RIETI Discussion Paper Series 17-E-006

Do Migrant and Business Networks Promote International Royalty Receipts?

TOMOHARA Akinori
RIETI

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 17-E-006

January 2017

Do Migrant and Business Networks Promote International Royalty Receipts?[1]

TOMOHARA Akinori

Research Institute of Economy, Trade and Industry and Aoyama Gakuin University

Abstract

This study examines how migration and business networks affect trade on intellectual property using bilateral data on Japan (or the United States) and the Organisation for Economic Co-operation and Development (OECD) member countries. The analyses are distinct in that they examine network effects comprehensively by combining previous works on tangible trade-migration relationships, together with the literature on trade-foreign direct investment (FDI) relationships. We show that intellectual property exports are positively related with the number of immigrants residing in Japan (or the United States). However, other network effects, specifically business networks, are not necessarily universal because two forces, i.e., network effects and trade-FDI interactions, could operate in opposite directions. We conclude that positive immigration network effects occur, but emigration and business network effects could vary depending on the development stages of intellectual property trade.

Keywords: Emigration, Foreign direct investment, Immigration, Intellectual property, License fees, Service surplus

JEL classification: F14; F21; F22

[1]This study is conducted while the author is Research Associate at RIETI. I am grateful for helpful comments and suggestions by Discussion Paper seminar participants at RIETI. I also appreciate Jin Ke and Jingkai Hong for their research assistance, and acknowledge financial support from Grants-in-Aid for Scientific Research (No. 16K03650) and Aoyama Gakuin University. The funding source had no involvement in the study design, analysis and data interpretation, the writing of the report, and the decision to submit the article for publication.

1. Introduction

The migration crisis is a pressing policy concern under the recent turmoil created by the large migration into Europe.[1] Although political debates often focus on negative aspects of immigration, such as losing natives' jobs, immigration has an aspect of not only international labor flows, but also social capital, which bridges different countries through their knowledge of foreign markets, business law and practices, cultures and languages, and contacts, etc. As globalization is advancing, interaction across countries, including cross-border movements of people, is an inevitable phenomenon. Under such circumstances, several works have discussed the potential benefits of migration.

One such topic is interaction between trade and migration. Specifically, several empirical studies have shown the possibility that migrant networks promote bilateral international trade (Gould (1994), Head and Ries (1998), Girma and Yu (2002), Rauch and Trindade (2002), White (2007), Egger et al. (2012), Law et al. (2013), and Aleksynska and Peri (2014) for country level; Co et al. (2004), Combes et al. (2005), Herander and Saavedra (2005), Dunlevy (2006), Coughlin and Wall (2011) for state level; Blanes (2005) and Leitão (2013) for intra-industry trade) (please refer to Table 1 for a summary of extant studies). One possible channel is through the reduction of information-related transaction costs. International trade requires bearing transaction costs, which are not necessary for trade within a country. One source of these costs is information problems. International trade requires knowledge of local laws and business practices, as well as marketing tactics, including local consumer preferences. Local traders are familiar with this knowledge, but outsiders may not be. Consequently, migrants play an intermediary role in alleviating such information problems related to trading opportunities, for example, by matching buyers and sellers through acting as brokers. Other examples include the reduction of communication barriers by multilingual and multicultural immigrants. Additionally, migrants help reduce information-related transaction costs by negotiating contracts and facilitating their enforcement, since reputation is important among migrant societies when migrants bridge business across countries. As such, migrant networks serve as community sanctions when contracts are violated. This is because opportunistic behavior ruins the reputation of cheating agents and leads to expelling them from the business community.[2] Trust is developed through migrant networks, but also through the

[1] BBC website ("Migrant crisis: Migration to Europe explained in seven charts") http://www.bbc.com/news/world-europe-34131911 (March 4, 2016).

[2] National court systems are not adequate at preventing opportunistic behavior related to international business (Rauch and Trindade, 2002).

diffusion of foreign goods. Certain foreign goods are imported from immigrants' home countries when they exhibit preference towards those goods, which are not available in their host countries. Additionally, increased imports of these goods may create new demand among locals in host countries once they become familiar with them. Typical examples include ethnic foods. In summary, migrant networks (or ethnic ties) form social capital, which can, in turn, promote international trade through several channels.

This study examines if positive trade–migration interactions occur for intellectual property trade. Since previous work reveals positive relationships between tangible trade and migration, it is natural to ask whether migrant network effects operate for intangible trade, since literature argues that the international trade of differentiated goods requires more detailed information; thus, migrant networks can play a more important role for differentiated goods than for homogeneous goods (Gould, 1994; Rauch and Trindade, 2002; Egger et al., 2012; Law et al., 2013; Aleksynska and Peri, 2014). Additionally, contract enforcement is more difficult for goods, for which the arm's length market does not exist (i.e., the pricing of the goods is not obvious). Again, migrant networks are expected to play a role in contract enforcement under such situations (Egger et al., 2012). Considering that intangible goods are differentiated, and their arm's length market might not exist per the transfer pricing literature cited below, migration networks may reduce transaction costs for intangible trade as they do for tangible trade.

While the policy arena points out the possibility that migration networks facilitate receipts from intellectual property trade (Nurse, 2016), formal analyses are lacking to the best of our knowledge. Literature used to discuss topics of migration and intellectual property independently. For example, the valuation of intellectual property is one popular topic related to international intellectual property trade in terms of transfer pricing issues (Kopits, 1976; Anson and Ahya, 2004; Anderson and Lam, 2006; Reams, Nehoray, and Dickert, 2010). Branstetter et al. (2005) study whether tightening intellectual property rights (IPR) enhances international technology transfer, measured by intrafirm royalty payments, etc. More recent literature relates migration and intellectual property but still focuses on IPR issues (e.g., interactive effects between international migration and intellectual property rights on the innovation of developing countries in McAusland and Kuhn (2011); IPR policy to attract knowledge international workers in Naghavi and Strozzi (2015)).

We examine if migration networks promote trade on intellectual property, along with business networks. Rauch (2001) points out that migration networks, as well as business networks, help reduce information costs by describing that "foreign direct investment … has the same effect [as the migrant network effect]" (p. 1185). Past

empirical works related to trade–foreign direct investment (FDI) relationships show a positive relationship (i.e., complementarity) between trade and FDI (Lipsey and Weiss, 1981, 1984; Pfaffermayr, 1996; Clausing, 2000; Head and Ries, 2001), although a different concern motivates the argument. Practically, research is related to political concerns, such as undermining the domestic industry and balance of payment issues (e.g., U.S. trade deficits and Japanese trade surplus during the 1980s and 1990s). Theoretically, research analyzes if FDI (foreign-affiliate production) displaces trade (exports) or not based on the implications of trade theory. The classic Heckscher–Ohlin model implies that FDI substitutes trade (Mundell, 1957). However, trade and FDI can be complementary when the assumptions of the model are relaxed (Markusen, 1983; Wong, 1986). The new trade theory (Helpman, 1984; Helpman and Krugman, 1985) also suggests export–FDI complementarity. Empirical evidences are mixed, depending on factors such as trade structure (e.g., exports of intermediate goods under vertically integrated firms across countries). Nonetheless, limited empirical works show substitution between trade and FDI (Belderbos and Sleuwaegen, 1998; Blonigen, 2001; Head and Ries, 2001) (see Table 1). We relate the empirical analyses of network effects on trade to the past argument on trade–FDI relationships.

Our analyses are distinct from previous works. First, we extend the analytical framework of the previous trade–migration discussions to intellectual property trade. Hitherto, literature mainly focuses on manufactured goods, except few studies, such as Law et al. (2013), which analyze migration effects on tourism casually as additional to goods trade analyses. Second, we examine network effects on intangible trade comprehensively. Past empirical studies have thoroughly examined the effects of immigration on trade, but neglected the effects of business networks on trade, except for Gould (1994) and Combes et al. (2005). While some researchers discuss trade–FDI relationships, the topic is motivated from a different perspective, so that the relationships are discussed independently from trade–migration relationships. We also examine if both migration and business networks promote trade on intellectual property. Third, our analysis includes bidirectional migration networks (i.e., immigration and emigration) and bidirectional business networks (i.e., inward and outward FDI). Most aforementioned literature examines the effects of immigration on trade (i.e., a unidimensional effect of migration). Existing empirical evidence related to the effects of both immigration and emigration on trade (i.e., a bidimensional effect of migration) is scarce, with few exceptions such as Combes et al. (2005) and Law et al. (2013). Similarly, past works on trade–FDI relationships focus on the unidimensional effect of FDI (i.e., outward FDI). Finally, we examine the dynamics of trade flows reflecting

changes in migration and FDI waves over a period of time using dynamic panel data analyses. Consequently, our analyses add insights related to trends in trade flows monitored over time, compared to a static approach in previous works.

The dynamic panel data analyses examine how migrant and business networks affect intellectual property trade among OECD countries—Japan and OECD countries—the U.S. We use bilateral data on 15 (or 18) OECD member countries, which have migrant and business relationships with Japan (or the U.S.), during 1996–2012 (or 2001–2012). Both countries are relevant for analysis, considering the large volume of intellectual property exports and their balance of payments structures. We fit a system generalized method of moments (GMM) to the data, using the Arellano–Bover (1995)/Blundell–Bond (1998) estimator. In our analyses, migrant network effects are captured by the number of immigrants and emigrants, and business network effects by inward and outward FDI between the two regions.

The results reveal that exports of intellectual property are positively related with immigrants residing in Japan (or the U.S.). Negative emigration–export relationships are also observed in both countries. However, the results of business networks vary between the two countries. The U.S. exports of intellectual property have a positive relationship with U.S. inward and outward FDI stocks, although Japanese exports are negatively related to inward FDI stocks, and do not exhibit any relationships outward FDI stocks. The robustness of the results is examined using different data sources, from the perspectives of different characteristics of trading partners, and by referring to results from past studies.

The analyses show that network effects are not necessarily universal. Positive immigration–export relationships are the only common robust result observed under different contexts. One percentage point increase in the number of immigrants in Japan brings additional revenues from intellectual property trade from USD 83 to USD 177 million for 2009 values. Our results also suggest USD 301 million increments in intellectual property revenues when similar estimates are calculated for the U.S. Other different results are partly explained by two offsetting forces: network effects and trade–FDI interactions. The former always promotes trade, but the latter may discourage trade depending on trade–FDI relationships (i.e., complements/substitutes). However, different results are mainly due to the different characteristics of intellectual property trade by either the U.S. or Japan. Japan, with a short history of service surplus, is at the premature stage of intellectual property trade compared to the U.S., who is at the mature stage. As such, we conclude that migrant and business network effects could vary depending on the development stage of intellectual property trade.

The results suggest policy implications regarding structural changes in the balance of payments. This study is originally motivated by a practical policy concern of industry mature countries. After experiencing the transition of the balance of payments structure, several countries suffer from trade deficits but enjoy service surpluses. Among service surpluses, exports of intellectual property are getting attention (*Nikkei Newspaper*, March 16, 2015). For example, the United States has royalties and license fees as primary factors contributing to its service surplus. Japan, which has been enjoying trade surplus for a lengthy period of time, has been experiencing trade deficits since 2011, while royalties and license fees began to show increasing trends since 2003. In fact, the volume of intellectual property is not negligible: "[Worldwide] intellectual property revenues are about the same level of trade in financial services in 2013. … [U.S. intellectual property revenues are] about equal to automotive-industry exports (Gresser, 2014)."[3] Additionally, industrial countries play primary exporter roles in intellectual property trade. The U.S. receives the largest intellectual property revenues, and the European Union and Japan follow as second and third, respectively (Gresser, 2014). Under these circumstances, enhanced intellectual property exports are expected to help attain sustainable growth for industry mature countries. Consequently, the results of our analyses help discuss how to promote intellectual property exports from the perspective of a possible but unexpected interaction of migration and business networks.

The paper proceeds as follows. Section 2 presents a summary of the data and the theoretical and empirical model used for analysis. The results of the analysis are presented in Section 3. Section 4 concludes the paper and suggests future research directions.

