KIEP Working Paper 09-07

# The Impact of Mutual Recognition Agreements on Foreign Direct Investment and Export

Yong Joon Jang

KIEP Korea Institute for International Economic Policy

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# Executive Summary

This paper analyzes the trade-off relationship between exports and horizontal FDI in response to a mutual recognition agreement (MRA) for technical regulations and certification procedures for import goods. As an MRA is concluded to reduce entry costs of exporting, multinationals (MNEs) derive more benefits from economies of scale than from tariff-jumping strategies, implying that they have more incentive to export than to perform horizontal FDI. In order to prove the above argument, the paper develops a monopolistic competition model with international trade, heterogeneous firms and MRA, based on the work of Helpman, Melitz and Yeaple (2004); and then tests empirically the theoretical results, utilizing data from U.S. multinational affiliate sales and exports. The empirical results show that MRAs have positive effects on the U.S. exports relative to horizontal FDI, bringing the results in line with the theoretical model.

**Keywords: MRA, FDI, Non-Tariff Barriers, TBT, Firm Heterogeneity**

*JEL Classification*: F12, F14, F23, F53

## 국문요약

본 논문에서는 무역상 기술장벽(TBT: Techinical Barriers to Trade)의 해결수단으로 최근 각광받고 있는 기술규제 및 적합성 평가절차에 대한 상호인정협정(MRA: Mutual Recognition Agreement)의 수출과 외국인직접투자에 대한 효과를 분석하고 있다. 각 국가간 MRA의 체결이 수출시장에 대한 진입비용을 낮춤에 따라, 다국적기업은 현지에 공장을 직접 설립하는 수평적 외국인직접투자(Horizontal FDI)를 추진하기보다는 수출을 통해 해외시장에 진출할 유인을 더 가지게 된다. 이는 MRA를 통해 다국적기업이 수평적 FDI를 통한 수출비용 절감효과보다는 수출을 통한 규모의 경제효과에서 더 이득을 보기 때문이다. 이를 증명하기 위해 본 논문은 Helpman, Melitz, and Yeaple(2004)의 독점적 경쟁시장 모형을 확장 개발하였고, 미국의 다국적기업 데이터를 이용하여 실증적 분석을 시도하였다. 연구 결과 MRA는 미국 다국적기업의 수평적 FDI에 대비하여 상대적으로 수출에 긍정적인 영향을 미치는 것으로 분석되었고, 이는 이론 모형의 결과와 일치하는 것으로 나타났다. 이러한 결과는 우리나라의 수출 및 FDI 진흥정책에 MRA가 어떠한 영향을 미칠 수 있는지에 대한 정책적 시사점을 도출하는 데 기초자료로 활용할 수 있다는 점에서 그 의의가 있다.

**Yong Joon Jang** is an associate research fellow at the Korea Institute for International Economic Policy (KIEP). He received his Ph.D. in Economics at Indiana University, Bloomington. His primarily research fields are International Trade, Industrial Organization, and Empirical Microeconomics. His research interests center on the empirical analysis of the various effects of trade liberalization and trade policy on firm-level economic performance across industries in different countries.

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**저서 및 약력**

「TBT(무역상 기술장벽) 관련 WTO 내 논의동향과 시사점」(오늘의 세계 경제 제39호, 2009) 외

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# The Impact of Mutual Recognition Agreements on Foreign Direct Investment and Export

Yong Joon Jang*

## I. Introduction

As bilateral and multilateral trade agreements such as the various Free Trade Agreements (FTAs), and the World Trade Organization (WTO) and the General Agreement on Tariffs and Trade (GATT) have increased rapidly since the 1990s, there has been a consistent decrease in the average tariff rate in the world according to statistical evidence (see Figure 1). On the other hand, an increasing number of countries are starting to use non-tariff barriers to protect their domestic industries (see Baldwin 2000), as non-tariff barriers have the effect of restricting imports without the overt use of tariffs.

One typical example of a non-tariff barrier is Technical Barriers to Trade (TBT). Countries have different technical regulations, standards and certification procedures regarding specific characteristics of a

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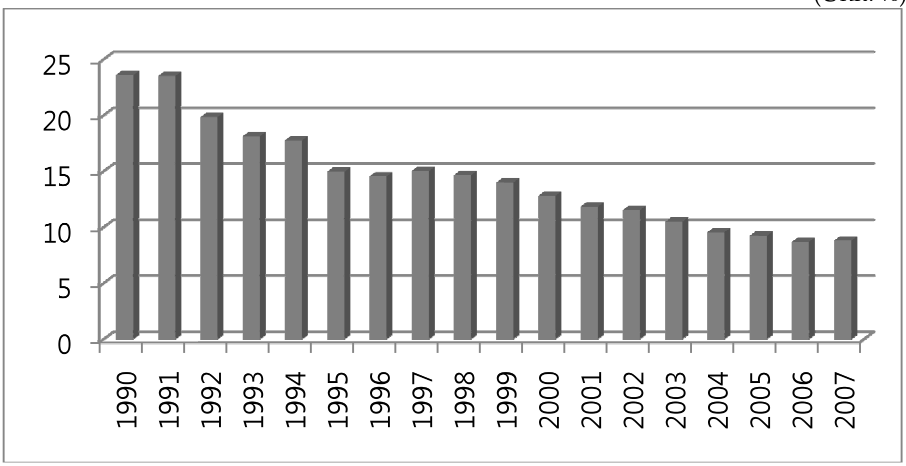
product such as shape, size, function, and production process for human and animal safety reasons, environmental protection and national

**Figure 1. Annual Average Tariff rate**

(Unit: %)

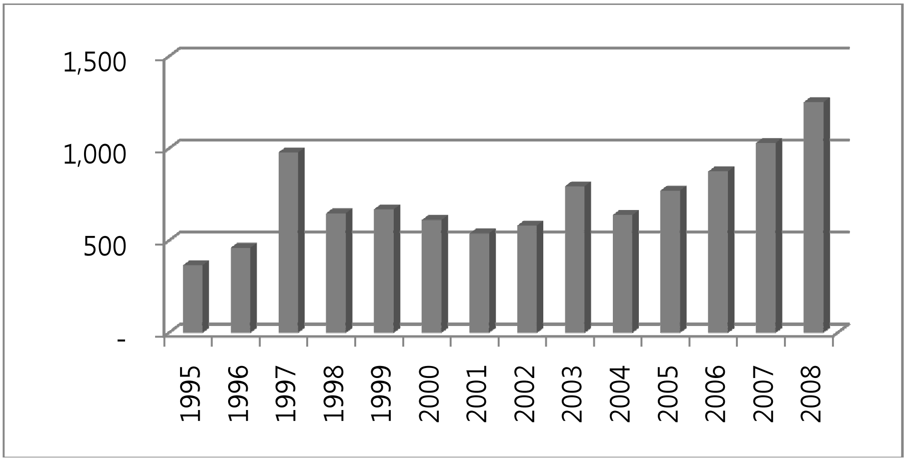



Source: World Bank, *Trends in Average Applied Tariff Rates in Developing and Industrial Countries, 1981-2007*.

security. These differences can create unnecessary obstacles to foreign producers who are made to pay extra costs for exporting. Though these regulations are necessary at times, they can become a guise for protectionism. If a country applies technical regulations without transparency and fairness on import products, these regulations can create unnecessary obstacles to trade.

