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Essays on International Trade, Vertical Linkages, and Trade Agreements

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ABSTRACT

International trade is the exchange of goods and services across international borders or regions. Promoting international trade is important for economic development. International agreements are common in the globalized world. Trade agreements (TAs) are agreements between countries to promote trade. Investment treaties (ITs) are agreements for private investment which helps promote trade. One crucial issue is technology and knowledge spillovers. Spillover effects emerge from developed to developing counties. Channels of spillovers to domestic firms are generally classified into two types, namely, 'horizontal' and 'vertical' spillovers. Horizontal or intra-industry spillovers benefit domestic firms operating in the same sector. Vertical or inter-industry spillovers benefit domestic firms operating in sectors that supply or purchase products to or from multinationals, and they originate from two types of international linkages, 'backward' linkage between local suppliers and their foreign affiliates (from downstream multinationals to upstream local suppliers) and 'forward' linkage between local buyers and their foreign affiliates (from downstream local buyers to upstream multinationals). The backward linkage and forward linkage effect on productivity growth is crucial. Our third study evaluates backward and forward linkages effect on not only firms' productivity but also choice of inputs (capital and labor).

The second chapter examines the effect of trade agreements on trade. The trade agreements have become prevalent in the globalized world. The primary objective of such international trade agreements is to promote economic integration, which would ultimately be reflected by trade flows. The second chapter discusses how trade agreements help promote bilateral trade flows by applying country fixed effects and matching methods over the period from 2000 to 2015. The estimated results of country fixed effects with the consideration of multilateral resistance show that the positive effects of trade agreements are larger for south-south trade agreements than for north-south trade agreements. However,

once we incorporate possible endogeneity problems, our matching estimates of treatment effects present different results, showing that north-south trade agreements are more effective in promoting bilateral trade flows than south-south trade agreements. These findings suggest that south countries could enhance trade with north partners by forming trade agreements under ongoing globalization.

The third chapter examines the effect of international agreements on trade and investment have become prevailed with the importance of trade-investment relationship in a globalized world. The third chapter discusses how trade agreements (TAs) and investment treaties (ITs) promote trade in the north-south trade contexts. Our entropy balancing matching estimates present that ITs intensify trade creation effects of TAs, i.e., ITs complement TAs, and such complementary effects are larger for north-north and north-south trades than for south-south trade. The estimated results of country fixed effects with the consideration of the MR terms have shown that south-south trade agreements have the most significant positive effects compared to north-north and north-south trade agreements. However, once we incorporate non-linear MR term and selection bias related to TA by applying matching method, the estimates have presented different results: north-north and north-south trade agreements are more effective than south-south trade agreements. Globalization with complex supply chains has intensified with trade integration involving inter- and intra-industry trade among not only developed countries but also developing countries. Our results suggest that south countries could enjoy more trade with north countries, rather than with other south countries, through the formation of trade agreements, and north countries could enjoy more trade through trade agreements with both north and south partners.

The fourth chapter examines how vertical spillover through backward and forward linkages in the garment sector, Myanmar, which is important export sectors in the country.

It is widely acknowledged that foreign direct investment (FDI) plays a crucial role in promoting horizontal and vertical spillovers in developing countries. Using primary survey data at the firm level, the fourth chapter examines how vertical spillovers through backward and forward linkages with multinationals relate to productivity and inputs allocation for garment firms in a recently liberalized developing country, Myanmar. The main results confirm that while both backward and forward linkages promote vertical spillover effects on productivity growth with capital accumulation, they fail to accelerate employment growth. In particular, domestic firms with backward linkages tend to reduce employment of skilled workers, and those with forward linkages tend to reduce employment of unskilled workers. In addition, this study also considers external-domestic and direct-indirect channels of backward and forward linkages to discuss spillover effects through the direct transaction with foreign-located firms and the use of brokers or middlemen. Myanmar government has emphasized increased employment opportunities for its people's welfare improvement by implementing a series of economic reforms with the provision of various incentives to attract foreign investment. One crucial lesson from our analysis is that although linkages with multinationals bring about productivity growth, such positive effects might be realized without clear evidence supportive of increased job opportunity for abundant labor.

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Chapter 1 Introduction

Globalization has encouraged many countries to promote the international trade of goods and services. Recent theoretical and empirical studies in the field of international trade have examined changes in trade patterns. Tangible products such as goods to be shipped as well as intangible commodities such as R&D and intellectual property belong to trade transactions (Hill, 1999; Reinsdorf & Slaughter, 2009). They become more and more complex and global. Foreign inputs had been estimated to cover about 30% of the value of global export. The theory of horizontal intra-industry trade with scale economies and consumers' preference for a variety of products, initiated by Krugman (1979), stresses the expansion of product variety for trade growth. The vertical intra-industry trade theory of Flam and Helpman (1987) considers product differentiation with heterogeneous qualities and prices and emphasizes upgrades in the qualities of products for trade growth. Recent trade models with heterogeneous firms, developed by many authors, such as Bernard, Eaton, Jensen, and Kortum (2003), Melitz (2003), and Arkolakis (2010), stress the role of the extensive margin through the acquisition of new exporting firms or partners to explain trade growth. De Benedictis and Gallegati (2005) states that international trade provides an example of markets in which, as the agents involved, firms and consumers, interact at different time horizons, the relationships among trade variables may well vary across time scales. Grossman and Helpman (1991) and Feenstra (1996) developed Ricardo's comparative advantage model with the two-country endogenous growth model.

Our second chapter discusses the effect of trade agreements on trade flow. According to the World Trade Organization (WTO), more than 600 trade agreements have been under negotiation, and approximately 400 trade agreements have come into effect as of 2015. The primary objective of trade agreements is to eliminate tariff and nontariff trade barriers for trade liberalization. Many studies have examined the effects of trade agreements on bilateral trade flows by employing some variant of the gravity equation with the inclusion of a dummy variable representing a trade agreement, which can be interpreted as a reduced form of trade

models. Their results have generally shown positive effects, but the estimations have presented the substantial heterogeneity in the effects of trade agreements across time, types of agreements, and trading partners (Baier & Bergstrand, 2007, 2009a; Behar & Cirera-i-Criville, 2013; Cheong et al., 2015; Baier et al., 2019; Falvey & Foster-McGregor, 2018). Anderson and van Wincoop (2003) mention that the traditional gravity equation is misspecified with biased estimates due to an omission of nonlinear multilateral (price) resistance (MR) terms and that unbiased estimates can be obtained using country fixed effects. Baier and Bergstrand (2004, 2009a) show that given that the selection of trade agreements is nonrandom, depending on some of the same variables that relate to bilateral trade flows, the combination of the nonrandomness of trade agreements and the omission of nonlinear MR terms could derive biased estimates. Baier and Bergstrand (2009a) argue that the matching estimates with the application of a Taylor approximation to the nonlinear gravity equation are stable and economically plausible to estimate the effects of trade agreements.

More relevant to this study, several works have discussed the role of trade agreements in the north-south trade context (Dahi & Demir, 2017, for a review of south-south and north-south economic exchanges). Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013) estimate gravity models, some of which control for MR terms, and they present that south-south trade agreements have a larger trade enhancing effect than north-south agreements due to trade barrier reductions in south-south agreements. We also examine the effects of trade agreements on north-south and south-south trade flows. Our study differs from the existing literature in two aspects. First, the empirical analyses of Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013) cover the periods 1960-2000 and 1978-2005, respectively. However, trade agreements have proliferated since the 1990s, and currently, many countries are even negotiating for the establishment of new trade agreements. Thus, we attempt to re-evaluate the effects of north-south and south-south trade agreements over the recent period of 2000-2015. Second, following the work of Baier and Bergstrand (2009a), our analysis accounts for a Taylor

approximation to the model with nonlinear MR terms and applies a matching method to mitigate the endogeneity problem related to the nonrandomness of trade agreements.

Our second chapter conducts empirical analysis by applying (i) traditional gravity estimations and (ii) entropy balancing as a matching method. We use four cross-sections of trade flows over every five-year dataset during the recent period from 2000 to 2015. The cross-sectional analysis of traditional gravity models with country fixed effects shows that positive effects of trade agreements are larger for south-south trade agreements than for north-south trade agreements, which coincides with the findings of past studies, such as Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013). However, once we incorporate possible endogeneity problems with the consideration of a Taylor approximation to the gravity models with nonlinear MR terms, our matching estimates of treatment effects present that north-south trade agreements are more effective in promoting bilateral trade flows than south-south trade agreements. These results are in sharp contrast to the argument of Kowalski and Shepherd (2006) that trade agreements increase south-south trade flows due to trade barrier reductions, but such effects may not appear on north-south trade flows. Our findings suggest that the world trade structure may change over time and that south countries could enjoy more trade and its related benefits from trade agreements with north partners.

At the same time, globalization has also proceeded in the contexts of cross-border financial and capital flows, particularly foreign direct investment (FDI), with the prevalence of investment treaties (ITs). The primary objective of ITs is the reduction of the cost of financial transactions and the legal protection of investments (Elkins et al., 2006; Neumayer & Spess, 2005). The proliferation of TAs and ITs has recently been evident not only between developed countries but also between developed and developing countries and even between developing countries. One important aspect of this proliferation is that with the prevalence of global supply chains, trade-investment relationships between countries would be a crucial determinant of trade flows.

Our third chapter extends the analysis of trade creation effects of TAs to its investigation with consideration of the roles of ITs. Our interest is on how trade is influenced by trade-investment relationships, particularly TAs and ITs. Although many studies examine the effects of TAs, no empirical studies have addressed the trade creation effects of TAs and ITs simultaneously.[1] Given the importance of trade-investment relationships and cross-border financial transactions, evaluating how ITs complement trade creation effects of TAs would provide important implications about the association of trade-investment relationships with trade promotion. In addition, no empirical studies have existed on the trade creation effects of TAs and ITs in the north-south trade context, although ongoing globalization has intensified the trade-investment relationship associated with the prevalence of cross-border production linkages in developing countries. Thus, this study evaluates trade creation effects of north-north, north-south, and south-south TAs and ITs and identifies possible differences among them to discuss the complementary roles of ITs in determining the TA effects in the north-south trade context.

Our fourth chapter will discuss effect of vertical linkages on output growth and input growth of garment firms in Myanmar. Multinational enterprises (MNEs) have undertaken a large number of foreign direct investment (FDI) projects in a globalized world with trade and financial liberalization. Much of the literature has emphasized spillovers in that FDI can generate positive externalities that increase domestic firms' productivity in host economies. Domestic firms may benefit from the entry or presence of multinationals operating in the same sector or through linkages or transactions with multinationals, since the values of the benefits are not fully internalized by multinationals. Channels of spillovers to domestic firms are generally classified into two types, namely, 'horizontal' and 'vertical' spillovers. Horizontal or intra-industry spillovers benefit domestic firms operating in the same sector. Vertical or inter-

[1] Many studies have revealed positive effects of ITs on FDI (Egger & Pfaffermayr, 2004; Salacuse & Sullivan, 2005; Neumayer & Spess, 2005; Buthe & Milner, 2008), while some studies have found less clear effects (Sauvant & Sachs, 2009; Hallward-Driemeier, 2003; Gallagher & Birch, 2009; Aisbett, 2009). Differently from their studies, our study focuses on how ITs complement TAs in terms of trade creation.

industry spillovers benefit domestic firms operating in sectors that supply or purchase products to or from multinationals, and they originate from two types of international linkages, 'backward' linkage between local suppliers and their foreign affiliates (from downstream multinationals to upstream local suppliers) and 'forward' linkage between local buyers and their foreign affiliates (from downstream local buyers to upstream multinationals).

Our fourth chapter discusses vertical spillovers through backward and forward linkages in a developing country, Myanmar, which has recently garnered much focus from international communities since the new government began in 2011. One critical issue is that most of the past studies focus on industry-level vertical spillovers, and the measures of vertical spillovers rely heavily on variables from input-output (IO) tables at the industry level instead of on direct firm-specific measures. In contrast to the existing literature, this study captures vertical spillovers through backward and forward linkages at the firm level by conducting a unique business survey covering 238 firms in Yangon and Mandalay, Myanmar. We selected the garment sector. Like other developing countries, the garment sector has attracted inward FDI with a growing number of operating multinationals in Myanmar, and the government has adopted a series of industrial policies targeting that sector, including the establishment of special economic zones. Since garment firms in Myanmar rarely involve transactions with other firms in the same sector, i.e., less horizontal firm-level relationship within the garment sector, focusing on the specific sector allows us to evaluate vertical spillover effects on firm performance and which source, backward and forward linkages can drive the effects.

By conducting business surveys and interviews with managers of garment firms located in Yangon and Mandalay, we collected various firm-level data of 238 garment firms, including basic characteristics of balance sheets and income statements in 2014 and 2016. To discuss vertical spillover effects on firm performance, we first evaluate how backward and forward linkages relate to individual firm productivity or total factor productivity (TFP), which can be measured by the residual derived from the estimated Cobb-Douglas production function. By constructing binary measures of backward and forward linkages, this study applies the entropy

balancing approach to examine the effects of these linkages on firm productivity, although we admit that the matching method may suffer from some methodological problems. The estimated results show clear evidence supportive of the positive vertical spillover effects through backward and forward linkages on firm productivity. Our findings of positive vertical spillovers are consistent with the argument in various past studies, such as that by Javorcik (2004) and Blalock and Gertler (2008), that backward linkages are a crucial driving force to promote productivity spillovers. At the same time, in addition to backward channels, our results presenting positive spillovers through forward linkages coincide with the works of Schoors and var del Tol (2002) and Du et al. (2012); however, they are in contrast with those of Javorcik (2004) and Jordaan (2011).

Once vertical spillovers to firm productivity are identified, the next step in our analysis is to examine how vertical linkages through backward and forward linkages are associated with firms' choice of input usages, including capital and labor. The estimations present certain interesting results. First, backward and forward linkages induce positive effects on capital growth rate. Second, backward linkages encourage firms to decrease skilled labor inputs, and forward linkages encourage firms to decrease unskilled labor inputs. Combining the findings of positive vertical spillover effects on firm productivity, our analysis highlights that both backward and forward linkages improve firm productivity and promote capital accumulation; however, they would cause adverse effects on labor inputs. Firms with vertical linkages tend to increase capital, perhaps due to the argument that multinationals support their domestic downstream customers' or upstream suppliers' capital installation and renovation since they intend to transfer knowledge and skills to their domestic partners, as emphasized in Javorcik (2004). In addition, firms with vertical linkages tend to involve more labor-saving activities with the ease of capital installation.

Our results have important implications given that the Myanmar government has implemented a series of economic policies and emphasized economic development with significant job creation. Although the presence of multinationals helps improve productivity,

vertical spillover effects through backward and forward linkages appear to be ineffective, or even destructive, in the context of job creation. Moreover, the trend of productivity progress with the combination of capital accumulation and job destruction may cast serious concerns of unequal economic development with widening income inequality.

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Chapter 2 Trade agreements and trade flows: Are there any differences between south-south and north-south trade agreements?

2.1 Introduction

Globalization has encouraged many countries to promote the international trade of goods and services. Particularly since the early 1990s, trade agreements have become prevalent and have played a crucial role in integrating developing countries into the global market. According to the World Trade Organization (WTO), more than 600 trade agreements have been under negotiation, and approximately 400 trade agreements have come into effect as of 2015. The primary objective of trade agreements is to eliminate tariff and nontariff trade barriers for trade liberalization. Trade agreements have continued to prevail, such that new agreements currently involve not only developed countries but also developing countries from different geographical regions. As a result, various debates have emerged on the relative merits of trade arrangements involving developing countries in the north-south and south-south trade contexts. Crucial concerns include whether or not a south country could obtain economic benefits, in terms of increased trade flows, from a trade agreement and which partner, south or north, could provide greater benefits for the south country through a trade agreement. The main objective of this study is to address such issues in north-south and south-south trade agreements by applying a matching method over the period of 2000-2015.

Many studies have examined the effects of trade agreements on bilateral trade flows by employing some variant of the gravity equation with the inclusion of a dummy variable representing a trade agreement, which can be interpreted as a reduced form of trade models. Their results have generally shown positive effects, but the estimations have presented the substantial heterogeneity in the effects of trade agreements across time, types of agreements, and trading partners (Greenaway & Milner, 2002; World Bank, 2005; Egger & Larch, 2008; Baier & Bergstrand, 2007, 2009a; Cipollina & Salvatici, 2010; Medvedev, 2010; Behar &

Cirera-i-Criville, 2013; Cheong et al., 2015; Baier et al., 2019; Falvey & Foster-McGregor, 2018). Anderson and van Wincoop (2003) mention that the traditional gravity equation is misspecified with biased estimates due to an omission of nonlinear multilateral (price) resistance (MR) terms and that unbiased estimates can be obtained using country fixed effects. Baier and Bergstrand (2004, 2009a) show that given that the selection of trade agreements is nonrandom, depending on some of the same variables that relate to bilateral trade flows, the combination of the nonrandomness of trade agreements and the omission of nonlinear MR terms could derive biased estimates. Baier and Bergstrand (2009a) argue that the matching estimates with the application of a Taylor approximation to the nonlinear gravity equation are stable and economically plausible to estimate the effects of trade agreements.

More relevant to this study, several works have discussed the role of trade agreements in the north-south trade context (Dahi & Demir, 2017, for a review of south-south and north-south economic exchanges). Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013) estimate gravity models, some of which control for MR terms, and they present that south-south trade agreements have a larger trade enhancing effect than north-south agreements due to trade barrier reductions in south-south agreements. We also examine the effects of trade agreements on north-south and south-south trade flows. Our study differs from the existing literature in two aspects. First, the empirical analyses of Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013) cover the periods 1960-2000 and 1978-2005, respectively. However, trade agreements have proliferated since the 1990s, and currently, many countries are even negotiating for the establishment of new trade agreements. Thus, we attempt to re-evaluate the effects of north-south and south-south trade agreements over the recent period of 2000-2015. Second, following the work of Baier and Bergstrand (2009a), our analysis accounts for a Taylor approximation to the model with nonlinear MR terms and applies a matching method to mitigate the endogeneity problem related to the nonrandomness of trade agreements.

This study conducts empirical analysis by applying (i) traditional gravity estimations and (ii) entropy balancing as a matching method. We use four cross-sections of trade flows over every five-year dataset during the recent period from 2000 to 2015. The cross-sectional analysis of traditional gravity models with country fixed effects shows that positive effects of trade agreements are larger for south-south trade agreements than for north-south trade agreements, which coincides with the findings of past studies, such as Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013). However, once we incorporate possible endogeneity problems with the consideration of a Taylor approximation to the gravity models with nonlinear MR terms, our matching estimates of treatment effects present that north-south trade agreements are more effective in promoting bilateral trade flows than south-south trade agreements. These results are in sharp contrast to the argument of Kowalski and Shepherd (2006) that trade agreements increase south-south trade flows due to trade barrier reductions, but such effects may not appear on north-south trade flows. Our findings suggest that the world trade structure may change over time and that south countries could enjoy more trade and its related benefits from trade agreements with north partners. The paper is organized as follows: Section 2 reviews the literature on the effects of trade agreements on trade flows, including the contexts of north-south trade flows. Section 3 presents the data description and empirical methodologies. Section 4 depicts our estimated results and provides some discussions based on our results. The final section ends with a conclusion.

2.2 Literature review

A trade agreement is a treaty between countries made to facilitate trade and eliminate trade barriers. Many studies have applied gravity models, theoretically and empirically, where a log-linear gravity equation is interpreted as the reduced form from a general equilibrium model, to evaluate the impacts of trade agreements on trade flows (Anderson & van Wincoop, 2004; Feenstra, 2015; Baier & Bergstrand, 2007; Baier & Bergstrand, 2009a). Cross-sectional and panel data for a particular year or years are used to calculate the coefficient estimates for a

dummy variable representing the presence or absence of a trade agreement. One critical issue is the instability or fragility of the average treatment effects (ATEs) estimation with upward or downward biases, possibly due to the problem of omitted variables that the dummy variable of trade agreements is related to other omitted factors that influence trade (Frankel, 1997; Ghosh & Yamarik, 2004; Baier & Bergstrand, 2009a).

Many works have conducted empirical analyses on a variety of modified gravity equations to address conventional omitted variables. Among them, Anderson and van Wincoop (2003) show that the misspecification of the traditional gravity equation originates from an omission of nonlinear multilateral (price) resistance (MR) terms and suggest that country fixed effects can be applied to obtain unbiased estimates. However, Baier and Bergstrand (2004, 2009a) emphasize that country fixed effects models may also suffer from endogeneity problems associated with the nonrandomness of selection into trade agreements. To solve the problems of the combination of the nonrandomness of trade agreements and the omission of nonlinear MR terms, Baier and Bergstrand (2009a) and Falvey and Foster-McGregor (2018) apply matching estimates with the application of a Taylor approximation to the nonlinear gravity equation with the MR terms to evaluate the treatment effects of trade agreements. Thus, our study also applies one of the matching methods, entropy balancing, to account for the nonrandomness of trade agreements with the nonlinear MR terms.

