost share equation to be estimated can be expressed as

$$s_g^M = d_g + r_t + d_1 FTA + d_2 CU + d_3 PROO + e_{gt} \quad (3A),$$

where $d_g = b_g + c_g$, *FTA* is the number of FTAs the importing country has entered into, *CU* the number of customs unions the importing country has concluded, both of which are used as instruments for the relative price of imported inputs, and *PROO* represents the restrictiveness of PROOs.

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[14] Yet the number of FTAs is not likely to be correlated with the demand for imports from non-member. Nor is it correlated with the error term.

FTA in equation (3A) corresponds to $\sum_{f=2}^{F} d_{gf} \ln\left(\frac{\mu_f q_f}{\mu_1 q_1}\right)$ in equation (3), and *CU* enters equation (3A) to control for the factors other than the number of FTAs that might have influence on the import share of a country's FTA partners, in particular, the effect of transiting to customs union on the number of FTAs.

Equation (3A) includes *PROO* as a measure for the relative intensity of restrictiveness. The restrictiveness of PROOs reflects the openness and inclusiveness of FTAs (Estevadeordal et al. , 2009, 23). It indicates the degree of restrictions on the use of non-originating inputs and on the structure of origin regime including the size of signatories to FTAs. The restrictiveness of PROOs varies across FTAs, which can be distinguished in accordance with their relative severity of PROOs. For example, FTAs entered into by the European Union have the most restrictive origin rules.

While the influence of restrictive PROOs on the composition of origins can be inferred from *PROO* in equation (3*A*), the influence of restrictive PROOs on the level of total imports is captured by θ_i, the technology factor, in equation (2A). Both FTAs and restrictive PROOs affect the terms of trade, although they move in the opposite direction, and "productivity" through a change in the GDP price index.[15] The origin-specific price change due to FTAs increases imports from a member-country, which is equivalent to a positive "neutral technological" change. However, restrictive PROOs partly reverse the change by inducing the importing country to source cheaper inputs from elsewhere. Thus, restrictive PROOs partly offset the positive change in the level of total imports from a member-country due to FTAs.

Trade Diversion and Trade Creation in the Presence of Restrictive PROOs

A. Decrease in Trade Diversion Due to Restrictive PROOs

The extent of trade diversion (*TD*) is inferred from the change in the elasticity of substitution. The elasticity of substitution between import sources is proportional to the price elasticity of demand normalized by the import share of the source country, which is given by

$$\sigma_{gf}^{M} = \left\{p_M\left[\partial^2 p_M(\cdot)/\left(\partial q_g \partial q_f\right)\right]\right\}/\left\{\left[\partial p_M(\cdot)/\partial q_g\right]\left[\partial p_M(\cdot)/\partial q_f\right]\right\} = \eta_{gf}/s_f^M \qquad (4),$$

where $\eta_{gf} \equiv \left(\partial \ln y_g(\cdot)/\partial \ln q_f\right)$ is a logarithmic change in the demand for imports from country g (y_g) due to a logarithmic change in the price of imports from country f (q_f), and s_f^M is the share of

[15] Feenstra (2004, 424-426)

country f in total imports.[16] With the level of aggregate imports fixed at y^M, the elasticity of substitution for an FTA with restrictive PROOs is expressed as $\hat{\sigma}_{gf}^M = \left(\hat{d}_1 + \hat{d}_3 + \hat{s}_g^M \hat{s}_f^M\right) / \left(\hat{s}_g^M \hat{s}_f^M\right)$[17], the elasticity of substitution for an FTA without restrictive PROOs as $\tilde{\sigma}_{gf}^M = \left(\tilde{d}_1 + \tilde{s}_g^M \tilde{s}_f^M\right) / \left(\tilde{s}_g^M \tilde{s}_f^M\right)$, and the elasticity of substitution before an FTA as $\bar{\sigma}_{gf}^M$.

For a given level of aggregate imports, the change in trade diversion (*TD*) is defined as the change in the elasticity of substitution:

$$\frac{\Delta TD}{s^M \pi(\cdot)} = \Delta \sigma_{gf}^M \qquad (5),$$

where $s^M \pi(\cdot)$ denotes aggregate imports and $\Delta \sigma_{gf}^M$ is the change in the elasticity of substitution.

For an FTA without restrictive PROOs, trade diversion amounts to $\Delta \sigma_{gf}^M = \bar{\sigma}_{gf}^M - \tilde{\sigma}_{gf}^M$, and, for an FTA with restrictive PROOs, trade diversion equals $\Delta \sigma_{gf}^M = \bar{\sigma}_{gf}^M - \hat{\sigma}_{gf}^M$. Thus, if $\left(\bar{\sigma}_{gf}^M - \tilde{\sigma}_{gf}^M\right) > \left(\bar{\sigma}_{gf}^M - \hat{\sigma}_{gf}^M\right)$, the presence of restrictive PROOs decreases the trade diversion effect of FTAs by $\left(\tilde{\sigma}_{gf}^M - \hat{\sigma}_{gf}^M\right)$.