2. Model and Data

We follow the theoretical foundation developed by Combes et al. (2005), which extends the traditional trade model of monopolistic completion (Dixit and Stiglitz, 1977; Krugman, 1980) by introducing both migrant and business networks. A representative consumer in country *i* maximizes a constant elasticity of substitution utility function U_i:

$$U_i = \left(\sum_{j=1}^{N}\sum_{h=1}^{n_j}(a_{ij}c_{ijh})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma-1}{\sigma}}, \qquad (1)$$

where c_{ijh} is the consumption of differentiated intangible variety *h* produced in country

[3] Edward Gresser (November 5, 2014), "U.S. share of world intellectual property revenue – 39 percent." (http://www.progressive-economy.org/trade_facts/u-s-share-of-world-intellectual-property-revenue-39-percent/)

j (either Japan or the U.S.), a_{ij} is a weight of i consumers' preferences towards intangibles imports from country j, n_j is the number of intangible varieties produced in country j, N is the number of countries, and σ is the elasticity of substitution assumed to be greater than one. Subsequently, the bilateral value of trade flows is derived as

$$p_{ij}c_{ij} = c_i P_i^{\sigma} n_j p_j^{1-\sigma} a_{ij}^{\sigma-1}\left(1+\tau_{ij}\right)^{1-\sigma}, \qquad (2)$$

where p_{ij} is the delivered price in country i of any intangible variety produced in country j; c_i is the total consumption of differentiated intangibles in country i imported from all countries, including i; P_i is the price index in country i expressed as $(\sum_j a_{ij}^{\sigma-1} n_j p_{ij}^{1-\sigma})^{\frac{1}{1-\sigma}}$; p_j is the mill price in country j; τ_{ij} is the ad valorem transaction cost between countries i and j; and $p_{ij} = \left(1+\tau_{ij}\right)p_j$. While equation (2) describes intangibles trade flows, it is also possible to interpret it as the demand for intermediate inputs derived from imported intangibles, such that the intangibles used to produce final goods. This is because "the demand for inputs and therefore trade flows in intermediates takes the same functional form" under Ethier's (1982) production function (Combes et al. (2005), p. 6, footnote 8).

Transaction costs are composed of two elements, direct transport costs, T_{ij}, and indirect information costs, I_{ij}, and are assumed to be expressed as:

$$1+\tau_{ij} = T_{ij}I_{ij}, \qquad (3)$$

$$\text{where} \quad T_{ij} = \left(1+t_{ij}\right)^{\delta} exp\left(-\theta t_{ij}^2\right) \qquad (4) \quad \text{and}$$

$$I_{ij} = \left(Mig_{ij}\right)^{-\alpha}\left(Mig_{ji}\right)^{-\beta}\left(FDI_{ij}\right)^{-\gamma}\left(FDI_{ji}\right)^{-\varphi} exp\left(-\omega_I C_{ij}\right), \qquad (5)$$

where t_{ij} is a transport cost index between countries i and j; δ and θ are parameters assumed to be positive; Mig_{ij} is the number of immigrants from country j to country i (emigrant effects from the perspective of country j); Mig_{ji} is the number of immigrants from country i to country j (immigrant effects from the perspective of country j); FDI_{ij} is FDI from country j to country i (outward FDI effects from the perspective of country j); FDI_{ji} is FDI from country i to country j (inward FDI effects from the perspective of country j); C_{ij} is a dummy variable, which is equal to one if countries i and j have some kind of relationships such as cultural ties (e.g., usage of the same language), historical ties (e.g., colonial experiences), and economic ties (e.g., OECD membership); and α, β, γ, φ, and ω_I are parameters assumed to be positive.

Equation (4) embodies a standard feature of transportation costs. Transport costs take a quadratic function with positive parameters, δ and θ, so that marginal transport

costs are positive, but decrease with t_{ij}. Equation (5) specifies the hypothesis that migrant and business networks reduce information costs, which are related to international transaction. Additionally, a positive parameter, ω_I, implies that information costs are lower for transactions between regions with stronger ties than for those with weaker ties.

The model is distinct from past research in the treatment of information costs, which depend on both migrant and business networks (equation (5)). While both networks are pointed out to reduce information costs in Rauch (2001), past empirical works have examined the effects of immigration on trade at most, but neglected to examine the effects of business networks, together with those of migration networks, except for Gould (1994) and Combes et al. (2005) (please refer to Table 1).[4] Additionally, most empirical literature focuses on the effects of unidimensional migration (i.e., immigration) on trade. Hitherto, empirical evidence related to the effects of bidimensional migration (i.e., immigration and emigration) on trade is limited, with the exception of Combes et al. (2005) and Law et al. (2013).

While we follow the approach in Combes et al. (2005), some elements are modified. For example, we use the FDI level to capture business networks, although Combes et al. (2005) construct a measure of connections within a business group, which are based on the number of plants, and sum the number over all business groups. Namely, they use the number of routes (i.e., something like an international airline map) that connect two regions through "plant networks." On the other hand, the usage of FDI incorporates volume effects, which may not be measurable under their approach. This is because one connection route might have a stronger tie than others, although both count as one (e.g., the effects of a large plant are treated the same as the ones of a small plant). Stronger ties between countries are captured by a higher FDI level. Additionally, we include both inward and outward FDI by assuming asymmetric effects of business networks, since the effect of inward FDI differs from the one of outward FDI. Combes et al. (2005) use one variable, because "the impact of plant networks is thus symmetric by construction" (p. 7).

Consumers' preferences are expressed as

$$a_{ij} = \left(Mig_{ij}\right)^{\alpha_a} exp\left(e_{ij} + \omega_a C_{ij}\right), \qquad (6)$$

where e_{ij} is a random term, and α_a, and ω_a are parameters assumed to be positive. The demand for intangibles produced in country j increases with a larger number of immigrants from country j, because immigrants prefer their home country products and/or

[4] White (2007) uses the ratio of FDI relative to GDP as the measure of economic integration.

local consumers became familiar with foreign products by interacting with immigrants.

Combes et al. (2005) use the following empirical specification in order to estimate the theoretical derivation of equation (2), together with a parametric assumption of equations (3)–(6):

$$\ln \tilde{c}_{ij} = f_i + f_j - b_1 \ln t_{ij} + \omega C_{ij} + \alpha \ln Mig_{ij} + \beta \ln Mig_{ji} + \gamma \ln FDI_{ij} + \varphi \ln FDI_{ji} + \varepsilon_{ij}, \text{ where } \tilde{c}_{ij} = p_{ij} c_{ij}. \quad (7)$$

They confront the problem of bridging their theory with empirical analysis because some variables, such as n_j and p_j in equation (2), are difficult to measure or even unobservable. Therefore, they refer to previous works with a similar theoretical framework, such as Redding and Venables (2004), and propose equation (7) (without the asymmetric business network term of FDI_{ji}), where f_i and f_j capture fixed effects specific to origin (*j*) and destination (*i*) countries, as an empirical specification consistent with their theory.

We apply the analytical framework of goods (or tangible) trade in Combes et al. (2005) to service (or intangible) trade and examine the relevance of its implications (i.e., both migrant and business networks promote trade) by using bilateral data among OECD countries and Japan (or the U.S.). In addition to an academic interest of examining this hypothesis, our analyses are motivated by practical policy interests, which industry mature countries face: the transition of the balance of payments structure. For example, Japan has been suffering from trade deficits from 2011 and decreasing trends of current account since the late 2000s. However, royalties and license fees show increasing trends (except for a temporal drop in 2009 due to the global financial crisis) since 2003, when the account of those fees turns to be in surplus after prolonged periods of deficit. Other countries, such as the U.S. and the United Kingdom attain real GDP growth despite permanent current account deficits. At the same time, they enjoy service surplus; specifically, royalties and license fees are the primary factors contributing to service surplus in the U.S. Reflecting this situation, the Japanese government has been promoting exports of intellectual properties aggressively (*Nikkei Newspaper*, March 16, 2015); as such, the Prime Minister established the Strategic Council on Intellectual Property[5] in 2002 and the Basic Law on Intellectual Property[6] was enacted in the same year. Government efforts have been continued under the Intellectual Property Strategy Headquarters,[7] established in 2003.

[5] http://www.kantei.go.jp/jp/singi/titeki/ (last accessed on August 19, 2016).
http://japan.kantei.go.jp/policy/titeki/index_e.html (last accessed on August 19, 2016).
[6] http://www.kantei.go.jp/jp/singi/titeki/hourei/021204kihon.html (last accessed on August 19, 2016).
http://law.e-gov.go.jp/htmldata/H14/H14HO122.html (last accessed on August 19, 2016).
[7] http://www.kantei.go.jp/jp/singi/titeki2/ (last accessed on August 19, 2016).

The Japan case is relevant for analysis because the government has also been promoting cross-border direct investment and geographic mobility. While Japanese outward FDI is represented by several famous Japanese multinational companies, the government's attempts of promoting inward FDI exist since the establishment of the Japan Investment Council (a ministerial-level meeting chaired by the Prime Minister) in 1994.[8] Regional governments also assume roles that facilitate inward FDI in order to revitalize local economies and increase tax revenues after the Basic Policies for Economic and Fiscal Policy Management and Structural Reform in 2002.[9]These efforts succeed the Investment Japan–Foreign Direct Investment Promotion Council established in 2014.[10] Specifically, inward FDI promotion has gained attention as to recently complement decreasing domestic savings for an aging population. Similarly, the government attempts to open up the labor market in order to handle labor shortage in a society characterized by an aging and declining population. The revised Immigration Control and Refugee Recognition Act in 1990 supports increased inflows of foreigners of Japanese descent. Japan began to accept foreign nurses and care workers from Southeast Asian countries, based on Economic Partnership Agreements (EPAs), from the late 2000s. Recently, a points-based preferential immigration treatment system for highly skilled foreign professionals was initiated in 2012.[11]

Consequently, our analyses help discuss the possible interaction of the policy promoting exports of intellectual property with the policy promoting FDI and migration. These items are targeted as priority policy areas in mature industrial countries, such Japan, for enhanced growth performance. It is important to identify interactions among those policies. However, these topics used to be discussed independently from a policy perspective. However, the comprehensive analyses of the exports of intellectual property, FDI, and migration would provide implications on the effectiveness of policies related to these items.

Empirical analyses

We introduce dynamic panel data analyses into the cross-section analyses of Combes et al. (2005). The empirical analyses examine the dynamics of trade flows, thus reflecting changes in migration and FDI waves over a period of time, and adding insights related

http://japan.kantei.go.jp/policy/titeki/index_e.html (last accessed on August 19, 2016).

[8] http://japan.kantei.go.jp/policy/index/investment/index_e.html (last accessed on August 19, 2016).

[9] http://japan.kantei.go.jp/policy/2002/0621kouzoukaikaku_e.html (last accessed on August 20, 2016).

[10] http://www.invest-japan.go.jp/ (last accessed on August 19, 2016).
http://www.invest-japan.go.jp/en_index.html (last accessed on August 19, 2016).
http://www.meti.go.jp/policy/investment/ (last accessed on August 19, 2016).

[11] http://www.immi-moj.go.jp/newimmiact_3/en/ (last accessed on August 20, 2016).

to trade flow trends monitored over time, compared to snapshots at a single point in time (i.e., the relationships between trade and migrant and business networks) in Combes et al. (2005). We examine the interaction of intellectual property trade, immigration, and FDI by using a system GMM. The usage of the system GMM has several merits because it can accommodate empirical issues unexplored in previous studies. Previous works on trade–immigration relationships handle endogeneity insufficiently. For example, simultaneous bias between trade and immigration was not explicitly considered using methodologies such as the instrumental variable approach. The trade–FDI literature is aware of this problem, but handles it using a lagged FDI variable at most, instead of a contemporaneous FDI variable as independent variable. Other concerns include fixed individual effects. There might be unobserved fixed effects related to the heterogeneity of partner countries. Some studies attempt to mitigate such fixed effects by including country dummies. However, "the idiosyncratic disturbances (those apart from the fixed effects) may have individual-specific patterns of heteroscedasticity and serial correlation" (Roodman, 2009, p.99). The system GMM is a dynamic panel estimator designed to account for such situations.

The analyses use data on 15 OECD member countries, which have migrant and business relationships with Japan, during 1996–2012. The sample comprises Australia, Belgium, Canada, France, Germany, Italy, Luxembourg, Mexico, Netherlands, South Korea, Spain, Sweden, Switzerland, the United States, and the United Kingdom. The current analysis requires four types of variables, bilateral migration (i.e., immigration and emigration) and bilateral FDI (i.e., inward and outward FDI). Although the official statistics of the Japanese government provide data on 28 countries regarding imports of intellectual property from Japan, our sample is restricted to 15 countries, due to data availability on Japanese emigrants (i.e., Japanese immigrants in foreign countries). The sample period corresponds to the time before and after royalties and license fees received by Japan turn to be surplus in 2003 (and when both FDI promotion and immigrant enhancement began to attract attention, because the working-age population began to decrease after reaching its peak in 1995).