Several studies have examined the effects of trade agreements on trade flows in the south-south and north-south trade contexts (Behar & Cirera-i-Criville, 2013). For south-south trade agreements, Cernat (2003) and Lee and Shin (2006) find positive trade-enhancing effects of several south-south trade agreements, such as the Association of Southeast Asian Nations Free Trade Area (AFTA). Mayda and Steinberg (2007) also show a positive, although relatively small, trade-enhancing effect of the Comment Market for Eastern and Southern Africa (COMESA) in the case of Uganda. Regarding north-south trade agreements, Cieslik and Hagemejer (2009) reveal the positive export creation effects of trade agreements between

European countries and Middle East and North African countries, and Trefler (2004) also shows a positive effect of the North American Free Trade Agreement (NAFTA) on Mexico's trade. In contrast, some studies, such as those of Anson et al. (2005) and Estevadeordal and Suominen (2004), argue that there is limited access for developing countries to the markets in developed countries due to the restrictive rules of origins (ROOs) in north-south trade agreements.

Some empirical works discuss the differences in trade creation effects between south-south and north-south trade agreements. South-south trade agreements are expected to have a large trade creation effect since the agreements can reduce high trade barriers between developing countries. In addition, south-south trade agreements encourage developing countries to reform other trade-related policies for liberalization, including regulatory and other domestic policies (Lawrence, 2000), which mitigate various trade barriers and help promote trade. Moreover, south-south trade agreements tend to provide a competition framework between countries at similar stages of development, enabling them to develop the capacity of market competition in the local and international markets and to avoid difficult competition with high-quality or cheap imports from developed countries (Behar & Cirera-i-Criville, 2013). These arguments suggest that developing countries could expect large trade creation effects of trade agreements with other developing partners. On the other hand, there are some doubts about the effectiveness of south-south trade agreements. For south-south trade, comparative advantages are less significant since developing countries are generally characterized by similar factor proportions with small size and scope of an economy and high transport and administrative costs. In addition, weak monitoring mechanisms make south-south trade agreements less effective in implementation, which fails to achieve trade cost reductions (World Bank, 2005).

North-south trade agreements cause economic integration between developed and developing countries that have different factor proportions; thus, trade liberalization through

trade agreements could induce larger trade creation effects due to the significant effects of comparative advantages based on the traditional Heckscher-Ohlin trade theory. In addition, north-south trade agreements provide developed and developing countries with larger market access or opportunities for overseas business activities of firms. This fact is currently crucial under ongoing globalization with complex supply chains. On the other hand, some obstacles are also present in north-south trade agreements. The rules of origin (ROOs) are more restrictive in north-south trade agreements than in south-south trade agreements (Estevadeordal & Suominen, 2004). Such restrictive ROOs can limit market access and trade flows between developed and developing countries that share the trade agreement. Given these arguments, some empirical studies have examined the differences in trade creation effects between south-south and north-south trade agreements. Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013) estimate gravity models with MR terms and present that south-south trade agreements have a larger trade enhancing effect than north-south agreements. Their empirical analyses are based on data covering periods ending in the early or mid-2000s. However, trade agreements have prevailed particularly for north-north and north-south country pairs. Currently, many countries are even negotiating for the establishment of new trade agreements. Thus, re-examining the trade creation effects of trade agreements during the recent period should be required to understand the current situations in the globalized world.

2.3 Empirical analysis

2.3.1 Data

Our empirical study uses the cross-sectional data of bilateral trade flows and trade agreements for 165 countries during each five-year period (2000, 2005, 2010, and 2015). Table 1 shows a list of sample countries. Trade data are from the United Nations International Trade Statistics Database (UN COMTRADE). Following past studies, such as Falvey and Foster-McGregor (2018), we apply mirrored flow to construct bilateral exports such that bilateral imports into the partner country are used to measure bilateral exports from the reporter. Then, we construct

a bilateral trade flow by summing the imports and exports for each country pair. Following Baier and Bergstrand (2009a), we exclude zero-trade flows from our sample. Concerning trade agreements, we use data from Mario Larch's Regional Trade Agreements database, following the transcription of the list of regional trade agreements made available on the WTO website. We include only full (not partial) trade agreements.

To discuss the possible differences in the effects of trade agreements, we divide the full sample into three groups of country pairs: north-north, north-south, and south-south.[2] The criteria to classify countries by income level are based on the World Bank thresholds. A country with more than US$6000 per capita is classified into the north, while a country with less than US$6000 per capita is classified into the south. The data on geographical distance, common official language, contiguity, and colonial relationship are from CEPII's GeoDist database. Nominal GDPs, real GDPs, and GDP per capita are from the World Bank's World Development Indicators (WDI). Table 2 shows the summary statistics of the variables used in this study for all country pairs, north-north country pairs, south-south country pairs, and north-south country pairs. Table 3 presents the number of trade agreements in terms of country pairs for each period in our sample. It is observed that trade agreements have proliferated drastically for north-north and north-south country pairs during our sample periods. In particular, the numbers of country pairs with trade agreements for north-north and north-south country pairs have increased drastically from 589 and 397 in 2000 to 1124 and 1152 in 2015, respectively.

2.3.2 Traditional gravity models

Econometric analysis of the effects of trade agreements on bilateral trade flows has been conducted by estimating the traditional gravity equation:

[2] This study also conducts empirical analysis on trade creation effects for north-north trade agreements, although our main concern is on north-south and south-south trade agreements.

$$\ln TF_{ij} = \beta_0 + \beta_1 \ln(GDP_i GDP_j) + \beta_2 DIST_{ij} + \beta_3 ADJ_{ij} + \beta_4 LANG_{ij} + \beta_5 COL_{ij} + \beta_6 TA_{ij} + \varepsilon_{ij} , \quad (1)$$

where TF_{ij} is real trade flows between countries i and j; GDP_i (GDP_j) is real gross domestic product (GDP) in country i (j); $DIST_{ij}$ is the log of the distance between two countries; ADJ_{ij} is a dummy variable, which equals one if two countries are adjacent (i.e., share a land border), and zero otherwise; $LANG_{ij}$ is a dummy variable, which equals one if two countries share an official language, and zero otherwise; COL_{ij} is a dummy variable, which equals one if two countries have a colonial relationship, and zero otherwise; TA_{ij} is our dummy variable of interest, which equals one if two countries share a trade agreement, and zero otherwise; and ε_{ij} is the error term. Many studies on trade agreement effects, such as Frankel (1997) and Baier and Bergstrand (2007, 2009a), cast concerns on the instability or fragility of the OLS estimates of the coefficient on the TA dummy variable that provides its average treatment effect (ATE).

Several methodological defects have been discussed to explain the instability of the estimated ATEs (Rose, 2004; Anderson & van Wincoop, 2003; Baier & Bergstrand, 2009a). Among them, the existence of omitted variables ('unobserved by the researcher') that relate to trade and trade agreements may derive biased estimates of the coefficient. Rose (2004) suggests that trade cost proxies could be one of the most important omitted variables. Anderson and van Wincoop (2003) mitigate omitted variable bias in the gravity equation and show that the omission of nonlinear multilateral (price) resistance (MR) terms for each country in each period may cause the bias of the coefficient estimates. They present an estimation of unbiased coefficients that is derived by minimizing the sum of squared residuals:

$$\ln\left[\frac{TF_{ij}}{GDP_i GDP_j}\right] = \alpha_0 + \alpha_1 DIST_{ij} + \alpha_2 ADJ_{ij} + \alpha_3 LANG_{ij} + \alpha_4 COL_{ij} + \alpha_5 TA_{ij} - \ln P_i^{1-\sigma} - \ln P_j^{1-\sigma} + \varepsilon_{ij}, \quad (2)$$

subject to N nonlinear market equilibrium conditions:

$$P_i^{1-\sigma} = \sum_{k=1}^{N} P_k^{\sigma-1} (GDP_k/GDP^T) e^{\alpha_1 DIST_{kj} + \alpha_2 ADJ_{kj} + \alpha_3 LANG_{kj} + \alpha_4 COL_{ij} + \alpha_5 TA_{ij}}, \quad (3)$$

where GDP^T is world income and $\alpha_0 = -\ln GDP^T$. The terms $P_i^{1-\sigma}$ and $P_j^{1-\sigma}$ are the MR terms for countries i and j, respectively. This specification requires a nonlinear least squares technique to estimate unbiased coefficients. However, Anderson and van Wincoop (2003) and Feenstra (2015) suggest that the unbiased estimates of the coefficients can be obtained by estimating equation (2), including country fixed effects for the MR terms of $P_i^{1-\sigma}$ and $P_j^{1-\sigma}$. Doing this enables us to mitigate the 'unobserved-by-researcher' problems.

Table 2.4 presents the estimated coefficients of the TA dummy over the full sample and three subsamples (north-north country pairs, south-south country pairs, and north-south country pairs) in each period under the country fixed effects estimations to account for the MR terms (see Table A1 in the appendix for details of the results). The results generally show that the coefficients on the TA dummy are significantly positive, which implies positive associations between trade agreements and bilateral trade flows, irrespective of the classifications of country pairs. Importantly, the three-subsample analysis presents that a positive association of trade agreements with trade flows is more substantial for south-south trades than for north-north and north-south trades. Our country fixed effects estimations appear to confirm the findings of past studies, including Behar and Cirera-i-Criville (2013) and Dahi and Demir (2013), and suggest that trade agreements are more effective for south-south trades due to significant reductions in trade barriers in developing countries, even during recent years.

2.3.3 Matching methods

Although the use of country fixed effects for the MR terms may solve the 'unobserved-by-researcher' problem, Baier and Bergtrand (2009a) suggest that it cannot fully ensure an unbiased estimation of the coefficient of the TA dummy in the gravity equation due to the issue of 'selection on observables.' As mentioned in Baier and Bergtrand (2009a) and Falvey and Foster-McGreggor (2018), the log-linear regressions with the MR terms may still suffer from

biased estimates of the effects of a trade agreement because the selection of trade agreements is not random, and the effects could depend on levels of covariates in the gravity equation. Baier and Bergtrand (2009a) and Falvey and Foster-McGreggor (2018) show clear evidence of the nonrandomness of trade agreements by presenting significant differences between country pairs with trade agreements and those without trade agreements. Several studies discuss the nonlinear interactions of trade agreements and typical covariates in the gravity equation by showing that the effects of trade agreements on trade flows depend on bilateral distance, GDP, and population (Brada & Mendiz, 1985; Frankel, 1997). Given these arguments, some studies, such as Baier and Bergtrand (2009a) and Falvey and Foster-McGreggor (2018), employ a matching method to mitigate the 'selection on observables' problem.

The objective of this study is to evaluate a causal link between trade agreements and trade flows. Our measure of interest is the average treatment effect on the treated (ATT). Following Imbens and Wooldridge (2009), the ATT is defined as follows:

$$\mathrm{ATT} = \mathrm{E}[\mathrm{Y}_1|\mathrm{D}=1] - \mathrm{E}[\mathrm{Y}_0|\mathrm{D}=1],$$

where D is the TA dummy; Y_1 and Y_0 are potential outcomes of country pairs that have a trade agreement and do not have a trade agreement (two counterfactual situations), respectively; $\mathrm{Y}_0|\mathrm{D}=1$ is the value of the outcome of our interest that would have been observed if the country had not had a trade agreement (counterfactual outcome); and $\mathrm{Y}_1|\mathrm{D}=1$ is the value of the outcome that is actually observed in the same country pair. A crucial problem concerns the difficulty of estimating the ATT because the counterfactual outcome is the unobservable value of $\mathrm{E}[\mathrm{Y}_0|\mathrm{D}=1]$. When a country pair's choice of trade agreement establishment is random, the average outcome of units not exposed to treatment, $\mathrm{E}[\mathrm{Y}_0|\mathrm{D}=1]$, is a proper substitute, such that the ATT can be estimated from differences in the sample means of the outcome variable between the treatment and control groups. However, the establishment of a trade agreement is endogenous.

In a nonexperimental analysis, the treatment assignment is not random (De Janvry et al., 2010; Heckman & Vytlacil, 2007). In the absence of random assignments, the observed and unobserved characteristics of country pairs may affect treatments and outcomes such that selection bias can persist. The idea of matching methods is to mimic randomization with regard to the assignment of the treatment. The unobserved counterfactual outcome is imputed by matching the treated units with untreated units that are as similar as possible with regard to all pretreatment characteristics that are associated with selection into treatment and affect the outcome of interest. The realizations of the outcome measures for these matches are used as an empirical proxy for the unobserved counterfactual. The estimate of the ATT based on matching is defined as follows:

$$\mathrm{ATT(x)} = \mathrm{E}[\mathrm{Y_1}|\mathrm{D} = 1, \mathrm{X} = \mathrm{x}] - \mathrm{E}[\mathrm{Y_0}|\mathrm{D} = 0, \mathrm{X} = \mathrm{x}],$$

where x is a vector of relevant pretreatment characteristics, $\mathrm{E}[\mathrm{Y_1}|\mathrm{D} = 1, \mathrm{X} = \mathrm{x}]$ is the expected outcome for the units that received treatment, and $\mathrm{E}[\mathrm{Y_0}|\mathrm{D} = 0, \mathrm{X} = \mathrm{x}]$ is the expected outcome for the treated units' best matches.[3]

One crucial issue with the matching method is to find a control group of country pairs without trade agreements that are virtually identical, in all other aspects, to a treatment group of country pairs with trade agreements, i.e., the two groups of country pairs are selected to be identical in all aspects, except for treatment, such that a random assignment is simulated into

[3] Many empirical studies estimate the ATT by applying the propensity score matching (PSM) method, which can reduce selection bias by creating comparable counterfactual outcomes for treated units. Once the treated units are matched, the PSM assumes no systematic differences in unobservable characteristics between treated and untreated units, given the estimated propensity scores under the assumptions, such as conditional independence, the independent and identically distributed observations, and the common support assumptions. The first assumption is the conditional independence assumption (CIA) or confoundedness; after controlling for observed covariates, the potential outcomes are independent of the treatment assignment. This assumption states that no unobservable variable affects both the likelihood of treatment and the outcome of interest after conditioning on covariates. The CIA is a strong assumption, and it does not consider any unobservable differences. The second assumption is the independent and identically distributed observations assumption, which requires that potential outcomes and the treatment status of each individual are independent of the potential outcomes and treatment status of all other individuals in the sample. The third assumption is the common support or overlap condition, which suggests that every observation has a positive probability of being both treated and control. In addition, the PSM should satisfy the balancing property; the mean value of covariates between treatment and control groups should be similar after matching. This property's objective is to ensure that treatment is independent of unit characteristics after conditioning on observed covariates (Heinrich et al., 2010).

treatment and control. For the method to be valid, our model specification should satisfy three main assumptions, i.e., the assumption of the ignorability of treatment (selection on observables), the overlap assumption, and the stable-unit-treatment-value assumption. Baier and Bergstrand (2009a) discuss the feasibility of these assumptions in the context of trade agreements and trade. The ignorability assumption can be achieved by selecting a control unit for each treated country pair that is closely matched to the treated unit regarding all relevant covariates (except the TA dummy) related to trade, such that the treatment assumption is random.[4] Theoretical foundations for the gravity model of trade flows imply that the relevant covariates for selection on observables are the sum of logs of GDPs, the log of bilateral distance, adjacency and language dummies, and the measures of the MR terms. Given that the MR terms are endogenous, Baier and Bergtrand (2009b) show a reduced-form function of linear combinations of the exogenous variables by applying a first-order log-linear Taylor series expansion around a symmetric equilibrium of equations (2) and (3):

$$\ln TF_{ij} = \beta_0 + \beta_1 \ln(GDP_i GDP_j) + \beta_2 BVDIST_{ij} + \beta_3 BVADJ_{ij} + \beta_4 BVLANG_{ij} + \beta_5 BVCOL_{ij} + \beta_6 BVTA_{ij} + \varepsilon_{ij}, \quad (4)$$

where

$$BVDIST_{ij} = DIST_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} DIST_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} DIST_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} DIST_{ij},$$

$$BVADJ_{ij} = ADJ_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} ADJ_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} ADJ_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} ADJ_{ij},$$

$$BVLANG_{ij} = LANG_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} LANG_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} LANG_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} LANG_{ij},$$

[4] Baier and Bergstrand (2009a) also discuss the overlap assumption and the stable-unit-treatment-value assumption. The overlap assumption could be satisfied due to the large number of FTAs. The third assumption consists of two parts, which may be more problematic. The first part is 'unique treatment,' which ensures that the treatment is identical for each treated observation. This is the standard assumption we make when we include an FTA dummy in a gravity equation. The second part is 'noninterference,' which ensures that the treatment of any country pair does not influence the trade of untreated country pairs. For further discussion, see Baier and Bergstrand (2009a) and Falvey and Foster-McGreggor (2018).

$$\mathrm{BVCOL_{ij}} = \mathrm{COL_{ij}} - \left(\frac{1}{\mathrm{N}}\right)\sum_{\mathrm{j=1}}^{\mathrm{N}} \mathrm{COL_{ij}} - \left(\frac{1}{\mathrm{N}}\right)\sum_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{COL_{ij}} + \left(\frac{1}{\mathrm{N^2}}\right)\sum_{\mathrm{i=1}}^{\mathrm{N}}\sum_{\mathrm{j=1}}^{\mathrm{N}} \mathrm{COL_{ij}},$$

$$\mathrm{BVTA_{ij}} = \mathrm{TA_{ij}} - \left(\frac{1}{\mathrm{N}}\right)\sum_{\mathrm{j=1}}^{\mathrm{N}} \mathrm{TA_{ij}} - \left(\frac{1}{\mathrm{N}}\right)\sum_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{TA_{ij}} + \left(\frac{1}{\mathrm{N^2}}\right)\sum_{\mathrm{i=1}}^{\mathrm{N}}\sum_{\mathrm{j=1}}^{\mathrm{N}} \mathrm{TA_{ij}}.$$

The explanatory variables are adjusted in a way that the variable between countries i and j is measured relative to the average value of both countries i and j to their trading partners. This specification suggests that exogenous covariates ($\ln(\mathrm{GDP_iGDP_j})$, $\mathrm{BVDIST_{ij}}$, $\mathrm{BVADJ_{ij}}$, $\mathrm{BVCOL_{ij}}$ and $\mathrm{BVLANG_{ij}}$) are used to conduct the matching estimation.

This study applies entropy balancing, as proposed by Hainmueller (2012), to select matches for the units exposed to treatment and to estimate the ATT. Recent empirical studies apply entropy balancing as a multivariate reweighting method to build balanced samples in observational studies with a binary treatment, where the control group data can be reweighted to match the covariate moments in the treatment group (Neuenkirch & Neumeier, 2016; Wilde, 2017). Entropy balancing is based on a maximum entropy reweighting scheme (see Hainmueller & Xu, 2013 for the detailed explanation). This scheme can allow us to fit weights that satisfy a potentially large set of balance constraints involving exact balance on the first and possibly higher moments of the covariate distributions in the treatment and the reweighted control group. Entropy balancing is implemented in two steps. The first step is to compute the weights that are assigned to units that are not subject to treatment such that the weights satisfy prespecified balance constraints involving sample moments of pretreatment characteristics and remain as close as possible to uniform base weights from an entropy perspective to prevent the loss of information and retain efficiency for the subsequent analysis. This study sets the balance constraints of equal covariate means and variances across the treatment and control groups. The second step is to use the weights that were obtained in the first step in a regression analysis, with the treatment indicator as an explanatory variable, which yields an estimate for the ATT.[5]

[5] In the second step in the regression, we include all covariates used in the first step to improve efficiency, as in the works of Neuenkirch and Neumeier (2016).

As suggested in Hainmueller (2012) and Hainmueller and Xu (2013), entropy balancing has several advantages. First, as the most important feature, entropy balancing at least weakly improves on the balance that can be obtained for the specified moment constraints by conventional preprocessing methods since a high degree of covariate balance is achieved by imposing a potentially large set of balance constraints involving the first and possibly higher moments of the covariate distributions as well as interactions. This method obviates the conventional need for balance checking, at least for the characteristics that are included in the specified balance constraints. Second, in contrast to other preprocessing methods such as nearest neighbor matching, where units are either discarded or matched, entropy balancing is more flexible in that it allows the unit weights to vary smoothly across units and thus to retain more information in the preprocessed data. Entropy balancing achieves balance with the weights kept as close as possible to the base weights to prevent loss of information and retain efficiency for the subsequent analysis. In this regard, entropy balancing produces a generalization of the propensity score weighting approach, which directly adjusts the weights to the known sample moments and, thus, obviates the need for continual balance checking and iterative searching over propensity score models.