According to the WTO TBT agreements, WTO members have a responsibility for notifying the WTO TBT committee of new technical regulations before their entry into force, as the notification can increase

**Figure 2. Annual Total Number of TBT Notifications**

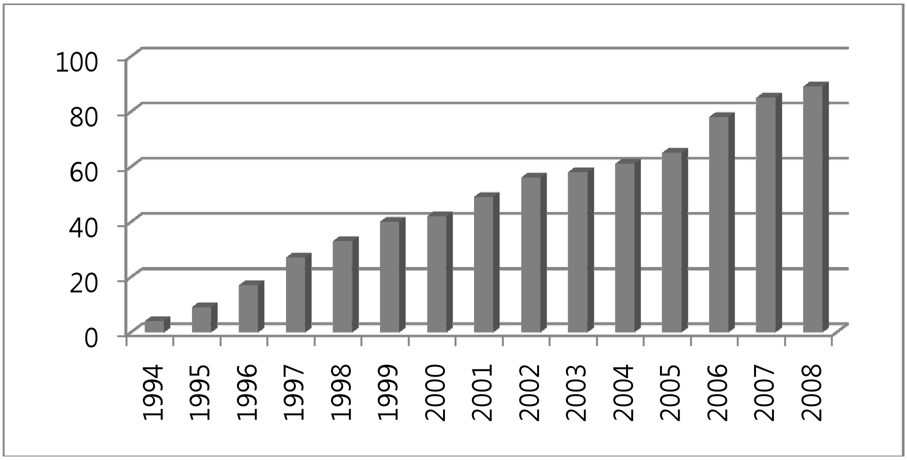



Source: WTO, *Annual Review of the Implementation and Operation of the TBT Agreement*.

transparency of the regulation. Figure 2 shows the total annual number of TBT notifications during the period 1995-2008. The graph shows that the number of technical regulations has increased over the period: the total number of notifications in 2008 is 1,251 which is about three times that of 1995. What is especially of note is that the number has kept increasing since 2004, implying that TBTs are becoming a more heated issue for trade liberalization and globalization recently.

Meanwhile, a mutual recognition agreement (MRA), which two or more countries agree to recognize one another's technical regulations and/or certification procedures, has become a common and useful method for eliminating TBTs. Figure 3 depicts the cumulative number of MRAs during the period 1994-2008. The graph shows that about 89 MRAs have been signed since 1994, and MRAs have kept increasing at an average annual rate of 29%.

**Figure 3. Cumulative Number of Mutual Recognition Agreements**




Source: Documents for notifications of mutual recognition agreements provided by the WTO TBT website.

One important issue in the TBT literature has been whether MRAs have positively affected exports. Recently, Baller (2007) analyzed how regional agreements for the liberalization of TBTs such as harmonization of rules and MRAs affect exports in EU and ASEAN countries, and showed that MRAs have a strong positive influence on exports, while the effects of harmonization are negligible. Chen and Mattoo (2008) also showed that among 28 OECD and 14 non-OECD countries, MRAs promoted trade much more actively compared to harmonization efforts.[1]

[1] See also Henty de Fraha &Vancauteren, 2006 and Wilson & Otsuki, 2004, for similar re-

In this paper, I will attempt to analyze how MRAs affect “horizontal” FDI relative to the relationship with exports: there exists the trade-off between horizontal FDI and exports, i.e., tariff jumping strategy vs. economies of scale.[2] Multinationals (MNEs) can serve foreign markets by constructing production facilities overseas to avoid variable trade costs such as tariffs and transportation costs or they can have all production facilities in their home countries to realize economies of scale and choose to export their products to foreign countries. As a result, when trade costs decrease from MRAs, MNEs may concentrate their activities on one country and develop trade flows rather than open a plant in a foreign member country. As MNEs derive more benefits from economies of scale than tariff jumping strategies after conclusion of MRAs, the relative exports to horizontal FDI sales might increase.

To test this hypothesis, I have developed the theoretical framework which analyzes the relationship between exports and horizontal FDI sales in response to MRA as well as variable trade costs and wage difference between two countries, based on the work by Helpman, Melitz and Yeaple (HMY 2004). After this I have empirically tested the theoretical results with four econometric specifications on U.S. multinationals' affiliate sales and exports in the period 1999-2006. The main results show that MRAs have positive effects on relative values of exports to FDI sales, both theoretically and empirically.

The rest of the paper is organized as follows. In Section 2, I have set

sults.

[2] See Markusen & Venables (1998), Yeyati, Stein & Daude (2003), Helpman, Melitz & Yeaple (2004), and Lesher & Miroudot (2006).

up a theoretical model on the basic framework of HMY (2004). Sections 3 and 4 provide sources of data and empirical specifications to test theoretical results concerning trade-off of exports and horizontal FDI sales in response to MRAs. Section 5 shows the empirical results from the regressions. Finally, the conclusion is provided in Section 6.

# Ⅱ. Theoretical Framework

There are two countries, domestic (1) and foreign (2). Assume that both countries are symmetric in every respect, except that each country is endowed with $L_i$ units of labor with the wage level, $w_i$, and income $M_i$, $w_i L_i = M_i$ ($i = 1\ or\ 2$). In each country, there are homogeneous consumers and heterogeneous firms.

## 1. Demand

A representative consumer has CES preferences over a continuum of differentiated goods indexed by $x$. A consumer's maximization problem is

$$\max_{q(x)} U = \left[\int_{x \in X} q(x)^{\rho} dx\right]^{\frac{1}{\rho}},\ 0 < \rho < 1 \tag{1}$$

$$s.t. \int_{x \in X} p(x) q(x) dx = M_i \tag{2}$$

where $q(x)$ is the demand for $x$, $p(x)$ is the price of $x$, $X$ is the set of goods, $M$ is the income and $\rho$ is the elasticity of substitution across goods with $\rho = \frac{\sigma-1}{\sigma}$ and $\sigma > 1$. From (1) and (2) the equilibrium demand and the price elasticity of demand are

$$q(x) = M_i P^{\sigma-1}\, p(x)^{-\sigma} \tag{3}$$

$$\varepsilon_p = -\frac{dq}{dp}\frac{p}{q} = \sigma \tag{4}$$

where $P$ is the aggregate price index, which is the indirect utility of the CES function, i.e., $P = \left[\int_{x\in X} p(x)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$.