Table 2 summarizes the description of variables used for the analysis, together with their data sources. In the dynamic panel data analyses, we apply time variant variables in estimating Equation (7), because time-invariant variables over the sample period are discarded in the estimation algorithm procedure. The variable $\tilde{c}_{ijt}$ represents the net receipts of royalties and license fees in Japan (i.e., the net imports of intangibles

from country *j* (or Japan) to country *i*) at time *t*,[12] Mig_{ijt} denotes the number of the Japanese emigrant stocks in country *i*, Mig_{jit} is the number of foreign immigrant stocks in Japan, FDI_{ijt} are Japanese direct investment stocks (outward FDI stocks) to country *i*, and FDI_{jit} are FDI stocks (inward FDI stocks) into Japan.

We use the absolute value of $\tilde{c}_{ijt}$ before log-transformation and adjust to the multiple value by minus one if the original value is negative. Other adjustments include using zero if the original value is zero because the logarithm of zero cannot be defined. The same adjustments are applied to FDI variables. A similar approach is taken in previous works, such as Eichengreen and Irwin (1995), Co et al. (2004), Dunlevy (2006), and Coughlin and Wall (2011), by transforming the dependent variable of value zero ($\tilde{c}_{ijt} = 0$ here) into ($1+\tilde{c}_{ijt}$), so that the logarithm of ($1+\tilde{c}_{ijt}$) becomes zero. Other works, such as Wagner et al. (2002), Law et al. (2013), and Aleksynska and Peri (2014), apply the same approach to zero migrant stocks so that the logarithm of ($1+Mig$) becomes zero.

In addition to dyadic variables of interests, the analyses use a time-variant transport cost variable, t_{ijt}, which accounts for distances and oil prices, although the literature typically uses time-invariant geographical distances (Head and Ries, 1998; Girma and Yu, 2002; Rauch and Trindade, 2002; Co et al., 2004; Dunlevy, 2006; Coughlin and Wall, 2011; Egger et al., 2012; Low et al., 2013; Aleksynska and Peri, 2014).[13] The variable is constructed by multiplying geographical distances by average world oil prices in real terms so as to proxy for time-variant transportation costs in monetary value. A similar approach is observed in Combes et al. (2005), which use "the cost for a truck to

---

[12] Intellectual property receipts used for the analysis are under "royalties and license fees" in the balance of payments table. Royalties are payments from one party (a "licensee") to another (the "licensor") for the usage of patents, copyright and trademarks, etc., and licensing fees are payments made when a tangible property is licensed for usage by a licensor to the licensee. Typically, royalties and license fees include not only payments on trademarks, copyright, and patents, but also payments on items consisting of an imported product with any of aforementioned items (https://www.flexport.com/learn/royalties-licensing-fees/). Examination of the trend on royalties and license fees balances in Japan reveals that royalties and license fees balances for industrial property rights etc. are surplus, while those for copyrights etc. are deficit since 2000. Trade balances related to research and development services and intellectual property are classified as balance on research and development services, which has been deficit from 2005 to 2015 (Cabinet office, Government of Japan, the tax commission, 2016 (http://www.cao.go.jp/zei-cho/gijiroku/discussion1/2016/__icsFiles/afieldfile/2016/05/27/28dis17kai2_part5.pdf).

[13] White (2007) uses time-variant distances weighted by trade volume.

connect each pair of French regions" (p. 14).

Prior to discussing our results, it is worth mentioning that we use the number of immigrants registered as Korean for the category of South Korea because the Japanese government data do not distinguish among North and South Korean citizens, but simply classify them as Korean. Fortunately, this treatment does not appear to be unreasonable. The *Annual Report of Statistics on Legal Migrants, Japan* shows that the number of North Korean entrants to Japan is negligible compared to South Korean ones, and most recent North Korean entrants are "special permanent residents" with reentry permits. The category of "special permanent residents" was designed for Koreans, Taiwanese, and their offspring living in Japan before September 2, 1945, when Japan signed the Instrument of Surrender. Considering that North Korea was only established in 1948, the distinction of North or South Korea is not crucial for entrants registered as Koreans immigrating to Japan before the Second World War.

One final remark is related to our use of the word immigration. The usage may confuse some readers because they may have an image of permanent residents, namely, foreigners with permanent residence in a host country, for immigrants. However, no common definition exists of immigrants, contrary to the term refugees, which is defined by the Convention Relating to the Status of Refugees in 1951. Specifically, confusion arises from the Japanese case, since "long-term foreign residents (in Japanese)" are classified as "immigrants" in the OECD migration database. We reiterate that the current study partly aims to examine whether even temporary immigrants such as guest workers create network effects in the same manner permanent immigrants do. We believe that the analysis would provide useful policy implications when developed countries have to rely on foreign laborers but do not expect them to stay permanently.

3. Results

The results of our analysis are presented in Table 4. For each variable, the first row shows the estimated coefficients and the second row the standard errors. In order to make our results comparable to those of past works, we present the results of the traditional gravity estimator, where time-variant GDP in each country is used to proxy for time-invariant country specific fixed effects in Equation (7) (Columns (1) and (3)). Additionally, estimations in Column (3) include the term of research and development (R&D) expenditures in country *i*. The term aims to capture substitution between imported and domestically produced intellectual property. Country *i* may import less intellectual property from country *j* if the former produces similar products. The estimation approach implicitly assumes that σ is a function of the R&D expenditures,

although σ, the elasticity of substitution, is assumed to be constant in the theory mentioned above. Greater R&D expenditures may create more intellectual property production domestically, so that imports of intellectual property may decrease.

Our analysis uses the system GMM estimator, where migration, FDI, R&D expenditures, and GDP, are treated as endogenous. The treatment accounts not only for simultaneous decisions on factor mobility regarding migration and FDI, but also for their interaction with national output and R&D expenditures. However, such dynamic interactions have not received attention in previous studies. The system GMM approach has another merit in the selection of instrumental variables. It is not easy to find instruments in our analysis, as our specification examines interactions among several factors. This complicates our study because similar factors affect all of them simultaneously, thus creating difficulties in identifying relevant instruments. The system GMM enables us to use the information within a dataset as instruments so that we do not need to search for variables not used as independent variables in models. We apply a one-step estimator with the endogenous variables lagged two or three periods as instruments for differenced equations and their once-lagged first differences for level equations.[14]

Our analysis shows positive bidirectional migrant network effects but negative unidirectional business effects. Imports of intellectual property increase with migrants from trading partners residing in Japan (or Japanese net exports of intellectual property have a positive relationship with immigrants in Japan). The coefficient of Mig_{ji} (the number of emigrants from country *i* residing in Japan) is estimated at a statistically significant level. Similarly, imports of intellectual property increase with Japanese immigrants in each country (or Japanese net exports of intellectual property have a positive relationship with Japanese emigrants). The coefficient of Mig_{ij} (the number of migrants from Japan residing in country *i*) is estimated as positive at a statistically significant level. Namely, both immigrant and emigrant network effects (defined from the perspective of Japan) exist, and the degree of these network effects is not negligible. Column (3) shows that a 1 percentage point increase in immigrants in Japan increases

[14] The analysis uses a one-step estimator with the default type of standard error, which uses "the conventionally derived variance estimator for generalized method of moment estimation (www.stata.com/manuals13/xtxtdpd.pdf)." Therefore, tests for autocorrelation are not provided because "after the one-step estimator, the test can be computed only when vce(robust) has been specified (http://www.stata.com/manuals13/xtxtdpdpostestimation.pdf)." In future work, we plan to try various specifications so as to examine the robustness of the initial analysis.

revenues from intellectual property trade by 2.96%. For example, the number of immigrants (total number of registered aliens) in Japan was 2,186,121, and the total net balance for charges for the use of intellectual property was USD 4.8 billion in 2009. Around 20 thousand immigrants increase Japan's international intellectual property revenues by USD 143 million. Similarly, a 1 percentage point increase in emigrants from Japan increases revenues from intellectual property trade by 2.30%. Using the number of Japanese emigrants, 1,131,807, around 10 thousand additional Japanese emigrants increase international intellectual property revenues by USD 111 million.[15] While Japan experienced increased revenues from intellectual property trade during the 2000s, they may be partly owed to migration network effects. Both immigration and emigration increased during the period. The annual average increments of immigrants in Japan were 55,520, and those of Japanese emigrants 35,566 during 2000–2009. The annual average increments of immigrants in Japan were 53,422 (or 42,153 during 1991–1999, if we exclude 1990, when we observe a big increase in immigrants because of the new legislation encouraging immigration), and those of Japanese emigrants 19,520 during 1990–1999.

On the other hand, imports of intellectual property decrease with FDI stocks in Japan (or Japanese net exports of intellectual property have a negative relationship with FDI_{jit}, inward FDI stocks). Additionally, imports of intellectual property do not have any relationships with Japanese direct investment stocks (FDI_{ijt}, outward FDI stocks) to country i. The result may simply indicate that countries with greater FDI in Japan have preference for domestically developed intellectual property. However, the results could imply either business network effects do not exist or other effects surpass these. A possible explanation states that effects of export–FDI complementarity dominate business network effects in case of inward FDIs to Japan (see Figure 1 a)). Complementarity, i.e., positive relationships between exports and outward FDI, is often shown in literature (Lipsey and Weiss, 1981, 1984; Pfaffermayr, 1996; Clausing, 2000; Head and Ries, 2001). Greater FDI from trading partners to Japan (outward FDI from trading partners) increases exports from those countries to Japan. Moreover, increased exports from partner countries imply decreased net exports from Japan to those countries. If such complementarity effects dominate business network effects, then inward FDI in Japan has a negative relationship with net exports from Japan, although business network effects increase Japanese exports to trading partners.

[15] These estimates are in nominal terms. Intellectual property revenues in Japanese yens are converted to the U.S. dollars using annual average USD–JPN exchange rates for 2009 provided by the Japanese government website (http://www.customs.go.jp/tetsuzuki/kawase/kawase2011/monthly-average.pdf) (last accessed on August 20, 2016).

On the other hand, export–FDI substitution effects may offset business network effects in case of outward FDI from Japan (see Figure 1 b)). Despite export–FDI complementarity being often observed in literature, few studies show substitution between exports and outward FDI in case of Japan (Belderbos and Sleuwaegen, 1998; Blonigen, 2001; Head and Ries, 2001). Substitution means that Japanese outward FDI decreases exports from Japan. If this effect offsets business network effects, which enhance Japanese exports to trading partners, then outward FDI from Japan does not have any relationships with exports from Japan. Specifically, this argument could be valid if either intellectual property produced by Japan is more complicated or vertically integrated trade dominates Japanese trade, where intellectual property is used as intermediate. This is because internalization theory implies substitution between FDI and exports; it is costly to export intellectual property as intermediate goods, considering the risks that confidential contents of intangibles are revealed. Interestingly, our results are interpretable using results from past works in a different area of research. Namely, the results are in line with studies on trade–FDI relationships.

Comparison with literature

The results of our analyses are mostly consistent with those shown in the past works on trade–migration relationships. The literature claims that immigrants increase both imports and exports (see Table 1): 1) the number of immigrants in an immigrants' host country is positively associated with the imports of an immigrants' host country from an immigrants' home country, 2) the number of immigrants in an immigrants' host country is positively associated with the exports of an immigrants' host country to an immigrants' home country, and 3) greater business ties are positively associated with trade. Our results in Columns (1)–(3) in Table 4 are consistent with the first two but not the last one of the above observations.

Since our analyses differ from past ones in a few points, we apply our data to empirical approaches similar to those used in previous studies, and compare the results with those of our analyses. This further clarifies new insights in our analyses. For this purpose, we use static analysis by applying generalized least squares to the traditional gravity equation, as per the literature. Figure 2 helps understand the compatibility between past works and ours in terms of transaction flows. We denote the Type 1 situation as imports. The Type 1 case is used to examine if the number of immigrants from country *j* residing in country *i* is positively associated with the imports in country *i* from country *j*. Similarly, we denote the Type 2 situation as exports, and the Type 2 case is used to examine if the number of immigrants from country *i* residing in country *j*

is positively associated with exports from country *j* to country *i*.

The results are shown in Columns (3) and (6) in Table 5, respectively. Positive coefficients on migration networks are consistent with the results in literature. Coefficients of Mig_{ij} (or Mig_{ji}) are estimated to be positive at statistically significant levels for imports (or exports). The results are not sensitive, even after including control variables such as indices of political stability and corruption in each country (Columns (4) and (7)) and additional observations of non-OECD member countries (Columns (5) and (8)). Our analyses are partly motivated to examine if network effects on intangible trade could differ from those on tangible trade; the literature focuses on tangible trade so that the results are not necessarily comparable with ours. To fill this gap, we apply our data to empirical approaches similar to those used in previous studies. Despite the differences, our static analyses in Columns (3)–(8) in Table 5 are consistent with the literature: immigrant networks are observed to promote both exports and imports. In this sense, differences between tangibles and intangibles do not seem to be crucial. As such, the differences appear in other control variables, because estimated coefficients of few control variables do not show the signs expected by the tangible trade theory. This may reflect the different nature of tangible and intangible trade.