Third, the weights obtained from entropy balancing can be applied for many standard estimators for the subsequent analysis of treatment effects. Entropy balancing is nonparametric in that no empirical model needs to be specified for either the outcome or selection into treatment; thus, we can mitigate biased estimates in the potential misspecification associated with the functional form of the empirical model. In addition, since entropy balancing orthogonalizes the treatment indicator with respect to the covariates that are included in the balance constraints, the estimates of treatment effects may not suffer from multicollinearity. Fourth, as noted in Neuenkirch and Neumeier (2016), entropy balancing ensures a high covariate balance between the treatment and control groups, even in small samples. With conventional matching methods, each treated unit is matched with the untreated units that are

closest in terms of a metric balancing score; accordingly, the control group consists of only a subset of the units that are not subject to treatment. For small samples and perhaps with the small number of untreated units and a large number of pretreatment characteristics, this procedure may suffer from biased treatment effect estimates because pretreatment characteristics cannot be balanced sufficiently across the treatment and control groups. However, entropy balancing allows the vector of weights assigned to the units not exposed to treatment to contain any nonnegative values so that entropy balancing can be interpreted as a generalization of the conventional matching approaches (Neuenkirch & Neumeier, 2016).[6]

2.4 Results

Our main interest in this study is to evaluate the effects of trade agreements on trade flows for north-north, north-south, and south-south country pairs over 165×165 country pairs by applying an entropy balancing matching approach.[7] All matching covariates may be well balanced, as the similar average realizations of the pretreatment characteristics between the two groups confirm the efficacy of entropy balancing.[8] This result implies that the control group in the subsequent empirical analysis consists of appropriate counterfactuals for the sample of observations subject to the existence of trade agreement linkages. Table 2.5 presents the estimated ATTs of trade agreements in each year for the full sample and each of the three subsamples of north-north, north-south, and south-south country pairs.[9]

[6] Matching approaches are an appropriate method to overcome the selection bias caused by observables and to estimate the average treatment effect in observational studies. However, these matching approaches can control only for observable selection biases and may generate unreliable results if unobservable biases exist, i.e., systematic differences between members and nonmembers.

[7] We also estimate the modified gravity equations with different covariates, BVDIST, BVLADJ, BVLANG, and BVCOL (instead of DIST, ADJ, LANG, and COL), applying the country fixed effects. Table A2 in the appendix shows that the estimated results are different from the previous finding in Table 2.4 and that the coefficients on the TA dummy for north-south trades take similar values as those for south-south trades.

[8] Table A3 presents the sample means of all matching covariates for the full sample and each of the subsamples (north-north, north-south, and south-south country pairs, which are obtained through entropy balancing, across the treatment group and the synthetic control group.

[9] For the robustness check, we divide the full sample into the three subsamples of north-north, north-south, and south-south country pairs, based on the classification of OECD and non-OECD countries, and estimate the ATTs applying the entropy balancing method. Table A4 in the appendix shows the estimated results, which confirm the baseline finding that trade agreements are more effective for north-south and north-north country pairs than for south-south country pairs.

The estimated results reveal that trade agreements have a positive effect on trade flows, irrespective of the classification of country pairs. The results of the matching method differ significantly from those of the country fixed effects estimations in the previous subsection in terms of the comparison among north-north, north-south, and south-south country pairs. The country fixed effects estimations with partial consideration of the MR terms have presented that trade agreements are more effective in promoting trade for south-south country pairs than for north-north and north-south country pairs. However, the matching estimations suggest the opposite results that trade agreements are more effective for north-south and north-north country pairs than for south-south country pairs. Our analysis implies that in addition to the control for the MR terms, controlling for endogeneity associated with 'selection on observables,' suggested by Baier and Bergstrand (2009a), would also be critical to measure the treatment effects of trade agreements on trade flows.

Recent globalization with complex supply chains has caused north-north and north-south trades to play a crucial role in international trade, including inter- and intra-industry trade transactions. South-south trades are often characterized as trading activities between developing countries that are generally endowed with similar factor proportions with economically small supplies, high transport and administrative costs and less scope for economies. In contrast, north-south trades imply trade integration between economies that have different factor proportions with advanced technology. Baier and Bergstrand (2004), among others, find that differences in relative factor endowments create trade more between two countries as a result of the Heckscher-Ohlin argument. Thus, north-south trade agreements provide developing countries with more market access and production efficiency gains, which suggests that developing countries could gain more from north-south trade agreements than from south-south trade agreements (Ethier, 1998; Krueger, 1999; Behar & Cirera-i-Criville, 2013).

In addition, trade agreements initiated by developed countries, such as north-south trade agreements, involve deeper integration than south-south trade agreements in terms of content, which may go beyond typical tariff restrictions to cover harmonization across a broad range of policies and regulations, including competition policy, investor rights, product standards, public procurement, and intellectual property rights (Schiff & Winters, 2003; Behar & Cirera-i-Criville, 2013). In contrast, south-south trade agreements are often ineffective without achieving trade cost reductions because of the lack of monitoring mechanisms (World Bank, 2005). This argument also supports that south-south trade agreements are less effective than north-north and north-south agreements. Moreover, recent globalization has encouraged private firms in developed countries, particularly multinational firms, to expand their overseas business toward not only other developed countries but also developing countries. Such business environments could also be one justification for why developed countries have initiated the formation of new trade agreements, possibly with less restrictive ROOs for more effective promotion of trade and investment, to reduce tariff and nontariff barriers in trading partners, irrespective of their partners' income levels; thus, north-north and north-south trade agreements have proliferated since the 2000s. Our matching estimations present clear evidence that is supportive of the substantially positive effects of trade agreements related to developed countries, i.e., north-north and north-south trade agreements.

2.5 Conclusion

This study has provided the nonparametric empirical estimates of the effects of trade agreements on bilateral trade flows using the entropy balancing matching method in every five-year period from 2000 to 2015. The estimated results of country fixed effects with the consideration of the MR terms have shown that south-south trade agreements have the most significant positive effects compared to north-north and north-south trade agreements. However, our matching estimates have presented different results: north-north and north-south trade agreements are more effective than south-south trade agreements. Measuring the effects

of trade agreements would require us to control for the endogeneity associated with 'selection on observables,' suggested by Baier and Bergstrand (2009a). Recent globalization with complex supply chains has intensified with trade integration involving inter- and intra-industry trade among not only developed countries but also developing countries. Our results have suggested that south countries could enjoy more trade with north countries, rather than with other south countries, through the formation of trade agreements, and north countries could enjoy more trade through trade agreements with both north and south partners.

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Table 2.1. List of sample countries

North countries				South countries				
United Arab Emirates	Dominica	Kuwait	Saudi Arabia	Afghanistan, I.R. of	Dominican Republic	Jamaica	Niger	Turkmenistan
Argentina	Denmark	Lebanon	Singapore	Angola	Algeria	Jordan	Nigeria	Tunisia
Antigua and Barbuda	Spain	Libya	San Marino	Albania	Ecuador	Kenya	Nicaragua	Tanzania
Australia	Estonia	St. Lucia	Suriname	Armenia	Egypt	Kyrgyz Republic	Nepal	Uganda
Austria	Finland	Lithuania	Slovak Republic	Azerbaijan, Rep. of	Eritrea	Cambodia	Pakistan	Ukraine
Belgium	France	Luxembourg	Slovenia	Burundi	Ethiopia	Lao People's Dem.Rep	Peru	Uzbekistan
Bulgaria	Gabon	Latvia	Sweden	Benin	Georgia	Liberia	Philippines	Vietnam
Bahrain, Kingdom of	United Kingdom	China,P.R.: Macao	Seychelles	Bangladesh	Ghana	Sri Lanka	Papua New Guinea	Yemen Arab Rep.
Belarus	Equatorial Guinea	Mexico	Trinidad and Tobago	Bosnia and Herzegovina	Guinea	Lesotho	Paraguay	Zambia
Barbados	Greece	Malta	Turkey	Belize	Gambia, The	Morocco	Russian Federation	Zimbabwe
Brunei Darussalam	Grenada	Mauritius	Uruguay	Bolivia	Guinea-Bissau	Moldova	Rwanda	
Botswana	Hong Kong	Malaysia	United States	Central African Rep	Guatemala	Madagascar	Sudan	
Canada	Croatia	Netherlands	St. Vincent & Grens.	China,P.R.: Mainland	Guyana	Macedonia, FYR	Senegal	
Switzerland	Hungary	Norway	Venezuela, Rep. Bol.	Côte d'Ivoire	Honduras	Mali	Sierra Leone	
Chile	Iceland	New Zealand	South Africa	Cameroon	Haiti	Myanmar	El Salvador	
Colombia	Israel	Oman		Congo, Dem. Rep. of	Indonesia	Mongolia	Swaziland	
Costa Rica	Italy	Panama		Comoros	India	Mozambique	Chad	
Cyprus	Japan	Poland		Cabo Verde	Ireland	Mauritania	Togo	
Czech Republic	Kazakhstan	Portugal		Cuba	Iran, I.R. of	Malawi	Thailand	
Germany	Korea, Republic of	Qatar		Djibouti	Iraq	Namibia	Tajikistan	

Table 2.2. Summary of Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Country-pairs					
Log of real trade flow	32116	16.935	3.374	3.768	27.146
Trade agreements	32116	0.258	0.438	0.000	1.000
Log of sum of real GDPs	32116	50.086	2.699	39.826	60.263
Log of distance	32116	8.554	0.860	4.088	9.894
Adjacent	32116	0.027	0.163	0.000	1.000
Common language	32116	0.155	0.362	0.000	1.000
Colonial relationship	32116	0.019	0.138	0.000	1.000
North country-pairs					
Log of real trade flow	9618	18.402	3.386	4.923	27.146
Trade agreements	9618	0.351	0.477	0.000	1.000
Log of sum of real GDPs	9618	51.274	2.807	39.826	59.867
Log of distance	9618	8.431	1.008	4.088	9.885
Adjacent	9618	0.029	0.168	0.000	1.000
Common language	9618	0.119	0.323	0.000	1.000
Colonial relationship	9618	0.028	0.164	0.000	1.000
South country-pairs					
Log of real trade flow	5745	15.434	3.227	3.796	24.964
Trade agreements	5745	0.340	0.474	0.000	1.000
Log of sum of real GDPs	5745	48.454	2.407	40.842	58.283
Log of distance	5745	8.438	0.921	5.014	9.894
Adjacent	5745	0.065	0.246	0.000	1.000
Common language	5745	0.232	0.422	0.000	1.000
Colonial relationship	5745	0.002	0.044	0.000	1.000
North and South country-pairs					
Log of real trade flow	16753	16.607	3.091	3.768	26.98
Trade agreements	16753	0.177	0.381	0.000	1.000
Log of sum of real GDPs	16753	49.963	2.392	40.443	60.263
Log of distance	16753	8.665	0.719	4.710	9.892
Adjacent	16753	0.013	0.114	0.000	1.000
Common language	16753	0.149	0.356	0.000	1.000
Colonial relationship	16753	0.021	0.142	0.000	1.000

Table 2.3. Numbers of trade agreements

	2000		2005		2010		2015	
	with TA	without TA	with TA	without TA	with TA	without TA	with TA	without TA
All	1407	5481	1774	5921	2264	6268	2844	6157
North-North	589	1687	742	1639	923	1558	1124	1356
South-South	421	640	460	815	503	1060	568	1278
North-South	397	3154	572	3467	838	3650	1152	3523

Table 2.4. Estimated coefficients on the TA dummy in the gravity equation with country fixed effects

Year	All country-pairs	North country-pairs	South country-pairs	North and South country-pairs
2000	0.351***	0.251***	0.967***	0.557***
	(0.056)	(0.089)	(0.155)	(0.104)
2005	0.395***	0.203**	0.968***	0.413***
	(0.054)	(0.098)	(0.140)	(0.093)
2010	0.276***	0.057	0.878***	0.325***
	(0.049)	(0.086)	(0.131)	(0.079)
2015	0.361***	0.274***	0.798***	0.341***
	(0.045)	(0.077)	(0.130)	(0.067)

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively. . TA is the dummy which equals one if a country pairs has a trade agreement and zero otherwise. Only the estimated coefficients on the TA dummy are presented.

Table 2.5. ATTs: Entropy balancing matching estimates

	All country-pairs	North country-pairs	South country-pairs	North and South country-pairs
2000	0.569***	0.951***	0.702***	0.982***
	(0.071)	(0.082)	(0.120)	(0.132)
2005	0.697***	1.127***	0.780***	1.155***
	(0.077)	(0.081)	(0.122)	(0.095)
2010	0.654***	1.056***	0.618***	0.999***
	(0.080)	(0.101)	(0.126)	(0.084)
2015	0.701***	1.136***	0.613***	0.771***
	(0.063)	(0.096)	(0.120)	(0.070)

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively.

Chapter 3 Do investment treaties complement trade agreements? Any differences between south-south and north-south trades?

3.1 Introduction

Economic integration has promoted cross-border trade of goods and, and trade agreements (TAs) have become prevalent around the world. The objective of TAs is to eliminate tariff and non-tariff barriers for trade liberalization. At the same time, globalization has also proceeded in the contexts of cross-border financial flows, particularly foreign direct investment (FDI), with the prevalence of investment treaties (ITs). The primary objective of ITs is the reduction in the cost of financial transactions and legal protection of investments (Elkins et al., 2006; Neumayer & Spess, 2005). The proliferation of TAs and ITs has recently been evident not only between developed countries but also between developed and developing countries, and even between developing countries. One important aspect is that under the prevalence of global supply chains with multinationals, trade-investment relationships between countries would be a crucial determinant of trade flows.

Many studies have presented the importance of TAs in promoting trade flows (Baier & Bergstand, 2009a; Carrere, 2006), although some works show the substantial heterogeneity in the trade creation effects across time, types of agreements, and trading partners (Greenaway & Milner, 2002; World Bank, 2005; Egger & Larch, 2008; Baier & Bergstrand, 2007, 2009a; Cipollina & Salvatici, 2010; Medvedev, 2010; Eicher & Henn, 2011; Behar & Cirera-i-Criville, 2013; Dahi & Demir, 2013; Cheong et al., 2015; Baier et al., 2019; Falvey & Foster-McGregor, 2018). Anderson and van Wincoop (2003) show that an omission of nonlinear multilateral resistance (MR) terms in gravity equations yields biased estimates and suggest that unbiased estimates can be obtained using the country fixed effects. Baier and Bergstrand (2004, 2009a) emphasize that the combination of the non-randomness of TAs and omission of nonlinear MR terms derives biased estimates. Baier and Bergstrand (2009a) suggest matching methods with

the application of a Taylor approximation to the nonlinear gravity equation to derive plausible estimates of trade creation effects of TAs, although the methods do not address explicitly selection bias on unobservable.

This study extends the analysis of trade creation effects of TAs to the investigation with the consideration of the roles of ITs. Our interest is on how trade is influenced by trade-investment relationships, particularly TAs and ITs. Although many studies examine effects of TAs, no empirical studies have addressed trade creation effects of TAs and ITs simultaneously.[10] Given the importance of trade-investment relationships, evaluating how ITs complement trade creation effects of TAs would provide important implications about the association of trade-investment relationship with trade promotion. In addition, no empirical studies have existed on trade creation effects of TAs and ITs in the north-south trade contexts, although ongoing globalization has intensified trade-investment relationship associated with the prevalence of cross-border production linkages in developing countries. Thus, this study evaluates trade creation effects of north-north, north-south, and south-south TAs and ITs and identifies possible differences among them to discuss complementary roles of ITs in determining the TA effects in the north-south trade contexts.

Following Baier and Bergstrand (2009a), this study applies a matching method with the consideration of the MR terms. We use four cross-sections of trade flows over every five-year data during the recent period from 2000 to 2015. To evaluate trade creation effects of TAs and the role of ITs, this study considers three groups: (i) country pairs without TAs, (ii) those with TAs but not ITs, and (iii) those with TAs and ITs. The results confirm positive trade creation effects of TAs for all of north-north, north-south, and south-south country pairs. More importantly, ITs intensify trade creation effects of TAs, i.e., ITs complement TAs, and such

[10] Many studies have revealed positive effects of ITs on FDI (Egger & Pfaffermayr, 2004; Salacuse & Sullivan, 2005; Neumayer & Spess, 2005; Buthe & Milner, 2008), while some studies find less clear effects (Sauvant & Sachs, 2009; Hallward-Driemeier, 2003; Gallagher & Birch, 2009; Aisbett, 2009). Differently from their studies, our study focuses on how ITs complement TAs in terms of trade creation.

complementary effects are larger for north-north and north-south country pairs than for south-south country pairs. Once north countries establish both TAs and ITs with their partners, irrespective of north and south countries, they would enjoy economic benefits associated with relatively large trade flows. On the other hand, the complementary role of ITs is not so substantial when south countries form TAs and ITs with their south partners. Moreover, our results propose an aspect of heterogeneity in trade creation effects of TAs, emphasized in many studies such as Baier and Bergstrand (2009) and Falvey and Foster-McGregor (2018), in the sense that the heterogeneity would originate in ITs. The rest of this paper is organized as follows. Section 2 explains methodology and the empirical results with some implications. Section 3 concludes.

3.2 Empirical analysis

3.2.1 Methodology

Our study uses the cross-sectional data of bilateral trade flows over 168 countries for every five-year periods (2000, 2005, 2010, and 2015). Table 1 shows a list of sample countries, and Tables 3.2 and 3.3 present data sources and the summary statistics of variables used in this study. Table 3.4 presents the numbers of TAs with and without ITs in terms of country pairs. It is observed that TAs and ITs have proliferated drastically during our sample periods. We apply the mirrored flow to construct bilateral exports, such that bilateral imports into the partner country are used to measure bilateral exports from the reporter, and construct bilateral trade flows by summing imports and exports for each country pair. Following Baier and Bergstrand (2009a), we also exclude zero trade flows from our sample. To discuss possible differences in trade creation effects, we divide the full sample into three groups of country-pairs: north-north, north-south, and south-south.[11]

[11] The criteria to classify countries by the income level are based on the World Bank thresholds. A country with more than US$6000 per capita is classified into north, while a country with less than US$6000 per capita is classified into south. This study also conducts empirical analysis for north-north trade, although our main concern is on north-south and south-south trades.

Many studies on trade creation effects of TAs, including Frankel (1997) and Baier and Bergstrand (2007, 2009a), cast concerns on the instability of OLS estimates of the coefficient on the TA dummy variable, i.e., the 'unobserved-by-researcher' problem. Several defects have been discussed to explain the instability of the estimations (Rose, 2004; Anderson & van Wincoop, 2003; Baier & Bergstrand, 2009a). Among them, the existence of omitted variables that relate to trade and TAs may derive the biased estimates. Anderson and van Wincoop (2003) show that the omission of nonlinear multilateral resistance (MR) terms for each country causes the bias of the coefficient estimates and present that an estimation of unbiased coefficients is derived by minimizing the sum of squared residuals of:

$$\ln\left[\frac{TF_{ij}}{GDP_i GDP_j}\right] = \alpha_0 + \alpha_1 DIST_{ij} + \alpha_2 ADJ_{ij} + \alpha_3 LANG_{ij} + \alpha_4 COL_{ij} + \alpha_5 TAO_{ij} + \alpha_6 TAIT_{ij} - \ln P_i^{1-\sigma} - \ln P_j^{1-\sigma} + \varepsilon_{ij}, \quad (2)$$

subject to the nonlinear market equilibrium conditions:

$$P_i^{1-\sigma} = \sum_{k=1}^{N} P_k^{\sigma-1} (GDP_k/GDP^T) e^{\alpha_1 DIST_{kj} + \alpha_2 ADJ_{kj} + \alpha_3 LANG_{kj} + \alpha_4 COL_{ij} + \alpha_5 TAO_{ij} + \alpha_6 TAIT_{ij}} \quad (3)$$

where TF_{ij} is real trade flows between countries i and j; GDP_i is real GDP; $DIST_{ij}$ is the log of the distance; ADJ_{ij} is a dummy of sharing a land border; $LANG_{ij}$ is a dummy of sharing an official language; COL_{ij} is a dummy of a colonial relationship; TAO_{ij} is a dummy which equals one if two countries share a TA without an IT and zero otherwise; $TAIT_{ij}$ is a dummy which equals one if two countries share a TA with an IT and zero otherwise; and GDP^T is world income. The terms of $P_i^{1-\sigma}$ and $P_j^{1-\sigma}$ are the MR terms for countries i and j. Although this specification requires a nonlinear least squares technique to estimate unbiased coefficients, Anderson and van Wincoop (2003) and Feenstra (2015) recommend the country fixed effects models to obtain unbiased estimates of the coefficients in equation (2). However, Baier and Bergtrand (2009a) suggest that although the country fixed effects may solve the 'unobserved-

by-researcher' problems, it cannot ensure an unbiased estimation due to the issue of 'selection on observables,' i.e., the selection of agreements is not random. Baier and Bergtrand (2009a) employ a matching method to mitigate the 'selection on observables' problem.