B. Decrease in Trade Creation Due to Restrictive PROOs

An increase in the relative price of imports from non-FTA partners causes not only a change in the composition of aggregate imports, but also a change in the demand for aggregate imports. A change in the demand for aggregate imports is represented by "total price effects," $E_{gf} = \eta_{gf} + s_f^M \varepsilon_{MM}$, where ε_{MM} is the own price elasticity of the demand for imports[18] and $\eta_{gf} = s_f^M \sigma_{gf}^M$ is the price elasticity of demand from equation (4). That is, $E_{gf} = s_f^M \sigma_{gf}^M + s_f^M \varepsilon_{MM} = s_f^M \left(\sigma_{gf}^M + \varepsilon_{MM}\right)$. Total price elasticity for an FTA with restrictive PROOs is $\hat{E}_{gf} = \hat{s}_f^M \left(\hat{\sigma}_{gf}^M + \hat{\varepsilon}_{MM}\right)$, total price elasticity for an FTA

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[16] Kohli (1991, 272). The price elasticities of demand sum to zero because the cost function is linearly homogeneous in import prices, $\sum_{f=1}^{F} \eta_{gf} = \sum_{f=1}^{F} s_f^M \sigma_{gf}^M = 0$. Thus, if the number of origins is limited to two, then $s_f^M \sigma_{gf}^M = -s_g^M \sigma_{gg}^M$ ($\sigma_{gf}^M > 0$, $\sigma_{gg}^M < 0$). Since $s_f^M + s_g^M = 1$, the import market share of a non-member country s_f^M satisfies $\left(1 - \sigma_{gf}^M / \sigma_{gg}^M\right) s_f^M = 1$.

[17] Kohli (1991, 93)

[18] Kohli (1991, 272) discusses total price effects.

without restrictive PROOs is $\widetilde{E}_{gf} = \widetilde{s}_{f}^{M}\left(\widetilde{\sigma}_{gf}^{M} + \widetilde{\varepsilon}_{MM}\right)$, and total elasticity before an FTA is $\overline{E}_{gf} = \overline{s}_{f}^{M}\left(\overline{\sigma}_{gf}^{M} + \overline{\varepsilon}_{MM}\right)$.

A change in total price effects, ΔE_{gf}, represents the extent to which a change in the relative price due to FTAs affects aggregate import flows. While trade diversion is one way that may increase intra-regional trade through a switch in import sources, trade creation (*TC*) is another way that may increase intra-regional trade through an increase in the demand for aggregate imports (through an "income" effect). The change in trade creation relative to total imports is defined as the difference between the change in total price effects and the change in trade diversion.

$$\frac{\Delta TC}{s^{M}\pi(\cdot)} = \Delta E_{gf} - \Delta\sigma_{gf}^{M} \quad (6)$$

The extent of trade creation under an FTA with restrictive PROOs is given by

$$\hat{s}_{f}^{M}\left(\hat{\sigma}_{gf}^{M} + \hat{\varepsilon}_{MM}\right) - \overline{s}_{f}^{M}\left(\overline{\sigma}_{gf}^{M} + \overline{\varepsilon}_{MM}\right) - \hat{\sigma}_{gf}^{M}.$$

The extent of trade creation under an FTA without restrictive PROOs is given by

$$\widetilde{s}_{f}^{M}\left(\widetilde{\sigma}_{gf}^{M} + \widetilde{\varepsilon}_{MM}\right) - \overline{s}_{f}^{M}\left(\overline{\sigma}_{gf}^{M} + \overline{\varepsilon}_{MM}\right) - \widetilde{\sigma}_{gf}^{M}.$$

Both types of trade creation (with and without restrictive PROOs) are positive. Yet the difference between them could be positive or negative. Restrictive PROOs moderate the trade creation effect of FTAs as restrictive PROOs move in the opposite direction of FTAs. However, the extent of moderation depends on the change in the trade diversion effect. Taken together, the extent of trade depression ("reverse" trade creation) due to restrictive PROOs is calculated as

$$\widetilde{s}_{f}^{M}\left(\widetilde{\sigma}_{gf}^{M} + \widetilde{\varepsilon}_{MM}\right) - \hat{s}_{f}^{M}\left(\hat{\sigma}_{gf}^{M} + \hat{\varepsilon}_{MM}\right) - \left(\widetilde{\sigma}_{gf}^{M} - \hat{\sigma}_{gf}^{M}\right).$$

IV. Empirical Results

Data

A panel of variables for years from 1985 to 2009 among 34 OECD countries has been used for estimation at the aggregate level. The data set includes price and quantity series for consumption, investment, exports, imports, and primary factors. The components of national income data are from the Penn World Table 7.0. To obtain the prices of the GDP components, the current dollar values are divided by the corresponding constant dollar values.[19] The price series are normalized to one for 2005. The data are annual covering the period from 1985 to 2009.