Columns (1) and (2) in Table 5 describe the results when all migrant and business networks are included. Bidirectional migration networks and unidirectional business networks are shown to be related with intellectual property trade (Column (2)). Migration is associated with trade promotion, regardless of the direction, that is, either immigration or emigration. This is consistent with Combes et al. (2005). However, inward FDI is related with less trade. The result is not in line with Combes et al. (2005). Different measurement of business networks may explain the difference in results. We consider two asymmetric networks depending on factor movements, while Combes et al. (2005) use symmetric business networks.

Comparing the results in Columns (3)–(8) in Table 5 with those in Columns (1)–(3) in Table 4 reveals that our analyses not only encompass the essence of past analyses, but also add new insights. We show positive immigration and emigration effects on trade, together with negative trade–FDI relationships. The results of immigration are consistent with those in literature. However, almost all extant studies examine immigration effects only. Our analyses are comprehensive by adding emigration and business networks. The results of emigration networks are consistent with those of Combes et al. (2005) and Law et al. (2013). A concern is inconsistency with positive trade–FDI relationships shown in Combes et al. (2005). They examine trade–network relationships between 94 French regions using 1993 data, and show

positive migration and business network effects. Overall, it is not obvious where differences come from, because their static cross-section analysis of tangible trade using regional data totally differs from our dynamic panel analyses of intangible trade at country-level. However, the differences could be partly explained by the model specification (i.e., they includes only symmetric business network, while we include bidirectional business networks). Specifically, differences in variables, which are used as proxies for business networks, could matter. We use FDI, while they use a measure based on plant numbers. Despite the differences, the relevance of our approach is supported. Our usage of FDI variables is not only suggested by Rauch (2001) but also makes the results of the analyses comparable to those in the literature on trade–FDI relationships. This allows us to interpret our results of negative trade–FDI relationships in consistent ways to those results shown in the different branch of the trade–FDI literature. Another possible explanation is related to empirical approaches (i.e., either static analyses or dynamic panel data analyses); however, this is not the case because the results of dynamic panel analyses shown in Columns (1)–(3) in Table 4 are consistent with those of static analyses in Column (3)–(8) in Table 5. Hitherto, Combes et al. (2005) is the only work incorporating both migration and business networks. However, future research in this area will provide a comprehensive understanding of network effects of migration and business on trade promotion.

While the analyses in Table 5 are conducted for reference purposes, a few observations follow. First, for the analyses in Columns (5) and (8) in Table 5, the number of foreign entrants registered as Chinese is used as migrant stocks from mainland China, Taiwan, and Hong Kong residing in Japan, because the Japanese government data do not distinguish among mainland Chinese, Taiwanese, and Hong Kong citizens, but simply classify them as Chinese. This treatment requires a stricter assumption compared to the Korean case. It assumes that Chinese share similar cultures to a certain degree, so that Chinese network externalities apply to the three countries/areas, i.e., total Chinese stocks in Japan affect the imports of intellectual property for each country from Japan. Second, for the analyses in Column (5) in Table 5, we merge the additional data on the number of Japanese emigrants living abroad by country during 1996–2009, which are available from the Bureau of Statistics, Ministry of Internal Affairs and Communications, Japan, to the original data of 15 OECD countries. They include seven non-OECD member countries: Brazil, China, Indonesia, Malaysia, Singapore, Taiwan, and Thailand (i.e., less developed countries). In the due course of the analyses, we also replace the original data on Canada and France instead of merging the new data to the original ones, because the OECD source provides the

data only on selected years for the two countries and the numbers in the two data sources are not necessarily consistent. Third, the analyses in Column (8) in Table 5 include observations for 26 countries (22 countries in Column (5) in Table 5 plus Hong Kong, Mexico, New Zealand, and Philippines). Additional observations are available because the analyses require data on immigrants in Japan only, but not Japanese emigrants abroad. Emigrant data are harder to obtain than immigrant data. Many countries have limited information on emigrants and/or do not have the information on their destination countries (Dumont and Lemaître, 2005). Finally, throughout the analyses, factors such as a common language and contiguity are not included, although they are often used to capture country-pair specific effects. This is because Japanese is neither an official language in other countries nor adjacent to any other countries.

Use of different data

We examine the robustness of the analyses using a different data source, which provides observations on Japanese emigrants in seven OECD countries: Australia, Canada, France, Germany, South Korea, the United States, and the United Kingdom, and eight non-OECD member countries/areas: Brazil, China including Hong Kong, Indonesia, Malaysia, Singapore, Taiwan, and Thailand. The Japanese government data, which are available from the Bureau of Statistics, Ministry of Internal Affairs and Communications, Japan, provides the number of Japanese emigrants living abroad by country during 1996–2009. Since the data do not distinguish Japanese emigrants living in mainland China and Hong Kong, but simply classify them as living in China, the analyses assume that Japanese emigrant networks operate equally to intangible imports in China and Hong Kong, respectively.

The results of the analyses using new data differ slightly from the results of the initial analyses. Columns (4) and (5) in Table 4 show the results of the seven OECD countries. Column (4) shows positive immigration network effects and negative inward FDI effects, but no emigration network effects. While the former results are consistent with ours, the latter is not. Emigration effects disappear after replacing the initial emigrant data with new data. Similarly, in Column (5), immigration network effects are still observed, but neither emigration nor dual directional business network effects are observed. We examine if the results are sensitive to the inclusion of the different nature of countries. Columns (6) and (7) show the results of eight Asian countries and Columns (8) and (9) the results of eight non-OECD countries/areas. When less developed countries dominate the sample, we observe positive immigrant effects and negative inward FDI effects, together with negative emigrant effects. While the former

two results are observed in our initial analyses, the latter results are new. Finally, Columns (10) and (11) show the results of all 15 countries/areas. Both positive immigrant network effects and negative inward FDI effects are observed.

Some results are robust to the usage of alternative data and additional observations with different country characteristics: 1) the number of immigrants in Japan is positively related to intangible imports to immigrants' home countries from Japan and 2) foreign direct investment in Japan is negatively related to intangible imports by the FDI home countries. However, the results of emigrant effects are sensitive to replacing emigrant data.

Different results are likely to be due to the different nature of data. Therefore, it is worthwhile defining migrants (Japanese migrants residing in trading partner countries, i.e., Japanese emigrants) used in both data sets. It is known that no common definitions on migrants exist; various data sources define migrants differently according to dimensions such as country of birth, nationality, and length of stay (Anderson and Blinder, 2013). Our initial analyses use the OECD international migration database, which is constructed from data compiled by governments in each country. Thus, the definition of immigrants varies by country. For example, most countries in the original sample define immigrants using the category of foreign population by nationality. Australia and the United States are two exceptions, which use foreign-born population by country of birth. Some countries, such as France, Mexico, Netherlands, Spain, and Sweden, provide the data of both categories; however, the analyses use the data of the nationality category, because the category provides larger sample sizes without missing years' data. On the other hand, for the emigrant data used for the robustness check, the Japanese government defines emigrants based on nationality and length of stay, and includes both permanent residents who have Japanese nationality and long-term Japanese expatriates, who live abroad for more than three months.

In any cases, our analyses examine a policy concern whether the temporal cross-border traffic of people helps reduce information costs related to international transactions, because our migrant networks are characterized by migrants in the broad sense, i.e., they include temporal migrants with a shorter length of stay than permanent residents, although this is partly due to technical reasons related to data sources. Among our sample countries, only Australia and the United States focus on permanent immigrants (or permanent residents) but not temporal ones (or those who come from abroad and stay in the host country for a certain duration). The data in other countries count temporal entrants, including intercompany staff transfers, as immigrants. For example, the minimum duration is three months for Belgium and Japan and one year for Sweden

(Dumont and Lemaître, 2005). Regarding the fact that several industrial countries have to rely on immigrant labor, but face strong resistance from their citizens, the current analyses would provide useful implications. Even temporal immigrants have the potential to promote intangible exports from industrial countries, although most are expected to return to their home countries.

Different country: the U.S. case

One may wonder whether the results are unique to Japanese trade and not necessarily universal. As such, we examine the validity of the results using U.S. data. The U.S. is relevant for analysis, considering it receives the largest intellectual property revenues in the world and royalties and license fees are primary factors contributing to its service surplus. We conduct the analyses equivalent to Columns (1)–(3) in Table 4 using the system GMM estimator, where migration, FDI, R&D expenditures, and GDP, are treated as endogenous. Endogenous variables lagged two or three periods are used as instruments for differenced equations and their once-lagged first differences are used for level equations.

The analyses use data on 18 OECD member countries, which have migrant and business relationships with the U.S. during 2001–2012. The sample comprises Australia, Canada, Chile, France, Germany, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, South Korea, Spain, Sweden, Switzerland, and the United Kingdom, thus overlapping the countries used for the initial analyses in Japan. Although the U.S. Bureau of Economic Analysis provides data on 35 countries/areas regarding U.S. exports of intellectual property during 1999–2014, data accessibility regarding U.S. emigrants (i.e., the U.S. immigrants residing in foreign countries) and business networks (FDI stocks in the U.S. and the U.S. FDI stocks of trading partners) limits the possible sample period and countries.

The lower part of Table 2 summarizes the description of variables used for the analysis, together with their data sources. The variables and their sources used for the analyses are mostly similar to those of the initial analyses, except a few minor differences. For example, the variable $\tilde{c}_{ijt}$ represents "charges for the use of intellectual property" (i.e., U.S. exports of intellectual property to country *i* at time *t*). Contrary to the initial analyses, the number of migrants is defined in terms of foreign-born population by country of birth for most observations, instead of foreign population by nationality. Summary statistics are shown in the lower half of Table 3. The nature of intellectual property trade differs between the U.S. and Japan. Specifically, the standard deviation of Japanese royalty and license fees is larger than the U.S. one, and the range varies from

deficits to surplus, depending on trading partners. Larger standard deviations are observed for other variables used in the Japanese analyses.

The results of the analyses are shown in Columns (12)–(13) in Table 4. The analysis shows positive immigrant and bidirectional business network effects, together with negative emigrant effects. Imports of intellectual property increase with migrants from trading partners residing in the U.S. (or the U.S. exports of intellectual property have a positive relationship with immigrants in the U.S.). Similarly, imports of intellectual property increase with FDI stocks in the U.S. and the U.S. direct investment stocks in trading partners (or the U.S. exports of intellectual property have a positive relationship with the U.S. inward and outward FDI stocks). On the other hand, imports of intellectual property decrease with the U.S. immigrants in each country (or the U.S. exports of intellectual property have a negative relationship with U.S. emigrants).

Some results using the OECD–U.S. sample are consistent with those from the analyses using the OECD–Japan sample, but others are not. However, it is certain that exports of intellectual property are positively related with immigrants residing in both the U.S. and Japan. Our analyses show that a 1 percentage point increase in immigrants in Japan increases revenues from intellectual property trade by 1.71–3.67%. This implies, for example, that an increase of 20 thousand immigrants in Japan induces international intellectual property revenues of USD 83–177 million for 2009. Similarly, a 1 percentage point increase in immigrants in the U.S. increases U.S. revenues from intellectual property trade by 0.3%. Using total U.S. revenues for 2009, a 1 percentage point increase in immigrants in the U.S. induces additional international intellectual property revenues by USD 301 million. The result is line with the results of the literature on trade–migration interactions: immigration is positively related to exports. Positive immigration network effects on intellectual property trade operate. Additionally, the result of negative emigration–export relationships is observed in not only the U.S. but also some Japanese cases. The result implies possible substitution effects between trade and factor movements (Mundell, 1957), which dominate migration network effects. Although the results are contrary to Combes et al.'s (2005), it is hard to conclude which result is more relevant because their analytical framework differ from ours. Additionally, we cannot refer to other past studies because literature seldom includes emigration network effects.

Hitherto, differences are also observed. Positive relationships between exports and outward FDI in the U.S. differ from no effects in Japan. However, the difference is interpretable in line with the trade–FDI literature. The U.S.'s positive relationship occurs under the situation of complementarity between U.S. exports and outward FDI observed in 1) and total effects 1) + 2) + 3) are greater than zero (case b) in Figure 1). Lastly, the

effects of inward FDI on exports differ between the two countries. Positive business network effects are observed for the U.S., but opposite (or negative) effects for Japan. The U.S. positive effects are possibly due to the nature of the dependent variable, exports of intellectual property, compared to net exports in the Japanese case. Since the literature mainly focuses on exports–outward FDI relationships, it is hard to judge the relevance by referring to past research. Therefore, the result of the current analyses is not comparable to those in literature.