One crucial issue with the matching method is to find a control group of country pairs without treatment that are virtually identical in all other aspects as a treatment group of country pairs with treatment. For the method to be valid, our model specification should satisfy three main assumptions, i.e., the assumption of ignorability of treatment (selection on observables), the overlap assumption, and the stable-unit-treatment-value assumption. [12] Theoretical foundations for the gravity model imply that relevant covariates for selection on observables are the sum of logs of GDPs, DIST, ADJ, LANG, COL, and the MR terms. Given that the MR terms are endogenous, Baier and Bergtrand (2009b) show a reduced-form function of linear combinations of the exogenous variables by applying a first-order log-linear Taylor series expansion around a symmetric equilibrium of equations (2) and (3):

$$\ln TF_{ij} = \beta_0 + \beta_1 \ln(GDP_i GDP_j) + \beta_2 BVDIST_{ij} + \beta_3 BVADJ_{ij} + \beta_4 BVLANG_{ij} + \beta_5 BVCOL_{ij} + \beta_6 BVTAO_{ij} + \beta_7 BVTAIT_{ij} + \varepsilon_{ij}, \quad (4)$$

where

$$BVDIST_{ij} = DIST_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} DIST_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} DIST_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} DIST_{ij},$$

$$BVADJ_{ij} = ADJ_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} ADJ_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} ADJ_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} ADJ_{ij},$$

$$BVLANG_{ij} = LANG_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} LANG_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} LANG_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} LANG_{ij},$$

[12] Baier and Bergstrand (2009a) discuss the feasibility of these assumptions in the context of trade agreements and trade. The ignorability assumption can be achieved by selecting for each treated country pair control units that are closely matched to the treated unit regarding all relevant covariates (except the TA dummy) related to trade, such that treatment assumption is random. They also discuss the overlap assumption and the stable-unit-treatment-value assumption. The overlap assumption could be satisfied due to the large number of FTAs. The third assumption consists of two parts, which may be more problematic. The first is 'unique treatment,' which ensures the treatment is identical for each treated observation. This is the standard assumption we make when we include an FTA dummy into a gravity equation. The second part is 'non-interference,' which ensures that the treatment of any country pair does not influence the trade of untreated country pairs. For further discussion, see Baier and Bergstrand (2009a) and Falvey and Foster-McGreggor (2018).

$$BVCOL_{ij} = COL_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} COL_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} COL_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} COL_{ij},$$

$$BVTAO_{ij} = TAO_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} TAO_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} TAO_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} TAO_{ij}.$$

$$BVTAIT_{ij} = TAIT_{ij} - \left(\frac{1}{N}\right)\sum_{j=1}^{N} TAIT_{ij} - \left(\frac{1}{N}\right)\sum_{i=1}^{N} TAIT_{ij} + \left(\frac{1}{N^2}\right)\sum_{i=1}^{N}\sum_{j=1}^{N} TAIT_{ij}.$$

This specification suggests that exogenous covariates ($\ln(GDP_iGDP_j)$, $BVDIST_{ij}$, $BVADJ_{ij}$, $BVCOL_{ij}$ and $BVLANG_{ij}$) are used to conduct the matching estimation.

Our measure of interest is the average treatment effect on the treated (ATT). This study applies entropy balancing, proposed by Hainmueller (2012), to select matches for the units exposed to treatment and to estimate the ATT.[13] Recent empirical studies apply entropy balancing as a multivariate reweighting method to build balanced samples in observational studies with a binary treatment where the control group data can be reweighted to match the covariate moments in the treatment group (Neuenkirch & Neumeier, 2016; Wilde, 2017).[14] To analyze the roles of TAs and ITs, this study first evaluates trade creation effects of TAs without the consideration of ITs. For the full sample and each of the three subsamples of north-north, north-south, and south-south country-pairs, we classify country pairs into those that have a TA (treatment group) and those that do not have a TA (control group) and apply the matching method (analysis 1). Once we identify trade creation effects of TAs, the next step is to discuss how ITs relate to trade creation effects of TAs. To do so, for the full sample and each subsample, we classify country pairs into three groups: (i) country pairs without TAs: (ii) those with only TAs without ITs, and (iii) those with both TAs and ITs. Then we apply the matching method to two analyses for the full sample and each subsample. The first analysis (analysis 2) is conducted over (i) country pairs without TAs (control group) and (ii) those with only TAs without ITs (treatment group), dropping (iii) those with both TAs and ITs. The second analysis

[13] Matching approaches are appropriate to overcome selection bias caused by observables and to estimate the ATTs in observational studies. However, it should be noted that the matching approaches can control only for observable selection biases and may generate unreliable results if unobservable biases exist.

[14] Entropy balancing is based on a maximum entropy reweighting. See Hainmueller (2012), Hainmueller and Xu (2013), and Neuenkirch and Neumeier (2016) for its detailed explanation.

(analysis 3) is conducted over (i) country pairs without TAs (control group) and (iii) those with both TAs and ITs (treatment group), dropping (ii) those with only TAs without ITs. These analyses enable us to evaluate how ITs play a complementary role in determining trade creation effects of TAs.

3.2.2 Results

Table 3.5 presents the estimated ATTs for analyses 1, 2, and 3 over the full sample and the three-subsamples of north-north, north-south, and south-south country pairs.[15] All matching covariates are well balanced, as the similar average realizations of the pre-treatment characteristics between the two groups confirm the efficacy of entropy balancing (Table 6). The results confirm positive trade creation effects of TAs for all classifications of country pairs. More importantly, the ATTs for analysis 3 are larger than those for analysis 2. This suggests that ITs intensify trade creation effects of TAs, i.e., ITs complement TAs. In addition, the trade creation effects of TAs and the complementary effects of ITs are larger for north-north and north-south country pairs than for south-south country pairs. Once north countries establish both TAs and ITs with their partners, irrespective of north and south countries, they would enjoy economic benefits associated with large trade creation. On the other hand, the complementary role of ITs is less substantial when south countries form TAs and ITs with south partners. Moreover, our results imply that ITs can be a possible source of heterogeneity in trade creation effects of TAs, emphasized in many studies including Baier and Bergstrand (2009a) and Falvey and Foster-McGregor (2018).

3.3 Conclusion

This study has addressed issues on trade-investment relationship by examining trade creation effects of TAs and ITs, accounting for the MR terms and the nonrandomness of international

[15] We also estimate the traditional gravity models including the log of sum of real GDP, DIST, ADJ, LANG, and COL with the country fixed effects. In addition, we estimate modified models including different covariates BVDIST, BVLADJ, BVLANG, and BVCOL (instead of DIST, ADJ, LANG, and COL). Tables B1 and B2 in the appendix show that the results qualitatively differ from the findings in Table 3.5, suggesting that the issue of selection on observables is crucial to estimate the ATTs, as emphasized in Baier and Bergtrand (2009a).

agreements. The results have confirmed positive trade creation effects of TAs, and importantly, ITs complement TAs particularly for north-north and north-south country pairs. Under ongoing globalization, TAs achieve the original purpose by reducing tariff and non-tariff barriers, and ITs help promote trade through the reduction in financial transaction costs and legal protection of investments.

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Table 3.1. List of sample countries

North countries				South countries				
United Arab Emirates	Dominica	Kuwait	Saudi Arabia	Afghanistan, I.R. of	Dominican Republic	Jamaica	Niger	Turkmenistan
Argentina	Denmark	Lebanon	Singapore	Angola	Algeria	Jordan	Nigeria	Tunisia
Antigua and Barbuda	Spain	Libya	San Marino	Albania	Ecuador	Kenya	Nicaragua	Tanzania
Australia	Estonia	St. Lucia	Suriname	Armenia	Egypt	Kyrgyz Republic	Nepal	Uganda
Austria	Finland	Lithuania	Slovak Republic	Azerbaijan, Rep. of	Eritrea	Cambodia	Pakistan	Ukraine
Belgium	France	Luxembourg	Slovenia	Burundi	Ethiopia	Lao People's Dem.Rep	Peru	Uzbekistan
Bulgaria	Gabon	Latvia	Sweden	Benin	Georgia	Liberia	Philippines	Vietnam
Bahrain, Kingdom of	United Kingdom	China,P.R.: Macao	Seychelles	Bangladesh	Ghana	Sri Lanka	Papua New Guinea	Yemen Arab Rep.
Belarus	Equatorial Guinea	Mexico	Trinidad and Tobago	Bosnia and Herzegovina	Guinea	Lesotho	Paraguay	Zambia
Barbados	Greece	Malta	Turkey	Belize	Gambia, The	Morocco	Russian Federation	Zimbabwe
Brunei Darussalam	Grenada	Mauritius	Uruguay	Bolivia	Guinea-Bissau	Moldova	Rwanda	
Botswana	Hong Kong	Malaysia	United States	Central African Rep	Guatemala	Madagascar	Sudan	
Canada	Croatia	Netherlands	St. Vincent & Grens.	China,P.R.: Mainland	Guyana	Macedonia, FYR	Senegal	
Switzerland	Hungary	Norway	Venezuela, Rep. Bol.	Côte d'Ivoire	Honduras	Mali	Sierra Leone	
Chile	Iceland	New Zealand	South Africa	Cameroon	Haiti	Myanmar	El Salvador	
Colombia	Israel	Oman		Congo, Dem. Rep. of	Indonesia	Mongolia	Swaziland	
Costa Rica	Italy	Panama		Comoros	India	Mozambique	Chad	
Cyprus	Japan	Poland		Cabo Verde	Ireland	Mauritania	Togo	
Czech Republic	Kazakhstan	Portugal		Cuba	Iran, I.R. of	Malawi	Thailand	
Germany	Korea, Republic of	Qatar		Djibouti	Iraq	Namibia	Tajikistan	

Table 3.2. Data sources

Data	Data source
Real trade flow	United Nations International Trade Statistics Database (UN COMTRADE)
Trade agreements	Mario Larch's Regional Trade Agreements database
Investment treaties	United Nations Conference on Trade and Development (UNCTAD) database
Real GDP	World Development Indicators (WDI)
Distance	CEPII's GeoDist database
Adjacent	CEPII's GeoDist database
Common language	CEPII's GeoDist database
Colonial relationship	CEPII's GeoDist database

Table 3.3. Summary of Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Country-pairs					
Log of real trade flow	32116	16.935	3.374	3.768	27.146
Trade agreements	32116	0.258	0.438	0.000	1.000
Trade agreements without investment treaties	32116	0.169	0.375	0.000	1.000
Trade agreements with investment treaties	32116	0.089	0.285	0.000	1.000
Log of sum of real GDPs	32116	50.086	2.699	39.826	60.263
Log of distance	32116	8.554	0.860	4.088	9.894
Adjacent	32116	0.027	0.163	0.000	1.000
Common language	32116	0.155	0.362	0.000	1.000
Colonial relationship	32116	0.019	0.138	0.000	1.000
North country-pairs					
Log of real trade flow	9618	18.402	3.386	4.923	27.146
Trade agreements	9618	0.351	0.477	0.000	1.000
Trade agreements without investment treaties	9618	0.207	0.405	0.000	1.000
Trade agreements with investment treaties	9618	0.144	0.351	0.000	1.000
Log of sum of real GDPs	9618	51.274	2.807	39.826	59.867
Log of distance	9618	8.431	1.008	4.088	9.885
Adjacent	9618	0.029	0.168	0.000	1.000
Common language	9618	0.119	0.323	0.000	1.000
Colonial relationship	9618	0.028	0.164	0.000	1.000
South country-pairs					
Log of real trade flow	5745	15.434	3.227	3.796	24.964
Trade agreements	5745	0.340	0.474	0.000	1.000
Trade agreements without investment treaties	5745	0.280	0.449	0.000	1.000
Trade agreements with investment treaties	5745	0.059	0.236	0.000	1.000
Log of sum of real GDPs	5745	48.454	2.407	40.842	58.283
Log of distance	5745	8.438	0.921	5.014	9.894
Adjacent	5745	0.065	0.246	0.000	1.000
Common language	5745	0.232	0.422	0.000	1.000
Colonial relationship	5745	0.002	0.044	0.000	1.000
North and South country-pairs					
Log of real trade flow	16753	16.607	3.091	3.768	26.98
Trade agreements	16753	0.177	0.381	0.000	1.000
Trade agreements without investment treaties	16753	0.109	0.312	0.000	1.000
Trade agreements with investment treaties	16753	0.067	0.250	0.000	1.000
Log of sum of real GDPs	16753	49.963	2.392	40.443	60.263
Log of distance	16753	8.665	0.719	4.710	9.892
Adjacent	16753	0.013	0.114	0.000	1.000
Common language	16753	0.149	0.356	0.000	1.000
Colonial relationship	16753	0.021	0.142	0.000	1.000

Table 3.4. Numbers of trade agreements and investment treaties

	2000	2005	2010	2015
All	1407	1774	2264	2844
Without investment treaties	1013	1134	1448	1839
With investment treaties	394	640	816	1005
North-North	589	742	923	1124
Without investment treaties	358	407	544	681
With investment treaties	231	335	379	443
South-South	421	460	503	568
Without investment treaties	368	373	404	466
With investment treaties	53	87	99	102
North-South	397	572	838	1152
Without investment treaties	287	354	500	692
With investment treaties	110	218	338	460

Table 3.5. The estimated ATTs

	Full			North-North			South-South			North-South		
	Analysis 1	Analysis 2	Analysis 3	Analysis 1	Analysis 2	Analysis 3	Analysis 1	Analysis 2	Analysis 3	Analysis 1	Analysis 2	Analysis 3
2000	0.569***	0.468***	0.795***	0.951***	0.904***	1.055***	0.702***	0.608***	1.143***	0.982***	0.687***	1.386***
	(0.071)	(0.075)	(0.070)	(0.082)	(0.090)	(0.098)	(0.120)	(0.129)	(0.188)	(0.132)	(0.170)	(0.149)
2005	0.697***	0.592***	0.842***	1.127***	1.063***	1.232***	0.780***	0.767***	0.790***	1.155***	(0.127)	1.370***
	(0.077)	(0.081)	(0.069)	(0.081)	(0.088)	(0.091)	(0.122)	(0.130)	(0.210)	(0.095)	(0.127)	(0.114)
2010	0.654***	0.435***	1.004***	1.056***	0.781***	1.487***	0.618***	0.577***	0.717***	0.999***	0.665***	1.392***
	(0.080)	(0.081)	(0.065)	(0.101)	(0.115)	(0.098)	(0.126)	(0.134)	(0.225)	(0.084)	(0.118)	(0.088)
2015	0.701***	0.469***	1.097***	1.136***	0.954***	1.440***	0.613***	0.587***	0.741***	0.771***	0.400***	1.261***
	(0.063)	(0.063)	0.870***	(0.096)	(0.113)	(0.088)	(0.120)	(0.129)	(0.220)	(0.070)	(0.094)	(0.077)

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively. Analysis 1 corresponds to the case where the treatment and control groups consist of country pairs with TAs and those without TAs, respectively; analysis 2 corresponds to the case where the treatment and control groups consist of country pairs with TAs but not ITs and those without TAs, respectively; and analysis 3 corresponds to the case where the treatment and control groups consist of country pairs with both TAs and ITs and those without TAs, respectively.

Table3.6. Covariate balancing of entropy balancing

	2000		2005		2010		2015	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
All country-pairs								
Before								
PRGDPij	49.3100	47.8900	49.7200	48.2700	49.8100	48.6300	50.1700	48.9500
BVDIST	-0.6004	0.1591	-0.6003	0.1823	-0.4660	0.1854	-0.3491	0.1836
BVADJ	0.0732	-0.0119	0.0662	-0.0130	0.0550	-0.0140	0.0432	-0.0139
BVLANG	0.1239	-0.0193	0.1110	-0.0211	0.0854	-0.0209	0.0663	-0.0207
BVCOLONY	0.0029	-0.0004	0.0032	-0.0006	0.0043	-0.0010	0.0043	-0.0013
After								
PRGDPij	49.3100	49.3000	49.7200	49.7100	49.8100	49.8100	50.1700	50.1700
BVDIST	-0.6004	-0.5993	-0.6003	-0.5992	-0.4660	-0.4656	-0.3491	-0.3489
BVADJ	0.0732	0.0731	0.0662	0.0660	0.0550	0.0549	0.0432	0.0431
BVLANG	0.1239	0.1237	0.1110	0.1108	0.0854	0.0853	0.0663	0.0662
BVCOLONY	0.0029	0.0029	0.0032	0.0032	0.0043	0.0043	0.0043	0.0043
North country-pairs								
Before								
PRGDPij	51.8900	50.2300	51.7500	50.6700	51.2700	51.2400	51.3700	51.4300
BVDIST	-0.4077	0.3069	-0.3691	0.3513	-0.1944	0.3285	-0.1283	0.3263
BVADJ	0.0464	-0.0143	0.0360	-0.0147	0.0258	-0.0145	0.0214	-0.0146
BVLANG	0.0852	-0.0289	0.0765	-0.0347	0.0553	-0.0351	0.0436	-0.0350
BVCOLONY	-0.0104	0.0041	-0.0081	0.0043	-0.0042	0.0033	-0.0036	0.0034
After								
PRGDPij	51.8900	51.8800	51.7500	51.7500	51.2700	51.2700	51.3700	51.3700
BVDIST	-0.4077	-0.4068	-0.3691	-0.3688	-0.1944	-0.1944	-0.1283	-0.1283
BVADJ	0.0464	0.0463	0.0360	0.0360	0.0258	0.0258	0.0214	0.0214
BVLANG	0.0852	0.0851	0.0765	0.0764	0.0553	0.0553	0.0436	0.0436
BVCOLONY	-0.0104	-0.0104	-0.0081	-0.0081	-0.0042	-0.0042	-0.0036	-0.0036
South country-pairs								
Before								
PRGDPij	47.4000	46.2000	47.9500	46.6400	48.4900	47.1600	48.9400	47.5800
BVDIST	-0.3987	0.2138	-0.4179	0.2206	-0.4224	0.2228	-0.4279	0.2259
BVADJ	0.0730	-0.0184	0.0763	-0.0195	0.0798	-0.0206	0.0790	-0.0206
BVLANG	0.0771	-0.0187	0.0811	-0.0200	0.0817	-0.0204	0.0809	-0.0204
BVCOLONY	0.0006	-0.0002	0.0006	-0.0002	0.0006	-0.0002	0.0006	-0.0002
After								
PRGDPij	47.4000	47.4000	47.9500	47.9500	48.4900	48.4900	48.9400	48.9400
BVDIST	-0.3987	-0.3986	-0.4179	-0.4178	-0.4224	-0.4222	-0.4279	-0.4277
BVADJ	0.0730	0.0730	0.0763	0.0762	0.0798	0.0798	0.0790	0.0790
BVLANG	0.0771	0.0770	0.0811	0.0811	0.0817	0.0817	0.0809	0.0809
BVCOLONY	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
North and South country-pairs								
Before								
PRGDPij	49.6600	48.3600	49.9500	48.7100	49.7900	49.0400	50.2000	49.3900
BVDIST	9.0450	9.2070	8.9640	9.1700	9.1340	9.1220	9.0620	9.1330
BVADJ	0.0622	0.0063	0.0551	0.0051	0.0446	0.0043	0.0332	0.0045
BVLANG	0.3206	0.1284	0.2669	0.1273	0.2233	0.1270	0.2010	0.1270
BVCOLONY	0.0407	0.0142	0.0337	0.0140	0.0310	0.0134	0.0276	0.0128
After								
PRGDPij	49.6600	49.6600	49.9500	49.9500	49.7900	49.7900	50.2000	50.1900
BVDIST	9.0450	9.0450	8.9640	8.9640	9.1340	9.1340	9.0620	9.0620
BVADJ	0.0622	0.0622	0.0551	0.0551	0.0446	0.0446	0.0332	0.0331
BVLANG	0.3206	0.3206	0.2669	0.2669	0.2233	0.2233	0.2010	0.2008
BVCOLONY	0.0407	0.0407	0.0337	0.0337	0.0310	0.0310	0.0276	0.0276

Chapter 4 Firm performance and backward and forward linkages: The case of the garment sector in Myanmar

4.1 Introduction

Multinational enterprises (MNEs) have undertaken a large number of foreign direct investment (FDI) projects in a globalized world with trade and financial liberalization. Much of the literature has emphasized spillovers in that FDI can generate positive externalities that increase domestic firms' productivity in host economies.[16] Domestic firms may benefit from the entry or presence of multinationals operating in their same sector or through linkages or transactions with multinationals, since the values of the benefits are not fully internalized by multinationals. Channels of spillovers to domestic firms are generally classified into two types, namely, 'horizontal' and 'vertical' spillovers. Horizontal or intra-industry spillovers benefit domestic firms operating in their same sector. Vertical or inter-industry spillovers benefit domestic firms operating in sectors that supply or purchase products to or from multinationals, and they originate from two types of international linkages, 'backward' linkage between local suppliers and their foreign affiliates (from downstream multinationals to upstream local suppliers) and 'forward' linkage between local buyers and their foreign affiliates (from downstream local buyers to upstream multinationals).