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[19] The prices have the form of a direct Paasche price index. Kohli (1991, 116)

For the calculations of the productivity index for each tradable component, the growth in nominal GDP, a revenue share-weighted change of component price indexes and a factor share-weighted average of the growth in primary inputs have been substituted into the Feenstra (2004) formula. The growth rate data for labor and capital endowment are from STAN indicators (Structural Analysis databases indicators).

For the disaggregation of imports by region of origin, the trading partners of each country are divided into two groups: members and non-members of FTAs. Imports by region of origin data are from UN Comtrade. Information on FTA and CU membership is from the World Trade Organization.

PROOs are regulatory barriers to trade, whose restrictiveness is not easily quantifiable. Nevertheless, various types of restrictiveness indexes have been devised for empirical purposes.[20] A customarily used measure is an unweighted (or weighted) average of item-by-item severity indexes, most of which are calculated at the highly disaggregated level (e.g. 6-digit HS level). However, this paper adopts an aggregate index calculated at the FTA level instead. The restrictiveness of PROOs in a particular FTA is calculated as a relative "distance" from the least restrictive non-preferential rules of origin.[21] How much "restrictive" PROOs in an FTA a country has entered into are depends on how far its restrictiveness is from the restrictiveness index of non-preferential rules of origin. The objectives of non-preferential rules of origin are different from those of PROOs. Non-preferential rules of origin are auxiliary to numerous trade-policy instruments. Yet non-preferential rules of origin provide a good point of reference.

Estevadeordal et al. (2009) provides information on the relative restrictiveness of PROOs in different FTAs. In particular, Figure 3 of Estevadeordal et al. (2009) reports the severity of PROOs based on the Harris index, from which the relative "distance" from the least restrictive rules of origin (non-preferential rules of origin) can be determined, and with which the relative severity of PROOs

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[20] Several indexes have been constructed for measuring the restrictiveness of PROOs. Two of the most prominent ones are the Estevadeordal index based on an analytical coding scheme for the product-specific and regime-wide PROOs (Estevadeordal and Suomien (2006, 92-98)) and the Harris index based on variations across products and across agreements in the definition of the rules of origin (Esatevadeordal, Harris, and Suominen (2009)). Estevadeordal has used two coding methods: restrictive indexes and facilitation indexes. The restrictiveness index measures the stringency of product-specific rules, and the facilitation index refers to the net effect of regime-wide rules that could either enhance the severity of product-specific rules or ease it. On the other hand, the Harris index is based on a rule that adds or subtracts points depending on the magnitude of the required change of classification and the required value content (Estevadeordal et al. ,2009). The Harris index also captures details of the variation across products and across agreements in defining the strictness of PROOs. Other indexes are also available. For example, Cadot et al. (2005) have constructed a synthetic index called R-index. The R-index highlights a common set of rules of origin that can affect countries differently depending on their export structures, and considers how their complexity varies across sectors. The R-index explains differences in the rate at which preferences are used.

[21] Estevadeordal et al. (2009, 26)

can be compared across FTAs. *PROO* in equation (3A) uses the standardized distance measure based on the Harris index. The *PROO* variable measures the extent to which the average restrictiveness of PROOs associated with FTAs a country in question has entered into is above the restrictiveness of non-preferential rules of origin. The restrictiveness indexes are indicative of orders of magnitude rather than a precise measure of restrictiveness. A country faces "relatively more restrictive" PROOs if the indexed measure of PROOs in FTAs it has entered into is far greater than that of the non-preferential PROOs.

—— Table 1 ——

Estimation

Estimation proceeds in two stages: the derived demand for each import source is estimated in the first stage and the aggregate import demand function in the second stage. The dependent variable in the "import allocation" model (3*A*) is the percentage share of FTA partners' in total imports, and the explanatory variables include the relative distance from the least restrictive PROOs and the numbers of FTAs and CUs.

The effect of restrictive PROOs on the FTA share is expected to be negative, since restrictive PROOs work as "indirect taxes" to offset the benefits of tariff preferences. The share of imports from FTA partners is positively related to the number of FTA partners, but it is negatively related to the number of CU partners since, in some instances, the number of FTA partners and the number of CU partners move in the opposite direction. For example, with EU expansion, former FTA partners of some EU members have become their new CU partners. For some EU members, a decrease in the number of FTA partners has been exactly offset by an increase in the number of CU partners.