In summing robustness checks from various points of views, we conclude that intangible trade–factor movement interactions are not universal. A similar idea was pointed out by Girma and Yu (2002) in case of tangible trade–immigration interactions. Although positive trade–immigration relationships are commonly shown in literature, they show that the U.K. trade–immigration interactions varies depending on the nature of trading partners, i.e., immigration from either Commonwealth countries or non-Commonwealth countries. Our analyses show that such uniqueness occurs depending on the nature of origin countries, but not trading partners. While we use mostly common OECD countries as trading partners, the results from the U.S. analyses differ from the Japanese ones. In fact, different results may be expected considering the different stages of the balance of payments structure, as Table 2 shows. Japan has a shorter history of service surplus than the U.S., placing it at the premature stage of intellectual property trade, while the U.S. has already reached the mature stage of intellectual property trade. Therefore, it may be natural to observe that Japanese trade relationships differ from U.S. ones, although we examine the relationships with similar trading partners. Additionally, the idea of development stages is relevant observing another interesting feature: the different degree of network elasticity between the two countries. The coefficient of immigrant networks (see the raw of immigrants (j) in Table 4) is estimated to be greater for Japan (1.7–3.7%) than the U.S. (about 0.3%). A similar feature is observed for other variables, such as the elasticity of emigrant networks. Network effects may be obsolete (or depreciated) for older migrants and direct investments. Such a possibility is shown for immigrant networks in the literature (Herander and Saavedra, 2005). Therefore, we conclude that migrant and business network effects could vary depending on the development stages of intellectual property trade.

4. Concluding remarks

This study examines if migration networks affect trade on intellectual property, together with business networks, using bilateral data on the U.S. (Japan) and OECD member countries during the 2000s (late 1990s to the 2000s). The analyses examined if positive

immigration–trade relationships shown in literature apply to intangible trade when various network effects are examined comprehensively. The analyses are distinct because 1) we extend the analytical framework of tangible trade to intangible trade, and 2) we examine bidirectional migration networks (i.e., immigration and emigration) and bidirectional business networks (i.e., inward and outward FDI) together, although past empirical studies have mainly focused on the unidimensional effects of either migrant or business networks, such as the effects of immigration on tangible trade. Our analyses show that exports of intellectual property are positively related to immigrants residing in Japan (or the U.S.). Negative emigration–export relationships are also often observed in both countries. However, no consensus has been reached regarding business network effects. In summary, positive immigration–export relationships are the only consensus after examination under different contexts. Emigration and business network effects are concluded to vary depending on the development stages of intellectual property trade.

The current analysis has several potential avenues for extension. One possible extension is examining the variation of network effects using data on other countries. The current analysis suggests a possible variation of network effects depending on the stages of intangible trade by using OECD countries–Japan, non-OECD countries–Japan, and OECD countries–U.S. data. If this is the case, another more interesting extension includes identifying threshold stages and classifying various migration and business network effects based on different stages. The signs (either positive or negative) of the effects might vary depending on each country's stage. Additionally, network effects may decrease for older migrants and direct investment. The usage of panel data allows us to compare cross-country differences, clarify the conditions under which positive network effects occur, and measure the decay rates of network effects. One concern regarding this extension is related to the characteristics of emigration data. The analyses reveal that results are sensitive to the usage of different emigration data. While the collection of emigration data is premature compared to the one of immigration data, one may want to investigate how the different definitions of emigrants affect network effects once well-organized emigration datasets are developed. Such analysis requires additional well-defined bilateral data on bidirectional migration and FDI among several countries, which is beyond the scope of this study.

Another possible extension is related to the theoretical foundation of network effects. Our model uses a simple parametric assumption of information costs expressed as the multiplication of migrant numbers and FDI levels. A new theory, which accounts for endogenous interactions of network effects, can be developed by introducing network effects into the theoretical framework used to analyze trade–FDI interactions.

The application of the current analytical framework to service trade is another possible extension. The current analysis assumes that migration networks reduce transaction costs related to international transactions. One may wonder why the mechanism is not so obvious, specifically how migration networks affect intellectual property trade. Possible examples include cases where Chinese immigrants in Japan have some knowledge into which properties are relevant for usage in Chinese manufacturing and they arrange license agreements for the usage between a licensee in Japan and a licensor in China. However, one may still not be certain if such processes are strong enough to influence intellectual property trade. If we extend our analysis to service trade, instead of intellectual property trade that is classified as a part of service trade, it is more revealing how migration networks affect trade, since service trade incorporates various possibilities. Increases in immigrants residing in Japan could increase international tourism from their home countries to Japan.

The extension proposes to examine more general trade, while another approach is to examine more specific trade. It is also interesting to examine the degree of migration (and business) networks for various product types and compare the impact on products item by item. Some product sectors may be strongly influenced by those networks, unlike others. If such variation is observed, the finding would add helpful policy implications regarding migration and direct investment policies.

We may also want to elaborate on the method of capturing migrant and business network effects. Following the method used in the literature, the analysis examines how the level of migration stocks (or FDI stocks) affects the level of trade. However, the current approach may simply capture correlations between migration (or business) growth and trade growth when globalization advances. Trade can grow together with migration (or FDI) when the world economy is being integrated under globalization. If we manage to determine additional impacts of migration (or FDI) beyond co-movement resulting from globalization, then it might be a more relevant approach to capture migrant and business network externalities.

All of these extensions are beyond the scope of our study, but represent potential future lines of research.

References

Aleksynska, Mariya and Giovanni Peri, 2014, Isolating the network effect of immigration on trade, *The World Economy* 37(3), 434–455.

Arellano, Manuel, and Olympia Bover, 1995, Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics* 68(1), 29–51.

Anderson, Bridget, and Scott Blinder. 2013, Who Counts as a Migrant?Definitions and their Consequences. Oxford:The Migration Observatory, 2013.

Anderson, Philip and Banny Lam, 2006, Cross-border IP transactions and transfer pricing planning, *International Tax Review*, Supplements, 8–13.

Anson, Weston and Chaitali Ahya, 2004, How to make transfer pricing work for IP and intangible assets, *International Tax Review* 15(9), 14–16.

Belderbos, René and Leo Sleuwaegen, 1998, Tariff jumping DFI and export substitution: Japanese electronics firms in Europe, *International Journal of Industrial Organization* 16, 601–638.

Blanes, José V., 2005, Does immigration help to explain intra-industry trade? Evidence from Spain, *Review of World Economics* 141(2), 244–270.

Blonigen, Bruce A., 2001, In search of substitution between foreign production and exports, *Journal of International Economics* 53, 81–104.

Blundell, Richard, and Stephen Bond, 1998, Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87(1), 115–143.

Branstetter, Lee, Raymond Fisman, and C. Flitz Foley, 2005, Do stronger intellectual property rights increase international technology transfer? Empirical evidence from U.S. firm-level data, NBER working paper series 11516, Cambridge, MA.

Clausing, Kimberly A., 2000, Does multinational activity displace trade? *Economic Inquiry* 38(2), 190–205.

Co, Catherine, Patricia Euzent, and Thomas Martin, 2004, The export effect of immigration into the USA. *Applied Economics* 36(6), 573–583.

Combes, Pierre-Philippe, Miren Lafourcade, and Thierry Mayer, 2005, The trade-creating effects of business and social networks: evidence from France, *Journal of International Economics* 66, 1–29.

Coughlin, Cletus C. and Howard J. Wall, 2011, Ethnic networks and trade: intensive versus extensive margins, *Economics Letters* 113, 73–75.

Dixit, Avinash K. and Joseph E. Stiglitz, 1977, Monopolistic competition and optimum product diversity, *American Economic Review* 67(3), 297–308.

Dumont, Jean-Christophe, and Georges Lemaître, 2005, Counting immigrants and expatriates in OECD countries, OECD Social, Employment, and Migration Working Papers No. 25. OECD Paris.

Dunlevy, James A., 2006, The influence of corruption and language on the protrade effect of immigrants: evidence from the American states, *The Review of Economics & Statistics* 88(1), 182–186.

Egger, Peter H., Maximilian von Ehrlich and Douglas R. Nelson, 2012, Migration and trade, *The World Economy* 35(2), 216–241.

Eichengreen, Barry and Douglas A. Irwin, 1985, Trade blocs, currency blocs and the orientation of world trade in the 1930s, *Journal of International Economics* 38, 1–24.

Ethier, Wilfred J., 1982, National and international returns to scale in the modern theory of international trade, *American Economic Review* 72(3), 389–405.

Girma, Sourafel and Zhihao Yu, 2002, The link between immigration and trade: evidence from the United Kingdom, *Weltwirtschaftliches Archiv* 138(1), 115–130.

Gould, David M. 1994, Immigrant links to the home country: empirical implications for U.S. bilateral trade flows. *The Review of Economics & Statistics* 76(2), 302–316.

Head, Keith and John Ries, 2001, Overseas investment and firm exports, *Review of International Economics* 9(1), 108–122.

Head, Keith, and John Ries, 1998, Immigration and trade creation: economic evidence from Canada. *Canadian Journal of Economics* 31(1), 47–62.

Helpman, Elhanan, 1984, A simple theory of international trade with multinational corporations, *Journal of Political Economy* 92(3), 451–471.

Helpman, Elhanan and Paul Krugman, 1985, Market structure and foreign trade, Cambridge, Mass: The MIT press.

Herander Mark G., and Luz A. Saavedra, 2005, Exports and the structure of immigrant-based networks: the role of geographic proximity, *The Review of Economics & Statistics* 87(2), 323–335.

Kopits, George F., 1976, Intra-firm royalties crossing frontiers and transfer-pricing behavior, *The Economic Journal* 86(344), 791–805.

Krugman, Paul, 1980, Scale economies, product differentiation, and the pattern of trade, *American Economic Review* 70, 950–959.

Law, David, Murat Genç and John Bryant, 2013, Trade, diaspora and migration to New Zealand, *The World Economy* 36(5), 582–606.

Leitão, Nuno Carlos, 2013, The impact of immigration on Portuguese intra-industry trade, *European Economics Letters*, 2(1), 7–11.

Lipsey, Robert E., and Merle Yahr Weiss, 1981, Foreign production and exports in manufacturing industries, *The Review of Economics and Statistics* 63(4), 488–494.

Lipsey, Robert E., and Merle Yahr Weiss, 1984, Foreign production and exports of individual firms, *The Review of Economics and Statistics* 63(4), 304–308.

Markusen, James R., 1983, Factor movements and commodity trade as complements,

Journal of International Economics 14(3/4), 341–356.

McAusland, Carol and Peter Kuhn, 2011, Bidding for brains: intellectual property rights and the international migration of knowledge workers, *Journal of Development Economics*, 95(1), 77–87.

Mundell Robert A. 1957, International trade and factor mobility, *American Economic Review* 47(3), 321–335.

Naghavi, Alireza and Chiara Strozzi, 2015, Intellectual property rights, diasporas, and domestic innovation, *Journal of International Economics* 96(1), 150–161.

Nurse, Keith, 2016, The diasporic economy, trade and investment linkages in the Commonwealth, International Trade Working Paper 2016/09, Commonwealth Secretariat, London.

Pfaffermayr, Michael, 1996, Foreign outward direct investment and exports in Austrian manufacturing: Substitutes or complements? *Weltwirtschaftliches Archiv* 132(3), 501–522.

Rauch, James E., 2001, Business and social networks in international trade, *Journal of Economic Literature* 39(4), 1177–1203.

Rauch James E. and Vitor Trindade, 2002, Ethnic Chinese networks in international trade, *The Review of Economics and Statistics* 84(1), 116–130.

Reams, Keith, Mark Nehoray, and Emily Dickert, 2010, IP migration: turning technology investments into value repositories, *International tax Review*, Supplement, 30–33.

Redding, S. and A. Venables, 2004, Economic geography and international inequality, *Journal of International Economics* 62(1), 53–82.

Roodman, David, 2009 How to do xtabond2:An introduction to difference and system GMM in Stata. *Stata Journal* 9(1), 86–136.