## 2. Production

There is the monopolistically competitive market in which each firm produces a different variety $x$. Let country 1 be domestic. The profit functions for domestic sales, exports and (horizontal) FDI are given by:

$$\pi_D = p_D q_D - \frac{w_1}{\theta} q_D - f_D \tag{5}$$
$$\pi_X = p_X q_X - \frac{w_1 \tau}{\theta} q_X - f_X \tag{6}$$
$$\pi_F = p_F q_F - \frac{w_2}{\theta} q_F - f_F \tag{7}$$

where *D*, *X* and *F* denote domestic sales, export and FDI, respectively. $f_l$, $p_l$ and $q_l$ are fixed costs, price and quantity for *l*, respectively ($l$ = *D* or *X* or *F*). $\tau > 1$ is a per-unit iceberg cost for exporting such as transportation costs, insurance fees and tariffs. $\theta \geq 1$ is the firm's heterogeneous productivity. After entering the market, a firm finds out its productivity $\theta$, which is drawn from a Pareto distribution with the cdf function:

$$F(\theta) = 1 - \theta^{-\gamma},\ \gamma > \sigma - 1 \tag{8}$$

Assume $0 < \frac{M_2}{M_1} f_D < \tau^{\sigma-1} f_X < \left(\frac{w_2}{w_1}\right)^{\sigma-1} f_F$ to ensure a trade-off between realizing economies of scale from exports and use of tariff-jumping strategies from FDI.[3]

[3] See Section 2.3. in detail.

From (3)-(7) the equilibrium prices, quantities and profits for domestics sales, exporting and FDI are as follows:

$$p_D = \frac{w_1}{\rho\theta}\ ,\ p_X = \frac{w_1\tau}{\rho\theta},\ \ p_F = \frac{w_2}{\rho\theta} \tag{9}$$

$$q_D = M_1 P^{\sigma-1}\left(\frac{\rho\theta}{w_1}\right)^{\sigma}, q_X = M_2 P^{\sigma-1}\left(\frac{\rho\theta}{w_1\tau}\right)^{\sigma}, q_F = M_2 P^{\sigma-1}\left(\frac{\rho\theta}{w_2}\right)^{\sigma} \tag{10}$$

From (9) and (10) the equilibrium profits for domestic sales, exports and FDI are

$$\pi_D = \ M_1(1-\rho)\left(\frac{P\rho\theta}{w_1}\right)^{\sigma-1} - f_D \tag{11}$$

$$\pi_X = \ M_2(1-\rho)\left(\frac{P\rho\theta}{w_1\tau}\right)^{\sigma-1} - f_X \tag{12}$$

$$\pi_F = \ M_2(1-\rho)\left(\frac{P\rho\theta}{w_2}\right)^{\sigma-1} - f_F \tag{13}$$

### 3. Cut-off Levels of Productivity for Operation

From the zero-profit condition, $\pi_D = 0$ and $\pi_X = 0$ in (11) and (12), and the condition, $\pi_X = \pi_F$ in (12) and (13), there are three cut-off levels of productivity for operating domestic sales, exporting and FDI, as follows:

$$(\bar{\theta}_D)^{\sigma-1} = \frac{f_D}{M_1(1-\rho)}\left(\frac{w_1}{P\rho}\right)^{\sigma-1} \tag{14}$$

$$(\bar{\theta}_X)^{\sigma-1} = \frac{f_X}{M_2(1-\rho)}\left(\frac{w_1\tau}{P\rho}\right)^{\sigma-1} \tag{15}$$

$$(\bar{\theta}_F)^{\sigma-1} = \frac{f_F - f_X}{M_2(1-\rho)\left[w_2^{1-\sigma}-(w_1\tau)^{1-\sigma}\right]}\left(\frac{1}{P\rho}\right)^{\sigma-1} \tag{16}$$ [4]

[4] If $\bar{\theta}_F < \theta$, then $\pi_X < \pi_F$. Hence a firm whose productivity is greater than $\bar{\theta}_F$ is more likely to have foreign investments instead of exports.

The condition, $0 < \frac{M_2}{M_1} f_D < \tau^{\sigma-1} f_X < \left(\frac{w_2}{w_1}\right)^{\sigma-1} f_F$, assures $0 < \bar{\theta}_D < \bar{\theta}_X < \bar{\theta}_F$.

As a result, after finding out its productivity, a firm with productivity $\theta < \bar{\theta}_D$ (equivalently, $\pi_D < 0$) will exit the market, a firm with $\bar{\theta}_D \leq \theta < \bar{\theta}_X$ (equivalently, $\pi_X < 0 \leq \pi_D$) will serve only the domestic market, a firm with $\bar{\theta}_X \leq \theta < \bar{\theta}_F$ (equivalently, $0 \leq \pi_X < \pi_D$ and $\pi_F < \pi_X$) will serve both the domestic and foreign markets via exports, and finally, a firm with $\bar{\theta}_F \leq \theta$ (equivalently, $0 < \pi_X \leq \pi_F < \pi_D$) will serve both the domestic and foreign markets via horizontal FDI.

From (9) the aggregate price index is defined as:

$$P = \left[\int_{\bar{\theta}_D}^{\bar{\theta}_X} {p_d}^{1-\sigma} dF(\theta) + \int_{\bar{\theta}_X}^{\bar{\theta}_F} {p_X}^{1-\sigma} dF(\theta) + \int_{\bar{\theta}_F}^{\infty} {p_F}^{1-\sigma} dF(\theta)\right]^{\frac{1}{1-\sigma}}$$

$$= \left[\int_{\bar{\theta}_D}^{\bar{\theta}_X} \left(\frac{w_1}{\rho\theta}\right)^{1-\sigma} dF(\theta) + \int_{\bar{\theta}_X}^{\bar{\theta}_F} \left(\frac{w_1\tau}{\rho\theta}\right)^{1-\sigma} dF(\theta) + \int_{\bar{\theta}_F}^{\infty} \left(\frac{w_2}{\rho\theta}\right)^{1-\sigma} dF(\theta)\right]^{\frac{1}{1-\sigma}}$$

$$= \left\{\frac{\rho^{\sigma-1}\gamma\left[w_1^{1-\sigma}\bar{\theta}_D^{\sigma-1-\gamma} + (w_1\tau)^{1-\sigma}\bar{\theta}_X^{\sigma-1-\gamma} + w_2^{1-\sigma}(1-\tau^{1-\sigma})\bar{\theta}_F^{\sigma-1-\gamma}\right]}{\gamma-(\sigma-1)}\right\}^{\frac{1}{1-\sigma}} \tag{17}$$

Note that three cut-off levels of productivity, $\bar{\theta}_D$, $\bar{\theta}_X$ and $\bar{\theta}_F$, are functions of $P$, which also depends on these levels. From (14)-(17) three cut-off levels of productivity can be functions of model parameters only as follows[5]:

$$\bar{\theta}_D = \left\{\frac{\gamma f_D\left[1+\left(\frac{1}{\tau}\right)^{\gamma}\left(\frac{f_D}{\mu f_X}\right)^{\varepsilon} + \omega^{\gamma}(1-\tau^{1-\sigma})^{\frac{\gamma}{\sigma-1}}\left(\frac{f_D}{\mu(f_F-f_X)}\right)^{\varepsilon}\right]}{M_1[\gamma-(\sigma-1)](1-\rho)}\right\}^{\frac{1}{\gamma}} \tag{18}$$

[5] See Appendix for derivation.

$$\bar{\theta}_X = \left\{ \frac{\gamma f_X \left[ 1 + \tau^{\gamma} \left( \frac{\mu f_X}{f_D} \right)^{\varepsilon} + \omega^{\gamma} (\tau^{\sigma-1} - 1)^{\frac{\gamma}{\sigma-1}} \left( \frac{f_X}{f_F - f_X} \right)^{\varepsilon} \right]}{M_2 [\gamma - (\sigma - 1)](1 - \rho)} \right\}^{\frac{1}{\gamma}} \tag{19}$$

$$\bar{\theta}_F = \left\{ \frac{\gamma (f_F - f_X) \left[ 1 + \frac{1}{\omega^{\gamma} (1 - \tau^{1-\sigma})^{\frac{\gamma}{\sigma-1}}} \left( \frac{\mu (f_F - f_X)}{f_D} \right)^{\varepsilon} + \frac{1}{\omega^{\gamma} (\tau^{\sigma-1} - 1)^{\frac{\gamma}{\sigma-1}}} \left( \frac{f_F - f_X}{f_X} \right)^{\varepsilon} \right]}{M_2 [\gamma - (\sigma - 1)](1 - \rho)} \right\}^{\frac{1}{\gamma}} \tag{20}$$

where $\omega = \frac{w_1}{w_2}$ $\mu = \frac{M_1}{M_2}$ and $\varepsilon = \frac{\gamma - (\sigma - 1)}{\sigma - 1}$.