In estimating the import aggregator function (3*A*), panel-data estimation methods such as first-difference (FD), fixed effects (FE), instrumental variables (IV) and dynamic panel-data (DPD) methods have been used to allow for various assumptions about possible correlation between the unobserved effect in the error term and the explanatory variables. First-differencing (FD) eliminates the unobserved effects. It is especially useful when the idiosyncratic error e_{it} is correlated over time or when it is a random walk. The fixed effects (FE) model controls for unobserved individual heterogeneity that influences both the restrictiveness of PROOs and the FTA share of trade flows simultaneously. In the standard panel estimation of equation such as (3*A*), fixed effects rather than random effects models are preferred.[22]

When the unobserved heterogeneity is suspected to be correlated with the explanatory variables, IVs orthogonal to the idiosyncratic errors are employed to deal with such an endogeneity problem. First-differenced IVs (FDIVs) and fixed effect IVs (FEIVs) remove the endogeneity bias by allowing for arbitrary correlations of the unobserved heterogeneity with the restrictiveness of PROOs. In the IV models, the IV for *PROO* is generated from a function of exogenous variables such as the change in the share of FTA trade in total trade under PTA (the sum of FTA trade and CU trade) and the difference in PROO structure across various regimes. The severity of new PROOs may decrease or increase with the share of FTA trade in total trade under PTA, while the current share of intra-FTA trade may not be affected by the change in the share of FTA trade. The current ratio of FTA trade to PTA trade may affect the current share of intra-FTA trade, but the change in the ratio of FTA trade to PTA trade from the previous period to the present may not. On the other hand, each PROO regime has its own criteria distinguishable from one another. Variations in the structure of PROO regimes often cause greater uncertainty about the restrictiveness of PROOs. The severity of PROOs is likely to vary with the structure of PROOs. For example, as PANEURO and NAFTA systems differ in their structure, selectivity and severity, so their relative restrictiveness differs accordingly.

Finally, the severity of PROOs may change over time and vary against different trading partners. Dynamic panel-data (DPD) estimation is appropriate for addressing the case where adjustment to equilibrium occurs with a lag in response to changes in the severity of PROOs.

In fixed-effects and fixed-effects IV models, both country-specific and time-specific individual effects are controlled for. However, for first-differenced models or dynamic panel-data models, only time effects are controlled for, since country-specific effects are differenced out or first-differenced instruments are applied.[23]

The first-stage estimation results are reported in Table 2. The estimates show marginal effects. In the static models, the estimates of PROOs range from (-0.015) to (-0.034), while the estimates of FTAs lie inside the range from (0.028) to (0.040). The static models provide evidence that, while the moderation effect of PROOs is real, it does not fully offset the price effect of FTAs. A comparison of FTA coefficients with PROO coefficients reveals that the moderation effect of PROOs (which is largest for the FD model and smallest for the FETW model) falls short of the initial effect of FTAs. In the

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[22] The Hausman Test also rejects a random effects model relative to a fixed effects model.
[23] Wooldridge(2002), 284

dynamic models, the long-run coefficient of PROOs is obtained from the slope of PROOs divided by (**1- the speed of adjustment**). The speed of adjustment is inferred from the estimated coefficient of the lagged dependent variable reported in the columns of the dynamic models ((0.304) for Arellano-Bond estimation and (0.321) for system dynamic estimation). For example, the calculation of the long-run PROO effect yields (-0.019) for Arellano-Bond estimation and (-0.047) for system dynamic estimation. The dynamic effect inferred from Arellano-Bond GMM procedures is smaller than the static effect of FE and FD models except FEAR1. Yet system dynamic panel-data estimation provides a much larger coefficient than any static FE or FD models. The system dynamic effect is greater than the static effect in those models where adjustment to a change in the restrictiveness of PROOs is immediate. The moderation effect of PROOs is smaller than the long-run effect of FTAs in Arellano-Bond estimation like in the static models, but it is greater than the long-run effect of FTAs in system dynamic estimation. The system estimation result indicates that the moderating effect of PROOs can become large enough to nullify the effect of FTAs in the long-run.

The estimates of PROOs are statistically significant except in the IV models, and the signs of estimates are consistent with theoretical speculation. That is, the more restrictive are PROOs, the greater will be the moderation effect on trade diversion away from non-FTA trading partners and trade creation within FTAs. As the severity of PROOs increases, the FTA members' share in total imports will decrease by the estimated amount. The moderation effect lies within the range of (-0.015)(FEAR1) and (-0.047)(SYSDP). For example, one unit increase in the standardized Harris index in the FEAR1 model with both FTA and CU numbers controlled for would decrease the FTA partners share in total imports by (0.015). The effect of an increase in the number of FTA partners on the FTA shares ranges from (0.028) (FEAR1) to (0.046) (SYSDP). The effect of an increase in the number of FTA members on the FTA share is greater than the moderation effect of an increase in the restrictiveness of PROOs on the FTA share except in the case of system dynamic estimation. This result implies that the direct effect of FTAs is greater than the indirect effect of PROOs. On the other hand, an increase in the number of CU partners reduces the FTA shares by (-0.011) (FEAR1) at the least and (-0.016) (SYSDP) at the most. The effect of joining CUs on the FTA share is smaller than the effect of PROOs in the absolute value. The estimates of PROOs in the IV models are not statistically significant, which reflects difficulty in finding a truly exogenous instrument. The generated instrument applied in the IV models might be correlated with the idiosyncratic errors.