This study discusses vertical spillovers through backward and forward linkages in a developing country, Myanmar, which has recently garnered much focus from international communities since the new government began in 2011. One critical issue is that most of the past studies focus on industry-level vertical spillovers, and the measures of vertical spillovers rely heavily on variables from input-output (IO) tables at the industry level instead of on direct firm-specific measures.[17] In contrast to the existing literature, this study captures vertical

[16] See, e.g., Blomstrom and Kokko (1998), Blomstrom et al. (2001), Crespo and Fontoura (2007), Gorg and Greenaway (2004), and Lipsey (2004).

[17] The critical issue in previous studies is that the measures of backward and forward linkages rely fully on the input-output coefficients of the IO tables (Barrios et al., 2011; Giroud et al., 2012). Following Javorcik (2004), most studies use the IO tables to construct the measure of backward linkages by calculating the share of total revenue downstream sectors explained

spillovers through backward and forward linkages at the firm level by conducting a unique business survey covering 238 firms in Yangon and Mandalay, Myanmar. We selected the garment sector. Like other developing countries, the garment sector has attracted inward FDI with a growing number of operating multinationals in Myanmar, and the government has adopted a series of industrial policies targeting that sector, including the establishment of special economic zones. Since garment firms in Myanmar rarely involve transactions with other firms in the same sector, i.e., less horizontal firm-level relationship within the garment sector, focusing on the specific sector allows us to evaluate vertical spillover effects on firm performance and which source, backward and forward linkages can drive the effects.

By conducting business surveys and interviews with managers of garment firms located in Yangon and Mandalay, we collected various firm-level data of 238 garment firms, including basic characteristics of balance sheets and income statements in 2014 and 2016.[18] To discuss vertical spillover effects on firm performance, we first evaluate how backward and forward linkages relate to individual firm productivity or total factor productivity (TFP), which can be measured by the residual derived from the estimated Cobb-Douglas production function. By constructing binary measures of backward and forward linkages, this study applies the entropy balancing approach to examine the effects of these linkages on firm productivity, although we admit that the matching method may suffer from some methodological problems.[19] The estimated results show clear evidence supportive of the positive vertical spillover effects

by foreign-owned firms and that of forward linkages by calculating the share of total revenue in upstream sectors explained by foreign-owned firms. In this specification, all firms in the same sector share identical measures of backward and forward linkages without the consideration of heterogeneous features of firms' structures. Since certain firms have international linkages and others do not even within the same sector, treating all firms as identical may fail to capture precise features of backward and forward linkages. To solve this issue, this study constructs the individual firm-level measures of backward and forward linkages by conducting business surveys of individual firms in the garment sector. Exceptions may include the work of Vacek (2010) on the case of Czech Republic, which shows positive spillovers through backward linkages but insignificant spillovers through forward linkages.

[18] Our firm-level data covers years 2014 and 2016. Since the exuberant general election was conducted in November, 2015, we believe that it would be difficult to collect reliable data of firm characteristics in 2015.

[19] One possible problem is on the common trend assumption. When treatment effect relative to controls being evaluated, treatment and control groups should follow the common trend, which means that the outcome variables should reveal the similar trend between the two groups before the treatment. Because our data have only two years of data, we simply conduct the balance check using the level of variables in the first year. However, this does not guarantee the common trend. Another possible problem is related to the argument that matching approaches can control only for observable selection biases, but they may generate unreliable results if unobservable biases exist. Although we admit such shortcomings, our analysis would be a first step to examine backward and forward linkages of vertical spillovers in Myanmar.

through backward and forward linkages on firm productivity. Our findings of positive vertical spillovers are consistent with the argument in various past studies, such as that by Javorcik (2004) and Blalock and Gertler (2008), that backward linkages are a crucial driving force to promote productivity spillovers. At the same time, in addition to backward channels, our results presenting positive spillovers through forward linkages coincide with the works of Schoors and var del Tol (2002) and Du et al. (2012); however, they are in contrast with those of Javorcik (2004) and Jordaan (2011).

Once vertical spillovers to firm productivity are identified, the next step in our analysis is to examine how vertical linkages through backward and forward linkages are associated with firms' choice of input usages, including capital and labor. The estimations present certain interesting results. First, backward and forward linkages induce positive effects on capital growth rate. Second, backward linkages encourage firms to decrease skilled labor inputs, and forward linkages encourage firms to decrease unskilled labor inputs. Combining the findings of positive vertical spillover effects on firm productivity, our analysis highlights that both backward and forward linkages improve firm productivity and promote capital accumulation; however, they would cause adverse effects on labor inputs. Firms with vertical linkages tend to increase capital, perhaps due to the argument that multinationals support their domestic downstream customers' or upstream suppliers' capital installation and renovation since they intend to transfer knowledge and skills to their domestic partners, as emphasized in Javorcik (2004). In addition, firms with vertical linkages tend to involve more labor-saving activities with the ease of capital installation.

Our results have important implications given that the Myanmar government has implemented a series of economic policies and emphasized economic development with significant job creation. Although the presence of multinationals helps improve productivity, vertical spillover effects through backward and forward linkages appear to be ineffective, or even destructive, in the context of job creation. Moreover, the trend of productivity progress with the combination of capital accumulation and job destruction may cast serious concerns of

unequal economic development with a widening income inequality. The paper is organized as follows. Section 2 reviews the literature. Section 3 presents a current overview of the Myanmar economy, focusing on the garment sector, and our business surveys and interviews with managers in the sector. This section also explains our measures of backward and forward linkages. Section 4 depicts our empirical models and presents the estimated results and discusses certain important implications derived from our estimated results. The final section ends with a conclusion.

4.2 Technology spillovers

Developing countries are major receiving countries of inward FDI for transfers of advanced technology and external financing of investment. Technology spillovers occur when the productivity of domestic firms is promoted by the existence of multinationals. These spillovers are generally classified into horizontal and vertical spillovers. This section presents literature reviews on vertical spillovers, since our main interest is on vertical spillovers, rather than horizontal spillovers.[20] Newman et al. (2015) and Gorodnichenko et al. (2014) suggest that vertical spillovers between sectors are more likely to occur, rather than horizontal spillovers within sectors, since domestic firms may share technological knowledge with foreign firms by trading the inputs and/or outputs between them and thus experience productivity improvements. Vertical spillovers may arise through (i) backward linkages between (downstream) foreign firms and their domestic suppliers and (ii) forward linkages between (upstream) foreign suppliers and their domestic buyers.[21] Backward spillovers may occur through technology and knowledge transfers from downstream foreign firms to their domestic suppliers, and these

[20] Many studies have also examined horizontal spillovers theoretically and empirically, although their empirical analysis has shown the mixed results (Abraham et al., 2006; Aitken & Harrison, 1999; Blalock & Gertler, 2008 Blomstrom & Persson, 1983; Castellani & Zanfei, 2003; Caves, 1974; Djankov & Hoekman, 2000; Du et al., 2012; Fons-Rosen et al., 2013; Globerman, 1979; Gorg & Strobl, 2003; Gorodnichenko et al., 2014; Haddad & Harrison, 1993; Haskel et al., 2007; Javorcik, 2004; Javorcik et al., 2011; Keller & Yeaple, 2003, 2009; Kokko et al., 1996; Konings, 2001; Kosova, 2010; Lin et al., 2009; Reganati & Sica, 2007; Sembenelli & Siotis, 2005; Teece, 1977; Yudaeva et al., 2003).

[21] Backward and forward linkages are potential channels for productivity spillovers, which refer to contacts between multinationals (foreign-invested firms) and their domestic supplier and those between multinationals (foreign-invested firms) and their domestic buyers, respectively (Javorcik, 2004; Vacek, 2010). Scott-Kennel (2007) also notes that vertical linkages may be backward (with suppliers and subcontractors), forward (with customers and agents), and contractual (with domestic franchisees and licensees). In contrast to horizontal linkages closely related to competition effects, vertical linkages occur through collaborative activities with local partners (Girma et al., 2008).

spillover effects can be positive or negative from theoretical perspectives.[22] Forward spillovers generally occur through gaining access to new, higher quality or less costly intermediate inputs produced by foreign firms in upstream sectors. Similar to backward linkages, forward spillover effects can also be positive or negative from theoretical perspectives.[23]

In accordance with the theoretical arguments, many studies have empirically examined vertical spillovers, including backward and forward linkages; however, their results remain mixed without a general consensus. Among these studies, some present clear evidence supportive of positive effects of backward linkages.[24] Javorcik (2004) finds a positive impact of backward linkages in Lithuania using firm-level panel data from 1996 to 2000. Using the data of manufacturing firms in Colombia, Kugler (2006) shows the presence of limited horizontal spillovers and positive backward linkage effects from multinationals, arguing that the outsourcing of inputs by foreign firms to domestic suppliers prevails as a result of a lack of dissemination of sector-specific technologies. Conversely, certain studies based on the firm-level data show negative or less clear effects of backward linkages.[25] Schoors and van der Tol (2002) find a negative effect of backward linkages in Hungary. In addition to backward

[22] Moran (2001) applies various case studies to argue that technology transfers are common with foreign firms as foreign firms often provide technical assistance and management experience to their domestic suppliers. For positive effects, backward spillovers may arise when domestic firms supply their inputs to foreign firms which have an incentive to provide assistance to their suppliers to ensure high quality and on-time delivery of their production inputs (Newman et al., 2015). Javorick (2004) also suggests the role of indirect channels of domestic firms' productivity gains since intense competition with foreign customers and greater demand for domestically-produced intermediate goods encourage domestic suppliers to supply high quality inputs and improve their efficiency. Conversely, domestic firms may experience negative backward spillover effects through direct linkages with downstream foreign firms. The profit of domestic firms decreases when foreign firms take advantage of the bargaining power of domestic firms during contract negotiations, resulting in a decline in productivity (Girma et al., 2008). Thus, domestic suppliers should produce various inputs to supply the inputs required by foreign firms (Rodriguez-Clare, 1996). In addition, if foreign firms import intermediate goods, domestic firms may also experience negative impacts on productivity through a competition channel, leading to a loss in customers and results in lower profits for domestic suppliers.

[23] Grossman and Helpman (1991) argue that domestic firms may improve productivity through direct linkages when upstream foreign firms supply inputs with higher technologies to domestic customers, such that domestic firms can learn advanced technologies, resulting in positive productivity gains for domestic producers. Javorick (2004) also shows that forward spillovers may appear in the form of externalities when foreign firms supply inputs of embodied services or other forms of support, which helps improve the productivity gains of domestic users. In addition, Newman et al. (2015) suggest the possibility of positive forward spillover effects through indirect linkages. Conversely, negative forward spillover effects are also possible when the entry of foreign firms into upstream sectors may be anti-competitive, and each foreign firm possesses a larger market share (Newman et al., 2015; Jordaan, 2011). In addition, foreign firms generally perform well in various aspects including efficiency, technical know-how, and managerial skill; thus, upstream domestic firms cannot compete with such foreign firms, resulting in a negative impact on downstream domestic firms due partly to the payment of higher prices for their inputs (Liang, 2017; Aitken & Harrison, 1999).

[24] See, e.g., Lin et al. (2009) for China, Du et al. (2012) for China, Javorcik (2004) for Lithuania, Kubny and Voss (2014) for Vietnam, Reganati and Sica (2007) for Italy, and Barrios et al. (2011) for Ireland.

[25] See, e.g., Schoors and van der Tol (2002) for Hungary, Javorcik and Spatareanu (2005) for the Czech Republic and Romania, and Stancik (2007) for the Czech Republic.

linkages, several empirical works also discuss the roles of forward linkages in vertical spillovers. Certain studies show positive effects of forward linkages.[26] Lin et al. (2009) find both backward and forward linkages have positive effects on productivity in China, regardless of the motivation of FDI (domestic market-oriented and export-oriented), the source of FDI (Hong Kong, Macao, and Taiwan (HMT) firms and non-HMT firms), and the ownership type of domestic firms (state-owned and non-state owned firms). Conversely, other studies show negative or less clear spillover effects of forward linkages. Newman et al. (2015) show negative forward spillover effects in Vietnam. Javorcik (2004) and Blalock and Gertler (2008) fail to find clear evidence for productivity gains through forward linkage in Lithuania and Indonesia, respectively.

4.3 Data

4.3.1 The garment sector in Myanmar

The garment sector development in Myanmar began in 1989 following the Military government-initiated economic transformation from a central planned economy to a market economy. The new foreign investment law was enacted in 1989, attracting multinationals to invest in various sectors. A steady increase in FDI inflows was recorded for a decade after 1989. The garment sector is one of the few manufacturing sectors through which Myanmar is participating in global values chains. During the 1990s, exports to the United States and Europe grew considerably and, in fact, garments had become the country's main export products with a share of over 20 percent of total exports by 2000 (Kudo, 2012). US and EU sanctions imposed on the country since 2003 caused Myanmar's economy to be isolated from the world economy. During this period, the share of the garment exports decreased sharply to approximately 8 percent in 2013 (OECD, 2014). The critical turning point was 2011 when the newly elected government began undertaking a series of political, administrative, and economic reforms. Among these reforms, the open door policy of the reform-oriented government provided

[26] See, e.g., Chang et al. (2007) for China, Lin et al. (2009) for China, Kubny and Voss (2014) for Vietnam, and Schoors and van der Tol (2002) for Hungary.

opportunities for private firms to grow in tandem with the expansion of external trade. The economic reform processes include various measures, including the establishment of economic industrial zones, creating a sound business environment for domestic and international businesses, and providing tax holidays and other incentives for FDI. All such measures target the country's penetration into regional and global markets. In addition, the gradual lifting of sanctions by the US and EU countries has also encouraged multinational firms to enter and invest in Myanmar markets.

Recently, the Myanmar garment sector has also attained positive growth rate under the continued reforms. The Myanmar Investment Commission (MIC) has granted permission to foreign firms from various countries, such as China, Hong Kong, Japan, Korea, Thailand, and Taiwan, for investment in local businesses, through joint ventures or even with 100% foreign ownership. The estimates by the World Trade Organization (WTO) suggested that the value of clothing exports from Myanmar in 2012 was US$ 972 million and that the garment sector represented 10.9% of the total exports (Business Innovation Facility, 2016). According to the Myanmar Garment Manufacturer Association Report 2017, the value of garment exports from Myanmar was approximately US$ 1.5 billion to the world markets in 2014; it increased to approximately US$ 2.1 billion in 2016. According to the Ministry of Industry, there are approximately 2,000 registered firms (approximately 450 firms in Yangon) in the garment sector with more than 240,000 employees in 2014. As the most labor-intensive sector, the garment sector is now expected as an incredibly powerful generator of job opportunities for people in Myanmar.

4.3.2 Business surveys

This study uses primary firm-level data obtained from a field survey conducted in Yangon and Mandalay. The first author of this paper mainly administered the business survey, with the support of Myanmar Garment Manufacturers Association, the Directorate of Industrial Supervision and Inspection, Yangon region and Mandalay region offices, the Ministry of

Industry, and the Directorate of Investment and Company Administration, the Ministry of Planning and Finance, which provided detailed information about the garment sector. We hired 11 research assistants who are researchers working in international NGOs. As of 2014, the garment sector in Myanmar consists of 2054 registered firms, among which 867 firms are located in Yangon or Mandalay. Our business survey focused on the Yangon and Mandalay regions because these two regions dominate most of the commercial and industrial activities in the garment sector of the country. One of the important industrial policies is to establish industrial zones normally with suitable transportation access and tax-related incentives, for industrial development. As of 2014, there are 17 industrial zones in Yangon and Mandalay, where 540 firms (62 percent) are located inside industrial zones, and 327 firms (38 percent) are located outside of industrial zones.

Considering the population groups based on operations in industrial zones, we use a stratified random sampling method, where a random sample from each stratum is captured in a number proportional to the stratum's size when compared to the population. The data were collected through interviews by the research assistants, jointly with the administrator, from January 2017 to March 2018. The data collection of firms' performances and characteristics, particularly for small and medium sized enterprises (SMEs), was extremely challenging in Myanmar because the concept of corporate disclosure standards has not prevailed, and most firms are reluctant to disclose their information due to concerns regarding various issues such as taxation and unexpected unofficial business interventions. For surveys and interviews on garment firms inside industrial zones, we first obtained official approval letters from the Directorate of Industrial Supervision and Inspection, the Ministry of Industry, and asked the industrial zone management committee to organize interviews with the CEO or firm owners. For garment firms outside industrial zones, we first obtained official approval letters from the Yangon and Mandalay regional government offices and requested that they arrange interviews with the CEO or firm owners. Despite the difficulty in conducting surveys and interviews in certain sample firms, we have attempted to retain the randomness of our sample as much as

possible by appealing to business associations, including Myanmar Garment Manufacturers Association, for assistance. We finalized our questionnaire after testing a draft questionnaire with a group of respondent firms as a pilot survey. Most firm owners are Myanmar; therefore, we used the Myanmar language to communicate with them. The survey yielded 327 garment firms in total. However, 89 firms did not complete questionnaires; thus, they were removed from the analysis. A total of 238 firms, consisting of 163 firms operating inside industrial zones (68 percent) and 75 firms operating outside industrial zones (32 percent), remain as the final sample. Given the exuberant general election in 2015, we believe that it would be difficult for us to collect reliable data of firm characteristics in 2015. Thus, our data contain basic characteristics of each firm, including sales, capital, and labor, in the two periods of the 2014 and 2016 calendar years.

4.3.3 Measuring backward and forward linkages

The measures of backward and forward linkages are the variables of particular interest in this study. In contrast to the widely used industry-level measures of vertical spillovers in past studies, which rely on the input-output coefficients, this study first constructs the measures of backward and forward linkages at the individual firm level, using our unique data from business surveys and interviews. Vertical spillovers through backward linkages are expected to benefit domestic firms that supply their products to downstream multinationals or foreign firms. Domestic firms in Myanmar are involved in sales to (i) local firms (owned by Myanmar citizens) operating in the country, (ii) multinationals operating in the country, and (iii) foreign firms operating abroad. The first two categories mean that domestic firms supply their products to domestic markets, and the last category implies that domestic firms export their products directly to foreign markets. For each domestic firm, we create a binary measure of backward linkages (BD), which equals one if the share of the sum of sales to multinationals operating in the country and foreign firms operating abroad is equal to or greater than 50 percent and zero otherwise.

Similarly, vertical spillovers through forward linkages are expected to benefit domestic firms that purchase the inputs (raw or intermediate materials) from upstream multinationals or foreign firms. Domestic firms are involved in purchases from (i) local firms (owned by Myanmar citizens) operating in the country, (ii) multinationals operating in the country, and (iii) foreign firms operating abroad. In the first two categories, domestic firms purchase their inputs from domestic markets, while in the last category, they import their inputs directly from foreign markets. For each domestic firm, we create a binary measure of forward linkages (FD), which equals one if the share of the sum of purchases from multinationals operating in the country and foreign firms operating abroad is equal to or greater than 50 percent and zero otherwise.[27] Our measures of backward and forward linkages capture the extent of an individual firm's relationship with foreign entities through sales of its products and purchases of its raw or intermediate materials, respectively, which enable us to evaluate the vertical spillover effects through backward and forward linkages at the firm level. Table 1 presents the shares of sampled firms with and without backward and forward linkages.

4.3.4 Measuring total factor productivity

Based on a log-linear transformation of a Cobb-Douglas production function, early studies estimate the production function by applying the OLS estimation and use the estimated parameters to derive a firm-specific measure of the total factor productivity (TFP). The OLS estimates of the production function require that a firm's choice of inputs, such as labor and capital, is determined independently of its productivity level. However, a firm may choose its inputs on the basis of observed productivity shocks, such that firms' inputs are correlated with unobserved productivity shocks; thus, the input choices are not exogenous. This finding leads to biased OLS estimates of the coefficients on the inputs in the production function. Thus, as suggested by many studies, the production inputs should be treated as endogenous variables.

[27] To check the robustness of our empirical results, we also use the different critical values of the shares of sales (purchases) differentiating backward (forward) linkages. Table C1 in Appendix shows the results based on alternative critical values by replacing 50 percent in the baseline with 30 percent. The estimated results are qualitatively similar to those in the baseline case.