## 4. Values of Export and FDI

Let $V_X$ and $V_F$ be the values of export and FDI, respectively. From (8), (9), (10) and (17), $V_X$ and $V_F$ are defined as follows:

$$\begin{aligned} V_X &= \int_{\bar{\theta}_X}^{\bar{\theta}_F} p_X q_X dF(\theta) \\ &= \frac{(w_1 \tau)^{1-\sigma} M_2 \left( \bar{\theta}_X^{\sigma-1-\gamma} - \bar{\theta}_F^{\sigma-1-\gamma} \right)}{w_1^{1-\sigma} \bar{\theta}_D^{\sigma-1-\gamma} + (w_1 \tau)^{1-\sigma} \bar{\theta}_X^{\sigma-1-\gamma} + w_2^{1-\sigma} (1 - \tau^{1-\sigma}) \bar{\theta}_F^{\sigma-1-\gamma}} \end{aligned} \tag{21}$$

$$\begin{aligned} V_F &= \int_{\bar{\theta}_F}^{\infty} p_F q_F dF(\theta) \\ &= \frac{{w_2}^{1-\sigma} M_2 \bar{\theta}_F^{\sigma-1-\gamma}}{w_1^{1-\sigma} \bar{\theta}_D^{\sigma-1-\gamma} + (w_1 \tau)^{1-\sigma} \bar{\theta}_X^{\sigma-1-\gamma} + w_2^{1-\sigma} (1 - \tau^{1-\sigma}) \bar{\theta}_F^{\sigma-1-\gamma}} \end{aligned} \tag{22}$$

Then the relative values of export to FDI in the foreign market is

$$\frac{V_X}{V_F} = \tau^{1-\sigma} \left\{ \left( \frac{1}{\omega} \right)^{\gamma} \left[ \frac{f_F - f_X}{(\tau^{\sigma-1} - 1) f_X} \right]^{\varepsilon} - 1 \right\} \tag{23}$$

## 5. Comparative Statics

As in Beller (2007) and Hogan & Hartson (2003), an MRA will be modeled as a drop in fixed costs of exporting, $f_F$: . Concluding an MRA with a foreign country means potential exporters in a domestic country do not need another production facility to adapt their exports to foreign technology regulations. In addition, an MRA might lead incumbent exporters to combine two facilities for domestic sales and exports so that they can obtain economies of scale. The expression for the relative values of export to FDI in (23) implies

$$\frac{\partial\left(\frac{V_X}{V_F}\right)}{\partial f_X} = \tau^{1-\sigma}\varepsilon\left(\frac{1}{\omega}\right)^{\gamma}\left[\frac{f_F-f_X}{(\tau^{\sigma-1}-1)f_X}\right]^{\varepsilon-1}\left[-\frac{1}{(\tau^{\sigma-1}-1)f_X}-(f_F-f_X)\frac{1}{(\tau^{\sigma-1}-1){f_X}^2}\right] \quad (24)$$

As the last parentheses in (24) is negative, $\frac{\partial\left(\frac{V_X}{V_F}\right)}{\partial f_X} < 0$. Hence when a domestic country concludes an MRA with a foreign country, its relative values of export to FDI will increase.

For the variable cost for exporting, $\tau$,

$$\frac{\partial\left(\frac{V_X}{V_F}\right)}{\partial \tau} = (1-\sigma)\frac{1}{\tau^{\sigma}}\left\{\left(\frac{1}{\omega}\right)^{\gamma}\left[\frac{f_F-f_X}{(\tau^{\sigma-1}-1)f_X}\right]^{\varepsilon}-1\right\} - \tau^{1-\sigma}\varepsilon\left(\frac{1}{\omega}\right)^{\gamma}\left[\frac{f_F-f_X}{(\tau^{\sigma-1}-1)f_X}\right]^{\varepsilon-1}\frac{(f_F-f_X)(\sigma-1)}{(\tau^{\sigma-1}-1)^2}\tau^{\sigma-2} \quad (25)$$

As $\sigma > 1$, the first term in (25) is negative. So $\frac{\partial\left(\frac{V_X}{V_F}\right)}{\partial\tau} < 0$. The relative values of export to FDI will increase as variables costs for exporting between domestic and foreign countries decrease.

In addition, the derivative of (23) with respect to $\omega$ is

$$\frac{\partial\left(\frac{V_X}{V_F}\right)}{\partial\omega} = \tau^{1-\sigma}\left[\frac{f_F - f_X}{(\tau^{\sigma-1}-1)f_X}\right]^{\varepsilon}(-\gamma)\frac{1}{\omega^{\gamma+1}} < 0 \tag{26}$$

which implies that the relative value of exports to FDI will decrease when the wage difference between domestic and foreign countries is higher.

## Ⅲ. Data

Table 1 lists the variables and their respective data sources. Note that every MRA has been concluded at the sector-level, not at the country-level. To test the effects of MRA on the trade-off relationship between exports and FDI, it was necessary to procure data for horizontal FDI across sectors and countries. In this respect, the Bureau of Economic Analysis (BEA) provides data for sales by foreign affiliates of U.S. multinational companies, which has been collected country by industry. The dataset is based on the 3-digit level of the North American Industry Classification System (NAICS) during 1999-2007.

**Table 1. Variables and Data Sources**

| Variable | Data Source |
|---|---|
| U.S. multinational affiliate sales | Bureau of Economic Analysis (BEA) |
| U.S. exports | National Bureau of Economic Research (NBER) |
| GDP (constant 2000 US$) | World Development Indicator (WDI) |
| Per capita GDP (constant 2000 US $) | World Development Indicator (WDI) |
| Weighted tariff rate | UNCTAD TRAINS |
| Calculated duty | National Bureau of Economic Research (NBER) |
| Import charges | National Bureau of Economic Research (NBER) |
| MRA | WTO TBT webpage |

The data for U.S. exports across sectors and countries comes from the National Bureau of Economic Research (NBER), which covers the period 1972-2006. As this dataset is based on the 6-digit level of NAICS, in this paper, the 6-digit level has been aggregated to the 3-digit level to make it comparable to the data for multinational affiliate sales.