—— Table 2 ——

In the second-stage, translog share functions (i.e. GDP components) are estimated. Since the share equations (2*A*) add up to unity, the covariance matrix is singular. To secure a variance matrix of full rank, one of the share equations has to be omitted from the system of estimating equations. The estimation method used is panel SUR (XTSUR), which is a Stata module to perform one-way random effect estimation of seemingly-unrelated regressions (SUR) on unbalanced panel data. This panel SUR method has been applied to the first-differenced model. The estimation of the first-differenced model is carried out with time dummies. Pooled SUR has been used to estimate the two-way fixed effects and first-differenced models for reference.

For the import share equation, the parameter estimate of the technology factor, $\ln\theta_M$, is expected to be non-negative. The estimate of γ_{MM}, the coefficient on $\ln\theta_M$, is equivalent to the "own-price" effect: technology improvement should increase aggregate imports (i.e. composite imported inputs). The technology parameter estimate is statistically significant at the 10.5 percent level. Productivity growth in the importable good sector improves the terms of trade, and increases the amount of importable inputs. As shown in Table 3, the estimate of the technology parameter is positive in the first-differenced panel SUR model. That is, one "unit improvement" in productivity due to using imported inputs increases the total import share by (0.485) percentage points.

The negative sign on the coefficient estimate of $\ln\theta_X$ is consistent with the hypothesis that technology improvement in the exportable good sector reduces aggregate imports. With deterioration in the terms of trade, a smaller amount of imports will be available for a given amount of exports. The sign on the factor proportions term ($\Delta\ln K/L$) is negative. One interpretation for this result is that the deepening of capital-labor ratio decreases aggregate imports. The capital-labor ratio increases if an increase in the endowment of capital is greater than an increase in the endowment of labor. The standard estimation results of the revenue function indicate that an increase in capital reduces imports and an increase in labor raises the demand for imports.[24] An increase in capital reduces the demand for imports because capital and imports are substitutes, and an increase in labor stimulates the demand for imports because the demand for imports responds strongly to a change in labor supply.[25] Thus, when the capital-labor ratio increases, the reduction in imports resulting from an increase in capital endowment more than offsets the increase in the demand for imports resulting from an increase in labor endowment. Taken together, the net effect will be positive. Alternative interpretation is that abundance in capital per worker is associated with a smaller import share

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[24] Kohli (1991, 185)
[25] Kohli (1991, 170)

because an increase in ($\Delta \ln K/L$) will induce a wide retention of capital-intensive production at home, which in turn leads to less use of imported inputs from abroad. The above interpretations are consistent with the estimation results. The coefficient estimates of the relative factor supply term in the pooled SUR models and the first-differenced panel SUR model are negative and statistically significant.

—— Table 3 ——

Calculations of the effect of PROOs on trade diversion and trade creation

The number of OECD members' FTA partners had changed 176 times over the sample period between 1985 and 2009. For new FTAs concluded among OECD members, the number of partners increased 143 times out of 176 incidents. The number of FTA partners decreased 33 times as some existing FTAs had been transformed into CUs. For example, the number of FTA partners for EU members decreased, when EU had expanded and replaced former FTAs with a customs union. Calculations of PROO effects on trade diversion and trade creation are possible for 74 out of 143 cases where the number of FTA partners has increased.

Unlike trade creation and trade diversion, "reverse trade diversion" and "trade depression" are caused by PROOs. The extent of reverse trade diversion and trade depression have been calculated for two representative estimates of PROOs ((0.019) from the two-way fixed effects model and (0.047) from the system dynamic model), which have been chosen to represent the short- and long-run effects respectively. The corresponding changes in elasticities are not reported here.[26] However, their averages are reported in Table 4A and Table 4B.

The elasticity of substitution σ_{gf} and the "price" elasticity of demand η_{gf} turn out to be positive. This result is consistent with the assumption that FTA members and non-FTA members are substitutable import sources.

In the total "price" effect, $E_{gf} = \eta_{gf} + s_f^M \varepsilon_{MM}$, the price elasticity of demand η_{gf} is positive since non-members and members are substitutable as an import source. The own price elasticity of the demand for aggregate imports, ε_{MM}, is normally negative. Yet if weighted elasticity $s_f^M \varepsilon_{MM}$ is not large enough in the absolute value to exceed the positive elasticity of demand η_{gf}, the total price effect E_{gf} will be positive. E_{gf} is normally larger than η_{gf}. In other words, the own price effect is

[26] They are available on request.

greater when the level of aggregate imports changes than when their level is fixed. This explains why intra-regional trade expands in response to an increase in the relative price of non-members caused by the formation of an FTA.

A decrease in total price elasticity indicates that non-members become less substitutable for FTA partners as an import source. However, PROOs largely offset the effect of tariff preferences allowed to member countries as they moderate the loss in the substitutability of imports from non-members for imports from FTA partners. ΔE_{gf} in the first and second columns of Table 4C shows that PROOs reverse a decrease in the substitutability of non-members for FTA partners due to an expansion of FTA partners, and that the dynamic effect is greater in the static effect. Without PROOs, the adverse effect of FTAs on non-members would have been much greater. Moreover, as it can be inferred from the difference between the static- and dynamic estimates ((0.063) and (0.210)), the moderation effect accumulates over time.