To eliminate such endogeneity problems, recent studies have applied semi-parametric approaches with the consideration of the underlying decision-making process of firms (Olley & Pakes, 1996; Levinsohn & Pertin, 2003; Ackerberg et al., 2006, 2015; Wooldridge, 2009).[28]

To solve the endogeneity problem, Olley and Pakes (1996) develop a consistent semi-parametric estimator by using the firm's investment decision as a proxy for unobserved productivity shocks. They present how to invert an investment rule to express productivity as an unknown function of capital and investment.[29] Differently from the Olley-Pakes approach relying on the investment decision to proxy for unobserved productivity, Levinsohn and Pertin (2003) use intermediate inputs as a proxy to address the underlying endogeneity problem. As with the Olley-Pakes approach, the Levinsohn-Pertin method also proposes a two-step estimation to estimate the consistent coefficients on the variable inputs and capital inputs.[30] Following the works of Olley and Pakes (1996) and Levinsohn and Pertin (2003), Ackerberg et al. (2006) suggest an alternative estimation procedure to address possible collinearity problems that may affect the Olley-Pakes and Levinsohn-Pertin approaches. Ackerberg et al. (2006, 2015) argue that the Olley-Pakes and Levinsohn-Petrin estimations can suffer from a collinearity problem by examining the identification strategy for the semi-parametric estimators.[31] Moreover, Wooldridge (2009) shows how to perform a consistent estimation within a single step generalized method of moments (GMM) framework, while the Olley-Pakes,

[28] See Van Beveren (2012) for an extensive review on the TFP.

[29] The identifying assumption of the Olley-Pakes approach is that, conditional on capital, investment is monotonically increasing with respect to the shock. Since capital responds to the shock with time lags through contemporaneous investment, the return to the other inputs can be obtained by non-parametrically inverting investment and capital as a proxy for the unobserved shock (Lin et al., 2009). The Olley-Pakes approach consists of a two-step estimation method, where semi-parametric methods are used to estimate the coefficients on the variable inputs in the first step; then, the parameters on capital inputs can be identified under assumptions on the dynamics of the productivity process in the second step.

[30] The monotonicity condition of the Olley-Pakes estimation that investment is strictly increasing in productivity requires that only observations with positive investment can be used in the empirical model. If firms involve zero investment due to substantial adjustment costs with capital stock, these observations cast doubt on the validity of the strict monotonicity condition. The Levinsohn-Pertin estimation mitigates this problem by using intermediate inputs instead of investment as a proxy. Firms typically report positive use of intermediate inputs; therefore, the analysis retains most observations with the strict monotonicity condition more likely satisfied.

[31] The approach of Ackerberg et al. (2006) allows for the possibility that a firm's private knowledge of its productivity may affect the input decisions and for firm-specific productivity differences that exhibit idiosyncratic changes over time to mitigate the simultaneity bias between productivity shocks and input choices (Javorcik et al., 2011). The Olley-Pakes and Levinsohn-Pertin approaches assume that firms can instantly adjust certain inputs at no cost when they are subject to productivity shocks. However, Ackerberg et al. (2006, 2015) suggest that the labor coefficient can be consistently estimated in the first stage only if the free variables show variability independently from the proxy variable. If this is not the case, the coefficients would be perfectly collinear in the first-stage estimation and hence would not be identifiable.

Levinsohn-Petrin, and Ackerberg-Caves-Frazer approaches propose two-step estimation procedures. The Wooldridge method presents the relevant moment restrictions in terms of two equations that have the same dependent variable but are characterized by a different set of instruments.[32]

To obtain measures of the TFP of firms, we estimate a log-linear transformation of a Cobb-Douglas production function:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \beta_3 \ln M_{it} + \varepsilon_{it},$$

where Y_{it} is output of firm i in period t, K_{it} is capital, L_{it} is labour, M_{it} is materials, and ε_{it} is the error term. Output and materials are measured by sales and the value of materials, respectively. Capital is proxied by the value of tangible fixed assets, and labor is measured by the number of employees. The value added is derived by making a difference between output and materials. All monetary values are adjusted to a real term by using the consumer price index. As recommended by Ackerberg et al. (2006, 2015), we estimate a value-added production function to derive the TFP of firm i:

$$\ln TFP_{it} = \ln V_{it} + \beta_K \ln K_{it} + \beta_L \ln L_{it},$$

where V_{it} is the value added of firm i and β_K and β_L are the estimated coefficients on labour and capital, respectively. Given that our data do not have information on investment that is required to apply the Olley-Pakes estimation, this study estimates four measures of the TFP based on (i) the OLS, (ii) the Levinsohn-Pertin, (iii) the Ackerberg-Caves-Frazer, and (iv) the Wooldridge estimations. Once the TFP is estimated for each firm, we use the first difference of the TFP to calculate its growth rates between 2014 and 2016 (TFP-OLS, TFP-LP, TFP-ACF, and TFP-W) which will be used to examine the effects of backward and forward linkages on productivity.

[32] The advantages of the Wooldridge method include that it overcomes potential identification issues in the first step estimation, emphasized by Ackerberg et al. (2006, 2015) and that it obtains robust standard errors, easily accounting for both serial correlation and heteroscedasticity.

4.4 Empirical analysis

4.4.1 Methodology

The objective of this study is to evaluate a causal link of vertical linkages, i.e., backward and forward linkages, with firms' productivity and their choice of input allocation. The reasons for establishing a vertical linkage can be associated with the firm's characteristics related to their productivity and inputs. Thus, simple regression models can suffer from potential endogeneity problems. To overcome the potential endogeneity with regard to the establishment of a vertical linkage, this study employs matching approaches. Our analysis is based on the idea that a vertical linkage represents a treatment, where firms with a vertical linkage comprise the treatment group, and those without a vertical linkage comprise the control group. Our measure of interest is the average treatment effect on the treated (ATT). Following Imbens and Wooldridge (2009), the ATT is defined as:

$$\mathrm{ATT} = \mathrm{E}[\mathrm{Y}_1|\mathrm{D}=1] - \mathrm{E}[\mathrm{Y}_0|\mathrm{D}=1],$$

where D is the vertical linkage dummy; Y_1 and Y_0 are potential outcomes of firms that have the linkage and do not have the linkage (two counterfactual situations), respectively; $\mathrm{Y}_0|\mathrm{D}=1$ is the value of the outcome of our interest that would have been observed if the firm had not had the linkage (counterfactual outcome); and $\mathrm{Y}_1|\mathrm{D}=1$ is the value of the outcome that is actually observed in the same firm. A crucial problem concerns the difficulty of estimating the ATT because the counterfactual outcome is the unobservable value of $\mathrm{E}[\mathrm{Y}_0|\mathrm{D}=1]$. When a firm's choice of linkage establishment is random, the average outcome of units not exposed to treatment, $\mathrm{E}[\mathrm{Y}_0|\mathrm{D}=1]$, is a proper substitute, such that the ATT can be estimated from differences in the sample means of the outcome variable between the treatment and control groups. However, the establishment of a vertical linkage, i.e., selection into treatment, can be endogenous.

In non-experimental analysis, the treatment assignment is not random (Janvry et al., 2010; Heckman & Vytlacil, 2007). In the absence of random assignments, observed and

unobserved characteristics of individual firms may affect treatments as well as outcomes such that selection bias can persist. The idea of matching methods is to mimic randomization with regard to the assignment of the treatment. The unobserved counterfactual outcome is imputed by matching the treated units with untreated units that are as similar as possible with regard to all pretreatment characteristics that are associated with selection into treatment and that affect the outcome of interest. The realizations of the outcome measures for these matches are used as an empirical proxy for the unobserved counterfactual. The estimate of the ATT based on matching is defined as:

$$\mathrm{ATT}(x) = \mathrm{E}[Y_1|D = 1, X = x] - \mathrm{E}[Y_0|D = 0, X = x],$$

where x is a vector of relevant pretreatment characteristics, $\mathrm{E}[Y_1|D = 1, X = x]$ is the expected outcome for the units that received treatment, and $\mathrm{E}[Y_0|D = 0, X = x]$ is the expected outcome for the treated units' best matches.[33]

This study applies entropy balancing, as proposed by Hainmueller (2012), to select matches for the units exposed to treatment and to estimate the ATT. Recent empirical studies apply entropy balancing as a multivariate reweighting method to build balanced samples in observational studies with a binary treatment where the control group data can be reweighted to match the covariate moments in the treatment group (Neuenkirch & Neumeier, 2016; Wilde, 2017). Entropy balancing is based on a maximum entropy reweighting scheme (see Hainmueller & Xu, 2013, for the detailed explanation). This scheme can allow us to fit weights satisfying a potentially large set of balance constraints that involve exact balance on the first and possibly higher moments of the covariate distributions in the treatment and the reweighted control group. Entropy balancing is implemented in two steps. The first step is to compute

[33] Many empirical studies estimate the ATT by applying various matching methods, like propensity score matching (PSM), which could reduce the selection bias by creating comparable counterfactual outcomes for treated units. Once the treated units are matched, the methods assume no systematic differences in unobservable characteristics between treated and untreated units, given the estimated propensity scores under some assumptions. The first is conditional independence assumption (CIA) or confoundedness; that is, after controlling for observed covariates, the potential outcomes are independent of the treatment assignment. The second is the independent and identically distributed observations assumption, which requires that the potential outcomes and treatment status of each individual are independent of the potential outcomes and treatment status of all other individuals in the sample. The third assumption is the common support or overlap condition, which suggests that every observation has a positive probability of being both treated and control (Heinrich et al., 2010).

weights that are assigned to units not subject to treatment such that the weights satisfy prespecified balanced constraints involving sample moments of pretreatment characteristics and remaining as close as possible from an entropy perspective to uniform base weights to prevent loss of information and to retain efficiency for the subsequent analysis. This study sets the balance constraints of equal covariate means and variances across the treatment and control groups. The second step is to use the weights, obtained in the first step, in a regression analysis with the treatment indicator as an explanatory variable, which yields an estimate for the ATT.[34]

As suggested in Hainmueller (2012) and Hainmueller and Xu (2013), entropy balancing has several advantages. First, as the most important feature, entropy balancing at least weakly improves on the balance that can be obtained by conventional preprocessing methods for the specified moment constraints, since a high degree of covariate balance is achieved by imposing a potentially large set of balance constraints involving the first and possibly higher moments of the covariate distributions as well as interactions. This method obviates the conventional need for balance checking, at least for the characteristics that are included in the specified balance constraints. Second, in contrast to other pre-processing methods, such as nearest neighbor matching where units are either discarded or matched, entropy balancing is more flexible such that entropy balancing allows the unit weights to vary smoothly across units and thus to retain more information in the pre-processed data. Entropy balancing achieves balance with the weights kept as close as possible to the base weights to prevent loss of information and retain efficiency for the subsequent analysis. In this regard, entropy balancing provides a generalization of the propensity score weighting approach, which directly adjusts the weights to the known sample moments and thus obviates the need for continual balance checking and iterative searching over propensity score models.

Third, the weights obtained from entropy balancing can be applied for many standard estimators for the subsequent analysis of treatment effects. Entropy balancing is nonparametric

[34] In the second step regression, we include all covariates used in the first step to improve efficiency, as in the works of Neuenkirch and Neumeier (2016).

in that no empirical model needs to be specified for either the outcome or selection into treatment; thus, we could mitigate biased estimates from the potential misspecification associated with the functional form of the empirical model. In addition, since entropy balancing orthogonalizes the treatment indicator with respect to the covariates that are included in the balance constraints, the estimates of treatment effects may not suffer from multicollinearity. Fourth, as noted in Neuenkirch and Neumeier (2016), entropy balancing ensures a high covariate balance between the treatment and control groups even in small samples. With conventional matching methods, each treated unit is matched with the untreated units that are closest in terms of a metric balancing score; accordingly, the control group consists of only a subset of the units that are not subject to treatment. For small samples, perhaps with the small number of untreated units and a large number of pre-treatment characteristics, this procedure may suffer from biased treatment effect estimates because pre-treatment characteristics cannot be balanced sufficiently across the treatment and control groups. However, entropy balancing allows the vector of weights assigned to the units not exposed to treatment to contain any nonnegative values, so that entropy balancing can be interpreted as a generalization of conventional matching approaches (Neuenkirch & Neumeier, 2016).[35]

This study examines vertical spillover effects on firms' productivity by using five measures of productivity growth rates between 2014 and 2016 as outcome variables, among which four measures are based on the TFP derived from the OLS, the Olley-Pakes, the Levinsohn-Petrin, the Ackerberg-Caves-Frazer, and the Wooldridge estimations (TFP-OLS, TFP-LP, TFP-ACF, and TFP-W). In addition, one measure is based on the value-added that equals sales minus the value of materials in a real term (Value-added). For analysis of the effects on input choices, we use the growth rates of capital and labor inputs (CAPITAL and LABOR) as outcome variables. To examine the vertical spillover effects on skilled and unskilled

[35] Matching approaches may be an appropriate method to overcome the selection bias caused by observables and to estimate the average treatment effect in observational studies. However, it should be noted that these matching approaches can control only for observable selection biases and may generate unreliable results if unobservable biases exist, i.e., systematic differences between treatment and control groups.

employment growth rates, we also use the growth rates of skilled and unskilled labor inputs (SKILLED and UNSKILLED) as outcome variables. For the treatment variables, we use the dummy variable of backward and forward linkages (BD and FD), as explained in the previous section. To construct a control group of untreated units that is as similar as possible to the treatment group, this study selects several covariates representing pretreatment characteristics in the initial year of 2014: the log of total sales (Y) to capture the size of a firm; the ratio of tangible capital to total labor (RKL) to measure capital-intensity; a foreign ownership dummy (FS), which equals one if the share of foreign ownership equals or is more than 50 percent and zero otherwise; an industrial zone dummy (INZ), which equals one if the production unit is located in industrial zones and zero otherwise; the firm duration dummy (DUR), which equals one if the establishment year of firm is before 2012 and zero otherwise; a business organization dummy (ORG), which equals one if the firm is a member of certain business associations or organizations and zero otherwise; and a location dummy (YGN), which equals one if the firm is located in the Yangon region and zero otherwise. Table 2 presents the descriptions of variables used in this study.

4.4.2 Results

Our main interest is to evaluate vertical spillovers through backward and forward linkages on productivity and choices of capital and labor inputs for garment firms in Myanmar by applying an entropy balancing matching approach.[36] Tables 4.3 and 4.4 show the descriptive statistics and the correlation matrix. In Table 4.3, column (1) presents the sample means and standard

[36] This study also discusses the roles of two channel classifications of backward and forward linkages, (i) the external-domestic channels and (ii) the indirect-direct channels, in Appendix C3 and C4. First, concerning the external-domestic channels, the external channel means that domestic firms trade directly with foreign-located firms operating abroad (direct exports or imports), while the domestic channel means that domestic firms trade with multinationals or foreign affiliates operating in the domestic country. The trade literature generally emphasizes the roles of external trade (imports and exports) in inducing spillover effects without the consideration of the domestic channels, and the existing studies on FDI do not consider different features between the external and domestic channels. Second, for the contexts of the indirect-direct channels, we evaluate the prevalence of domestic firms' use of brokers or intermediaries, often called 'middlemen.' Such middlemen often play a crucial role as an intermediary or distributor in a transaction or process chain in facilitating interaction between buyers and sellers (Li et al., 2017). In our study, the indirect channel of backward and forward linkages means that domestic firms trade with foreign middlemen operating in the country, while the direct channel means that domestic firms trade with foreign firms which are not middlemen. The examination of the external-domestic and indirect-direct channels would help us understand the source of vertical spillover effects in developing economies.

deviations of all outcome variables and all covariates across the full samples. Columns (2) and (3) show the sample means and standard deviations across the treatment group of firms with backward linkages and the control groups of firms without backward linkages, respectively. Similarly, columns (4) and (5) correspond to the groups of firms with and without forward linkages, respectively. Table 4.3 also shows the differences in means between the treatment and control groups. The descriptive statistics reveal insignificant differences in means of productivity measures between the two groups. However, significant differences in means of employment growth rate and most pretreatment characteristics appear between the two groups. Thus, it is important to select an appropriate unit in the control group using a matching method before calculating the treatment effects.

We estimate the ATTs of backward and forward linkages (BD and FD). Table 5 presents the sample means of all matching covariates, which are obtained through entropy balancing, across the treatment group and the synthetic control group, based on each of the treatment indicators of backward and forward linkages. All matching covariates may be well balanced, as the similar average realizations of the pretreatment characteristics between the two groups confirm the efficacy of entropy balancing. It implies that the control group in the subsequent empirical analysis consists of appropriate counterfactuals for the sample of observations subject to the existence of backward and forward linkages.

4.4.2.1 Spillover effects on productivity

Table 6 shows the estimated ATTs of the growth rates of productivity, which reveal that backward and forward linkages have a positive effect on productivity. This finding implies that vertical spillover effects on productivity at the individual firm level are evident in Myanmar garment firms, and these spillovers would be materialized through both backward and forward linkages. Technology and knowledge transfers from downstream foreign firms (multinationals) toward domestic suppliers as well as from upstream foreign suppliers (multinationals) toward

domestic customers help improve firms' productivity. Our results showing the positive effects of backward and forward linkages are consistent with the findings of many empirical studies.[37]

Possible interpretations of the links of backward and forward linkages with productivity are as follows. First, the effects of backward spillovers on productivity can be positive or negative in the theoretical contexts. For the positive effects, domestic firms could enhance their productivity, when their inputs are supplied to downstream foreign firms which require inputs with high-quality and less-cost structures (Newman et al., 2015). In addition, competitive environments also encourage domestic firms with backward linkages to produce high quality intermediate inputs and to gain progress in their efficiency (Javorick, 2004). For the negative effects, domestic firms may experience unfavorable effects through backward linkages with downstream foreign firms. Foreign firms with market access take advantage of the trading power over domestic firms in contract negotiations, resulting in a decrease in productivity and profits of domestic firms (Girma et al., 2008). Our empirical analysis suggests that the positive effects dominate the negative ones, such that establishing backward linkages is important to improve productivity for garment firms in Myanmar.

Second, similar to backward linkages, forward linkages can also have positive or negative effects on productivity. For the positive sides, domestic customers obtaining high technology inputs from upstream foreign firms tend to absorb technology easily, resulting in positive productivity advantages (Grossman & Helpman, 1991). Forward spillover may appear in the form of the externality when multinationals supply intermediate inputs through services or other forms of support, including technical support contracts (Javorcik, 2004). In contrast, domestic firms often experience negative effects through forward linkages with upstream foreign firms. Once foreign firms hold a large market share, the upstream sectors may be anti-competitive, which would cause negative forward spillover effects (Newman et al., 2015;

[37] See Lin et al. (2009), Du et al. (2012), Merlevede et al. (2014), Vacek (2010), Javorick (2004), Blalock and Gertler (2008), Kubny and Voss (2014), Reganati and Sica (2007), and Barrios et al. (2011) for positive effects of backward linkages and Chang et al. (2007), Lin et al. (2009), Kubny and Voss (2014), Schoors and Van der Tol (2002), Du et al. (2012), and Xu and Sheng (2012) for positive effects of forward linkages.

Jordaan, 2011). In addition, since foreign firms generally perform well in various aspects, including efficiency, technical know-how, and managerial skill, upstream domestic firms have difficulty in competing with such advanced foreign firms (Liang, 2017; Aitken & Harrison, 1999). This assertion would result in a negative impact on downstream domestic firms due partly to payment of higher prices for their inputs. Given the different arguments related to the effects of forward linkages, our estimations reveal that the positive effects are larger than the negative ones; thus, garment firms in Myanmar can enjoy productivity improvement if they establish forward linkages. In summary, our empirical analysis suggests clear evidence supporting the positive effects of vertical spillovers through both backward and forward linkages, so that connecting with foreign firms could be crucial to obtain high technological skills and efficient management styles and thus to improve production performance for garment firms in Myanmar.

4.4.2.2 Spillover effects on inputs

In addition to vertical spillover effects on productivity, we discuss how backward and forward linkages affect the use of intermediate inputs for domestic firms to examine the conventional argument that FDI is beneficial to host countries in providing additional capital and generating new employment (Abor & Harvey, 2008). Table 4.7 presents the estimated ATTs on the growth rates of capital, total labor, and skilled and unskilled labor. Concerning the ATTs on firms' capital growth rate, the estimated results show clear evidence that backward and forward linkages have a positive impact on capital growth rate. Positive vertical spillover effects through backward and forward linkages are evident in not only productivity growth rate but also in the form of capital accumulation for Myanmar garment firms. Since the Myanmar garment sector is characterized as traditional labor-intensive production with an abundance of labor, international linkages would enable domestic firms to access financial sources, install new high technology equipment, and produce better quality products that are competitive in international markets. Regarding the ATTs on firms' labor growth rate, the results show that backward linkages have a negative effect on labor growth rate, although the results are less

clear for forward linkages. Considering the positive effects on capital growth rate, technical substitution from labor to capital would be promoted by vertical linkages, particularly backward linkages. In addition, when we consider the ATTs on the growth rates of skilled and unskilled employment, the analysis reveals clear evidence supporting that backward linkages reduce the growth rate of skilled labor employment, and forward linkages reduce the growth rate of unskilled labor employment.