GDP is a proxy for a host country's demand level. In addition, as it was difficult to obtain data for sector-level wage rates in each country,[6] I have used the differences of per capita GDP between the U.S. and other countries as a proxy for the average wage differences. Therefore, both GDP and per capita GDP are country-level, which are available in the World Bank's World Development Indicator (WDI).

Three proxies were used for the variable cost of exporting: industry-level weighted tariff rates of host countries, calculated duty and import charges of U.S. Weighted tariff rates are from the UNCTAD TRAINS. Two other industry-level datasets were used for the variable cost of U.S. exports: the calculated duty and the import charges.[7] The calculated duty represents the estimated duty of foreign merchandise imported into the U.S. The import charges represent the sum of transportation costs such as freight, insurance and other charges excluding import duties.

Table 2 shows MRAs which the U.S. has signed with other countries from 1998 to 2006. As every WTO member is supposed to notify its MRA contract to the WTO TBT committee, data was drawn from U.S.

[6] The International Labor Organization (ILO) provides annual wage rates across sectors and countries. However, each wage rate has been reported by different time (i.e. hourly or daily or monthly) and currency units. More importantly, there are many missing values in the dataset.

[7] These datasets are based on U.S. imports. As the datasets for the calculated duty and the export charges of U.S. merchandise exported into foreign countries do not exist, I use them as a proxy for sector-level variable costs for U.S. exporting.

**Table 2. U.S. MRAs**

| MRA | Year* | Sectors covered | NAICS code |
|---|---|---|---|
| US-EU | 1998 | Telecommunication equipment, Electro-magnetic compatibility, Electrical safety, Recreational Craft, Pharmaceutical good manufacturing practices, Medical devices | 325, 334, 335, 336 |
| US-Japan | 2002 | Raw or processed plant-based agricultural products labeled as organic | 311 |
| US-EU | 2004 | Marine equipment | 334, 335, |
| US-Singapore | 2004 | Telecommunication equipment | 334 |
| US-EFTA | 2006 | Telecommunication equipment, Electro-magnetic compatibility, Recreational Craft, Marine equipment | 334, 335 336 |

Note: Year of entry into force.

**Table 3. List of Countries and Sectors**

| Countries (8) | Sectors (7) | |
|---|---|---|
| | NAICS Code | Title |
| Australia, Canada, France, Germany, Japan, Netherlands, Switzerland, United Kingdom | 311 | Food |
| | 325 | Chemicals |
| | 331 | Primary and Fabricated metals |
| | 333 | Machinery |
| | 334 | Computers and electronic products |
| | 335 | Electrical equipment appliances, and components |
| | 336 | Transportation equipment |

notification documents of MRA in the WTO TBT website. Since the notification is based on the Harmonized System (HS) code, it was accorded with and adjusted to NAICS 3-digit-level. After adjusting data coverage among datasets, the sample covers 8 countries and 7 sectors during 1999-2006. Table 3 shows the list of countries and sectors.

# Ⅳ. Econometric Specifications

Four econometric specifications were set up for this treatise: the fixed effects model, the constant treatment effects model and two specifications of the time-varying treatment effects model. I have mainly followed Giavazzi and Tabellini (2005) and Laporte and Windmeijer (2005) for two specifications of time-varying treatment effects models, respectively. Both constant treatment effects and the time-varying treatment effects models are in the group of the Difference-in-Difference (DID) estimator.

## 1. Fixed Effects Model

Equation (27) shows the first regression model:

$$Y_{ijt} = \beta_0 + \beta_1 GDP_{it} + \beta_2 WAGE_{DIFF_{it}} + \beta_3 TARIFF_{ijt}\left(or\ \beta_3 DUTY_{ijt}\right) + \beta_4 CHARGES_{ijt} + \beta_5 MRA_{ijt} + \gamma_i + \delta_j + \tau_t + \varepsilon_{ijt} \tag{27}$$

*i*, *j*, *t* refer to foreign countries, industries and years, respectively. $Y_{ijt}$ is the dependent variable, which represents the log of the relative values of U.S. exports to U.S. multinational affiliate sales for industry *j* in country *i* at year *t*. $GDP_{it}$ is the log of country *i*'s GDP at year *t*. $WAGE\_DIFF_{it}$ is the log of per capita GDP difference between the U.S. and country *i* at year *t*. $CHARGES_{ijt}$ is the log of country *i*'s aggregate costs which consist of all freight, insurance and other charges for industry $j$ in the U.S. at year $t$.

$TARIFF_{ijt}$ is the log of the weighted tariff rate for industry $j$ in country $i$ at year $t$. $DUTY_{ijt}$ is the log of the estimated duty of goods imported into the U.S. for industry $j$ from country $i$ at year $t$. To estimate the effects of various sector-level tariff rates on the dependent variable I have replaced $TARIFF_{ijt}$ with $DUTY_{ijt}$ in some regressions.

The key variable, $MRA_{ijt}$, is a dummy variable which is 1 after an MRA is entered into force with country $i$ in industry $j$ at year $t$; and 0 otherwise. $\gamma_i$, $\delta_j$ and $\tau_t$ denote country-fixed effects, industry-fixed effects and year-fixed effects, respectively. Finally, $\varepsilon_{ijt}$ is an unobserved error term.

Based on theoretical results in the previous section, I expect $WAGE\_DIFF_{it}$, $TARIFF_{ijt}$, $DUTY_{ijt}$ and $CHARGES_{ijt}$ to have negative effects but $MRA_{ijt}$ to have positive effects on $Y_{ijt}$. In addition, I expect $GDP_{it}$ to have negative effects on $Y_{ijt}$, implying that MNEs is more likely to have horizontal FDI rather than exports as a host country's demand level increases.

## 2. Constant Treatment Effects Model

One important concern about the fixed effects model in (27) is the endogenous problem. For this the DID estimation is a useful instrument for isolating the effects of a treatment (i.e., MRA) from those of other unobservable characteristics on the dependent variable. It is based on a comparison of outcomes in the treated group with those in the control group before and after the treatment. Hence there are two differences at the same time: the first one is whether it is treated or not (cross sectional variation), and the second one is whether it is pre- or post-treatment (time series variation).

For the first difference, I divided all industries into two groups: the treated group and the control group. The treated group consists of U.S. industries which signed an MRA during the sample period, 1999-2006. The control group consists of industries which signed an MRA before 1999 or never signed any MRA during the sample period. Second, since the U.S. has not signed an MRA with other countries in the same year, it is impossible to define with certainty whether the second difference represents pre- or post-treatment. To solve this problem, Giavazzi and Tabellini (2005)'s methods were used as benchmarks, placing the DID estimator within the framework of the panel analysis.

Therefore, the constant treatment effects model of the DID estimator is:

$$Y_{ijt} = \beta_0 + \beta_1 X_{i(j)t} + \beta_2 TREAT_{ijt} + \gamma_i + \delta_j + \tau_t + \varepsilon_{ijt} \qquad (28)$$

As before, $Y_{ijt}$ and $\varepsilon_{ijt}$ denote the log of the relative values of U.S. exports to U.S. multinational affiliate sales and an unobserved error term, respectively. $TREAT_{ijt}$ is a dummy variable which is 1 in years after the entry into force of the MRA in the treated group and 0 otherwise. Therefore, both the treated group before the entry into force of an MRA and the control group have zero values of $TREAT_{ijt}$ in the regression.