Wagner, Don, Keith Head, and John Ries, 2002, Immigration and the trade of provinces,

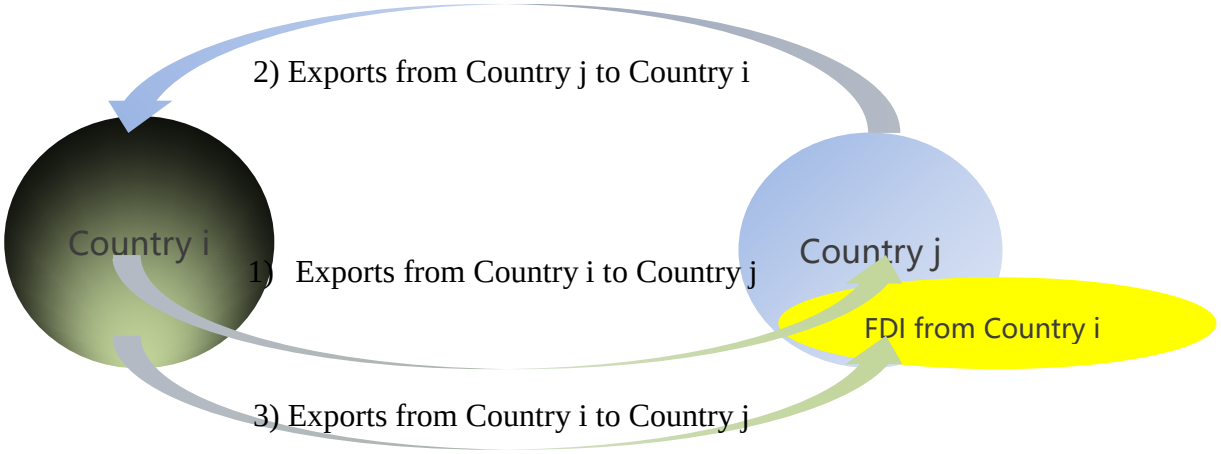
Scottish Journal of Political Economy 49(5), 507–525.

White, Roger, 2007, Immigrant-trade links, transplanted home bias and network effects, *Applied Economics* 39, 839–852.

Wong, Kar-yiu, 1986, Are international trade and factor mobility substitutes? *Journal of International Economics* 21, 25–43.

Figure 1 Different forces offset each other

a) Inward FDI in Japan

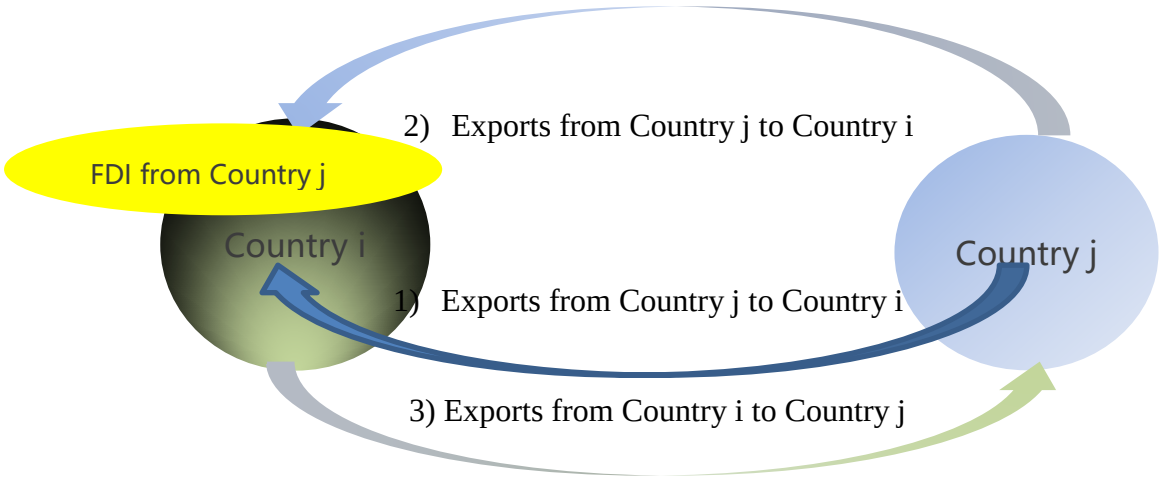


Notes:

1) Export–FDI complementarity: FDI↑→ exports from trading partners↑
2) Business network effects 1: FDI↑→ exports to trading partners↑
3) Business network effects 2: FDI↑→exports from trading partners↑

Net effects: 1) + 3) > 2), so that FDI↑→ net exports to trading partners↓

b) Japanese outward FDI



Notes:

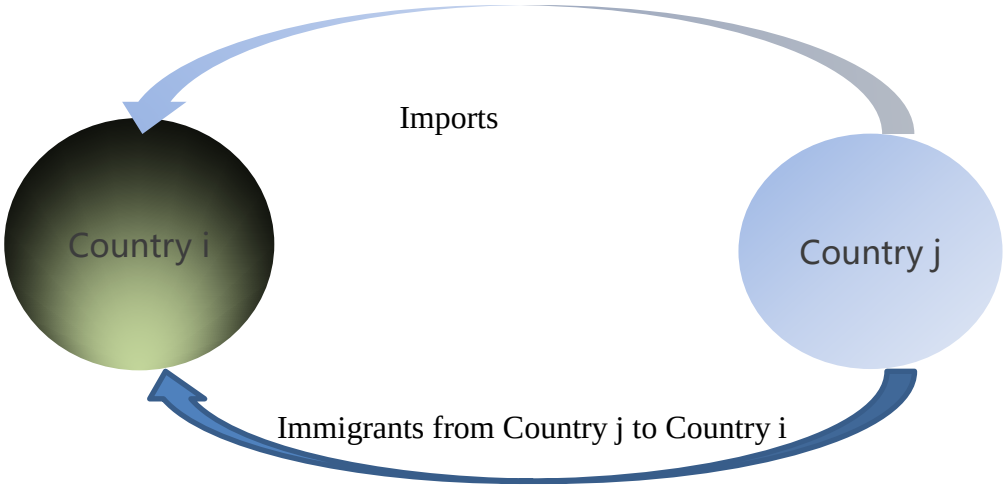
1) Export–FDI substitution: FDI↑→ exports to trading partners↓
2) Business network effects 1: FDI↑→ exports to trading partners↑
3) Business network effects 2: FDI↑→exports from trading partners↑

Net effects: 1) + 2) + 3) =0 (they offset each other), so that FDI↑→no effects on net exports to trading partners.

Literature shows export–FDI substitution as a unique feature of the Japanese case.

Figure 2 Trade flows comparable to those in literature

Type 1 Imports



Type 2 Exports

Table 1 Literature

	Literature	Trade			Countries/regions		Periods	Migration networks		Business networks	
		Flows	Units	Types	Trade Destination (i)	Trade Origin (j)		Destination M(ij)	Origin M(ji)	Destination (ij)	Origin (ji)
	Our analyses	imports in region i (or exports from region j)	values (US dollars)	intangibles (intellectual property)	15 OECD member countries, 8 non-OECD member countries	Japan	1996-2012	Bilateral stocks.	Bilateral stocks.	FDI stocks.	FDI stocks.
					18 OECD member countries	the U.S.	2001-2012				
	Combes et al. (2005)	imports in region i	quantities (tons)	tangibles	94 French regions such as Paris and Rhône	94 French regions	1993	Stocks. "the number of people working in the destination region who were born in the origin region"	Stocks. "the number of people working in the origin region who were born in the destination region"	"the number of plants belonging to the same business group in both the origin and destination regions"(symmetric)	
Trade-migration relationships											
the country level											
	Gould (1994)	imports, exports	values	producer goods, consumer manufactured goods, aggregate manufactured goods	47 trading partners	the U.S.	1970-1986	n/a	Stocks. the number of immigrants in the U.S.	Stocks. the sum of bilateral FDI stocks (robustness check)	
	Head and Ries (1998)	exports, imports	values	goods	136 countries	Canada	1980-1992	n/a	Stocks. the number of immigrants from country j in Canada.	n/a	n/a
	Girma and Yu (2002)	exports, imports	values	goods	48 countries (26 Commonwealth and 22 non-Commonwealth countries)	U.K.	1981-1993	n/a	Stocks. the number of immigrants from country j in UK	n/a	n/a

Table 1 (continued)

	Literature	Results
	Our analyses	Exports of intellectual property are positively related with immigrants residing in Japan (or the U.S.). Negative emigration—export relationships is also often observed in both countries.
	Combes et al. (2005)	Both migration and business networks inrease trade. The effects work in both directions, i.e., i's imports from and exports to region j.
Trade-migration relationships		
the country level		
	Gould (1994)	Trade is positively correlated with immigration. The effect on exports is stronger than the effect on imports. The effect on consumer goods (more differenciated) is larger than the effect on producer goods. Trade is positively correlated with FDI.
	Head and Ries (1998)	Immigrant stocks are positively correlated with exports and imports. The effect on imports is stronger than the effect on exports.
	Girma and Yu (2002)	immigration from non-Commonwealth countries is positively correlated with both exports and imports. Immigration from Commonwealth countries is not related to UK exports and are negatively correlated with UK imports. The authors interpret the results as the evidence that trade-immigration interactions are driven by the information on market and business practices brought by immigrants but not their personal contacts.

Table 1 (continued)

	Rauch and Trindade (2002)	trade (exports + imports between countries i and j)	values	commodities	63 countries ("exports of country i to country j of commodity x equals imports of country j from country i of commodity x.")		1980, 1990 separately	"the product of the ethnic Chinese population shares for countries i and j"		n/a	n/a
	White (2007)	exports, imports, exports+imports	values	goods	73 countries	the U.S.	1980–2001	n/a	Stocks. the number of immigrants from country j in the U.S. (the author estimated the stock values of the intra-census years by combining stock data (the census) with inflow data.	Stocks. U.S. FDI stock in country j relative to county j's GDP. (the measure of economic integration).	Stocks. FDI stocks of country j in the U.S. relative to county j's GDP.
	Egger et al. (2012)	bilateral imports of 27 countries from 130 countries	values	goods	130 countries	27 OECD countries	2000	n/a	Stocks. the number of immigrants in 27 OECD countries.	n/a	n/a
	Law et al. (2013)	merchandise exports & imports, (NZ's imports from country i or NZ's exports to country i) and tourism exports & imports (which are proxied by short-term visitor numbers)	values	1) merchandise trade & 2) trade in services (tourism)	190 countries	New Zealand	1981–2006 (Data on the foreign-born population in NZ are available only for 1981, 1986, 1991, 1996, 2001, and 2006. The authors interpolated vaules of inter-censal years. Data on NewZealanders in foreign countries are avaiable for only 2000.)	Stocks. the number of New Zealanders living in a foreign country.	Stocks. the number of immigrants in NZ.	n/a	n/a
	Bowen and Wu (2013)	exports	values	goods, serivices, goods+services	22 OECD countries		1970–2009	n/a	Flows. The number of inflows of migrants lagged one period (t-1).	n/a	n/a
	Aleksynska and Peri (2014)	bilateral imports/exports of 89 countries from/to 233 countries	values	goods	233 countries	89 countries	one year between 1996 and 2005 depending on countries	n/a	Stocks. the number of immigrants in occupations of business directors or managers	n/a	n/a
Intra-industry trade											
	Blanes (2005)	"the index of intra-industry trade between Spain and a partner country"	index	manufactured goods, non-manufactured goods	18 OECD countries, 24 non-OECD countires	Spain	1991–1998	n/a	Stocks. the number of immigrants from country j in Spain	n/a	n/a
	Leitão (2013)	intra-industry trade between Portugal and a partner country	index	goods	European Union's member states (EU-27)	Potugal	2000–2010	n/a	Stocks. the number of immigrants from country j in Portugal	n/a	n/a

Table 1 (continued)

	Rauch and Trindade (2002)	Differenciated goods enjoy greater positive Chinese-network effect on bilateral trade than homegeneous goods.
	White (2007)	Migrant network effect is observed only for low income countries but not high and medium income countries.
	Egger et al. (2012)	Immigrants induce "imports with at least about 100 migrants, but the effects declines with the number of immigrants."The effect disappers when "the number of immigrants exceeds about 4000."
	Law et al. (2013)	Immigrants in NZ increases merchandise exports and imports. Emigrants from NZ increases merchandise imports but do not affect merchandise exports. Both immigrants and emigrants increase tourism exports and imports. The immigrant network effect on imports is larger than the one on exports.
	Bowen and Wu (2013)	"Immigration and trade are complements" (i.e., immigration increases trade).
	Aleksynska and Peri (2014)	The number of immigrants is a poor measure to evaluate the migrant effect on trade. Instead, they propose immigrants in occupations of business directors or managers and show a positive correlation between those immigrants and trade. The effect on imports is larger than the effect on exports.
Intra-industry trade		
	Blanes (2005)	Immigration is positively correlated with the share of bilateral intra-industry trade in total trade. The author examine if migration network effect is stronger for intra-indutry trade (i.e., trade in differenciated goods) than inter-industry trade (i.e., trade in homogeneous goods).
	Leitão (2013)	Immigration is positively correlated with intra-industry trade.