Our findings have important implications for the garment sector, which has been a crucial strategic sector for economic development in Myanmar. Vertical linkages with multinationals would improve productivity for domestic garment firms, which could help them to become more competitive in international markets and contribute to garment sector development. However, our results also suggest that vertical spillovers encourage domestic firms to adjust their input allocation toward less labor-intensive production structures. Backward linkages would cause skilled labor to be substituted for capital, and forward linkages would cause unskilled labor to be substituted for capital. That is, upstream domestic firms supplying their products to downstream multinationals tend to replace skilled labor for capital, and downstream domestic firms purchasing their products from upstream multinationals tend to replace unskilled labor for capital. Such management changes associated with backward and forward linkages would lead to concerns about widening an income gap between a small portion of capital owners and a large portion of the general public, most of whom may be categorized as less educated and unskilled labor. Since the current democratic government's initiatives are based on people's support, but with less political stability, economic growth without income inequality and with equal sharing of economic benefits should be crucial policy agendas. In addition, one of the most important policy objectives is an increase in job opportunities for people, particularly a large number of unskilled or uneducated people (Ko et al., 2016). In this sense, our empirical results showing the unfavorable effects of vertical linkages on employment would cast a negative aspect to the current situation in Myanmar.

Thus, the regulators should prepare for sound labor market policy with the consideration of the adverse side effects of FDI.

4.5 Conclusion

The transition toward democratic reforms in 2011 is a turning point for Myanmar's economic integration into the world economy. The new government has implemented a series of economic policy reforms toward liberation, along with the gradual lifting of sanctions by the US and EU countries. Various incentives have attracted FDI by multinationals from advanced countries. FDI can be a key driver of economic development, since it is generally expected to play a crucial role in promoting horizontal and vertical spillovers in developing countries. This study has investigated vertical spillover effects through backward and forward linkages on firms' productivity and input allocation in the Myanmar garment sector by applying the entropy balancing matching method with unique survey data at the firm level.

The main results have confirmed that although backward and forward linkages promote spillover effects on productivity improvement with capital accumulation, they fail to accelerate employment growth rate. Given that current political conditions are founded on a support base from a general public that strongly expects their welfare improvement without income inequality, the government has emphasized the implementation of a series of effective public policies targeting significant job creation. Our empirical results have suggested that although backward and forward linkages with multinationals help improve productivity, such economically favorable effects may partially be offset by negative side effects on employment growth rate, which is perhaps politically important for the current government; this is caused by capital-labor substitution associated with capital accumulation. To mitigate such issues, the government should evaluate the quality of FDI with the consideration of resource allocation for sustainable development and establish appropriate regulations to encourage domestic firms to engage in job creation.

This study has evaluated the roles of backward and forward linkages, focusing on the case of the garment sector in Myanmar. However, the implications derived from our analysis could be applicable to other sectors, including the processed food sector and the industrial raw material sector. These sectors were originally characterized as highly labor-intensive sectors, which have absorbed many less-educated or unskilled people in Myanmar, but recently they have attracted FDI from foreign firms or multinationals in developed countries. The processes of integration in global markets have caused the transformation of production structures from labor-intensive features toward capital-intensive ones in such sectors. Thus, we believe that our analysis would provide important implications for the understanding of vertical spillovers in various sectors in developing countries, like Myanmar, which have a potential of attracting FDI under globalization.

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Table 4.1. Shares of firms with backward and forward linkages

	Without linkages	With linkages
Backward linkage	0.41	0.59
Forward linkage	0.39	0.61

Table 4.2. Description of variables

Variable	Description
TFP-OLS	Total factor productivity growth rate based on OLS
TFP-LP	Total factor productivity growth rate based on Levinsohn and Pertin (2003)
TFP-ACF	Total factor productivity growth rate based on Ackerberg et al. (2006)
TFP-W	Total factor productivity growth rate based on Wooldridge (2009)
Value-added	Value added growth rate
CAPITAL	Capital growth rate
LABOR	Labor growth rate
SKILLED	Skilled labor growth rate
UNSKILLED	Unskilled labor growth rate
BD	Dummy for backward linkages
FD	Dummy for forward linkages
Y	Log of output
RKL	Tangible capital to labor ratio
FS	Dummy for foreign share
INZ	Dummy for industrial zone
DUR	Dummy for a firm which established before 2012
ORG	Dummy for business association or organization members
YGN	Dummy for location in Yangon

Table 4.3. Descriptive statistics

Variable	Whole sample (1)		Backward linkage (2)		Non-backward linkage (3)		Mean diff. (2) and (3)	Forward linkage (4)		Non-forward linkage (5)		Mean diff. (4) and (5)
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.		Mean	Std. Dev.	Mean	Std. Dev.	
BD	0.588	0.493	-	-	-	-	-	-	-	-	-	-
FD	0.609	0.489	-	-	-	-	-	-	-	-	-	-
TFP-OLS	0.028	0.657	0.033	0.601	0.021	0.732	-0.011	0.012	0.694	0.054	0.597	0.042
TFP-LP	0.140	0.662	0.158	0.629	0.113	0.709	-0.045	0.139	0.713	0.142	0.576	0.003
TFP-ACF	0.015	0.659	0.007	0.602	0.027	0.736	-0.019	-0.012	0.690	0.058	0.608	0.069
TFP-W	0.131	0.661	0.150	0.627	0.105	0.708	-0.045	0.130	0.711	0.133	0.576	0.003
Value-added	0.158	0.678	0.184	0.657	0.122	0.709	-0.062	0.164	0.736	0.149	0.581	-0.062
CAPITAL	0.116	0.342	0.113	0.289	0.122	0.408	0.009	0.116	0.341	0.117	0.346	0.001
LABOR	0.176	0.374	0.213	0.417	0.124	0.295	-0.088*	0.214	0.408	0.118	0.305	-0.096**
SKILLED	0.187	0.568	0.250	0.692	0.097	0.296	-0.154**	0.256	0.672	0.079	0.324	-0.177***
UNSKILLED	0.072	0.632	0.067	0.672	0.078	0.574	0.010	0.028	0.724	0.139	0.448	0.112
Y	13.190	1.504	13.815	1.241	12.297	1.396	-1.518***	13.835	1.214	12.185	1.357	-1.650***
RKL	1.082	1.891	1.026	1.829	1.162	1.984	0.136	0.954	1.687	1.282	2.167	0.328
FS	0.408	0.492	0.679	0.469	0.020	0.142	-0.658***	0.648	0.479	0.032	0.178	-0.616***
INZ	0.685	0.466	0.879	0.328	0.408	0.494	-0.470***	0.869	0.339	0.398	0.492	-0.471***
DUR	0.912	0.284	0.900	0.301	0.929	0.259	0.029	0.890	0.314	0.946	0.227	-0.057
ORG	0.756	0.430	0.936	0.246	0.500	0.503	-0.436***	0.938	0.242	0.473	0.502	-0.465***
YGN	0.895	0.307	0.964	0.186	0.796	0.405	-0.168***	0.966	0.183	0.785	0.413	-0.181***
No of obs.	238	-	140	-	98	-	-	145	-	93	-	-

Notes: (1) Backward and forward linkages are measured by BD1 and FD1.

Table 4.4. Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) TFP-OLS	1.000																	
(2) TFP-LP	0.949	1.000																
(3) TFP-ACF	0.951	0.943	1.000															
(4) TFP-W	0.956	0.999	0.949	1.000														
(5) Value-added	0.931	0.995	0.928	0.998	1.000													
(6) CAPITAL	-0.180	0.045	-0.185	0.020	0.006	1.000												
(7) LABOR	-0.056	0.216	-0.061	0.238	0.299	0.221	1.000											
(8) SKILLED	0.162	0.356	0.158	0.373	0.415	0.124	0.746	1.000										
(9) UNSKILLED	-0.030	0.095	-0.032	0.107	0.139	0.059	0.489	0.158	1.000									
(10) BD	0.009	0.033	0.008	0.037	0.045	-0.013	0.116	0.134	-0.008	1.000								
(11) FD	-0.031	-0.002	-0.032	0.002	0.011	-0.002	0.125	0.152	-0.086	0.835	1.000							
(12) Y	-0.127	-0.114	-0.127	-0.114	-0.111	0.036	0.025	0.026	-0.108	0.498	0.537	1.000						
(13) RKL	0.037	0.066	0.037	0.078	0.099	-0.164	0.245	0.189	0.179	-0.035	-0.085	-0.008	1.000					
(14) FS	0.022	0.051	0.022	0.056	0.067	-0.038	0.150	0.206	-0.028	0.659	0.612	0.438	0.039	1.000				
(15) INZ	-0.026	0.006	-0.026	0.011	0.021	-0.009	0.144	0.150	0.041	0.498	0.495	0.372	-0.052	0.452	1.000			
(16) DUR	-0.048	-0.107	-0.046	-0.115	-0.131	0.005	-0.260	-0.289	-0.055	-0.050	-0.097	0.022	-0.044	-0.013	-0.052	1.000		
(17) ORG	-0.087	-0.082	-0.087	-0.082	-0.080	0.021	0.006	0.057	-0.054	0.499	0.528	0.329	-0.102	0.331	0.310	0.030	1.000	
(18) YGN	0.077	0.087	0.077	0.091	0.097	-0.058	0.085	0.133	-0.008	0.270	0.287	-0.010	-0.024	0.256	0.476	-0.010	0.284	1.000

Table 4.5. Covariate balancing of entropy balancing (backward and forward linkages)

	Backward (BD)		Forward (FD)	
	Treatment	Control	Treatment	Control
Before				
Y (log of total sales)	13.820	12.300	13.840	12.180
RKL (ratio of tangible capital to total labor)	1.026	1.162	0.954	1.282
FS (foreign ownership)	0.679	0.020	0.648	0.032
INZ (industrial zone)	0.879	0.408	0.869	0.398
DUR (firm duration)	0.900	0.929	0.890	0.946
ORG (business organization)	0.936	0.500	0.938	0.473
YGN (location at Yangon)	0.964	0.796	0.966	0.785
After				
Y (log of total sales)	13.820	13.810	13.840	13.830
RKL (ratio of tangible capital to total labor)	1.026	1.026	0.954	0.957
FS (foreign ownership)	0.679	0.678	0.648	0.648
INZ (industrial zone)	0.879	0.878	0.869	0.869
DUR (firm duration)	0.900	0.900	0.890	0.890
ORG (business organization)	0.936	0.935	0.938	0.937
YGN (location at Yangon)	0.964	0.964	0.966	0.966

Table 4.6. ATTs on productivity growth rate

	Backward linkage (BD)		Forward linkage (FD)	
	Model 1	Model 2	Model 1	Model 2
TFP-OLS	0.2049***	0.2049***	0.1818***	0.1818***
	(0.0664)	(0.0703)	(0.0605)	(0.0722)
TFP-LP	0.2039***	0.2040***	0.1983***	0.1984**
	(0.0673)	(0.0723)	(0.0659)	(0.0841)
TFP-ACF	0.1430**	0.1431**	0.1329**	0.1329*
	(0.0645)	(0.0688)	(0.0619)	(0.0756)
TFP-W	0.1968***	0.1968***	0.1910***	0.1910**
	(0.0674)	(0.0728)	(0.0656)	(0.0842)
Value-added	0.1704***	0.1705***	0.1728***	0.1729*
	(0.0701)	(0.0781)	(0.0703)	(0.0934)
No. of Obs.	238	238	238	238
Covariates	Yes	No	Yes	No

Notes: *, **, *** indicate statistically significant at the 10%, 5% and 1% respectively. Standard errors are shown in parentheses.

Table 4.7. ATTs on input growth rate

	Backward linkage (BD)		Forward linkage (FD)	
	Model 1	Model 2	Model 1	Model 2
CAPITAL	0.1243***	0.1242***	0.1233***	0.1233**
	(0.0404)	(0.0469)	(0.0374)	(0.0486)
LABOR	-0.1019**	-0.1018**	-0.0589	-0.0588
	(0.0408)	(0.0516)	(0.0548)	(0.0721)
SKILLED	-0.1782***	-0.1780*	-0.1272	-0.1270
	(0.0682)	(0.1033)	(0.0843)	(0.1318)
UNSKILLED	-0.1035	-0.1034	-0.1937***	-0.1938***
	(0.1035)	(0.1178)	(0.0681)	(0.0713)
No. of Obs.	238	238	238	238
Covariates	Yes	No	Yes	No

Notes: *, **, *** indicate statistically significant at the 10%, 5% and 1% respectively. Standard errors are shown in parentheses.

Appendix

Table A1. The gravity equation

	TA	PRGDPs	DIST	ADJ	LANG	COLONY	No of obs.	R-squared
All country-pairs								
2000	0.351***	1.062***	-1.391***	0.450***	0.549***	1.166***	6888	0.797
	(0.056)	(0.033)	(0.030)	(0.116)	(0.061)	(0.133)		
2005	0.395***	1.103***	-1.476***	0.356***	0.675***	0.965***	7695	0.803
	(0.054)	(0.032)	(0.030)	(0.118)	(0.059)	(0.134)		
2010	0.276***	1.038***	-1.517***	0.435***	0.659***	0.870***	8532	0.804
	(0.049)	(0.033)	(0.029)	(0.119)	(0.058)	(0.138)		
2015	0.361***	1.013***	-1.463***	0.518***	0.674***	0.819***	9001	0.808
	(0.045)	(0.028)	(0.028)	(0.118)	(0.058)	(0.139)		
North country-pairs								
2000	0.251***	0.965***	-1.417***	-0.087	0.343***	1.086***	2276	0.868
	(0.089)	(0.030)	(0.045)	(0.170)	(0.102)	(0.174)		
2005	0.203**	0.922***	-1.459***	-0.161	0.494***	0.897***	2381	0.853
	(0.098)	(0.028)	(0.049)	(0.182)	(0.109)	(0.186)		
2010	0.057	1.004***	-1.498***	-0.241	0.467***	0.839***	2481	0.857
	(0.086)	(0.030)	(0.045)	(0.188)	(0.107)	(0.193)		
2015	0.274***	1.017***	-1.508***	-0.339*	0.331***	0.860***	2480	0.867
	(0.077)	(0.025)	(0.041)	(0.180)	(0.104)	(0.184)		
South country-pairs								
2000	0.967***	1.098***	-1.156***	0.882***	0.681***	0.417	1061	0.664
	(0.155)	(0.195)	(0.090)	(0.241)	(0.153)	(1.302)		
2005	0.968***	1.101***	-1.400***	0.657***	0.790***	-0.189	1275	0.721
	(0.140)	(0.067)	(0.080)	(0.238)	(0.141)	(1.056)		
2010	0.878***	1.051***	-1.416***	0.843***	0.587***	-1.268	1563	0.730
	(0.131)	(0.121)	(0.076)	(0.233)	(0.135)	(1.083)		
2015	0.798***	1.130***	-1.489***	0.967***	0.687***	-0.875	1846	0.729
	(0.130)	(0.066)	(0.073)	(0.234)	(0.133)	(1.105)		
North and South country-pairs								
2000	0.557***	0.978***	-1.575***	0.789***	0.574***	1.289***	3551	0.775
	(0.104)	(0.052)	(0.047)	(0.222)	(0.084)	(0.178)		
2005	0.413***	0.961***	-1.605***	0.566**	0.721***	1.067***	4039	0.787
	(0.093)	(0.045)	(0.046)	(0.220)	(0.081)	(0.178)		
2010	0.325***	0.996***	-1.645***	0.590***	0.801***	0.921***	4488	0.787
	(0.079)	(0.035)	(0.045)	(0.216)	(0.079)	(0.181)		
2015	0.341***	0.957***	-1.562***	0.810***	0.796***	0.859***	4675	0.799
	(0.067)	(0.040)	(0.043)	(0.210)	(0.076)	(0.177)		

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively.
TA is the dummy which equals one if a country pairs has a trade agreement and zero otherwise.

Table A2. Estimated coefficients on the TA dummy in the gravity equation with country fixed effects

Year	All country-pairs	North country-pairs	South country-pairs	North and South country-pairs
2000	0.351***	0.393***	0.981***	0.966***
	(0.056)	(0.124)	(0.160)	(0.144)
2005	0.395***	0.353**	0.969***	1.259***
	(0.054)	(0.137)	(0.149)	(0.131)
2010	0.276***	0.007	0.805***	1.052***
	(0.049)	(0.114)	(0.142)	(0.107)
2015	0.361***	0.214**	0.823***	0.793***
	(0.045)	(0.104)	(0.139)	(0.087)

Notes: All models include BVDIST, BVADJ, BVLANG, and BVCOL, instead of DIST, ADJ, LANG, and COL. Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively. TA is the dummy which equals one if a country pairs has a trade agreement and zero otherwise. Only the estimated coefficients on the TA dummy are presented.

Table A3. Covariate balancing of entropy balancing

	2000		2005		2010		2015	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
All country-pairs								
Before								
PRGDPij	49.3100	47.8900	49.7200	48.2700	49.8100	48.6300	50.1700	48.9500
BVDIST	-0.6004	0.1591	-0.6003	0.1823	-0.4660	0.1854	-0.3491	0.1836
BVADJ	0.0732	-0.0119	0.0662	-0.0130	0.0550	-0.0140	0.0432	-0.0139
BVLANG	0.1239	-0.0193	0.1110	-0.0211	0.0854	-0.0209	0.0663	-0.0207
BVCOLONY	0.0029	-0.0004	0.0032	-0.0006	0.0043	-0.0010	0.0043	-0.0013
After								
PRGDPij	49.3100	49.3000	49.7200	49.7100	49.8100	49.8100	50.1700	50.1700
BVDIST	-0.6004	-0.5993	-0.6003	-0.5992	-0.4660	-0.4656	-0.3491	-0.3489
BVADJ	0.0732	0.0731	0.0662	0.0660	0.0550	0.0549	0.0432	0.0431
BVLANG	0.1239	0.1237	0.1110	0.1108	0.0854	0.0853	0.0663	0.0662
BVCOLONY	0.0029	0.0029	0.0032	0.0032	0.0043	0.0043	0.0043	0.0043
OECD country-pairs								
Before								
PRGDPij	51.8900	50.2300	51.7500	50.6700	51.2700	51.2400	51.3700	51.4300
BVDIST	-0.4077	0.3069	-0.3691	0.3513	-0.1944	0.3285	-0.1283	0.3263
BVADJ	0.0464	-0.0143	0.0360	-0.0147	0.0258	-0.0145	0.0214	-0.0146
BVLANG	0.0852	-0.0289	0.0765	-0.0347	0.0553	-0.0351	0.0436	-0.0350
BVCOLONY	-0.0104	0.0041	-0.0081	0.0043	-0.0042	0.0033	-0.0036	0.0034
After								
PRGDPij	51.8900	51.8800	51.7500	51.7500	51.2700	51.2700	51.3700	51.3700
BVDIST	-0.4077	-0.4068	-0.3691	-0.3688	-0.1944	-0.1944	-0.1283	-0.1283
BVADJ	0.0464	0.0463	0.0360	0.0360	0.0258	0.0258	0.0214	0.0214
BVLANG	0.0852	0.0851	0.0765	0.0764	0.0553	0.0553	0.0436	0.0436
BVCOLONY	-0.0104	-0.0104	-0.0081	-0.0081	-0.0042	-0.0042	-0.0036	-0.0036
Non-OECD country-pairs								
Before								
PRGDPij	47.4000	46.2000	47.9500	46.6400	48.4900	47.1600	48.9400	47.5800
BVDIST	-0.3987	0.2138	-0.4179	0.2206	-0.4224	0.2228	-0.4279	0.2259
BVADJ	0.0730	-0.0184	0.0763	-0.0195	0.0798	-0.0206	0.0790	-0.0206
BVLANG	0.0771	-0.0187	0.0811	-0.0200	0.0817	-0.0204	0.0809	-0.0204
BVCOLONY	0.0006	-0.0002	0.0006	-0.0002	0.0006	-0.0002	0.0006	-0.0002
After								
PRGDPij	47.4000	47.4000	47.9500	47.9500	48.4900	48.4900	48.9400	48.9400
BVDIST	-0.3987	-0.3986	-0.4179	-0.4178	-0.4224	-0.4222	-0.4279	-0.4277
BVADJ	0.0730	0.0730	0.0763	0.0762	0.0798	0.0798	0.0790	0.0790
BVLANG	0.0771	0.0770	0.0811	0.0811	0.0817	0.0817	0.0809	0.0809
BVCOLONY	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
OECD and Non-OECD country-pairs								
Before								
PRGDPij	49.6600	48.3600	49.9500	48.7100	49.7900	49.0400	50.2000	49.3900
BVDIST	9.0450	9.2070	8.9640	9.1700	9.1340	9.1220	9.0620	9.1330
BVADJ	0.0622	0.0063	0.0551	0.0051	0.0446	0.0043	0.0332	0.0045
BVLANG	0.3206	0.1284	0.2669	0.1273	0.2233	0.1270	0.2010	0.1270
BVCOLONY	0.0407	0.0142	0.0337	0.0140	0.0310	0.0134	0.0276	0.0128
After								
PRGDPij	49.6600	49.6600	49.9500	49.9500	49.7900	49.7900	50.2000	50.1900
BVDIST	9.0450	9.0450	8.9640	8.9640	9.1340	9.1340	9.0620	9.0620
BVADJ	0.0622	0.0622	0.0551	0.0551	0.0446	0.0446	0.0332	0.0331
BVLANG	0.3206	0.3206	0.2669	0.2669	0.2233	0.2233	0.2010	0.2008
BVCOLONY	0.0407	0.0407	0.0337	0.0337	0.0310	0.0310	0.0276	0.0276

Table A4. ATTs: Entropy balancing matching estimates (OECD and non-OECD countries)

	All country-pairs	OECD country-pairs	Non-OECD country-pairs	OECD and Non-OECD country-pairs
2000	0.569***	1.679***	0.545***	1.250***
	(0.071)	(0.114)	(0.081)	(0.070)
2005	0.697***	1.736***	0.719***	1.298***
	(0.077)	(0.109)	(0.083)	(0.065)
2010	0.654***	1.812***	0.707***	0.871***
	(0.080)	(0.109)	(0.095)	(0.070)
2015	0.701***	1.881***	0.721***	0.824***
	(0.063)	(0.107)	(0.090)	(0.063)

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively.