PROOs moderate the diversion effect of FTAs as shown in the third and fourth columns of Table 4C. The moderation effect is greater in the dynamic model than in the static model. In the dynamic model, the effects of PROOs and FTAs almost cancel each other out. For example, the initial trade diversion effect is reversed by 25.5 percent. In the static model, however, moderation is relatively weak. The initial trade diversion effect is reduced by only 7.7 percent. Without PROOs, the trade diversion effect would have been much greater. The presence of PROOs is analogous to a contraction of FTAs. The substitutability of non-members for FTA partners would have increased if the number of FTA partners decreased. The decrease in the number of FTA partners would have improved the substitutability of non-members. The effects of PROOs on substitutability depend on the direction of changes in the number of FTA partners.

PROOs may help recover substitutability so much that the recovery of the substitutability loss due to FTAs may exceed the recovery of the reduction in total price effects. Trade creation with and without PROOs are both positive. Yet, if trade diversion is initially much greater than trade creation, and if the reduction in trade diversion due to PROOs is substantial, then initial trade creation without PROOs could be smaller than trade creation with PROOs. With given total price effects, the recovery of trade diversion could be so large that the change in trade creation could be negative as shown in the fifth and sixth columns of Table 4C. Trade depression is (-1.4) percent in the static model and (-4.5) percent in the dynamic model. Again, the change in trade creation is greater in the dynamic model than in the static model.

—— Table 4 ——

V. Conclusion

This paper has looked into the "moderation" effect of restrictive PROOs on trade creation and trade diversion initially caused by FTAs. A two-stage process, in which the appropriate mix of import sources and the optimal level of aggregate imports along with the other GDP components are determined consecutively, has been used to infer the effects of FTAs (and restrictive PROOs) on trade creation and trade diversion.

Trade diversion is defined as a decrease in the elasticity of substitution, while trade creation a "compensating variation," both of which are associated with the properties of the isoquants. Trade diversion occurs when FTAs cause a decrease in the elasticity of substitution implies to make imports from non-member countries less substitutable for imports from FTA partners for a given amount of total imports. On the other hand, trade creation occurs if the change in the total price elasticity due to FTAs is greater than the change in the elasticity of substitution. However, restrictive PROOs partly reverse these processes. The effects of restrictive PROOs on trade diversion and trade creation are moving in the opposite direction of those of FTAs. What is interesting is that the respective effects of FTAs and restrictive PROOs on trade diversion/trade creation may differ in the absolute value.

Empirical results in this paper confirm that, while the "gross" substitutability between imports from non- members and FTA members decreases under FTAs, restrictive PROOs counteract the initial effect of FTAs (i.e. restrictive PROOs cause the substitutability to move in the opposite direction). It is theoretically conceivable that restrictive PROOs might more than fully offset the benefits of preferential tariff reductions to FTA members, but such an unusual result did not occur. Findings in this paper suggest that restrictive PROOs may hinder the trade creation and trade diversion effects of FTAs from being fully materialized, but will not totally eliminate them. Still, FTA member-country producers in general will be able to increase their share of exports at the expense of non-member producers. Indeed, "net" trade diversion occurred in 33 OECD countries as a whole over the sample period. Also "net" trade creation occurred on average because the magnitude of trade diversion was not large enough to cancel off decrease in imports due to the gross substitution ("cross-price") effect.

While restrictive PROOs partly offset the advantages of FTAs to member-country producers obtainable at the expense of non-member producers, FTA member-country consumers may nevertheless lose from trade distortion due to preferential trade arrangements. The total amount of importable goods available to FTA member-country consumers may decrease even in the presence of "net" trade creation, since trade diversion from non-members to FTA members (the initial substitution effect) may not be fully offset by the "reverse" substitution effect of restrictive PROOs.

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Table1: GDP component shares, factor growth rates and intraregional shares in total trade (average, 1985-2009)