Also included here is a set of other control variables, $X_{i(j)t}$, and three dummies, $\gamma_i$, $\delta_j$ and $\tau_t$ to control unobserved heterogeneity affecting the dependent variable of the treated group and the control group differently. $X_{i(j)t}$ consists of explanatory variables in (27) excluding $MRA_{ijt}$.

$\beta_2$ is expected to be a positive sign in (28), which implies that the treatment affects positively the relative values of U.S. exports to U.S. multinational affiliate sales in the treated group after the entry into force of the MRA compared with those in the control group over the same time period.

### 3. Time-varying Treatment Effects Models

In some cases, it would take some years for an MRA to influence the relative values of U.S. exports to U.S. multinational affiliate sales. In other cases, there would be *ex ante* effects of MRA on the relative values of U.S. exports to U.S. multinational affiliate sales, as firms anticipate change. To control these timed effects of the treatment, estimates were derived using the first time-varying treatment effects model of the DID estimator, following Giavazzi and Tabellini (2005):

$$\begin{aligned} Y_{ijt} = \beta_0 + \beta_1 X_{i(j)t} + \beta_2 TREAT\_3Y\_PRE_{ijt} + \beta_3 TREAT\_3Y\_POS_{ijt} + \\ \beta_4 TREAT\_4Y\_ON_{ijt} + \gamma_i + \delta_j + \tau_t + \varepsilon_{ijt} \end{aligned} \tag{29}$$

$Y_{ijt}$, $X_{i(j)t}$, $\gamma_i$, $\delta_j$, $\tau_t$ and $\varepsilon_{ijt}$ are the same as in (28). $TREAT\_3Y\_PRE_{ijt}$ is a dummy variable which is 1 in the three preceding years before the entry into force of the MRA and 0 otherwise. $TREAT\_3Y\_POS_{ijt}$ is a dummy variable which is 1 in the year of the entry into force of the MRA and two following years. $TREAT\_4Y\_ON_{ijt}$ is a dummy variable which is 1 from the third year onward after the entry into force of the MRA. Hence, $TREAT\_3Y\_PRE_{ijt}$ represents *ex ante* effects of MRA on the dependent variable, while both $TREAT\_3Y\_POS_{ijt}$ and $TREAT\_4Y\_ON_{ijt}$ represent *ex post* effects of the MRA on the dependent variable.

Following Laporte and Windmeijer (2005), the second time-varying treatment effects model of the DID estimator is:

$$\begin{aligned} Y_{ijt} = {} & \\ & \beta_0 + \beta_1 X_{i(j)t} + \beta_2 TREAT_{ijt} + \beta_3 TREAT\_4Y\_LAG_{ijt} + \\ & \beta_4 TREAT\_3Y\_LAG_{ijt} + \cdots + \beta_6 TREAT\_1Y\_LAG_{ijt} + \beta_7 TREAT\_0Y_{ijt} + \\ & \beta_8 TREAT\_1Y\_LEAD_{ijt_{ijt}} + \beta_9 TREAT\_2Y\_LEAD_{ijt} + \cdots + \\ & \beta_{15} TREAT\_8Y\_LEAD_{ijt} + \gamma_i + \delta_j + \tau_t + \varepsilon_{ijt} \end{aligned} \quad (30)$$

$Y_{ijt}$, $X_{i(j)t}$, $TREAT_{ijt}$, $\gamma_i$, $\delta_j$, $\tau_t$ and $\varepsilon_{ijt}$ are the same as before. $TREAT\_kY\_LAG_{ijt}$ is a dummy variable which is 1 in the *k*-th year before the entry of the MRA into force and 0 otherwise (*k*=1,2,…,4). $TREAT\_dY\_LEAD_{ijt}$ is a dummy variable which is 1 in the $d$-th year after the entry of MRA into force and 0 otherwise (*d*=1,2,…,8). $TREAT\_0Y_{ijt}$ is a dummy variable which is 1 in the year of the entry of the MRA into force. Therefore,$TREAT_kY_LAG_{ijt}$and $TREAT\_dY\_LAG\_\ LEAD_{ijt}$ represent *ex ante* effects and *ex post* effects of MRA on the dependent variable, respectively.

In all regressions, I have estimated standard errors, which happen to be robust and clustered by industry, country and year-level because unobservable factors within them inflate the significance of coefficient estimates (see Moulton 1990). In addition, the robustness check was performed for all regressions with industry-specific time trends, $\delta_j \times t$, instead of industry-fixed effects, $\delta_j$, to control for unobserved time-varying industry characteristics (see Aghion, Burgess, Redding and Zilimotti 2003). The empirical results with the industry-specific time trends are the same as those with industry-fixed effects.

# V. Empirical Results

Table 4 reports the regression results of the fixed effects model with current year (columns (1) and (2)), one-year lag (columns (3) and (4)), two-year lag (columns (5) and (6)) and three-year lag (columns (7) and

**Table 4. Empirical Results of the Fixed Effects Estimator**

| Variable | No lag | | 1-year lag | | 2-year lag | | 3-year lag | |
|---|---|---|---|---|---|---|---|---|
| | **Col.(1)** | **Col.(2)** | **Col.(3)** | **Col.(4)** | **Col.(5)** | **Col.(6)** | **Col.(7)** | **Col.(8)** |
| *GDP* | -2.656 | -1.468 | 1.446 | 3.203 | 5.841 | 7.026 | 3.173 | 3.473 |
| | (5.630) | (5.695) | (6.922) | (6.946) | (8.275) | (8.305) | (11.121) | (11.257) |
| *WAGE_Diff* | -7.693 | -5.750 | -2.941 | -0.309 | 2.253 | 4.423 | -0.954 | 0.330 |
| | (7.915) | (7.837) | (9.470) | (9.296) | (11.230) | (11.015) | (14.882) | (14.891) |
| *TARIFF* | -0.127*** | | -0.106*** | | -0.077* | | -0.048 | |
| | (0.039) | | (0.040) | | (0.042) | | (0.045) | |
| *DUTY* | | -0.337*** | | -0.347*** | | -0.302*** | | -0.249*** |
| | | (0.076) | | (0.075) | | (0.082) | | (0.086) |
| *CHARGES* | -0.638*** | -0.317*** | -0.648*** | -0.319*** | -0.672*** | -0.389*** | -0.706*** | -0.474*** |
| | (0.066) | (0.102) | (0.074) | (0.107) | (0.084) | (0.119) | (0.095) | (0.131) |
| *MRA* | 1.129*** | 1.112*** | 1.186*** | 1.157*** | 1.189*** | 1.147*** | 1.186*** | 1.139*** |
| | (0.142) | (0.141) | (0.152) | (0.150) | (0.166) | (0.165) | (0.181) | (0.180) |
| Industry dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 405 | 405 | 356 | 356 | 307 | 307 | 259 | 259 |
| $R^2$ | 0.719 | 0.725 | 0.727 | 0.736 | 0.722 | 0.729 | 0.724 | 0.730 |

Notes: 1. Figures in parentheses are robust standard errors clustered by industry, country and year level.