Table 1 (continued)

the state level											
	Co et al. (2004)	exports from US states to an immigrant's home country	values (US dollars)	state exports	28 countries	US states	1993	n/a	Stocks. "the number of immigrants from country j residing in state i"	n/a	n/a
	Herander and Saavedra (2005)	exports from U.S. state i to an immigrant's home country j	values	1) total state exports & 2) consumer goods	36 countries	51 U.S. states	1993–1996	n/a	Stocks. "the number of immigrants from country j residing in state i" and "the population of country j immigrants living outside state i"	n/a	n/a
	Dunlevy (2006)	average exports from U.S. state i to an immigrant's home country j	values	manufactured goods	87 countries	51 U.S. states	1990–1992	n/a	Stocks. the number of immigrants born in country j residing in state i (the 1990 Census)	n/a	n/a
	Coughlin and Wall (2011)	manufacturing exports from a U.S. state to immigrant's home country	values	manufactured exports	29 countries	48 U.S. states	1990, 2000	n/a	Stocks. the number of foreign-born residents from each country j in state i.	n/a	n/a

Table 1 (continued)

the state level		
	Co et al. (2004)	immigrantion are positively correlated with state exports. The results apply when immigrants' home countries are either developed countries or less developed countries. They are motivated by the fact that migrtant destinations are not homogeneous but heterogeneous in the sense that immigrants concentrate in several cities in a host country.
	Herander and Saavedra (2005)	Local immigrant networks on state exports is greater than out-of-state immigrant networks ("the role of proximity"of immigrants within a host country is emphasized). Newer immigrants have greater network effects.
	Dunlevy (2006)	Immigrant network effects are stronger when the political system in immigrants' home countries is more corrupt and are weaker when their native language is either Spanish or English (language similarity).
	Coughlin and Wall (2011)	Migrant networks are positively correlated with exports "on the intensive margin (the level of exports, given that exports already occur) but not on the extensive margin (whether exports occur)."

Table 1 (continued)

Trade–FDI relationships (substitutes or complements): not necessarily bilateral trade											
		Flows	Units	Types	Trade & FDI Destination	Trade & FDI Origin	Periods	Destination M	Origin M	Destination	Origin
	Lipsey and Weiss (1981)	exports	industry level	14 manufacturing industries	44 foreign destinations	the U.S./ 13 other exporting countries	1970	n/a	n/a	Net sales (total sales – imports from the U.S.) for U.S. affliates. Numbers of foreign-owned affiliates.	n/a
	Lipsey and Weiss (1984)	exports	firm level	about 200 individual manufacturing firms in 14 indutries	five areas	the U.S. (exports of company i to area j)	1970	n/a	n/a	Net sales (total sales – imports from the U.S.)	n/a
	Pfaffermayr (1996)	exports	industry level	7 Austrian manufacturing industries	Unspecified (non-bilateral trade)	Austria	1980–1994	n/a	n/a	Shares in indutry output (the book value of FDI stocks)	n/a
	Belderbos and Sleuwaegen (1998)	exports	firm level	86 Japanese electronics firms	EC	Japan	1989	n/a	n/a	The number of production lines for individual products in Europe. The number of manufacturing subsidiaries in Europe (divided by the number of consolidated subsidiaries).	n/a
	Clausing (2000)	U.S. exports	country level	–	exports: 29 countries & U.S. affiliates abroad	exports: U.S. & U.S. multinational firms	1977–1994	n/a	n/a	1. Affiliate sales(–intrafirm imports from the parent company), 2. the share of a country's inward FDI stock originating in the U.S. for the year of 1989 as robustness check	n/a
		U.S. imports	country level	–	imports: U.S. imports & foreign affiliates in the U.S.	29 countries	1977–1994	n/a	n/a	Affiliate sales(–intrafirm imports from the parent company)	n/a
	Blonigen (2001)	imports of Japanese automobile parts	product level	Japanese manufacturing firms	the U.S.	Japan	1978–1991 for 10 automobile parts; 1979–1994 for 11 final consumer goods	n/a	n/a	Japanese auto part production in the U.S., which is proxyed by employment levels of Japanese-owned auto part plants in the U.S. due to data availability. Japanese automobile production in the U.S., which is measured in millions of vehicles.	n/a
	Head and Ries (2001)	exports	firm level	932 Japanese manufacturing firms	Unspecified (non-bilateral trade)	Japan	1966–1990	n/a	n/a	Affiliate counts are used to proxy for outward FDI flows	n/a

Table 1 (continued)

Trade–FDI relationships (substitutes or complements): not necessarily bilateral trade		
	Lipsey and Weiss (1981)	Complements. U.S. affilate activities are 1) positively related to U.S. exports, and 2) negatively related to exports by 13 other countries in less developed countries. 3) The number of foreign affiliates positively related to exports of foreign countries. 4) U.S. (or foreign) affiliate activities seem to substitute for exports of foreign countries (or U.S. exports).
	Lipsey and Weiss (1984)	Complements. U.S. affilate activities are positively related to U.S. exports.
	Pfaffermayr (1996)	Complements (lagged exports are positively related to FDI. Lagged FDI is positively related to exports.)
	Belderbos and Sleuwaegen (1998)	Substitutes. Japanese foreign investment substitutes for exports from Japan.
	Clausing (2000)	Complements (Multinational activity and trade).
	Blonigen (2001)	Substitutes (Japanese automobile parts production in the U.S. is negatively related to US imports of Japanese automobile parts). Complements (Japanese automobile production in the U.S. is positively related to imports of Japanese automobile parts).
	Head and Ries (2001)	Coplements (overall outward FDI and exports are complementary). Substitutes (However, they are substitutes for selected firms that are not vertically integrated).

Table 2 Data

Variables	Units	Sources	Description
Royalties and license fees	ten thousand (constant 2005 USD)	The Ministry of Finance, Japan, Regional Balance of Payments, Royalties & License Fees by Area, Historical Data (https://www.mof.go.jp/international_policy/reference/balance_of_payments/bpm5bparea.htm); Principal Global Indicators (http://ecodb.net/exchange/usd_jpy.html);	The data on royalties and license fees in nominal terms in Japanese yen are transformed to real terms using GDP deflators in Japan (100 in 2005) taken from the World Development Indicators and U.S.–Japan exchange rates (interbank rates taken from Principal Global Indicators).
Emigrants (15 OECD countries)	persons	OECD, International Migration Database (https://stats.oecd.org/Index.aspx?DataSetCode=MIG)	The number of Japanese emigrant stocks by country (or Japanese immigrant stocks in foreign countries). As it is well known, the definition of immigrants varies by country (Dumont and Lemaître, 2005). We enter "Japan" for "Country of birth/nationality" category and choose either "Stock of foreign-born population by country of birth" or "Stock of foreign population by nationality" for "Variable" category. We mainly use the data based on the nationality category, because most countries, such as Belgium, Germany, Italy, South Korea, Netherlands, Sweden, and the U.K., provide data based on the category only. While countries such as France, Mexico, Netherlands, Spain, Sweden, provide data of both categories, we also use the data of the nationality category, because the category provides larger sample sizes without missing years. Only two countries, Australia and the United States, provide the data based on the country of birth category only.
Emigrants (non-OECD countries)	persons	Bureau of Statistics, Ministry of Internal Affairs and Communications, Japan (http://www.stat.go.jp/data/chouki/02.htm) . Table 2-13	The number of Japanese emigrant stocks by country and by the status of residence (the sum of permanent expatriates and long-term expatriates) (or Japanese immigrant stocks in foreign countries). Japanese immigrants in China include those living in both China and Hong Kong, except the data in 1996, which do not include those living in Hong Kong.
Immigrants	persons	"Statistics on the Foreigners Registered in Japan" by the Japan Immigration Association	The number of foreign immigrant stocks in Japan. In countries such as Belgium, Japan, and Sweden, "immigrants consists of persons who are enrolled onto a population register, … (and those who) intend to stay in the country for more than a specified minimum period …" (Dumont and Lemaître, 2005, p. 2). The analysis uses the number of foreign registrations. The "alien registration system" in Japan requires foreigners who stay longer than 90 days to register.
FDI (outward and inward)	ten thousand (constant 2005 USD)	Japan External Trade Organization (JETRO) (https://www.jetro.go.jp/world/japan/stats/fdi.html)	FDI stocks in Japan by country (inward FDI) and Japanese FDI stocks in each country (outward FDI). Negative numbers imply excess withdrawal. The original FDI data in nominal terms are transformed to real terms using GDP deflators in Japan (100 in 2005) taken from World Development Indicators and U.S.–Japan exchange rates (interbank rates taken from Principal Global Indicators). We calculate values for Belgium during 1996–2000 by splitting FDI values in Belgium and Luxemburg, which are reported together during the periods, based on the average ratios of FDI values between Belgium and Luxemburg during 2001–2012.
Distances	kilometers	GeoDist: the CEPII's database on distances (http://www.cepii.fr/anglaisgraph/bdd/distances.htm)	Geographical distances between country i and Japan. We use a distance variable, which is coded as distcap (distances) in dist_cepii.xls file. Mayer and Zignago (2011) provide detailed information related to the dataset.
Oil prices	(constant 2005 USD)	World Bank, Global Economic Monitor (GEM) Commodities (http://databank.worldbank.org/data/reports.aspx?source=global-economic-monitor-(gem)-commodities#)	Average world crude oil prices in real terms (USD/bbl).
Research and development expenditures	ten thousand (constant 2005 USD)	World Bank, World Development Indicators (http://databank.worldbank.org/data/reports.aspx?source=2&series=GB.XPD.RSDV.GD.ZS&country=)	We calculate the level of R&D expenditures by multiplying R&D expenditure indices expressed in the percentage of GDP by real GDP (constant 2005 USD) taken from World Development Indicators (NY.GDP.MKTP.KD).
GDP	ten thousand (constant 2005 USD)	World Development Indicators (WDI) (http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators)	Real GDP (constant 2005 USD)
Corruption	index	Worldwide Governance Indicators (http://info.worldbank.org/governance)	An evaluation of governance performance for a country during 1996–2011 except for the years 1997, 1999, and 2001, and indicators range from -2.5 (weak) to 2.5 (strong). It "reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests." Details related to the data can be found in Kaufmann, Kraay, and Mastruzzi (2010).
Political stability	index	Worldwide Governance Indicators (http://data.worldbank.org/data-catalog/worldwide-governance-indicators)	It "measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism."

Table 2 (continued)

Variables	Units	Sources	Description
U.S. Royalties and license fees	constant 2010 USD	Bureau of Economic Analysis, U.S. Department of Commerce (http://www.bea.gov/iTable/bp_download_modern.cfm?pid=41)	Charges for the use of intellectual property taken from Table 2.2. U.S. Trade in Services, by Type of Service and by Country or Affiliation. The data in nominal terms are transformed to real terms using the U.S. GDP deflators (100 in 2010) taken from World Development Indicators.
Emigrants	persons	OECD, International Migration Database (https://stats.oecd.org/Index.aspx?DataSetCode=MIG)	The number of the U.S. emigrant stocks by country (or the U.S. immigrant stocks in foreign countries). They are defined as stocks of foreign-born population by country of birth, except the data in Germany, Italy, Switzerland, Mexico, Japan, and South Korea. Those countries provide the immigrant data based on stocks of foreign population by nationality.
Immigrants	persons	OECD, International Migration Database (https://stats.oecd.org/Index.aspx?DataSetCode=MIG)	The number of foreign immigrant stocks in the U.S. They are stocks of foreign-born population by country of birth.
FDI (outward and inward)	constant 2010 USD	United Nations Conference on Trade and Development (UNCTAD) (http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx) webdiaeia2014d3_USA.xml	The data in nominal terms are transformed to real terms using the U.S. GDP deflators (100 in 2010) taken from World Development Indicators.