	C share	I share	X share	M share	L share	K share	K growth (%)	L growth (%)	Intra-region trade (billion US$)	FTA trade/ total trade	FTA partner	CU trade/ total trade	CU partner
Australia	0.75	0.23	0.19	0.16	0.73	0.27	1.1	1.4	48.3	0.12	1.3	0.00	0.0
Austria	0.76	0.22	0.41	0.39	0.79	0.21	0.6	0.6	78.6	0.10	7.9	0.77	15.4
Belgium	0.77	0.21	0.66	0.63	0.76	0.24	0.8	0.2	240.0	0.04	7.7	0.83	17.7
Canada	0.77	0.19	0.33	0.28	0.78	0.22	1.1	1.1	183.0	0.59	2.9	0.00	0.0
Chile	0.71	0.19	0.34	0.24	.		.	.	10.9	0.33	9.7	0.00	0.0
Czech	0.74	0.24	0.51	0.49	.		.	.	43.5	0.49	14.2	0.31	7.4
Denmark	0.76	0.18	0.40	0.34	0.75	0.25	1.0	0.3	43.6	0.14	7.2	0.76	14.3
Estonia	0.72	0.31	0.48	0.52	.		.	.	4.5	0.49	13.3	0.33	8.0
Finland	0.77	0.20	0.32	0.29	0.77	0.23	0.5	-0.2	28.5	0.14	7.2	0.50	11.2
France	0.81	0.19	0.21	0.21	0.77	0.23	0.7	-0.1	292.0	0.07	7.4	0.76	15.9
Germany	0.79	0.19	0.29	0.27	0.74	0.26	0.5	-0.3	383.0	0.11	6.5	0.64	14.0
Greece	0.88	0.19	0.19	0.27	.		.	.	27.1	0.04	6.6	0.80	14.3
Hungary	0.80	0.21	0.43	0.43	.		.	.	30.2	0.54	13.6	0.29	6.7
Iceland	0.83	0.20	0.31	0.33	.		.	.	2.4	0.77	22.1	0.00	0.0
Ireland	0.69	0.23	0.62	0.55	0.80	0.20	0.8	1.2	39.9	0.04	7.2	0.68	15.2
Israel	0.84	0.21	0.34	0.39	.		.	.	26.7	0.74	20.0	0.00	0.0
Italy	0.79	0.19	0.24	0.23	0.75	0.25	0.8	0.3	211.0	0.08	7.4	0.79	15.9
Japan	0.74	0.25	0.10	0.10	0.75	0.25	0.9	-0.3	164.0	0.01	0.4	0.00	0.0

Korea	0.71	0.32	0.25	0.28	0.78	0.22	1.7	0.7	89.4	0.01	0.8	0.00	0.0
Luxembourg	0.59	0.20	1.33	1.12	.		.	.	14.8	0.02	7.7	0.92	17.7
Mexico	0.79	0.21	0.20	0.20	.		.	.	122.0	0.71	13.3	0.00	0.0
Netherlands	0.76	0.19	0.51	0.46	0.75	0.25	0.8	0.8	151.0	0.06	7.2	0.72	15.1
New Zealand	0.77	0.21	0.26	0.24	0.75	0.25	0.9	0.8	11.8	0.29	1.0	0.00	0.0
Norway	0.63	0.20	0.43	0.25	.		.	.	37.3	0.83	24.2	0.00	0.0
Poland	0.82	0.20	0.25	0.26	.		.	.	56.7	0.55	13.5	0.32	7.5
Portugal	0.83	0.22	0.25	0.30	0.81	0.19	0.8	0.5	34.6	0.05	7.3	0.87	14.0
Slovak	0.77	0.27	0.53	0.57	.		.	.	15.1	0.51	14.1	0.32	7.5
Slovenia	0.76	0.24	0.55	0.54	.		.	.	11.9	0.29	9.7	0.34	7.5
Spain	0.75	0.26	0.21	0.22	0.77	0.23	1.2	1.2	135.0	0.05	6.9	0.80	14.3
Sweden	0.80	0.17	0.37	0.34	0.76	0.24	0.9	0.2	71.1	0.18	8.2	0.64	13.6
Switzerland	0.72	0.22	0.40	0.34	0.74	0.26	0.8	0.5	82.7	0.88	22.2	0.00	0.0
Turkey	0.83	0.18	0.16	0.17	.		.	.	39.5	0.06	4.9	0.48	11.0
U.K.	0.85	0.16	0.22	0.23	0.78	0.22	1.0	0.5	282.0	0.11	7.6	0.68	15.5
U.S.A.	0.86	0.17	0.09	0.12	0.81	0.19	0.9	0.8	713.0	0.43	3.3	0.00	0.0
Total	0.77	0.21	0.36	0.34	0.77	0.23	0.9	0.5	109.0	0.29	9.0	0.38	7.8

Source: Penn World Table 5.6, 7.0; STAN indicators; UN Comtrade; and WTO

Table 2: Demand for imports from FTA partners

method	FE	FETW A	FEAR1 A	FEIV A	FD A	FDIV A	ABDP B	SYSDP B
	ftashare	ftashare	ftashare	ftashare	Δ ftashare	Δ ftashare	ftashare	ftashare
FTA share L.1							0.304*** (0.020)	0.321*** (0.062)
PROOs	-0.023*** (0.008)	-0.019*** (0.007)	-0.015* (0.008)	-0.034 (0.030)			-0.013*** (0.005)	-0.032* (0.018)
FTA number	0.029*** (0.001)	0.039*** (0.008)	0.028*** (0.002)	0.040*** (0.002)			0.031*** (0.002)	0.031*** (0.004)
CU number	-0.012*** (0.001)	-0.014*** (0.004)	-0.011*** (0.001)	-0.014*** (0.002)			-0.011*** (0.001)	-0.011*** (0.002)
Δ PROOs					-0.034** (0.015)	-0.023 (0.077)		
Δ FTA number					0.036*** (0.002)	0.036*** (0.002)		
Δ CU number					-0.014*** (0.001)	-0.014*** (0.001)		
constant	0.127*** (0.018)	0.148** (0.073)	0.128*** (0.006)	0.106** (0.045)	-0.014 (0.016)	-0.003 (0.008)	0.119*** (0.021)	0.026 (0.043)
controls	country	country time	country	country time	time	time	time	time
ρ C	0.79	0.85	0.93	0.86	0.06			
R^2	0.823	0.825	0.826	0.849	0.835	0.835		
data points	517	517	483	483	482	482	454	489