2. * Significance at the 10% level, ** Significance at the 5% level, *** Significance at the 1% level.

(8)) independent variables. In columns (2), (4), (6) and (8) I replace $TARIFF_{ijt}$ with $DUTY_{ijt}$ to control various industry-level tariff rates.

For variables for GDP and the wage difference, the signs of the coefficients are as expected in columns (1) and (2). However, the coefficient estimates of GDP and the wage difference are statistically insignificant in all regressions. The coefficient estimates of the weighted tariff rate are negative and statistically significant at 1% level with no lag and one-year lag independent variable (see columns (1) and (3)), while they are statistically insignificant in column (7). Also as expected, the coefficient estimates of *DUTY* and *CHARGES* are negative and statistically significant at 1% level in all regressions. These results show that an industry-level data (*TARIFF*, *DUTY* and *CHARGES*) explains theoretical results better than a country-level data (*GDP* and *WAGE_DIFF*).

The key result is that the coefficient estimates of MRA are positive and statistically significant at 1% level in all regressions, implying that MRA affects the relative exports to FDI sales positively, as expected from theoretical results. Therefore, these four industry-level variables (*TARIFF*, *DUTY*, *CHAGES* and *MRA*) have displayed all expected signs and were statistically significant, while two country-level variables (*GDP* and *WAGE_DIFF*) displayed expected signs but were statistically insignificant.

Table 5 reports the regression results from three models of the DID estimator: the constant treatment effects model and two time-varying treatment effects models. Columns (1) and (2) report the results of the constant treatment effects model. The results in columns (3) and (4) are from Giavazzi & Tabellini (2005), while columns (5) and (6) are from Laporte

**Table 5. Empirical Results of DID Estimators: Constant and Time-varying Treatment Effects**

| Variable | Constant treatment | | Time-varying treatment | | | |
|---|---|---|---|---|---|---|
| | | | Giavazzi & Tabellini | | Laporte & Windmeijer | |
| | Col.(1) | Col.(2) | Col.(3) | Col.(4) | Col.(5) | Col.(6) |
| *TREAT* | 0.582*** (0.191) | 0.571*** (0.181) | | | 0.013 (0.201) | -0.012 (0.198) |
| *TREAT_3Y_PRE* | | | 0.612*** (0.198) | 0.484** (0.191) | | |
| *TREAT_3Y_POS* | | | 0.664*** (0.219) | 0.602*** (0.207) | | |
| *TREAT_4Y_ON* | | | 2.146*** (0.256) | 2.005*** (0.247) | | |
| *TREAT_4Y_LAG* | | | | | -0.533 (1.156) | -0.543 (1.232) |
| *TREAT_3Y_LAG* | | | | | -0.761 (0.687) | -0.833 (0.639) |
| *TREAT_2Y_LAG* | | | | | -0.847 (0.683) | -0.862 (0.585) |
| *TREAT_1Y_LAG* | | | | | -0.639 (0.760) | -0.689 (0.670) |
| *TREAT_0Y* | | | | | 0.004 (0.581) | -0.072 (0.544) |
| *TREAT_1Y_LEAD* | | | | | 1.201*** (0.321) | 1.184*** (0.308) |
| *TREAT_2Y_LEAD* | | | | | 0.977*** (0.225) | 0.991*** (0.216) |
| *TREAT_3Y_LEAD* | | | | | 1.196*** (0.224) | 1.178*** (0.213) |
| *TREAT_4Y_LEAD* | | | | | 1.225*** (0.230) | 1.188*** (0.218) |
| *TREAT_5Y_LEAD* | | | | | 1.374*** (0.256) | 1.335*** (0.248) |
| *TREAT_6Y_LEAD* | | | | | 1.166*** (0.302) | 1.198*** (0.304) |
| *TREAT_7Y_LEAD* | | | | | 1.319*** (0.290) | 1.342*** (0.283) |
| *TREAT_8Y_LEAD* | | | | | 1.152*** (0.312) | 1.185*** (0.316) |
| Observations | 405 | 405 | 405 | 405 | 405 | 405 |
| $R^2$ | 0.680 | 0.687 | 0.693 | 0.696 | 0.734 | 0.741 |

Notes: 1. Figures in parentheses are robust standard errors clustered by industry, country and year level.
2. * Significance at the 10% level, ** Significance at the 5% level, *** Significance at the 1% level

and Windmeijer (2005)'s econometric specifications of the time-varying treatment effects model. In columns (2), (4) and (6), $TARIFF_{ijt}$ is replaced with $DUTY_{ijt}$ for other independent variables ($X_{i(j)t}$) in the regressions.

As expected, the coefficient estimates of *TREAT*, *TREAT_3Y_PRE*, *TREAT_3Y_POS* and *TREAT_4Y_ON* are positive and statistically significant at 1% level. These results seem to suggest that there are both positive *ex ante* and *ex post* effects of MRA on the relative values of exports to multinational affiliate sales in the U.S. (see columns (1)-(4))

However, the results from Laporte and Windmeijer (2005)'s econometric specifications show that there does not exist *ex ante* effects of MRA on the relative values of exports to multinational affiliate sales in the United States. On the other hand, as expected, there are positive *ex post* effects of MRA on the relative values of exports to multinational affiliate sales in U.S., and these effects have remained significant during 8 years after the entry into force of the MRA. These results imply that it would take some years for MRA to affect the relative values of exports positively.

# Ⅵ. Conclusion

As MRAs have become increasingly common since 1994 in order to eliminate unnecessary obstacles to trade from TBT, and to facilitate trade between countries, many researchers have forced to analyze the effects of MRAs on trade performance. The main objective of this paper was to show whether MRAs can affect the trade-off relationship between exports and horizontal FDI. Theoretically, MNEs have two different strategies to serve a foreign market. First, MNEs build a production facility in a foreign country and then provide their products to foreign consumers, which is horizontal FDI. In this case, MNEs gain benefits from tariff-jumping. In another case, MNEs might keep all production facilities in one country (usually the home country) and then serve foreign consumers by exporting. In this way, MNEs gain benefits from economies of scale.

As an MRA is created to reduce the entry cost of exporting, MNEs have more incentive to export than engage in horizontal FDI because more benefits can be derived from economies of scale than tariff-jumping strategies. To prove this hypothesis, I have first developed a simple model, based on HMY (2004)'s model of international trade and horizontal FDI. There are two countries with homogeneous consumers and heterogeneous firms in the monopolistic competitive market. Each country has different populations, wage rates and income levels. In the model, I analyzed how the MRA relates to exports relative to horizontal FDI sales: as an MRA reduces the fixed entry cost of exporting, the exports relative to horizontal FDI sales increase. In addition, the model shows that there are negative effects of trade variable costs and wage difference between countries.

Using data on U.S. exports and multinational sales in 8 countries and 7 manufacturing sectors during the period 1999-2006, I estimated the effects of MRAs, demand levels in host countries, wage differences between U.S. and host countries, and trade variable costs such as tariff rates and transportation costs on exports relative to FDI sales. The main regression model is the fixed effects estimator, and the DID estimator is used to solve the endogenous problem in the previous regression. For the DID estimator, I estimated two specifications of the time-varying treatment effects model as well as the constant treatment effects model to control timing effects of the treatment which is the entry into force of an MRA.