Table 3 Summary statistics

Variables	Mean	Std. Dev.	Min	Max
15 OECD countries and Japan				
Royalties and license fees	-0.074	9.562	-12.975	11.605
Immigrants (j)	8.592	2.082	2.708	13.396
Immigrants (i)	9.423	1.475	5.666	12.965
FDI (j)	11.359	3.056	-10.150	15.791
FDI (i)	13.511	1.655	8.559	16.936
Distances	3.492	0.853	0.478	4.573
GDP(i)	18.526	1.101	14.990	21.025
GDP(j)	19.920	0.041	19.859	19.979
R&D expenditures (i)	14.662	1.198	10.991	17.446
Political stability (i)	0.685	0.489	-0.739	1.668
Political stability (j)	1.000	0.099	0.836	1.189
Corruption (i)	1.470	0.708	-0.410	2.404
Corruption (j)	1.284	0.222	0.857	1.613
18 OECD countries and the U.S.				
Royalties and license fees	21.576	1.114	18.490	23.390
Immigrants (j)	12.043	1.375	10.074	16.279
Immigrants (i)	10.453	0.831	8.956	12.482
FDI (j)	24.377	1.781	17.357	26.873
FDI (i)	24.854	1.059	22.365	27.154
Distances	12.894	0.597	9.931	14.128
GDP(i)	27.744	0.900	25.495	29.357
GDP(j)	30.302	0.060	30.183	30.375
R&D expenditures (i)	28.433	1.170	25.000	30.599

Table 4 Results

Variables	15 OECD countries system GMM						7 OECD countries system GMM				8 Asian countries system GMM			
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
Immigrants (j)	2.382	***	4.337	***	2.956	***	2.738	***	3.664	***	3.062	***	2.686	***
	0.432		0.354		0.454		0.686		0.741		0.327		0.296	
Immigrants (i)	2.170	**	1.795	*	2.299	**	-0.987		0.216		-1.390	**	-1.116	**
	0.901		0.999		1.028		1.551		1.562		0.616		0.551	
FDI (j)	-0.235	**	-0.278	*	-0.321	**	-1.029	**	-0.524		-0.683	***	-0.487	***
	0.119		0.161		0.154		0.526		1.037		0.088		0.094	
FDI (i)	-0.999	**	-0.425		-0.175		1.226		-0.224		0.333		0.881	
	0.424		0.457		0.448		0.987		0.536		0.743		0.753	
Distances	1.887	*	4.609	***	1.083		4.658	***	3.802	**	-0.383		-2.102	***
	0.997		0.586		1.062		1.612		1.672		0.717		0.779	
GDP(i)	-5.114	***			4.177	***	-8.540	***	9.801	**	-1.252	**	1.573	**
	0.882				1.323		1.157		4.043		0.578		0.719	
GDP(j)	37.329	***			55.881	***	28.131	#	52.961	***	16.922	##	18.739	###
					15.682		19.128		20.840		11.629		12.500	
R&D expenditures (i)			-9.013	***	-11.095	***			-17.349	***			-2.343	***
			1.021		1.187				3.359				0.387	
Constant	-680.250	**	69.973	***	-1073.840	**	-432.558		-1016.781	**	-324.784		-384.383	
	285.765		9.323		312.113		376.483		416.273		226.152		244.725	
No. of observations	189		171		171		98		91		111		90	

Variables	8 non-OECD countries system GMM				All 15 countries (new data) system GMM						US-18 OECD countries system GMM			
	(8)		(9)		(10)		(11)				(12)		(13)	
Immigrants (j)	3.097	***	2.975	***	2.087	***	1.706	***			0.326	***	0.306	***
	0.318		0.283		0.306		0.264				0.021		0.018	
Immigrants (i)	-1.890	***	-1.448	***	-1.206	####	-0.692				-0.246	***	-0.158	***
	0.593		0.555		0.759		0.739				0.032		0.029	
FDI (j)	-0.675	***	-0.584	***	-0.359	***	-0.292	***			0.299	***	0.052	**
	0.085		0.100		0.105		0.119				0.017		0.025	
FDI (i)	0.349		0.872		0.206		-0.785				0.372	***	0.555	***
	0.657		0.689		0.565		0.533				0.027		0.027	
Distances	-0.741		-1.256	***	-1.556	***	-1.356	**			0.536	***	0.286	***
	0.496		0.492		0.557		0.569				0.053		0.051	
GDP(i)	-1.110	**	1.365	*	-1.150	***	1.388	$			0.018		-0.142	***
	0.572		0.756		0.384		0.857				0.033		0.046	
GDP(j)	22.057	**	5.464		58.029	***	62.705	***			-2.962	***	-1.921	***
	9.714		10.589		8.959		9.499				0.399		0.396	
R&D expenditures (i)			-1.936	***			-2.328	***					0.445	***
			0.396				0.555						0.047	
Constant	-423.809	**	-121.979		-1133.627	***	-1229.986	***			86.025	***	50.302	***
	189.639		207.253		175.940		187.793				11.353		11.474	
No. of observations	111		86		209		177				148		132	

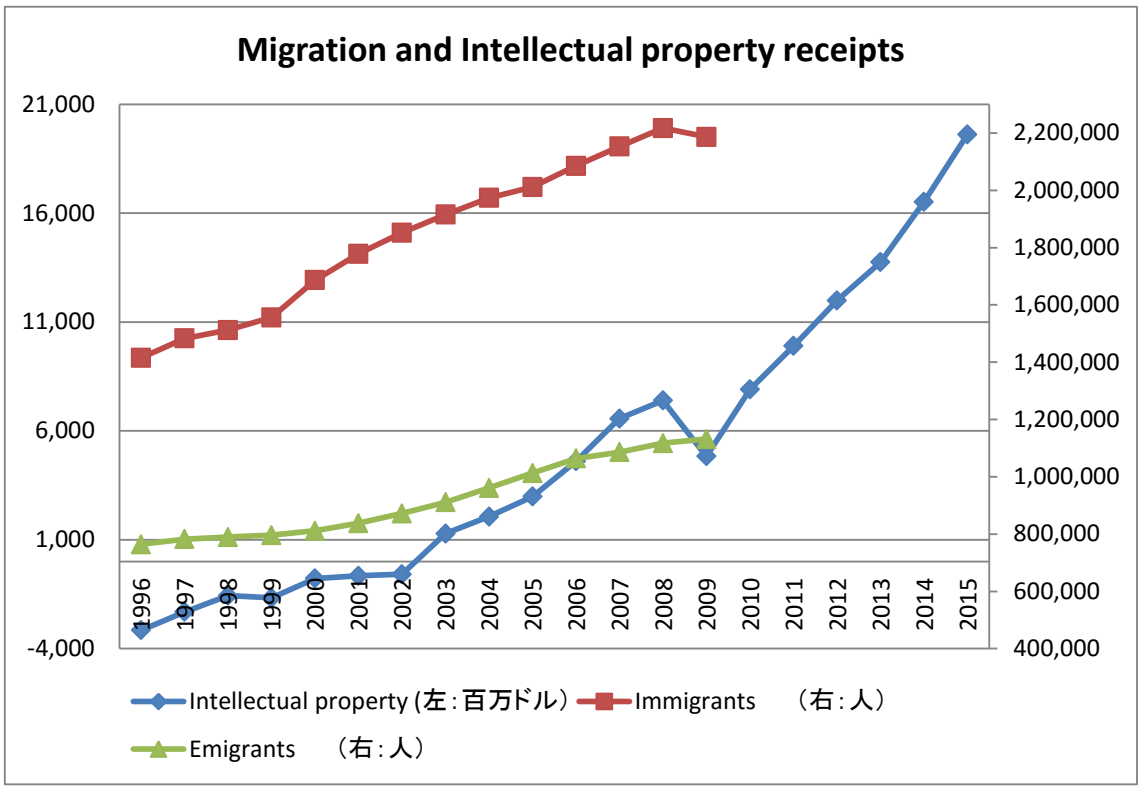
*** Statistically significant at 1%, ** at 5%, * at 10%, # at 14.1%, ## at 14.6%, ### at 13.4%, #### at 11.2%, $ at 10.5%.

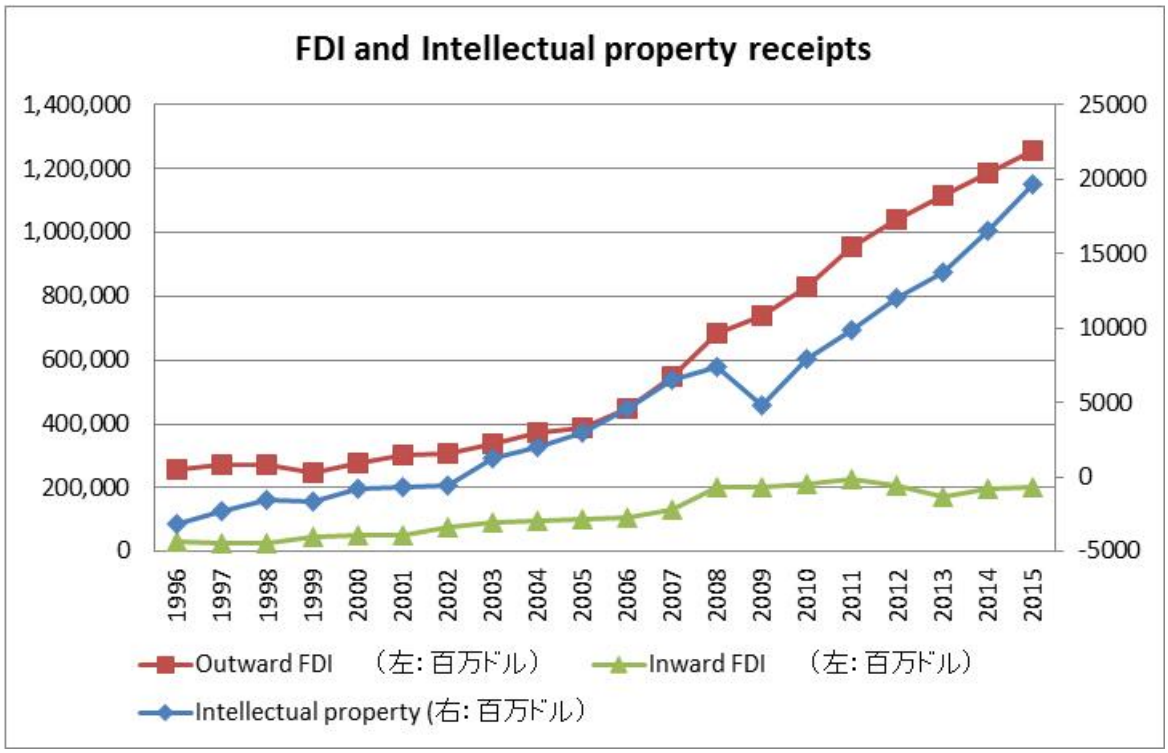
Table 5 Static analyses

	15 OECD countries									22 countries		15 OECD countries				26 countries	
	GLS				GLS							GLS					
Variables					Literature (imports)							Literature (exports)					
	(1)		(2)		(3)		(4)			(5)		(6)		(7)		(8)	
Immigrants (j)	3.710	***	2.895	***								3.776	***	4.673	***	2.037	***
	0.806		0.876									0.678		0.739		0.207	
Immigrants (i)	1.452		3.202	**	1.868	**	5.058	***		1.745	***						
	1.278		1.311		0.858		0.883			0.469							
FDI (j)	-0.907	***	-1.592	***													
	0.241		0.451														
FDI (i)	-0.731		0.039														
	0.615		0.696														
Distances	5.303	***	5.668	***	-3.779	***	-0.160			-3.579	***	4.795	**	9.207	***	0.557	
	1.960		2.221		1.017		1.129			0.744		1.897		2.216		0.763	
GDP(i)	-6.641	***	-9.215	***	-4.138	***	-10.206	***		-2.935	***	-6.464	***	-9.346	***	-2.629	***
	1.188		1.429		1.164		1.268			0.529		0.973		1.051		0.328	
GDP(j)	9.160		45.196		105.414	***	76.009	***		85.279	***	-11.928		-14.205		18.573	
	30.834		30.410		20.203		25.227			15.441		29.204		30.231		13.379	
Political stability (i)			-8.262	***			-11.716	***						-8.861	***		
			1.718				1.695							1.707			
Political stability (j)			6.226				12.113							13.128	+		
			8.324				8.990							8.828			
Corruption (i)			0.394				-1.408							-1.205			
			1.226				1.213							1.168			
Corruption (j)			-10.163	***			-5.829	++						-12.969	***		
			3.938				3.929							4.202			
Constant	-103.410		-775.209		-2027.658	***	-1366.903	***		-1647.862	***	308.085		394.428		-340.382	
	611.402		607.973		402.876		507.006			306.625		583.578		607.338		265.363	
No. of observations	189		156		189		156			305		189		156		442	

*** Statistically significant at 1%, ** at 5%, * at 10%, + at 13.7%, ++ at 13.8%

Appendix


Migration and Intellectual property receipts
21,000
16,000
11,000
6,000
1,000
-4,000
2,200,000
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Intellectual property (左：百万ドル)
Immigrants （右：人）
Emigrants （右：人）


FDI and Intellectual property receipts
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
25000
20000
15000
10000
5000
0
-5000
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Outward FDI （左: 百万ドル）
Inward FDI （左: 百万ドル）
Intellectual property (右: 百万ドル)