[A] Country and time effects are controlled for, but their coefficient estimates are not reported for brevity. Superscripts (*) (**) (***) indicate 10, 5, 1 percent significant levels respectively.
[B] Time effects are controlled for, but their coefficient estimates are not reported for brevity.
[C] ρ indicates the fraction of variance due to individual effects.

FD – first-difference; FE – fixed effects; FETW – two-way fixed effects; FEAR1 – fixed effects with AR(1) disturbances; FDIV – first-differenced instrumental variables; FEIV – fixed effects instrumental variables; ABDPD – Arellano-Bond dynamic panel-data estimation; and SYSDPD – system dynamic panel-data estimation

Table 3: Supply of consumption and investment goods and demand for aggregate imports[A]

Pooled SUR two-way fixed effects				Pooled SUR first-differenced				Panel SUR[B] first-differenced: GLS			
	scp	**sip**	**smp**		Δ **scp**	Δ **sip**	Δ **smp**		Δ **scp**	Δ **sip**	Δ **smp**
$\ln\theta_X$	0.111 (0.391)	-2.299*** (0.476)	-1.675*** (0.502)	$\Delta\ln\theta_X$	-0.148 (0.404)	-1.553*** (0.496)	-0.829 (0.562)	$\Delta\ln\theta_X$	-1.739*** (0.219)	-1.157*** (0.232)	-0.550** (0.238)
$\ln\theta_M$	-0.370 (0.457)	2.494*** (0.588)	1.987*** (0.598)	$\Delta\ln\theta_M$	0.250 (0.475)	1.106* (0.584)	0.835 (0.661)	$\Delta\ln\theta_M$	1.486*** (0.273)	1.111*** (0.290)	0.485 (0.299)
$\Delta\ln K/L$	0.218*** (0.048)	-0.413*** (0.061)	-0.200*** (0.065)	$\Delta\ln K/L$	0.113** (0.058)	-0.149** (0.071)	-0.161** (0.081)	$\Delta\ln K/L$	0.351*** (0.028)	-0.309*** (0.030)	-0.194*** (0.030)
lagged dependent variable	0.927*** (0.018)	0.982*** (0.024)	0.975*** (0.015)								
controls	country and time effects	country and time effects	country and time effects	controls	time effects	time effects	time effects	controls	time effects	time effects	time effects
data points	431	431	431	data points	411	411	411	data points	411	411	411

[A] Country and time effects are controlled for, but their coefficient estimates are not reported for brevity. Superscripts (*) (**) (***) indicate 10, 5, 1 percent significant levels respectively.
[B] XTSUR is a module to perform one-way random effect estimation of seemingly-unrelated regressions (SUR) on unbalanced panel data.
scp(percent consumption share); **sip**(percent investment share); **smp**(percent import share)

Table 4A: averages of substitution elasticity

σ_{gf}^{s}	σ_{gf}^{sp}	σ_{gf}^{d}	σ_{gf}^{dp}
static without PROOs	static with PROOs	dynamic without PROOs	dynamic with PROOs
1.157	1.080	1.068	0.813

Table 4B: averages of partial price effects

η_{gf}^{s}	η_{gf}^{sp}	η_{gf}^{d}	η_{gf}^{dp}
static without PROOs	static with PROOs	dynamic without PROOs	dynamic with PROOs
1.089	1.014	1.001	0.749

Table 4C: averages of change in total price effects, "reverse" trade diversion and "trade depression" due to PROOs[A]

ΔE_{gf}^{s} (static)	ΔE_{gf}^{d} (dynamic)	$\Delta\sigma_{gf}^{s}$ (static)	$\Delta\sigma_{gf}^{d}$ (dynamic)	ΔTC_{gf}^{s} (static)	ΔTC_{gf}^{d} (dynamic)
change in total price effects	change in total price effects	reverse trade diversion	reverse trade diversion	trade depression	trade depression
0.063	0.210	0.077	0.255	-0.014	-0.045

[A] Superscript *s* indicates that the parameter estimate of the two-way fixed effect model (0.019) has been applied to the calculations of elasticities, trade diversion, and trade depression. Superscript *d* indicates that the parameter estimate of the system dynamic model (0.047) has been applied to the calculations of elasticities, trade diversion, and trade depression.

[B] The number of new FTA partners has increased in 74 cases ($\Delta FTA > 0$).