The key fact found and established by this paper is that MRAs have positive effects on the relative U.S. exports to horizontal FDI, while trade variable costs have negative effects. The results are robust for another specification of industry-fixed effects, that is, the industry-specific time trends, and standard errors which are clustered by industry, country and year-level. Hence, the empirical results are consistent with those from the theoretical model.

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# Appendix

### Derivation of three cut-off levels of productivity

1. $\bar{\theta}_D$

From (14) and (17),

$$(\bar{\theta}_D)^{\sigma-1} = \frac{\gamma\left[w_1^{1-\sigma}\bar{\theta}_D^{\sigma-1-\gamma}+(w_1\tau)^{1-\sigma}\bar{\theta}_X^{\sigma-1-\gamma}+w_2^{1-\sigma}\left(1-\tau^{1-\sigma}\right)\bar{\theta}_F^{\sigma-1-\gamma}\right]f_D w_1^{\sigma-1}}{[\gamma-(\sigma-1)]M_1(1-\rho)}$$

$$\leftrightarrow 1 = \frac{\gamma\left[w_1^{1-\sigma}\bar{\theta}_D^{-\gamma}+(w_1\tau)^{1-\sigma}\left(\frac{\bar{\theta}_X}{\bar{\theta}_D}\right)^{\sigma-1}\bar{\theta}_X^{-\gamma}+w_2^{1-\sigma}\left(1-\tau^{1-\sigma}\right)\left(\frac{\bar{\theta}_F}{\bar{\theta}_D}\right)^{\sigma-1}\bar{\theta}_F^{-\gamma}\right]f_D w_1^{\sigma-1}}{[\gamma-(\sigma-1)]M_1(1-\rho)} \qquad \text{(A1)}$$

From (14), (15) and (16),

$$\left(\frac{\bar{\theta}_X}{\bar{\theta}_D}\right)^{\sigma-1} = \frac{M_1 f_X \tau^{\sigma-1}}{M_2 f_D}\ ;\ \left(\frac{\bar{\theta}_F}{\bar{\theta}_D}\right)^{\sigma-1} = \frac{M_1(f_F-f_X)w_2^{\sigma-1}}{M_2 f_D(1-\tau^{1-\sigma})w_1^{\sigma-1}} \qquad \text{(A2)}$$

Therefore, from (A1) and (A2),

$$\frac{1}{M_1}f_D\bar{\theta}_D^{-\gamma}+\frac{1}{M_2}f_X\bar{\theta}_X^{-\gamma}+\frac{1}{M_2}(f_F-f_X)\bar{\theta}_F^{-\gamma} = \frac{[\gamma-(\sigma-1)](1-\rho)}{\gamma} \qquad \text{(A3)}$$

$$\leftrightarrow \bar{\theta}_D^{-\gamma}\left[\frac{1}{M_1}f_D+\frac{1}{M_2}f_X\left(\frac{\bar{\theta}_X}{\bar{\theta}_D}\right)^{-\gamma}+\frac{1}{M_2}(f_F-f_X)\left(\frac{\bar{\theta}_F}{\bar{\theta}_D}\right)^{-\gamma}\right] = \frac{[\gamma-(\sigma-1)](1-\rho)}{\gamma}$$

$$\leftrightarrow \bar{\theta}_D^{-\gamma} = \frac{M_1[\gamma-(\sigma-1)](1-\rho)}{\gamma f_D\left\{1+\left(\frac{1}{\tau}\right)^{\gamma}\left(\frac{M_2 f_D}{M_1 f_X}\right)^{\frac{\gamma-\sigma-1}{\sigma-1}}+\left(\frac{w_1}{w_2}\right)^{\gamma}\left(1-\tau^{1-\sigma}\right)^{\frac{\gamma}{\sigma-1}}\left[\frac{M_2 f_D}{M_1(f_F-f_X)}\right]^{\frac{\gamma-\sigma-1}{\sigma-1}}\right\}}$$

2. $\bar{\theta}_X$

From (A3),

$$\bar{\theta}_X^{-\gamma}\left[\frac{1}{M_1}f_D\left(\frac{\bar{\theta}_D}{\bar{\theta}_X}\right)^{-\gamma}+\frac{1}{M_2}f_X+\frac{1}{M_2}(f_F-f_X)\left(\frac{\bar{\theta}_F}{\bar{\theta}_X}\right)^{-\gamma}\right]=\frac{[\gamma-(\sigma-1)](1-\rho)}{\gamma} \quad \text{(A4)}$$

From (15) and (16),

$$\left(\frac{\bar{\theta}_F}{\bar{\theta}_D}\right)^{\sigma-1}=\frac{f_X(\tau^{\sigma-1}-1)w_1^{\sigma-1}}{(f_F-f_X)w_2^{\sigma-1}} \quad \text{(A5)}$$

Therefore, form (A4) and (A5),

$$\bar{\theta}_X^{-\gamma}=\frac{M_2[\gamma-(\sigma-1)](1-\rho)}{\gamma f_X\left[1+\tau^{\gamma}\left(\frac{M_1 f_X}{M_2 f_D}\right)^{\frac{\gamma-\sigma-1}{\sigma-1}}+\left(\frac{w_1}{w_2}\right)^{\gamma}(\tau^{\sigma-1}-1)^{\frac{\gamma}{\sigma-1}}\left(\frac{f_X}{f_F-f_X}\right)^{\frac{\gamma-\sigma-1}{\sigma-1}}\right]}$$

3. $\bar{\theta}_F$

From (A2), (A3) and (A5),

$$\bar{\theta}_F^{-\gamma}=$$

$$\frac{M_2[\gamma-(\sigma-1)](1-\rho)}{\gamma(f_F-f_X)\left\{1+\frac{1}{(1-\tau^{1-\sigma})^{\frac{\gamma}{\sigma-1}}}\left(\frac{w_2}{w_1}\right)^{\gamma}\left[\frac{M_1(f_F-f_X)}{M_2 f_D}\right]^{\frac{\gamma-\sigma-1}{\sigma-1}}+\frac{1}{(\tau^{\sigma-1}-1)^{\frac{\gamma}{\sigma-1}}}\left(\frac{w_2}{w_1}\right)^{\gamma}\left(\frac{f_F-f_X}{f_X}\right)^{\frac{\gamma-\sigma-1}{\sigma-1}}\right\}}$$

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# The Impact of Mutual Recognition Agreements on Foreign Direct Investment and Export

Yong Joon Jang

This paper analyzes the trade-off relationship between exports and horizontal FDI in response to a mutual recognition agreement (MRA) for technical regulations and certification procedures for import goods. As an MRA is concluded to reduce entry costs of exporting, multinationals (MNEs) derive more benefits from economies of scale than from tariff-jumping strategies, implying that they have more incentive to export than to perform horizontal FDI. In order to prove the above argument, the paper develops a monopolistic competition model with international trade, heterogeneous firms and MRA, based on the work of Helpman, Melitz and Yeaple (2004); and then tests empirically the theoretical results, utilizing data from U.S. multinational affiliate sales and exports. The empirical results show that MRAs have positive effects on the U.S. exports relative to horizontal FDI, bringing the results in line with the theoretica l model.

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