Table B1. The gravity equation estimates (country fixed effects)

	Full		North country pairs		South country pairs		North-South country pairs	
	TAO	TAIT	TAO	TAIT	TAO	TAIT	TAO	TAIT
2000	0.334***	0.396***	0.209**	0.323***	0.880***	1.583***	0.570***	0.525***
	(0.061)	(0.088)	(0.099)	(0.115)	(0.159)	(0.291)	(0.116)	(0.160)
2005	0.384***	0.420***	0.111	0.355***	0.976***	0.934***	0.405***	0.430***
	(0.060)	(0.077)	(0.106)	(0.119)	(0.146)	(0.239)	(0.104)	(0.130)
2010	0.222***	0.394***	-0.115	0.390***	0.898***	0.789***	0.328***	0.320***
	(0.054)	(0.070)	(0.092)	(0.109)	(0.137)	(0.225)	(0.089)	(0.110)
2015	0.329***	0.434***	0.207**	0.429***	0.885***	0.372	0.307***	0.402***
	(0.049)	(0.065)	(0.082)	(0.100)	(0.135)	(0.227)	(0.076)	(0.093)

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively. TAO is the dummy that equal one if a country pair has a trade agreement without an investment treaty and zero otherwise. TAIT is the dummy variable which equals one if a country pair has a trade agreement with an investment treaty and zero otherwise. Only the estimated coefficients on TAO and TAIT are presented.

Table B2. The gravity equation estimates (country fixed effects with BVDIST, BVADJ, BVLANG, BVCOL)

	Full		North country pairs		South country pairs		North-South country pairs	
	TAO	TAIT	TAO	TAIT	TAO	TAIT	TAO	TAIT
2000	0.351***	0.396***	0.795***	0.793***	0.896***	1.386***	0.540**	1.099***
	(0.056)	(0.088)	(0.190)	(0.201)	(0.124)	(0.212)	(0.232)	(0.202)
2005	0.395***	0.420***	0.675***	0.776***	0.911***	0.899***	0.820***	0.942***
	(0.054)	(0.077)	(0.191)	(0.207)	(0.116)	(0.178)	(0.210)	(0.178)
2010	0.276***	0.394***	0.692***	0.805***	0.794***	0.829***	0.576***	0.932***
	(0.049)	(0.070)	(0.145)	(0.156)	(0.112)	(0.168)	(0.119)	(0.123)
2015	0.361***	0.434***	0.699***	0.693***	0.920***	0.648***	0.306***	0.689***
	(0.045)	(0.065)	(0.132)	(0.146)	(0.108)	(0.168)	(0.099)	(0.103)

Notes: Standard errors are in parentheses. *, **, and *** represent the significance at 10%, 5%, and 1% levels, respectively. TAO is the dummy that equal one if a country pair has a trade agreement without an investment treaty and zero otherwise. TAIT is the dummy variable which equals one if a country pair has a trade agreement with an investment treaty and zero otherwise. Only the estimated coefficients on TAO and TAIT are presented. All models include BVDIST, BVADJ, BVLANG, and BVCOL as independent variables, instead of DIST, ADJ, LANG, and COL.

Table C1. ATTs on productivity and inputs growth rate

	Backward linkage (BD)		Forward linkage (FD)	
	Model 1	Model 2	Model 1	Model 2
TFP-OLS	0.2039***	0.2042***	0.1557***	0.1554**
	(0.0682)	(0.0709)	(0.0609)	(0.0679)
TFP-LP	0.2012***	0.2019***	0.1759***	0.1758**
	(0.0680)	(0.0721)	(0.0645)	(0.0768)
TFP-ACF	0.1434**	0.1439**	0.1113*	0.1111
	(0.0658)	(0.0689)	(0.0613)	(0.0705)
TFP-W	0.1943***	0.1950***	0.1683***	0.1683**
	(0.0681)	(0.0727)	(0.0641)	(0.0768)
Value-added	0.1679**	0.1689**	0.1513**	0.1514*
	(0.0705)	(0.0778)	(0.0676)	(0.0847)
CAPITAL	0.1203***	0.1197**	0.1255***	0.1254**
	(0.0413)	(0.0477)	(0.0390)	(0.0522)
LABOR	-0.1031**	-0.1015*	-0.0519	-0.0512
	(0.0404)	(0.0529)	(0.0547)	(0.0737)
SKILLED	-0.1776***	-0.1746*	-0.1209	-0.1196
	(0.0664)	(0.1038)	(0.0840)	(0.1316)
UNSKILLED	-0.1032	-0.1023	-0.1749**	-0.1747**
	(0.1026)	(0.1179)	(0.0687)	(0.0717)
No. of Obs.	238	238	238	238
Covariates	Yes	No	Yes	No

Notes: *, **, *** indicate statistically significant at the 10%, 5% and 1% respectively.
Standard errors are shown in parentheses.

Table C.2. Covariate balancing of entropy balancing (external-domestic and indirect-direct channels)

	Backward (BDExt)		Forward (FDExt)		Backward (BDInd)		Forward (FDInd)	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Before								
Y (log of total sales)	13.870	13.720	13.810	13.870	13.430	13.840	13.270	13.870
RKL (ratio of tangible capital to total labor)	1.158	0.788	1.153	0.672	1.095	1.022	1.337	0.932
FS (foreign ownership)	0.778	0.500	0.741	0.517	0.625	0.682	0.375	0.664
INZ (industrial zone)	0.956	0.740	0.941	0.767	0.625	0.894	0.625	0.883
DUR (firm duration)	0.878	0.940	0.859	0.933	0.875	0.902	1.000	0.883
ORG (business organization)	0.967	0.880	0.965	0.900	0.750	0.947	0.750	0.949
YGN (location at Yangon)	0.978	0.940	0.977	0.950	0.875	0.970	1.000	0.964
After								
Y (log of total sales)	13.870	13.860	13.810	13.800	13.430	13.430	13.270	13.270
RKL (ratio of tangible capital to total labor)	1.158	1.157	1.153	1.153	1.095	1.094	1.337	1.339
FS (foreign ownership)	0.778	0.775	0.741	0.738	0.625	0.625	0.375	0.375
INZ (industrial zone)	0.956	0.952	0.941	0.938	0.625	0.625	0.625	0.624
DUR (firm duration)	0.878	0.879	0.859	0.859	0.875	0.875	1.000	0.998
ORG (business organization)	0.967	0.966	0.965	0.963	0.750	0.750	0.750	0.750
YGN (location at Yangon)	0.978	0.978	0.977	0.977	0.875	0.875	1.000	0.999

This appendix discusses the roles of two channel classifications of backward and forward linkages: (i) the external-domestic channels and (ii) the indirect-direct channels.

C1 External-domestic and direct-indirect channels

With a focus on the garment sector in Myanmar, our study basically focuses on vertical spillovers through backward and forward linkages. To discuss spillover effects in the garment sector in Myanmar, there remain two possible issues to be considered carefully, which have not yet been addressed extensively in the literature. The first issue is that the conventional measures of vertical linkages do not consider sources of backward and forward linkages. In general, two channels can exist for these linkages. The first originates from 'external channels,' through which domestic firms purchase the inputs from, or sell the output to, firms operating in foreign countries (direct export or import). This corresponds to direct imports and exports. The second originates from 'domestic channels,' through which domestic firms purchase the inputs from, or sell the output to, multinationals operating in the domestic country. On the one hand, many studies, such as Keller and Yeaple (2003) and Dalgıç and Mıhçı (2013), in the traditional trade literature emphasize that technology spillovers are mainly promoted by external trade with imports and exports without the consideration of the roles of the domestic channels. On the other hand, most of existing studies on FDI effects are based on the standard production function approach without careful consideration of different features between external trade with foreign-located firms and internal trade with domestically operating multinationals or foreign affiliates. Incorporating such distinction into the analysis would be important because foreign-located firms and foreign affiliates may have different characteristics, including information about legal systems, market structures, and business practices and culture. To capture possible differences between the two entities, we construct the measures of external and domestic channels for backward and forward linkages.

The second issue concerns the prevalence of domestic firms' use of brokers or intermediaries as an internationalization strategy to expand their market base into domestic and international markets. Like other developing economies, trading with brokers is common business practices for domestic firms, particularly small and medium sized enterprises in the garment sector of Myanmar (Business Innovation Facility, 2016). Such brokers are often called a 'middleman,' which plays a role as an intermediary or distributor in a transaction or process chain in facilitating interaction between buyers and sellers typically for a commission and matching them. For domestic firms particularly which cannot enjoy scope and scale economies without enough management and marketing skills, the use of a middleman helps their business processes in various ways, including the advertisement of their products and the organization of interviews, discussions, and negotiations with potential counterparts (Li et al., 2017; Scott-Kennel, 2007). Several studies in the management fields distinguish between 'direct' and 'indirect' channels. The direct-indirect channel classification suggests that firms sell their products to foreign customers directly or through a company-owned distribution channel located overseas in a direct channel, whereas firms sell to a middleman or distributor which exports for them to the target countries in an indirect channel (Brady & Bearden, 1979; Trabold, 2002; Li et al., 2017). Previous empirical studies on vertical spillover effects in the international trade literature do not explain the roles of a middleman, although the indirect channels with brokers seem to be more substantial in most developing countries, where the internalization of business processes is relatively difficult due to the lack of management skills and their high costs. Thus, this study builds the measures of direct and indirect channels for backward and forward linkages to evaluate possible differences in vertical spillover effects between them.

C2 Measuring external-domestic and direct-indirect channels

Regarding external-domestic channels, external channels mean that domestic firms purchase the inputs from upstream firms, or supply the output to downstream firms, operating in foreign countries, i.e., direct exports or imports. On the other hand, domestic channels suggest that domestic firms purchase the inputs from, or supply the output to, multinationals operating in the domestic country. In this study, a domestic firm with backward linkage is classified as (i) the firm with 'external-oriented backward linkages' if sales to foreign firms operating abroad (direct exports) dominate those to multinationals operating in the country, and as (ii) the firm with 'domestic-oriented backward linkages' otherwise. Specifically, for each firm with backward linkages, we build a binary measure of external-internal backward linkages (BDExt), which equals one if the share of sales to foreign firms operating abroad (direct exports) is equal to or greater than that to multinationals operating in the country (external-oriented backward linkages) and zero otherwise (domestic-oriented backward linkages). In a similar manner, we also classify domestic firms with forward linkages into (i) the firm with 'external-oriented forward linkages' and (ii) the firm with 'domestic-oriented forward linkages.' For each firm with forward linkages, a binary measure of external-internal forward linkages (FDExt) is defined as one if the share of purchases from foreign firms operating abroad (direct imports) is equal to or greater than that to multinationals operating in the country (external-oriented forward linkages) and zero otherwise (domestic-oriented forward linkages).

Concerning direct-indirect channels of backward and forward linkages, direct channels suggest that domestic firms trade directly with multinationals operating in the country or foreign firms operating abroad, while indirect channels mean that domestic firms trade with foreign agents operating in the country, i.e., trade through a foreign middleman or distributor operating in the country, called 'foreign agents' in this study. In our survey

data, multinationals operating in the country contain foreign middlemen or distributors. The data provide information about sales to and purchases from foreign agents operating in the country for each domestic firm, which enables us to distinguish backward and forward linkages into indirect and direct channels. In this study, a domestic firm with backward linkages is classified as (i) the firm with 'indirect-oriented backward linkages' if sales to foreign agents operating in the country dominate the sum of sales to multinationals operating in the country and those to foreign firms operating abroad (direct exports), and as (ii) the firm with 'direct-oriented backward linkages' otherwise. Specifically, for each firm with backward linkages, a binary measure of external-internal backward linkages (BDInd) is defined as one if a firm's feature is classified as indirect-oriented backward linkages and zero if it is classified as direct-oriented backward linkages. Similarly, for each firm with forward linkages, a binary measure of external-internal forward linkages (FDInd) is defined as one if a firm's feature is classified as indirect-oriented forward linkages and zero if it is classified as direct-oriented forward linkages.

C3 Results

This subsection discusses two types of channels of backward and forward linkages. The first category is domestic-external channels of backward and forward linkages. To evaluate the difference in vertical spillover effects between external and domestic channels, we restrict ourselves to the subsample of firms with backward (forward) linkages and estimate the ATTs of external channels on the growth rates of productivity and inputs by applying the entropy balancing method with a binary measure of external-oriented backward (forward) linkages, BDExt (FDExt), as a treatment variable. In addition, the second category to be addressed is direct-indirect channels of backward and forward linkages. To examine possible differences in vertical spillover effects between indirect and direct channels, we restrict ourselves to the subsample of firms with backward (forward) linkages and estimate the ATTs of indirect

channels by applying the entropy balancing method with a binary measure of indirect-oriented backward (forward) linkages, BDInd (FDInd), as a treatment variable. We confirm that for each treatment variable (BDExt, FDExt, BDInd, and FDInd), all matching covariates may be well balanced, as the similar average realizations of the pretreatment characteristics between the two groups show the efficacy of entropy balancing (Table C2).

Table C3 shows the results for external-domestic channels of backward and forward linkages, respectively. The estimated ATTs indicate insignificant treatment effects of external-oriented backward and forward linkages on productivity growth rate. Domestic firms with external-oriented vertical linkages (direct exports and imports) do not achieve higher productivity growth rate than those with domestic-oriented vertical linkages with domestically operating multinationals. Concerning the ATTs on the growth rates of inputs, the results reveal a positive effect of external-oriented backward and forward linkages on skilled employment growth rate but fail to show any significant effects on other inputs, such as the growth rates of capital and unskilled employment. Our results imply that firms' management choice between external- and domestic-oriented vertical linkages is irrelevant to their technological progress and speed of capital accumulation; however, external-oriented vertical linkages, i.e., direct exports or imports, encourage domestic firms to increase skilled labor, compared with those with domestic-oriented vertical linkages.

Table C4 presents the results for indirect-direct channels of backward and forward linkages, respectively. Similar to the previous case of external-domestic channels, the empirical results indicate insignificant treatment effects of indirect-oriented backward and forward linkages on productivity growth rate. Domestic firms with indirect-oriented vertical linkages with agents or middlemen are not advantageous for productivity growth rate, compared with those with direct-oriented vertical linkages without the use of foreign middlemen. In addition, the estimated ATTs on the growth rates of inputs show a negative

effect of indirect-oriented backward linkages on capital growth rate but fail to show any significant effects on other inputs. Our analysis of indirect-direct channels suggests that firms' management choice between indirect- and direct-oriented vertical linkages does not influence their technological progress and growth rates of skilled and unskilled employment; however, domestic firms with direct-oriented vertical linkages are encouraged to promote capital formation, compared with those with indirect-oriented vertical linkages.

Table C3. ATTs on productivity and inputs growth rates (external-domestic channels)

	Backward linkage (BDExt)		Forward linkage (FDExt)	
	Model 1	Model 2	Model 1	Model 2
TFP-OLS	0.0478	0.0490	0.0891	0.0908
	(0.1005)	(0.1063)	(0.0952)	(0.1056)
TFP-LP	-0.0077	-0.0060	0.0631	0.0655
	(0.1003)	(0.1223)	(0.0996)	(0.1331)
TFP-ACF	-0.0530	-0.0515	-0.0018	0.0003
	(0.1070)	(0.1231)	(0.0994)	(0.1273)
TFP-W	-0.0019	-0.0002	0.0662	0.0686
	(0.0998)	(0.1208)	(0.0986)	(0.1306)
Value-added	-0.0092	-0.0073	0.0641	0.0666
	(0.1047)	(0.1339)	(0.1034)	(0.1460)
CAPITAL	-0.0869	-0.0867	-0.0467	-0.0459
	(0.0790)	(0.0829)	(0.0653)	(0.0726)
LABOR	-0.0645	-0.0634	-0.0254	-0.0241
	(0.0786)	(0.1244)	(0.0822)	(0.1398)
SKILLED	0.1481*	0.1495	0.2063**	0.2076**
	(0.0881)	(0.0999)	(0.0851)	(0.1019)
UNSKILLED	0.1952	0.1953	0.2046	0.2083
	(0.1910)	(0.2324)	(0.1770)	(0.2229)
No. of Obs.	140	140	145	145
Covariates	Yes	No	Yes	No

Notes: *, **, *** indicate statistically significant at the 10%, 5% and 1% respectively.
Standard errors are shown in parentheses.

Table C4. ATTs on productivity and inputs growth rates (indirect-direct channels)

	Backward linkage (BDInd)		Forward linkage (FDInd)	
	Model 1	Model 2	Model 1	Model 2
TFP-OLS	-0.1047	-0.1047	-0.1016	-0.1020
	(0.2321)	(0.2558)	(0.2139)	(0.2936)
TFP-LP	-0.1124	-0.1124	-0.1112	-0.1118
	(0.2245)	(0.2476)	(0.2071)	(0.2868)
TFP-ACF	-0.0010	-0.0010	-0.1359	-0.1360
	(0.2380)	(0.2642)	(0.1967)	(0.2830)
TFP-W	-0.1076	-0.1077	-0.1087	-0.1093
	(0.2245)	(0.2467)	(0.2056)	(0.2848)
Value-added	-0.0945	-0.0945	-0.1049	-0.1056
	(0.2213)	(0.2411)	(0.1977)	(0.2769)
CAPITAL	-0.0800***	-0.0800	-0.0396	-0.0393
	(0.0289)	(0.0523)	(0.0520)	(0.0590)
LABOR	0.0455	0.0455	0.0086	0.0080
	(0.0552)	(0.0823)	(0.0701)	(0.1051)
SKILLED	0.0277	0.0277	0.0065	0.0058
	(0.1000)	(0.1465)	(0.0888)	(0.1260)
UNSKILLED	-0.2569	-0.2568	-0.0514	-0.0491
	(0.1794)	(0.2019)	(0.1027)	(0.1176)
No. of Obs.	140	140	145	145
Covariates	Yes	No	Yes	No

Notes: *, **, *** indicate statistically significant at the 10%, 5% and 1% respectively.
Standard errors are shown in parentheses.

Chapter 5 Conclusion

Our second chapter has provided the nonparametric empirical estimates of the effects of trade agreements on bilateral trade flows using the entropy balancing matching method in every five-year period from 2000 to 2015. The estimated results of country fixed effects with the consideration of the MR terms have shown that south-south trade agreements have the most significant positive effects compared to north-north and north-south trade agreements. However, our matching estimates have presented different results: north-north and north-south trade agreements are more effective than south-south trade agreements. Our results have suggested that south countries could enjoy more trade with north countries, rather than with other south countries, through the formation of trade agreements, and north countries could enjoy more trade through trade agreements with both north and south partners.

Our third chapter has addressed issues on trade-investment relationship by examining trade creation effects of TAs and ITs, accounting for the MR terms and the nonrandomness of international agreements. The results have confirmed positive trade creation effects of TAs, and importantly, ITs complement TAs particularly for north-north and north-south country pairs. Under ongoing globalization, TAs achieve the original purpose by reducing tariff and non-tariff barriers, and ITs help promote trade through the reduction in financial transaction costs and legal protection of investments.

Our fourth chapter has investigated vertical spillover effects through backward and forward linkages on firms' productivity and input allocation in the Myanmar garment sector by applying the entropy balancing matching method with unique survey data at the firm level. The main results have confirmed that although backward and forward linkages promote spillover effects on productivity improvement with capital accumulation, they fail to accelerate employment growth rate. Given that current political conditions are founded on a support base from a general public that strongly expects their welfare improvement without

income inequality, the government has emphasized the implementation of a series of effective public policies targeting significant job creation. Our empirical results have suggested that although backward and forward linkages with multinationals help improve productivity, such economically favorable effects may partially be offset by negative side effects on the employment growth rate, which is perhaps politically important for the current government; this is caused by capital-labor substitution associated with capital accumulation. To mitigate such issues, the government should evaluate the quality of FDI with the consideration of resource allocation for sustainable development and establish appropriate regulations to encourage domestic firms to engage in job creation.